Part 1

The role of financial intermediaries

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Contents

Bank Liquidity Creation

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Although the modern theory of financial intermediation portrays liquidity creation as an essential role of banks, comprehensive measures of bank liquidity creation do not exist. We construct four measures and apply them to data on virtually all U.S. banks from 1993 to 2003. We find that bank liquidity creation increased every year and exceeded \$2.8 trillion in 2003. Large banks, multibank holding company members, retail banks, and recently merged banks created the most liquidity. Bank liquidity creation is positively correlated with bank value. Testing recent theories of the relationship between capital and liquidity creation, we find that the relationship is positive for large banks and negative for small banks. (*JEL* G21, G28, G32)

According to the modern theory of financial intermediation, banks exist because they perform two central roles in the economy—they create liquidity and they transform risk.[1] Analyses of banks' role in creating liquidity and thereby spurring economic growth have a long tradition, dating back to Adam Smith (1776).[2] Modern reincarnations of the idea that liquidity creation is central to banking appear most prominently in the formal analyses in Bryant (1980) and

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[1] These two roles are often jointly referred to as banks' qualitative asset transformation (QAT) function (e.g., Bhattacharya and Thakor 1993).

[2] Smith (book II, chapter II, 1776) highlights the importance of liquidity creation by banks and describes how it helped commerce in Scotland. In particular, he notes "That the trade and industry of Scotland, however, have increased very considerably during this period, and that the banks have contributed a good deal to this increase, cannot be doubted."

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Diamond and Dybvig (1983). These theories argue that banks create liquidity on the balance sheet by financing relatively illiquid assets with relatively liquid liabilities. Holmstrom and Tirole (1998) and Kashyap, Rajan, and Stein (2002) suggest that banks also create liquidity off the balance sheet through loan commitments and similar claims to liquid funds.[3]

Banks' role as risk transformers is also well studied. A vast literature has emerged on bank risk taking and prudential regulation, supervision, and market discipline to control risk-taking behavior. According to the risk transformation theories, banks transform risk by issuing riskless deposits to finance risky loans (e.g., Diamond 1984; Ramakrishnan and Thakor 1984; Boyd and Prescott 1986). Risk transformation may coincide with liquidity creation, as for example, when banks issue riskless liquid deposits to finance risky illiquid loans. However, liquidity creation and risk transformation do not move in perfect tandem—the amount of liquidity created may vary considerably for a given amount of risk transformed. It is therefore essential to study both roles of banks and to distinguish between them.

Most of the empirical literature has focused on banks' role as risk transformers, rather than on their role as liquidity creators. Consequently, comprehensive empirical measures of bank liquidity creation are conspicuously absent, making it difficult to address numerous questions of research and policy interest. How much liquidity does the banking sector create? How has bank liquidity creation changed over time? How does it vary in the cross section? Which banks create the most and least liquidity? What are the value implications of bank liquidity creation? Moreover, without measures of liquidity creation in hand, it is not possible to examine policy-relevant issues, such as the effect of bank capital on bank liquidity creation.

Our main goals here are threefold. Our first goal is to develop comprehensive measures of bank liquidity creation. We create four such measures that differ in how off-balance sheet activities are treated and how loans are classified. Our second goal is to use these measures to gain a deeper insight into banks' role as liquidity creators by addressing the questions highlighted above. Specifically, we explore how much liquidity banks create, how liquidity creation has changed over time, how it varies in the cross section, which banks create the most and least liquidity, and how liquidity creation is related to bank value. We do this by applying our liquidity creation measures to data on virtually all U.S. banks over 1993–2003, by splitting the data in various ways (by bank size, bank holding company status, wholesale versus retail orientation, and merger status), by contrasting the top 25% and bottom 25% of liquidity creators in each size class, and by examining correlations between liquidity creation and bank

[3] Other theoretical contributions explain the existence of bank loan commitments as providing a mechanism for optimal risk sharing (Campbell 1978; Ho and Saunders 1983), reducing credit rationing (James 1981; Blackwell and Santomero 1982; Morgan 1994; Thakor 2005), and ameliorating informational frictions between the borrower and bank (Berkovitch and Greenbaum 1991; Boot, Thakor, and Udell 1991; Boot, Greenbaum, and Thakor 1993). Melnik and Plaut (1986); Shockley and Thakor (1997); and Sufi (2007) provide detailed overviews of the contractual features of loan commitments and lines of credit.

value. The current financial crisis raises the additional question of how bank liquidity creation responds during crises. This is one of the issues addressed in a follow-up paper that uses one of the measures of liquidity creation developed here (Berger and Bouwman 2008). Our third goal is to use our liquidity creation measures to examine the policy-relevant issue mentioned above—the effect of bank capital on bank liquidity creation. Some recent theories predict that bank capital reduces bank liquidity creation, while others predict that capital makes banks capable of absorbing more risk, and thereby allows them to create more liquidity. We develop economic intuition about the types of banks for which these opposing effects may dominate, and test the relationship between capital and liquidity creation predicted by the theories.

To construct our liquidity creation measures, we use a three-step procedure. In step 1, we classify all bank assets, liabilities, equity, and off-balance sheet activities as liquid, semiliquid, or illiquid. We do this based on the ease, cost, and time for customers to obtain liquid funds from the bank, and the ease, cost, and time for banks to dispose of their obligations in order to meet these liquidity demands. Our use of just three liquidity classifications (liquid, semiliquid, and illiquid) is a necessary simplification—any finer distinctions would have to be made rather arbitrarily. In step 2, we assign weights to the activities classified in step 1. The weights are consistent with the theory—maximum (i.e., dollar-for-dollar) liquidity is created when illiquid assets are transformed into liquid liabilities and maximum liquidity is destroyed when liquid assets are transformed into illiquid liabilities or equity. In step 3, we construct four liquidity creation measures by combining the activities as classified in step 1 and as weighted in step 2 in different ways. The measures classify all activities other than loans by both product category and maturity but—due to data limitations—classify loans based either solely on category ("cat") or solely on maturity ("mat"). To assess how much liquidity banks create on the balance sheet versus off the balance sheet, we alternatively include off-balance sheet activities ("fat") or exclude them ("nonfat"). We thus construct liquidity creation measures based on the four combinations: "cat fat," "mat fat," "cat nonfat," and "mat nonfat." As explained below, "cat fat" is our preferred measure.

When we apply our measures to the data, we find that the U.S. banking industry created \$2.843 trillion in liquidity in 2003 using our preferred "cat fat" measure.[4] This equals 39% of bank gross total assets or *GTA* (total assets plus allowance for loan and lease losses and the allocated transfer risk reserve) and is 4.56 times the overall level of bank equity capital, suggesting that the industry creates \$4.56 of liquidity per \$1 of capital. To provide further perspective on liquidity creation relative to bank size, note that bank liquidity creation equals 70% of gross loans and 58% of total deposits.

Liquidity creation has grown dramatically over time: it increased every year and virtually doubled between 1993 and 2003 based on our preferred "cat fat" measure. This evidence contradicts the notion that the role of banks in creating

[4] All liquidity creation measures in the article are as of December 31 of a given year.

liquidity has declined due to the development of capital markets. Our results are fairly similar when we calculate liquidity creation using our "mat fat" measure, which classifies loans based on maturity instead of category. Results based on our "nonfat" measures reveal that the banking sector only creates about half of its liquidity on the balance sheet, highlighting the importance of liquidity created off the balance sheet as in Holmstrom and Tirole (1998) and Kashyap, Rajan, and Stein (2002).

Liquidity creation differs considerably among large banks (*GTA* exceeding $3 billion), medium banks (*GTA* $1 billion–$3 billion), and small banks (*GTA* up to $1 billion) (measured in real 2003 dollars). We split our sample by bank size because size differences among banks are substantial and various empirical studies have shown that components of liquidity creation vary greatly by bank size. Based on our preferred "cat fat" measure, large banks are responsible for 81% of industry liquidity creation, while comprising only 2% of the sample observations. All size classes generate substantial portions of their liquidity off the balance sheet, but the fraction is much higher for large banks. All size classes increased liquidity creation in real terms over the sample period. While large banks showed the greatest growth in the dollar value of liquidity creation, small banks had the greatest growth in liquidity creation divided by *GTA*, equity, loans, and deposits.

Liquidity creation also varies with several key bank characteristics. It is starkly different for banks split by bank holding company status, wholesale versus retail orientation, and merger status. Based on our preferred "cat fat" measure, banks that are members of a multibank holding company, have a retail orientation, and engaged in M&A activity during the prior three years created most of the banking industry's overall liquidity. These banks also show the strongest growth in liquidity creation over time.

Liquidity creation is also positively linked with value. We examine the value implications of liquidity creation by focusing on listed independent banks and banks that are part of listed bank holding companies. We find that banks and bank holding companies that create more liquidity have significantly higher market-to-book and price-earnings ratios.

Turning to the theories on the relationship between bank capital and liquidity creation, some recent contributions suggest that bank capital may impede liquidity creation by making the bank's capital structure less fragile (e.g., Diamond and Rajan 2000, 2001). A fragile capital structure encourages the bank to commit to monitoring its borrowers, and hence allows it to extend loans. Additional equity capital makes it harder for the less-fragile bank to commit to monitoring, which in turn hampers the bank's ability to create liquidity. Capital may also reduce liquidity creation because it "crowds out" deposits (e.g., Gorton and Winton 2000). For expositional ease, we refer to this first set of theories jointly as the "financial fragility-crowding out" hypothesis.

An alternative view—related to banks' role as risk transformers—is that higher capital improves banks' ability to absorb risk and hence their ability to create liquidity. Liquidity creation exposes banks to risk—the greater the liquidity created, the greater are the likelihood and severity of losses associated with having to dispose of illiquid assets to meet customers' liquidity demands (Allen and Santomero 1998; Allen and Gale 2004). Capital absorbs risk and expands banks' risk-bearing capacity (e.g., Bhattacharya and Thakor 1993; Repullo 2004; Von Thadden 2004; Coval and Thakor 2005), so higher capital ratios may allow banks to create more liquidity. We refer to this second set of theories collectively as the "risk absorption" hypothesis, while recognizing that the theories together rather than separately produce this prediction.

Both the "financial fragility-crowding out" and the "risk absorption" effects may apply in differing degrees to liquidity creation by different banks, so the relevant empirical issue is discovering the circumstances under which each effect empirically dominates. We address this by testing whether the net effect of bank capital on liquidity creation is negative or positive for different sizes of banks. We expect that the "financial fragility-crowding out" effect is likely to be relatively strong for small banks. One reason is that small banks deal more with entrepreneurial-type small businesses, where the close monitoring highlighted in Diamond and Rajan (2000, 2001) is important. A second reason is that small banks tend to raise funds locally, so that capital may "crowd out" deposits as in Gorton and Winton (2000).[5] This effect is likely to be relatively weak for large banks that can more easily access funding from national or international capital markets. In contrast, the "risk absorption" effect is likely to be stronger for large banks because they are generally subject to greater regulatory scrutiny and market discipline than small banks, which may affect their capacity to absorb risk. Since medium banks fall somewhere in the middle, we expect that either effect may dominate for these banks or that these effects may simply offset each other.

While the theories suggest a causal relationship from capital to liquidity creation, in practice both may be jointly determined. This makes it challenging to establish causation. Although we present regression results using lagged capital to mitigate the endogeneity problem, we interpret our results with care and do not claim to have established causation. Nonetheless, at a minimum, the results should be viewed as interesting correlations between capital and liquidity creation that are consistent with the theories. We also address the endogeneity problem more directly with instrumental variable regressions and obtain consistent results.

Keeping these precautions in mind, we test the relationship between capital and liquidity creation by regressing the dollar amount of bank liquidity creation (calculated using our four measures and normalized by *GTA*) for each bank-year observation on the bank's lagged equity capital ratio and a number of

[5] Gorton and Winton (2000) develop a general equilibrium model, so it theoretically applies to all banks, small and large. However, we argue in Section 1.2 that as an empirical matter, it is likely to be more applicable to small banks.

control variables. Since the effect of capital on liquidity creation may be driven by banks' role as risk transformers rather than their role as liquidity creators, all our regressions control for bank risk. We use three-year lagged average values of capital and the other exogenous variables to mitigate potential endogeneity problems, as lagged values represent earlier bank decisions. We run the tests separately for large, medium, and small banks to allow for the possibility that capital may affect these banks differently.

We find empirical support for both hypotheses. For large banks, the relationship between capital and liquidity creation is positive, consistent with the expected empirical dominance of the "risk absorption" effect. In sharp contrast, for small banks, the relationship between capital and liquidity creation is negative, consistent with the expected dominance of the "financial fragility-crowding out" effect for these institutions. The relationship is not significant for medium banks, suggesting that the two effects cancel each other out for this size class. To understand more deeply why these differences exist, we also examine the relationship between capital and the individual components of liquidity creation and find substantial differences across size classes in which components are significantly correlated with capital.

We test the robustness of our main regression results in various ways. First, our main liquidity creation measures are based on the ease, cost, and time for customers to obtain liquid funds, and the ease, cost, and time for banks to dispose of obligations to provide liquid funds. Since buyers of loan commitments and letters of credit may not fully draw down committed funds, we construct an alternative measure that incorporates the likelihood with which these customers request actual funds. Second, we construct a liquidity creation measure that uses an alternative way to establish which assets are securitizable. Third, to address a potential concern that our dependent variable (liquidity creation) includes current equity capital with a weight of $-½$ while our key independent variable is the lagged equity capital ratio, we construct an alternative liquidity creation measure that does not include current capital. Fourth, since the theories sometimes use a broader definition of equity that includes other funds that cannot easily run on banks, we use an alternative capital ratio that includes equity plus other financial instruments, such as long-term subordinated debt (total capital specified in the Basel I capital standards). Fifth, because the intertemporal and cross-sectional liquidity creation patterns are so different for banks split by holding company status, wholesale versus retail orientation, and merger status, we rerun our regressions for these subsamples. The results of all of these robustness checks reinforce our main findings and suggest that the relationship between capital and liquidity creation is positive for large banks, insignificant for medium banks, and negative for small banks.

Since capital and liquidity creation may be jointly determined and the use of three-year lagged average values of capital may not be sufficient to mitigate such endogeneity concerns, we use an instrumental variable approach as our final robustness check. We select the effective state income tax rate and the fraction of seniors in the markets in which a bank operates as potentially valid instruments for lagged capital. Based on first-stage regression results, we use the tax rate as an instrument for large banks only and the fraction of seniors as an instrument for small banks only. Using these instruments, we find—consistent with our main findings—that the effect of capital on liquidity creation is significantly positive for large banks and significantly negative for small banks.

The remainder of the article is organized as follows. Section 1 reviews the literature. Section 2 describes the construction of our liquidity creation measures. Section 3 discusses our panel dataset of U.S. banks over 1993–2003, shows how bank liquidity creation varies over time and in the cross section, contrasts high and low liquidity creators, and explores the value implications of bank liquidity creation. Section 4 outlines our regression framework, and Section 5 contains our regression results. Section 6 addresses robustness issues, and Section 7 concludes.

1. Literature Review

In this section, we provide a brief review of the literature to place our article in context. Our research is related to three strands of literature: the measurement of bank liquidity creation; the theories of the effect of capital on liquidity creation; and the empirical studies of capital and liquidity creation. We discuss these three literatures in turn.

1.1 Measurement of bank liquidity creation

We are aware of only one paper that attempts to measure bank liquidity creation. Deep and Schaefer (2004) construct a measure of liquidity transformation and apply it to data on the two hundred largest U.S. banks from 1997 to 2001. They define the liquidity transformation gap or "LT gap" as (liquid liabilities − liquid assets)/total assets. They consider all loans with maturity of one year or less to be liquid, and they explicitly exclude loan commitments and other off-balance sheet activities because of their contingent nature. They find that the LT gap is about 20% of total assets on average for their sample of large banks. The authors conclude that these banks do not appear to create much liquidity, and run some tests to explain this finding, examining the roles of insured deposits, credit risk, and loan commitments.

The LT gap is an intuitive step forward, but we do not believe that it is sufficiently comprehensive. To illustrate, we highlight a few key differences between their approach and ours. First, we include virtually all commercial banks and compare findings for large, medium, and small banks, rather than including only the largest institutions. Second, our preferred "cat fat" liquidity creation measure classifies loans by category ("cat"), rather than by maturity. We treat business loans as illiquid regardless of their maturity because banks generally cannot easily dispose of them to meet liquidity needs, but we treat residential mortgages and consumer loans as semiliquid because these loans can often be securitized and sold to meet demands for liquid funds. Third, our preferred measure includes off-balance sheet activities ("fat"), consistent with the arguments in Holmstrom and Tirole (1998) and Kashyap, Rajan, and Stein (2002). In our less-preferred liquidity measures, we classify loans by maturity ("mat") and exclude off-balance sheet activities ("nonfat") to determine the effects of these assumptions. As discussed in Section 2, the LT gap is conceptually close to our "mat nonfat" measure.

1.2 Bank liquidity creation and capital: the theories

In the seminal theories on financial intermediary existence highlighted above, banks do not hold any capital. Bank capital was introduced in subsequent papers, which argue that the primary reason why banks hold capital is to absorb risk, including the risk of liquidity crunches, protection against bank runs, and various other risks, most importantly credit risk. Although the reason why banks hold capital is motivated by their risk transformation role, recent theories suggest that bank capital may also affect banks' ability to create liquidity. These theories produce opposing predictions on the link between capital and liquidity creation.

One set of theories, which we refer to collectively as the "financial fragility-crowding out" hypothesis, predicts that higher capital reduces liquidity creation. Diamond and Rajan (2000, 2001) focus on financial fragility. They model a relationship bank that raises funds from investors to provide financing to an entrepreneur. The entrepreneur may withhold effort, which reduces the amount of bank financing attainable. More importantly, the bank may also withhold effort, which limits the bank's ability to raise financing. A deposit contract mitigates the bank's holdup problem, because depositors can run on the bank if the bank threatens to withhold effort, and therefore maximizes liquidity creation. Providers of capital cannot run on the bank, which limits their willingness to provide funds, and hence reduces liquidity creation. Thus, the higher a bank's capital ratio, the less liquidity it will create.[6] Note that the negative effect of capital on liquidity creation as suggested by Diamond and Rajan (2000, 2001) depends crucially on deposit insurance coverage being incomplete. If insurance were complete, depositors would have no incentive to run on the bank, and a deposit contract would not mitigate the bank's holdup problem.

Gorton and Winton (2000) show how a higher capital ratio may reduce liquidity creation through the crowding out of deposits.[7] They argue that

[6] Diamond and Rajan's (2000, 2001) model builds on Calomiris and Kahn's (1991) argument that the ability of uninsured depositors to run on the bank in the event of expected wealth expropriation by bank managers is an important disciplining mechanism. A related idea is proposed by Flannery (1994), who focuses on the disciplining effect of depositors' ability to withdraw funds on demand, and thus prevent the bank from expropriating depositor wealth through excessively risky investments.

[7] A similar argument regarding capital requirements is made by Van den Heuvel (2008).

deposits are more effective liquidity hedges for investors than investments in equity capital and higher capital ratios shift investors' funds from deposits to bank capital. Since deposits are liquid and bank equity is illiquid, there is a reduction in overall liquidity for investors when the capital ratio is higher.[8]

While the theories underlying the "financial fragility-crowding out" hypothesis apply to banks of all sizes, we argue that they are most applicable to small banks. An essential feature of the Diamond and Rajan (2000, 2001) model is the bank's monitoring of the borrower using its borrower-specific skills, without which the loan's value diminishes. As the analyses in Berger et al. (2005) suggest, small banks engage in more relationship-specific lending involving bank monitoring than large banks. The Gorton and Winton (2000) model is general equilibrium and theoretically applies to all banks, but as an empirical matter the assumptions of their model seem to fit small banks better. In their model, there is a single, unsegmented capital market, so more bank equity capital implies less bank deposits. In reality, however, this is the case only in the smaller markets in which small banks operate. The larger (especially national and international) capital markets are often quite segmented, with investors segmenting themselves based on various characteristics, including investment style (e.g., choice of equity versus debt instruments). This implies that an increase in the bank's demand for equity capital may simply cause "equity investors" to shift out of other equities, rather than inducing a shift out of bank deposits. That is, changes in bank capital may induce general equilibrium effects, but these effects may be manifested in securities other than bank deposits. Further, bank equity capital in practice accounts for a relatively small fraction of total equity capital held by investors in the national/international capital markets. Thus, even if the "crowding out" effect by Gorton and Winton (2000) exists for large banks, it is likely to be empirically smaller than for small banks. Small banks operate in smaller, less segmented markets, where there is significant overlap between those who invest in bank equity and those who invest in bank deposits, and any increase in bank capital is more likely to crowd out deposits. A final and related reason why the crowding out effect may be stronger for small banks is that these banks fund themselves largely with deposits and capital. In contrast, large banks also use other liabilities that are less liquid than deposits (such as subordinated debt), suggesting that an increase in capital may lead to a drop in other liabilities rather than deposits. Thus, capital is more likely to crowd out deposits at small banks than at large banks.

Under the alternative "risk absorption" hypothesis, which is directly linked to the risk-transformation role of banks, higher capital enhances banks' ability to create liquidity. This insight is based on two strands of the literature. One strand consists of papers that argue that liquidity creation exposes banks to risk

[8] Gorton and Winton's (2000) analysis suggests that even if equityholders did not reduce funding to the bank in Diamond and Rajan (2000), there would be less liquidity creation with a higher capital ratio.

(e.g., Allen and Santomero 1998; Allen and Gale 2004). The more liquidity that is created, the greater is the likelihood and severity of losses associated with having to dispose of illiquid assets to meet the liquidity demands of customers. The second strand consists of papers that posit that bank capital absorbs risk and expands banks' risk-bearing capacity (e.g., Bhattacharya and Thakor 1993; Repullo 2004; Von Thadden 2004; Coval and Thakor 2005). Combining these two strands yields the prediction that higher capital ratios may allow banks to create more liquidity.

We argue that the risk absorption hypothesis applies more strongly to large banks than to small banks. The reasons are threefold. First, large banks are typically exposed to more intense regulatory scrutiny, increasing the value of capital to the banks as part of its overall risk management. Second, large banks are also subject to greater market discipline from uninsured providers of finance, so capital has a greater effect on both the cost and the availability of uninsured financing. Third, some large banks may see new opportunities to offer large loan commitments or engage in other off-balance sheet activities. Since these activities involve risk, these banks may boost equity capital in anticipation of engaging in these new activities.

Finally, we point out one additional contribution of some of the recent theories. The standard view of liquidity creation is that banks create liquidity by transforming illiquid assets into liquid liabilities. Diamond and Rajan (2000, 2001) and Gorton and Winton (2000) show, however, that banks can create more or less liquidity by simply changing their funding mix on the liability side. Thakor (1996) shows that capital may also affect banks' asset portfolio composition, thereby affecting liquidity creation through a change in the asset mix. Our measures of liquidity creation incorporate these insights—they explicitly recognize that liquidity creation by banks occurs through changes in the mixes on both sides of the balance sheet, as well as through off-balance sheet activities.

1.3 Bank capital and liquidity creation: the existing empirical evidence

Some empirical studies examine issues related to liquidity creation, but do not focus on the role of capital. Kashyap, Rajan, and Stein (2002) provide empirical evidence of synergies between commitment lending and deposits, consistent with their model. Gatev, Schuermann, and Strahan (2006) and Gatev and Strahan (2006) find that banks have a comparative advantage in hedging liquidity risk in the economy because banks experience deposit inflows following a market crisis or liquidity shock that allow them to have more funds to provide the additional loans drawn down under commitments at such times. Pennacchi (2006) confirms the existence of synergies between loan commitments and deposit taking, but finds that such synergies do not hold prior to the creation of FDIC deposit insurance. These studies do not focus on the role of bank capital, but they do in some cases include the capital ratios in regressions of some liquidity creation components, yielding ambiguous predictions related to the effect of capital on liquidity creation.[9]

The credit crunch literature tests hypotheses about bank capital and one type of liquidity creation, usually business lending or real estate lending, during the early 1990s when bank lending declined significantly. Several studies find that the decline in bank capital ratios arising from loan losses in the late 1980s and early 1990s contributed significantly to the reduction in lending (e.g., Peek and Rosengren 1995). This is consistent with a positive relationship between capital and liquidity creation during a period of distress. In the early 1990s, U.S. regulators also imposed new leverage requirements, as well as the Basel I risk-based capital standards. Most of the studies found that the leverage requirements contributed to the decline in lending, consistent with the hypothesis of a negative effect of bank capital on liquidity creation (e.g., Berger and Udell 1994; Hancock, Laing, and Wilcox 1995; Peek and Rosengren 1995), and generally concluded that the risk-based capital requirements had little effect on lending. Unfortunately, the unusual combination of several major changes in bank capital regulation and a recession makes it difficult to parse the different effects and draw general conclusions.

Finally, some studies of bank lending behavior include capital ratios, but focus on other issues. For example, Berger and Udell (2004) study procyclical lending and find positive, statistically significant effects of capital on the annual growth of business loans. Holod and Peek (2007) examine monetary policy effects and find that the capital ratio has significant positive effects on loan growth. Gambacorta and Mistrulli (2004) use Italian data and find that the impact of monetary policy and GDP shocks on bank lending depends on bank capitalization.

Thus, the existing empirical literature sheds relatively little light on the relationship between bank capital and liquidity creation. Some studies test the liquidity creation theories, but do not focus on the role of bank capital. Others include capital in their regressions, but specify only limited components of liquidity creation, and often under unusual circumstances. Our empirical analysis uses a significantly different approach.

2. Construction of Our Liquidity Creation Measures

In this section, we pursue our first main goal of developing measures of liquidity creation. We explain the construction of our four liquidity creation measures and clarify which is our preferred measure. We also show how Deep and Schaefer's (2004) liquidity transformation measure can be viewed as a special case of one of our measures.

[9] For example, Gatev and Strahan (2006) find that a higher bank capital ratio tends to be followed by greater loans and deposits (which may increase liquidity creation) and greater liquid assets and nondeposit liabilities (which may reduce liquidity creation).

We construct the liquidity creation measures using a three-step procedure. In step 1, we classify all bank balance sheet and off-balance sheet activities as liquid, semiliquid, or illiquid. In step 2, we assign weights to the activities classified in step 1. In step 3, we combine the activities as classified in step 1 and as weighted in step 2 in different ways to construct our four liquidity creation measures: "cat fat," "mat fat," "cat nonfat," and "mat nonfat." Table 1 illustrates the three-step procedure. We discuss these steps in turn.

2.1 Step 1: Classifying activities as liquid, semiliquid, or illiquid

In step 1, we classify all assets as liquid, semiliquid, or illiquid based on the ease, cost, and time for banks to dispose of their obligations to obtain liquid funds to meet customers' demands. We similarly classify bank liabilities plus equity as liquid, semiliquid, or illiquid, based on the ease, cost, and time for customers to obtain liquid funds from the bank. Off-balance sheet guarantees and derivatives are classified consistently with treatments of functionally similar on-balance sheet items.[10]

Ideally, we would use information on both product category and maturity to classify all bank activities. For example, as noted above, business loans are generally more illiquid than residential mortgages and consumer loans, as the latter can often be more easily securitized and sold to meet liquidity demands. Within each category, shorter maturity items are more liquid than longer maturity items because they self-liquidate without effort or cost sooner.

For bank activities other than loans, Call Reports provide sufficient detail on category and maturity, so our classifications incorporate both aspects. Unfortunately, this is not the case for loans. Call Reports split loans into various loan categories and into different maturity classes, but do not provide maturity information for individual loan categories. We therefore either classify loans entirely by category ("cat") or entirely by maturity ("mat"). Thus, our "cat" and "mat" liquidity creation measures constructed below classify loans either by category or maturity, but in all cases incorporate both key characteristics for other bank activities.

2.1.1 Assets

- *Classifying loans*

    (a) *Category ("cat"):* For the "cat" measures of liquidity creation, we classify business loans and leases as illiquid assets, because these items typically cannot be sold quickly without incurring a major loss. Residential mortgages and consumer loans are generally relatively easy to securitize, and loans to depositories and governments are likely to be comparatively easy to sell or otherwise dispose of because the

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[10] In a robustness check, we use an alternative approach to measuring the liquidity contribution of some of these items (see Section 6.1).

Table 1
Liquidity classification of bank activities and construction of four liquidity creation measures

Step 1: We classify all bank activities as liquid, semiliquid, or illiquid. For activities other than loans, we combine information on product category and maturity. Due to data limitations, we classify loans entirely by product category ("cat") or maturity ("mat")
Step 2: We assign weights to the activities classified in step 1

Assets

Illiquid assets (weight = $^1/_2$)		Semiliquid assets (weight = 0)		Liquid assets (weight = $-^1/_2$)
(cat)	(mat)	(cat)	(mat)	
Commercial real estate loans (CRE)	All loans and leases with a remaining maturity >1 year	Residential real estate loans (RRE)	All loans and leases with a remaining maturity ≤1 year	Cash and due from other institutions
Loans to finance agricultural production		Consumer loans		All securities (regardless of maturity)
Commercial and industrial loans (C&I)		Loans to depository institutions		Trading assets
Other loans and lease financing receivables		Loans to state and local governments		Fed funds sold
		Loans to foreign governments		
Other real estate owned (OREO)				
Customers' liability on bankers acceptances				
Investment in unconsolidated subsidiaries				
Intangible assets				
Premises				
Other assets				

Liabilities plus equity

Liquid liabilities (weight = $^1/_2$)	Semiliquid liabilities (weight = 0)	Illiquid liabilities plus equity (weight = $-^1/_2$)
Transactions deposits	Time deposits	Bank's liability on bankers acceptances
Savings deposits	Other borrowed money	Subordinated debt
Overnight federal funds purchased		Other liabilities
Trading liabilities		Equity

(*continued overleaf*)

Table 1
(Continued)

Off-balance sheet guarantees (notional values)

Illiquid guarantees (weight = $^1/_2$)	Semiliquid guarantees (weight = 0)	Liquid guarantees (weight = $-^1/_2$)
Unused commitments	Net credit derivatives	Net participations acquired
Net standby letters of credit	Net securities lent	
Commercial and similar letters of credit		
All other off-balance sheet liabilities		

Off-balance sheet derivatives (gross fair values)

		Liquid derivatives (weight = $-^1/_2$)
		Interest rate derivatives
		Foreign exchange derivatives
		Equity and commodity derivatives

Step 3: We combine bank activities as classified in step 1 and as weighted in step 2 in different ways to construct four liquidity creation measures by using the "cat" or "mat" classification for loans, and by alternatively including off-balance sheet activities ("fat") or excluding these activities ("nonfat")

cat fat =	$+\frac{1}{2}$ * illiquid assets (cat)	+0 * semiliquid assets (cat)	$-\frac{1}{2}$ * liquid assets
	$+\frac{1}{2}$ * liquid liabilities	+0 * semiliquid liabilities	$-\frac{1}{2}$ * illiquid liabilities
			$-\frac{1}{2}$ * equity
	$+\frac{1}{2}$ * illiquid guarantees	+0 * semiliquid guarantees	$-\frac{1}{2}$ * liquid guarantees
			$-\frac{1}{2}$ * liquid derivatives
cat nonfat =	$+\frac{1}{2}$ * illiquid assets (cat)	+0 * semiliquid assets (cat)	$-\frac{1}{2}$ * liquid assets
	$+\frac{1}{2}$ * liquid liabilities	+0 * semiliquid liabilities	$-\frac{1}{2}$ * illiquid liabilities
			$-\frac{1}{2}$ * equity
mat fat =	$+\frac{1}{2}$ * illiquid assets (mat)	+0 * semiliquid assets (mat)	$-\frac{1}{2}$ * liquid assets
	$+\frac{1}{2}$ * liquid liabilities	+0 * semiliquid liabilities	$-\frac{1}{2}$ * illiquid liabilities
			$-\frac{1}{2}$ * equity
	$+\frac{1}{2}$ * illiquid guarantees	+0 * semiliquid guarantees	$-\frac{1}{2}$ * liquid guarantees
			$-\frac{1}{2}$ * liquid derivatives
mat nonfat =	$+\frac{1}{2}$ * illiquid assets (mat)	+0 * semiliquid assets (mat)	$-\frac{1}{2}$ * liquid assets
	$+\frac{1}{2}$ * liquid liabilities	+0 * semiliquid liabilities	$-\frac{1}{2}$ * illiquid liabilities
			$-\frac{1}{2}$ * equity

This table explains our methodology to construct liquidity creation measures in three steps.

counterparties are relatively large and informationally transparent. We classify these loan categories as semiliquid assets.[11]

(b) *Maturity ("mat"):* Shorter maturity items are more liquid than longer maturity items because they self-liquidate sooner. We therefore classify all short-term loans of up to one year as semiliquid and all long-term loans of over one year as illiquid for the "mat" measures.

- *Classifying assets other than loans:* We classify premises and investments in unconsolidated subsidiaries as illiquid assets, because typically these items cannot be sold quickly without incurring a major loss. We classify cash, securities, and other marketable assets that the bank can use to meet liquidity needs quickly without incurring major losses as liquid assets.

2.1.2 Liabilities plus equity

- *Classifying liabilities:* We count funds that can be quickly withdrawn without penalty by customers, such as transactions deposits, savings deposits, and overnight federal funds purchased, as liquid liabilities. We classify deposits that can be withdrawn with slightly more difficulty or penalty as semiliquid. This includes all time deposits regardless of maturity. We do not differentiate between short-term and long-term time deposits since all time deposits can be borrowed against with a penalty regardless of maturity. We also classify as semiliquid the balance sheet item "other borrowed money," which contains other short and medium maturities with terms longer than overnight, such as term federal funds, repurchase agreements, and borrowings from Federal Reserve Banks and Federal Home Loan Banks. We classify long-term liabilities that generally cannot be withdrawn easily or quickly, such as subordinated debt, as illiquid.
- *Classifying equity:* We classify equity as illiquid because investors cannot demand liquid funds from the bank and the maturity is very long. Although the equity of some banks is publicly traded and may be sold relatively easily, the investors are able to retrieve liquid funds through the capital market, not from the bank. Thus, while traded equity may be liquid from an individual investor's point of view, such liquidity is created by the capital market, rather than by the bank, the focus of this article.

2.1.3 Off-balance sheet activities

- *Classifying guarantees:* We classify loan commitments and letters of credit as illiquid guarantees. These items are functionally similar to on-balance sheet business loans in that they are obligations that are illiquid from the

[11] In a robustness check, we use a different method to establishing which loans are securitizable (see Section 6.2).

point of view of the bank; except in very unusual circumstances, the bank must provide the funds to the customer upon demand.[12] As well, in most cases, the bank cannot sell or participate these items. We classify net credit derivatives (i.e., the amount guaranteed minus the beneficiary amount) and net securities lent (i.e., the amount lent minus the amount borrowed) as semiliquid guarantees since they can potentially be sold or participated, analogous to semiliquid on-balance sheet residential mortgages and consumer loans. We classify net participations acquired from other institutions (i.e., the amount acquired minus the amount conveyed to others) as liquid guarantees, since they are functionally similar to on-balance sheet liquid securities.

- *Classifying derivatives:* We classify all derivatives (other than credit derivatives, which we classify above as guarantees)—interest rate, foreign exchange, and equity and commodity derivatives—as liquid because they can be bought and sold easily and are functionally similar to liquid securities. We focus on the gross fair values of these derivatives (which are sometimes positive and sometimes negative), which measure how much liquidity the bank is providing to or absorbing from the public.

2.2 Step 2: Assigning weights to the activities classified in step 1

In step 2, we assign weights to all of the bank activities classified in step 1. That is, we assign weights to the classes of liquid, semiliquid, and illiquid assets, liabilities plus equity, and off-balance sheet guarantees and derivatives shown in Table 1.

We base the weights on liquidity creation theory. According to this theory, banks create liquidity on the balance sheet when they transform illiquid assets into liquid liabilities. An intuition for this is that banks create liquidity because they hold illiquid items in place of the nonbank public and give the public liquid items. We therefore apply positive weights to both illiquid assets and liquid liabilities, so when liquid liabilities (such as transactions deposits) are used to finance illiquid assets (such as business loans), liquidity is created. Following similar logic, we apply negative weights to liquid assets, illiquid liabilities, and equity, so that when illiquid liabilities or equity is used to finance a dollar of liquid assets (such as treasury securities), liquidity is destroyed. Note that the negative weight on equity only captures the direct effect of capital on liquidity creation. Any indirect (positive or negative) effects on liquidity creation are attributed to the individual items that are affected. For example, if capital allows banks to extend more illiquid loans, this positive effect is captured by the positive weight applied to illiquid loans multiplied by the associated dollar increase in loans.

[12] We acknowledge that banks could dispose of loan commitments by invoking the material adverse change (MAC) clause and the customer would not have access to the funds. However, failing to honor loan commitments is generally very costly since it may create legal liabilities and reputational losses, and is therefore rarely done.

The magnitudes of the weights are based on simple dollar-for-dollar adding-up constraints, so that \$1 of liquidity is created when banks transform \$1 of illiquid assets into \$1 of liquid liabilities. Similarly, we require that \$1 of liquidity is destroyed when banks transform \$1 of liquid assets into \$1 of illiquid liabilities. Based on these constraints, we assign a weight of ½ to both illiquid assets and liquid liabilities and a weight of −½ to both liquid assets and illiquid liabilities. Thus, when a dollar of liquid liabilities (such as transactions deposits) is used to finance a dollar of illiquid assets (such as business loans), liquidity creation equals ½ * \$1 + ½ * \$1 = \$1. In this case, maximum liquidity (\$1) is created. Intuitively, the weight of ½ applies to both illiquid assets and liquid liabilities, since the amount of liquidity created is only "half" determined by the source or use of the funds alone—both are needed to create liquidity. Similarly, when a dollar of illiquid liabilities or equity is used to finance a dollar of liquid assets (such as treasury securities), liquidity creation equals −½ * \$1 + −½ * \$1 = −\$1, as maximum liquidity is destroyed.

Using these weights, banks do not create liquidity when they use liquid liabilities (e.g., transaction deposits) to finance liquid assets (e.g., treasuries), or when they use illiquid liabilities or equity to finance illiquid assets (e.g., business loans). In these cases, banks hold items of approximately the same liquidity as they give to the nonbank public.

We apply the intermediate weight of 0 to semiliquid assets and liabilities, based on the assumption that semiliquid activities fall halfway between liquid and illiquid activities. Thus, the use of time deposits to fund residential mortgages would yield approximately zero net liquidity creation, since the ease, cost, and time with which the time depositors may access their funds early and demand liquidity roughly equals the ease, cost, and time with which the bank can securitize and sell the mortgage to provide the funds.

We apply weights to off-balance sheet guarantees and derivatives using the same principles, consistent with the functional similarities to on-balance sheet items discussed in step 1. For example, illiquid off-balance sheet guarantees (such as loan commitments) are functionally similar to on-balance sheet illiquid loans (such as business loans) in that they are obligations of the bank to provide funds that cannot be easily sold or participated. We therefore apply the same weight of ½ to illiquid guarantees as we do to illiquid assets. Similarly, we apply the same weight of 0 to semiliquid guarantees as we do to functionally similar semiliquid on-balance sheet assets, and we apply the same weight of −½ to liquid guarantees that we do to functionally similar on-balance sheet liquid assets.

Analogously, the gross fair values of derivatives are assigned the same weight of −½ as on-balance sheet liquid assets.[13] As discussed in step 1, these

[13] Fair values reported in Call Reports are as in FASB 133: the amount at which an asset (liability) could be bought (incurred) or sold (settled) in a current transaction between willing parties, that is, other than in a forced or liquidation sale. The fair value equals the quoted market price, if available. If a quoted market price is not available, the estimate of fair value is based on the best information available in the circumstances.

contracts can be bought and sold easily and are functionally similar to liquid securities. Like securities, derivatives with gross positive fair values reduce bank liquidity creation as the bank effectively holds a valuable liquid asset in place of the public. Derivatives with gross negative fair values increase bank liquidity creation as the bank effectively holds a negatively valued liquid asset in place of the public. Since the Call Reports assign positive values to contracts with gross positive fair values and negative values to those with gross negative fair values, we capture these opposing effects on liquidity creation by simply applying weights of $-\frac{1}{2}$ to the dollar values of both.[14, 15]

We arrange the columns in Table 1 such that all the bank activities that contribute to liquidity creation are on the left, all those that subtract from liquidity creation are on the right, and all those with an approximately neutral effect on liquidity creation are in the center. Thus, those that are assigned a weight of $\frac{1}{2}$ —illiquid assets, liquid liabilities, and illiquid guarantees—are grouped together on the left. Liquid assets, illiquid liabilities plus equity, and liquid guarantees and derivatives, which are assigned a weight of $-{}^{1}\!/_{2}$, are grouped on the right. Finally, semiliquid assets, liabilities, and guarantees with 0 weights are grouped in the center.

2.3 Step 3: Constructing liquidity creation measures by combining activities as classified in step 1 and as weighted in step 2

In step 3, we combine the activities as classified and weighted in step 1 and step 2, respectively, in different ways to construct our liquidity creation measures. The measures are similar in that they all classify activities other than loans using information on product category and maturity, as discussed in step 1. The measures differ in that we alternatively classify loans by category or maturity ("cat" versus "mat"), and—to gauge how much liquidity banks create off the balance sheet—alternatively include or exclude off-balance sheet activities ("fat" versus "nonfat"). Hence, we have four measures: "cat fat," "cat nonfat," "mat fat," and "mat nonfat." The formulas are shown in Table 1. In Table 1, we again arrange the bank activities that add to liquidity creation on the left, those that subtract from liquidity creation on the right, and those with an approximately neutral effect in the center. For all measures, we multiply the weights of ${}^{1}\!/_{2}$, $-{}^{1}\!/_{2}$, or 0, respectively, times the dollar amounts of the corresponding bank activities and add the weighted dollar amounts to arrive at the total dollar value

[14] While the gross positive and negative fair values of derivatives are often quite substantial, most banks operate with nearly matched books, so these values tend to offset each other, yielding a small net contribution to liquidity creation.

[15] The seminal papers say nothing about the role that derivatives play in the liquidity creation function of banks. Rather, derivatives play a more major role in the risk-transformation function of banks. Nonetheless, it is important to consider the contribution of all balance sheet and off-balance sheet activities to liquidity creation in our measurement, whether or not the theory has spoken on these activities. Thus, for measurement purposes, we take the gross fair values of liquid derivatives and assign a weight consistent with that of a functionally similar on-balance sheet item, which in this case is liquid securities.

of liquidity creation at a particular bank. We sum across all banks to obtain the total dollar value of liquidity created by the entire industry.

We recognize that our liquidity creation measures are rough approximations. We classify all bank activities as liquid, semiliquid, or illiquid, and use three weights, $^1/_2$, 0, and $-^1/_2$. Differences in liquidity obviously exist within each of the three classifications, but the data generally do not allow for much finer distinctions, and there are no other unambiguous weights to apply. The use of $^1/_2$, $-^1/_2$, and 0 are the clear demarcations of full liquidity, full illiquidity, and neutrality, respectively, and no other clear choices present themselves.

Note that Deep and Schaefer's (2004) LT gap measure is conceptually close to our "mat nonfat" measure and may be viewed as a special case of it. If we classified all assets and liabilities as either liquid or illiquid (none as semiliquid) using maturities, excluded off-balance sheet activities, and specified assets (A) rather than gross total assets (GTA), our "mat nonfat" formula reduces to their formula.[16]

We next discuss why we consider "cat fat" to be our preferred liquidity creation measure. First, we argue that the "cat" measures are preferred to the "mat" measures primarily because what matters to liquidity creation on the asset side is the ease, cost, and time for banks to dispose of their obligations to obtain liquid funds. The ability to securitize loans is closer to this concept than the time until self-liquidation. For example, a 30-year residential mortgage may be securitized relatively quickly even though it is a long-term loan. Second, we argue that the "fat" measures are preferred to the "nonfat" measures because off-balance sheet activities provide liquidity in functionally similar ways to on-balance sheet items. Hence, "cat fat" is our preferred measure.

3. Bank Liquidity Creation over Time, in the Cross Section, and Value Implications

In this section, we pursue our second main goal of gaining a deeper insight into banks' role as liquidity creators by applying our four measures to data on the U.S. banking sector. We first describe how we construct our sample. We then measure how much liquidity banks create. We next explore the time-series and cross-sectional variation in bank liquidity creation, and examine the characteristics of banks that create the most and least liquidity over the sample period. In all of these analyses, we split the sample by size. In addition, we divide the data by bank holding company status, wholesale versus retail orientation, and merger status. Finally, we explore the value implications of bank liquidity creation.

[16] Applying these changes, our formula becomes [½ * illiquid assets − ½ * liquid assets + ½ * liquid liabilities − ½ * illiquid liabilities − ½ * equity]/A = [½ * (A − liquid assets) − ½ * liquid assets + ½ * (liquid liabilities) − ½ * (A − liquid liabilities)]/A = [liquid liabilities − liquid assets]/A, which is their LT gap measure.

3.1 Sample description

Our sample includes almost all commercial banks in the United States that are in business during the 1993 to 2003 period. To ensure that our sample only contains "true," viable commercial banks, we impose the following restrictions. We exclude a bank if it (1) has no commercial real estate or commercial and industrial loans outstanding; (2) has zero deposits; (3) has zero or negative equity capital in the current or lagged year; (4) is very small (average lagged *GTA* below \$25 million);[17] (5) has unused commitments exceeding four times *GTA*; (6) resembles a thrift (residential real estate loans exceeding 50% of *GTA*); or (7) is classified by the Federal Reserve as a credit card bank or has consumer loans exceeding 50% of *GTA*.[18] We also eliminate 0.7% of all bank-year observations because some of the exogenous variables used in our regression analysis are missing.

For all the banks in our sample, we obtain annual Call Report data as of 31 December of each year. In all of our analyses, we split the sample by size for several reasons. First, there are many empirical studies that show that size matters when studying components of bank liquidity creation. For example, Berger et al. (2005) argue that large and small banks have comparative advantages in handling different types of credit information, and hence will extend different types of loans. They split their sample by bank size, and indeed find that large and small banks make very different loans. Furthermore, Kashyap, Rajan, and Stein (2002) provide empirical evidence that the relationship between commitments and transactions deposits is different for banks in different size classes. Second, although there are no theories that argue that the effect of capital on liquidity creation depends on bank size, we expect that the net effect of capital on liquidity creation would be different for banks of different size classes. As shown in Sections 5 and 6, we find confirming empirical evidence. Thus, we split the sample into large banks (*GTA* exceeding \$3 billion), medium banks (*GTA* \$1 billion–\$3 billion), and small banks (*GTA* up to \$1 billion).[19]

Our definition of small banks with *GTA* of up to \$1 billion conforms to the usual notion of "community banks" that primarily create liquidity by transforming locally generated deposits into local loans on the balance sheet.[20] We divide the remaining observations roughly in half with the \$3 billion cutoff for

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[17] Banks with lagged average *GTA* below \$25 million are not likely to be viable commercial banks in equilibrium. This exclusion reduced the sample size by 12,955 bank-year observations (from 96,953 to 83,998), but does not materially affect our findings. Inclusion of these banks increases liquidity creation of small banks by only 0.1% (\$0.0027 trillion) in 2003 based on our "cat fat" measure, and leaves our regression results qualitatively unchanged.

[18] The Federal Reserve Board defines a credit card bank as having (1) 50% or more of its total assets in the form of loans to individuals; (2) 90% or more of its loans to individuals in the form of credit card outstandings; and (3) \$200 million or more in loans to individuals.

[19] We apply the \$3 billion and \$1 billion cutoffs, measured in real 2003 dollars, in each year to separate the banks in our sample into large, medium, and small banks.

[20] We also tried splitting small banks into banks with *GTA* up to \$100 million and banks with *GTA* \$100 million–\$1 billion. Since the regression results presented in Sections 5 and 6 yielded very similar results for both size classes, we decided not to pursue this finer partitioning of the data.

GTA. Large banks with *GTA* over $3 billion create much more liquidity off the balance sheet than small banks. Large institutions also tend to generate and disperse on-balance sheet funds on more national and international bases than small institutions. Medium banks with *GTA* between $1 billion and $3 billion tend to have portfolios that mix some of the characteristics of small and large banks.

Our sample contains 83,998 bank-year observations: 1804 for large banks, 2132 for medium banks, and 80,062 for small banks.

3.2 Liquidity creation over time and in the cross section for banks split by size and by bank holding company status, wholesale versus retail orientation, and merger status

We next measure how much liquidity banks create and explore how liquidity creation has changed over time and how it varies in the cross section. We initially split banks only by size, and then we also divide banks by bank holding company status, wholesale versus retail orientation, and merger status.

Panel A of Table 2 shows the summary statistics on bank liquidity creation based on our four measures for the entire banking sector and separately for large, medium, and small banks in 1993 and in 2003, the first and last years of our sample period, respectively. It also shows graphs of liquidity creation over the entire sample period using the corresponding measures. As shown, due to consolidation of the banking industry, the numbers of observations of large and small banks fell by about one-quarter each, while the number of medium banks remained approximately constant. Overall, the number of banks in the sample fell by about 23% from 9095 in 1993 to 6968 in 2003.

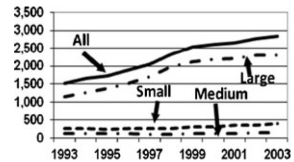
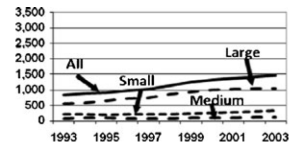
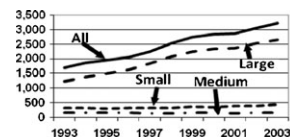
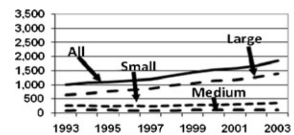
We find that banks created liquidity of $2.843 trillion in 2003 based on our preferred "cat fat" measure, which classifies loans by category and includes off-balance sheet activities (see panel A of Table 2).[21] Liquidity creation equals 39% of industry *GTA* and represents $4.56 of liquidity per $1 of equity capital. It is about 70% as large as gross loans and 58% as large as total deposits, which are standard asset and liability measures of bank size. Overall liquidity creation almost doubled in real terms between 1993 and 2003. As shown, liquidity creation also increased as a fraction of *GTA*, equity, gross loans, and total deposits, suggesting that liquidity creation grew at a faster rate than these items.

Large banks created 81% of industry liquidity at the end of the sample period, despite representing only about 2% of the sample observations. Medium and small banks generated only about 5% and 14% of industry liquidity creation as of 2003, respectively, despite their greater numbers of observations. Medium

[21] Applying the formula given in step 3 of Table 1: liquidity creation = ½ * illiquid assets of $2.752 trillion + 0 * semiliquid assets of $1.905 trillion − ½ * liquid assets of $2.550 trillion + ½ * liquid liabilities of $3.718 trillion + 0 * semiliquid liabilities of $1.777 trillion − ½ * illiquid liabilities of $0.370 trillion − ½ * equity of $0.624 + ½ * illiquid guarantees of $2.781 trillion + 0 * semiliquid guarantees of $0.782 trillion − ½ * liquid guarantees of −$0.001 trillion − ½ * liquid derivatives of $0.023 trillion = $2.843 trillion.

Table 2
Summary statistics on bank liquidity creation

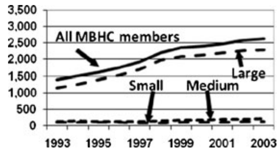
Panel A: Bank liquidity creation over time (1993–2003) and in the cross section using our four liquidity creation measures for banks split by size

Liquidity creation measure		1993 liquidity creation						2003 liquidity creation						Liquidity creation 1993–2003
		N	*LC $ bill*	*LC/GTA*	*LC/EQ*	*LC/LNS*	*LC/DEP*	*N*	*LC $ bill*	*LC/GTA*	*LC/EQ*	*LC/LNS*	*LC/DEP*	*$ billion*
cat fat	All banks	9095	1523	0.34	4.36	0.60	0.46	6968	2843	0.39	4.56	0.70	0.58	
(preferred)	Large	205	1154	0.40	5.44	0.70	0.58	143	2298	0.41	4.93	0.75	0.64	
	Medium	208	115	0.30	3.73	0.53	0.38	205	149	0.38	3.69	0.61	0.51	
	Small	8682	254	0.21	2.40	0.39	0.25	6620	396	0.33	3.37	0.51	0.40	
cat nonfat	All banks	9095	830	0.19	2.38	0.33	0.25	6968	1463	0.20	2.35	0.36	0.30	
	Large	205	562	0.19	2.65	0.34	0.28	143	1041	0.19	2.23	0.34	0.34	
	Medium	208	73	0.19	2.37	0.33	0.24	205	108	0.27	2.68	0.44	0.44	
	Small	8682	195	0.16	1.84	0.30	0.19	6620	315	0.26	2.67	0.41	0.41	
mat fat	All banks	9095	1693	0.38	4.85	0.67	0.51	6968	3234	0.45	5.18	0.79	0.66	
	Large	205	1224	0.42	5.77	0.74	0.61	143	2647	0.47	5.68	0.86	0.86	
	Medium	208	144	0.38	4.68	0.66	0.48	205	160	0.41	3.98	0.66	0.66	
	Small	8682	324	0.27	3.06	0.50	0.32	6620	427	0.35	3.63	0.55	0.55	
mat nonfat	All banks	9095	1000	0.22	2.87	0.40	0.30	6968	1855	0.26	2.97	0.45	0.38	
	Large	205	633	0.22	2.98	0.38	0.32	143	1391	0.25	2.98	0.45	0.45	
	Medium	208	102	0.27	3.32	0.47	0.34	205	119	0.30	2.96	0.49	0.49	
	Small	8682	265	0.22	2.50	0.41	0.26	6,620	345	0.28	2.93	0.45	0.45	

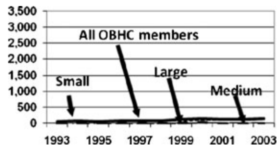
Panel B: Bank liquidity creation over time (1993–2003) and in the cross section using our preferred "cat fat" measure for banks in each size class split by bank holding company status, wholesale versus retail orientation, and merger status

	N 1993	*N* 2003
Multibank holding company (MBHC) members		
All banks	3323	2681
Large	195	136
Medium	168	164
Small	2960	2381

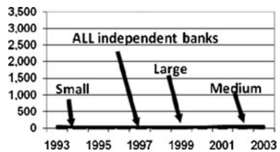
Liquidity creation 1993–2003 $ *billion*



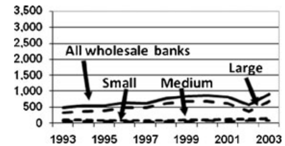
	N 1993	*N* 2003
One-bank holding company (OBHC) members		
All banks	3397	3022
Large	4	3
Medium	14	22
Small	3379	2997



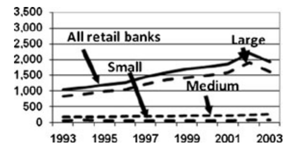
	N 1993	*N* 2003
Independent banks		
All banks	2375	1265
Large	6	4
Medium	26	19
Small	2343	1242



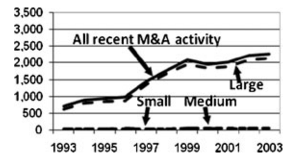
	N 1993	*N* 2003
Wholesale banks (below average number of branches)		
All banks	6659	4809
Large	131	106
Medium	131	113
Small	6397	4590



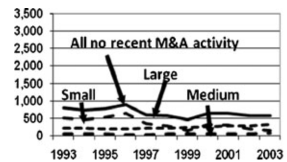
	N 1993	*N* 2003
Retail banks (above average number of branches)		
All banks	2436	2159
Large	74	37
Medium	77	92
Small	2285	2030



	N 1993	*N* 2003
Recent M&A activity (engaged in M&As during prior three years)		
All banks	694	576
Large	95	98
Medium	73	73
Small	526	405



	N 1993	*N* 2003
No recent M&A activity		
All banks	8401	6392
Large	110	45
Medium	135	132
Small	8156	6215



(*continued overleaf*)

Table 2
(Continued)

Panel C: Characteristics of banks that create the most and least liquidity over 1993–2003 in each size class using our preferred “cat fat” measure

		Large banks		Medium banks		Small banks	
Banks split by		High liquidity creators (top 25%)	Low liquidity creators (bottom 25%)	High liquidity creators (top 25%)	Low liquidity creators (bottom 25%)	High liquidity creators (top 25%)	Low liquidity creators (bottom 25%)
Overall *LC*	A. Average liquidity creation ($ billion)	36.00	0.67	1.20	0.12	0.12	−0.00
	Composition of high and low liquidity creators						
	a. MBHC members	0.99	0.85	0.93	0.56	0.54	0.20
	b. OBHC members	0.01	0.05	0.05	0.16	0.31	0.46
	c. Independent banks	0.00	0.10	0.01	0.28	0.15	0.34
	a. Wholesale banks	0.25	0.97	0.47	0.76	0.29	0.91
	b. Retail banks	0.75	0.03	0.53	0.24	0.71	0.09
	a. Recent M&A activity	0.74	0.47	0.52	0.28	0.16	0.02
	b. No recent M&A activity	0.26	0.53	0.48	0.72	0.84	0.98
LC/*GTA*	B. Average liquidity creation/*GTA*	0.66	0.15	0.57	0.08	0.43	0.00
	Composition of high and low liquidity creators						
	a. MBHC members	0.99	0.84	0.89	0.59	0.45	0.22
	b. OBHC members	0.00	0.06	0.07	0.14	0.36	0.45
	c. Independent banks	0.00	0.10	0.03	0.27	0.19	0.33
	a. Wholesale banks	0.60	0.86	0.62	0.68	0.58	0.83
	b. Retail banks	0.40	0.14	0.38	0.32	0.42	0.17
	a. Recent M&A activity	0.63	0.53	0.41	0.31	0.10	0.03
	b. No recent M&A activity	0.37	0.47	0.59	0.69	0.90	0.97

LC/EQ	C. Average liquidity creation/equity	8.56	1.78	6.9	0.92	5.35	0.07
	Composition of high and low liquidity creators						
	a. MBHC members	1.00	0.84	0.89	0.58	0.46	0.21
	b. OBHC members	0.00	0.06	0.07	0.13	0.36	0.45
	c. Independent banks	0.00	0.10	0.04	0.29	0.18	0.34
	a. Wholesale banks	0.57	0.88	0.60	0.68	0.57	0.84
	b. Retail banks	0.43	0.12	0.40	0.32	0.43	0.16
	a. Recent M&A activity	0.62	0.52	0.39	0.31	0.10	0.03
	b. No recent M&A activity	0.38	0.48	0.61	0.69	0.90	0.97

Panel A shows liquidity creation of the banking sector in $ billion and divided by gross total assets (*GTA*, i.e., total assets plus the allowance for loan and lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans)), equity (EQ), gross loans (LNS), and deposits (DEP) from 1993 to 2003. Panel B contains graphs of liquidity creation by banks split by BHC status, wholesale versus retail orientation, and merger status. Panel C uses these bank characteristics to contrast banks that create the most and least liquidity (top 25% and bottom 25% in each size class, respectively) over 1993–2003. All panels show results for large banks (*GTA* exceeding $3 billion), medium banks (*GTA* $1 billion–$3 billion), and small banks (*GTA* up to $1 billion). Panel A measures liquidity creation using all four liquidity creation measures as defined in Table 1, while panels B and C only show liquidity creation based on our preferred "cat fat" measure. All financial values are expressed in real 2003 dollars using the implicit GDP price deflator. The cat (mat) liquidity creation measures classify all bank activities other than loans based on product category and maturity, and loans by category (maturity) only. The fat (nonfat) liquidity creation measures include (exclude) off-balance sheet activities.

and small institutions also had slightly lower ratios of liquidity creation divided by *GTA*, equity, gross loans, and total deposits than large banks. As will be shown, this is because these institutions generated much less liquidity off the balance sheet. At large banks, liquidity creation doubled in real dollars, although it only rose as a fraction of *GTA* from 40% in 1993 to 41% in 2003. Perhaps surprisingly, small banks showed the greatest increase in liquidity creation divided by *GTA*, equity, gross loans, and total deposits.

As shown in the "cat fat" graph in panel A of Table 2, liquidity creation based on this measure increased in every year from 1993 to 2003. This was primarily driven by large banks—medium and small banks experienced smaller, nonmonotonic increases in liquidity creation. The increase in overall liquidity creation was driven by substantial growth in illiquid assets, liquid liabilities, and illiquid guarantees, which outweighed smaller increases in liquid assets, illiquid liabilities, and equity.

Liquidity creation is almost 50% less based on our "cat nonfat" measure, which is the same as "cat fat" except for the exclusion of off-balance sheet activities. Large banks still created most of the industry's liquidity, although the percentage is lower (71% as of 2003 versus 81% based on our "cat fat" measure). As shown in the "cat nonfat" graph, liquidity creation based on this measure also increased in every year of the sample period, primarily due to increases by large banks. Liquidity creation by medium and small banks experienced smaller, nonmonotonic increases in liquidity creation.

A comparison of liquidity creation based on the "cat fat" and "cat nonfat" measures reveals that banks create almost half of their liquidity off the balance sheet. This highlights the importance of including off-balance sheet activities. Although banks engage in a variety of off-balance sheet activities, the main drivers of off-balance sheet liquidity creation are illiquid guarantees of $2.781 trillion, in particular unused commitments ($2.426 trillion) and, to a lesser extent, net standby letters of credit ($0.287 trillion).[22] Derivatives ($0.023 trillion) are not among the major components of off-balance sheet liquidity creation. As noted in Section 2.2, while banks may have substantial derivatives portfolios, most operate with nearly matched books, so gross positive and negative fair values tend to offset each other. As an interesting side note, we also find that unused commitments, C&I commitments (a subset of unused commitments), net standby letters of credit, and commercial and similar letters of credit are all highly positively and significantly correlated with transactions deposits ($\rho = 0.73$, 0.81, 0.80, and 0.68, respectively), consistent with the predictions and findings of Kashyap, Rajan, and Stein (2002).

A second insight gained from comparing liquidity creation based on our "cat fat" and "cat nonfat" measures is that large, medium, and small banks create liquidity in very different ways. For example, as of 2003, unused loan

[22] Commercial and similar letters of credit and other off-balance sheet liabilities only amounted to $0.024 trillion and $0.043 trillion, respectively.

commitments equal 48% of total liquidity created by large banks, while only amounting to 26% and 19% of liquidity created by medium and small banks, respectively. Commercial real estate, on the other hand, equals only 12% of total liquidity creation for large banks, while equaling 36% and 42% of liquidity creation for medium and small banks, respectively. Similarly, for large banks, transactions deposits equal only 9% of total liquidity creation, whereas the corresponding figures for medium and small banks are 15% and 31%, respectively (not shown for reasons of brevity).

We now turn to liquidity creation based on our "mat" measures. Liquidity creation is the highest in all years using our "mat fat" measure, which differs from our preferred "cat fat" measure by using loan maturities in place of categories to classify loans. Treating all loans with maturity of at least one year as illiquid assets increases measured liquidity creation primarily because most residential mortgages are classified as illiquid (weight = $^1/_2$). Recall that these mortgages are classified as semiliquid (weight = 0) in the "cat fat" measure because they are relatively easy to securitize. The "mat fat" pattern of liquidity creation over time is similar to the "cat fat" pattern. The "mat nonfat" measure, which uses loan maturities and excludes off-balance sheet activities, yields much smaller measured liquidity creation. The "mat nonfat" liquidity creation pattern resembles the pattern of the other measures, increasing in all periods, driven by the large banks.

To understand more deeply how liquidity creation has changed over time and how it varies in the cross section, we split banks in each size class based on three additional characteristics. First, we divide banks by bank holding company status into multibank holding company (MBHC) members, one-bank holding company (OBHC) members, and independent banks. Second, we divide banks by wholesale versus retail orientation, defined here as having below-average and above-average numbers of branches for their size class, respectively. Third, we split banks by merger status: those that did and did not engage in mergers and acquisitions during the prior three years. For each subsample, we show the numbers of banks in 1993 and 2003, and present graphs that highlight how liquidity creation has changed over time (see panel B of Table 2). For brevity, we focus on liquidity creation based on our preferred "cat fat" measure.

Panel B of Table 2 contains the results. As shown on the left, the vast majority of large and medium banks are in MBHCs, while small banks are more evenly divided among the three governance structures. As the graphs make clear, MBHC members created most of the overall industry liquidity creation, and these banks also experienced the greatest increase in liquidity creation. Within each size class, MBHC members also created the most liquidity.

As shown on the top right in panel B of Table 2, most of the banks have wholesale orientation by our definition, but retail banks create most of overall industry liquidity. This result is driven by large and small banks; among medium banks, liquidity created by retail and wholesale banks is similar. As shown, liquidity creation grows in each year for both retail and wholesale banks, except for the spikes in 2002 and 2003. These spikes occur because Citibank shifted from a wholesale bank to a retail bank in 2002 and back to wholesale status in 2003.

Finally, as shown in the bottom right in Table 2, panel B, most banks did not engage in M&As, but most of overall industry liquidity is created by recently merged institutions. This result is purely driven by large banks; among medium and small banks, institutions that did not engage in recent merger activity create more liquidity than those that did. This explains why liquidity creation by recently merged banks increased in almost every year, whereas liquidity creation remained relatively constant over the sample period for banks that did not engage in M&As.

3.3 Characteristics of banks that create the most and least liquidity

We next examine the characteristics of banks that create the most and least liquidity. In each size class, we split banks into "high liquidity creators" and "low liquidity creators" based on our preferred "cat fat" measure. We define high and low liquidity creators as those in the top 25% and bottom 25%, respectively, based on (1) overall liquidity creation; (2) liquidity creation divided by *GTA*; and (3) liquidity creation divided by equity.

The top, middle, and bottom parts of panel C in Table 2 show the results based on overall liquidity creation (*LC*), *LC/GTA*, and *LC/EQ*, respectively. Each part shows the average amount of liquidity created by high and low liquidity creators, and some key characteristics (BHC status, wholesale versus retail orientation, and merger status) of these banks. For example, among large banks, each of the high liquidity creators on average created $36 billion in liquidity. Splitting these high liquidity creators by BHC status, we find that 99% of these banks are MBHC members, and 1% are OBHC members. Similarly, 25% have a wholesale orientation, while 25% are retail banks; 74% engaged in recent M&A activity, while 26% were not involved in recent M&A activity.

Several findings are noteworthy. First, not surprisingly, high liquidity creators create substantially more liquidity than low liquidity creators in each size class. What may be surprising, however, is just how small the numbers are for the low liquidity creators. In particular, the bottom 25% of small banks in terms of overall liquidity creation create slightly negative liquidity. This raises the question of whether these institutions should still be considered to be banks. To address this question, it is important to recall that banks perform two central roles in the economy, liquidity creation and risk transformation. While these banks may not create liquidity, they may still provide valuable risk-transformation services, although a deeper investigation of this issue is beyond the scope of this article.

Second, MBHC members tend to create the most liquidity in every size class by every measure of liquidity creation. In all cases, OBHC members and independent banks tend to be more prevalent among the low liquidity creators.

Third, based on overall liquidity creation, retail banks tend to be high liquidity creators in every size class. Maybe surprisingly, we find opposite results when we split banks based on liquidity creation divided by *GTA* and equity. One explanation may be that retail banks tend to be the largest banks in each size class. While these banks create substantial amounts of liquidity, they create far less liquidity per dollar of assets or equity. Wholesale banks tend to be low liquidity creators in every size class.

Fourth, a far more diverse picture arises when we look at banks' M&A history. Among large banks, high liquidity creators tend to be banks with recent M&A activity, while low liquidity creators are approximately evenly distributed among those that did and those that did not engage in M&As. Since most of the small banks did not engage in recent M&As, it is not surprising that among these banks, most of both the high and low liquidity creators had no recent M&A activity. However, it is clear that small banks that did engage in M&As in the prior three years are better represented among the high liquidity creators. The medium bank pattern falls somewhere in between the patterns for large and small banks.

3.4 Value implications of bank liquidity creation

We next investigate the value implications of bank liquidity creation. If liquidity creation creates a net surplus to be shared between the bank, its borrowers, and its depositors, then liquidity creation should be positively associated with the market value of the bank or its holding company. To examine this issue, we focus on banks that are individually traded or part of a traded bank holding company. For the purposes of this analysis, we include listed independent banks and OBHCs, and we aggregate the liquidity creation of all the banks in a listed MBHC. To ensure that any relationship between liquidity creation and value is likely to be due to the liquidity created by our sample banks, we exclude holding companies in which these banks account for less than 90% of holding company assets.[23] Imposing this restriction reduces our sample from 3686 to 3223 bank-year observations.

Since we are not aware of any theories that predict a causal link between liquidity creation and value, we focus on correlations. In particular, we present correlations between liquidity creation and value, where liquidity creation is measured by the dollar amount of liquidity creation and liquidity creation divided by *GTA* and equity (all calculated using our "cat fat" measure), and value is measured as the *Market-to-Book ratio* and the *Price-Earnings ratio* (based on earnings before and after extraordinary items).

Table 3 contains the results. As shown, the dollar amount of liquidity creation and liquidity creation divided by *GTA* and equity are all significantly positively correlated with the market-to-book ratio, with correlations between 0.115 and 0.164. The correlations with the price-earnings ratio (based on earnings before

[23] The findings are similar if we instead impose an 85% or a 95% cutoff. If we do not impose any restriction, results based on the market-to-book ratio are unchanged, but the findings based on the price-earnings ratio are somewhat weaker (significant in only two of six cases).

Table 3
Value implications of liquidity creation

	N	Market-to-Book ratio	Price-Earnings ratio (based on earnings before extraordinary items)	Price-Earnings ratio (based on earnings after extraordinary items)
Liquidity creation: *LC* ($)	3223	0.115	0.042	0.042
		(0.00)***	(0.02)**	(0.02)**
Liquidity creation: *LC/GTA*	3223	0.151	0.041	0.042
		(0.00)***	(0.02)**	(0.02)**
Liquidity creation: *LC/EQ*	3223	0.164	0.024	0.025
		(0.00)***	(0.18)	(0.16)

This table shows correlations between liquidity creation and valuation of listed banks and bank holding companies. For independent banks, these are direct correlations between the amount of liquidity created by the bank and its valuation. For multibank holding companies, we aggregate liquidity created by all the banks in the holding company. For one-bank holding companies and multibank holding companies we require that the total assets of the banks comprise at least 90% of the total assets of the bank holding company, and calculate correlations between total bank liquidity created and the valuation of the holding company. The dollar amount of liquidity creation (*LC*) is calculated using our preferred "cat fat" liquidity creation measure as defined in Table 1. *GTA* equals total assets plus the allowance for loan and lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans). EQ is total equity capital. The valuation measures used are the market-to-book ratio and the price-earnings ratio. The market-to-book ratio is defined as the market value of equity measured as of 31 December divided by the book value of equity measured as of the previous fiscal year end. The book value of equity is defined as the Compustat book value of stockholder's equity, plus balance sheet deferred taxes and investment tax credit, minus the book value of preferred stock. All accounting data are winsorized at the 1% and 99% level to reduce the impact of outliers. As in Fama and French (1993), we use the redemption, liquidation, or par value (in that order) to estimate the value of preferred stock. The price-earnings ratio is defined as the share price as of 31 December divided by earnings (before and after extraordinary items) per share measured as of the previous fiscal year end. *p*-values are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

and after extraordinary items) are also all positive, but they are smaller in magnitude, and are significant in only four of six cases. These results suggest that banks that create more liquidity are valued more highly by investors.

4. Analytical Framework

We next turn to our third main goal of analyzing the effect of bank capital on liquidity creation. In this section, we describe our regression framework and explain our regression variables. In Section 5, we present our empirical results, and in Section 6, we examine the robustness of our results.

Before we present our regression framework, we note that the theories suggest a causal link between capital and liquidity creation. According to the "financial fragility-crowding out" hypothesis, the effect of capital on liquidity creation is negative, and according to the "risk absorption" hypothesis the effect is positive. The negative effect of capital on liquidity creation as suggested by Diamond and Rajan (2000, 2001), i.e., the financial fragility effect, only arises if deposit insurance coverage is incomplete. Deposit insurance is indeed incomplete for banks in all three of our size classes over our sample period: most banks fund themselves partly with uninsured deposits and with overnight federal funds purchased, another funding source that can run on the bank.[24]

[24] For example, as of 2003, large banks fund 21.4% and 7.5% of their *GTA* with uninsured deposits and overnight federal funds purchased, respectively. For medium banks, the corresponding figures are 24.3% and 5.7%, respectively, while for small banks, the figures are 19.8% and 2.2%, respectively.

In practice, capital and liquidity creation are to some extent jointly determined. To mitigate this potential endogeneity problem, our exogenous variables are lagged values, as discussed above. Nonetheless, this may not be sufficient. We therefore interpret all our regression results with care. We do not claim to establish causation in our regressions, but at a minimum, our results yield interesting correlations between capital and liquidity creation that are consistent with the theories and are robust to a variety of checks, including tests that involve instrumental variables for capital.

4.1 Regression framework

To examine whether the "financial fragility-crowding out" effect or the "risk absorption" effect empirically dominates, we use panel datasets on large, medium, and small banks from 1993 to 2003. We regress the dollar amount of bank liquidity creation (calculated using our four liquidity creation measures) divided by *GTA* on the lagged equity capital ratio while controlling for other factors that may affect bank liquidity creation. Normalization by *GTA* is necessary to make the dependent variables meaningful and comparable across banks and to avoid giving undue weight to the largest institutions. Use of dollar amounts of liquidity creation without normalization would primarily amount to a regression of bank size on capital and other exogenous variables because banks differ so greatly in size even within each size class.

Our control variables include bank risk, bank size, BHC membership, merger and acquisition history, and local market competition and economic environment, as explained in detail below. We include bank fixed effects to account for average differences over time across banks that are not captured by the other exogenous variables and to reduce correlations across error terms. Time fixed effects are added to control for average differences in liquidity creation across years that are not captured by the other exogenous variables, and to reduce serial correlation problems. All regressions are estimated with robust standard errors, clustered by bank, to control for heteroskedasticity, as well as possible correlation among observations of the same bank in different years.

Table 4 gives descriptions and summary statistics for the exogenous variables. All financial values are expressed in real 2003 dollars using the implicit GDP price deflator.[25] The exogenous variables are lagged values created using annual data averaged over the three years prior to observation of the dependent variables to reduce potential endogeneity problems, as lagged values are more likely to reflect earlier decisions.[26] The use of three-year averages, rather than a single lagged year, also reduces the effects of short-term fluctuations and problems with the use of accounting data. As well, portfolio changes take time to occur and likely reflect decisions made on the basis of historical experience, so

[25] We obtain similar results if we express all values in real 1993 dollars.

[26] Exceptions are two of our risk measures, which are calculated using data from the previous twelve quarters (see Section 4.3).

Table 4
Definitions and summary statistics for exogenous variables

Variable	Definition	Mean for all banks	Mean for large banks	Mean for medium banks	Mean for small banks
Bank capital ratio					
EQRAT	Equity capital ratio: total equity capital as a proportion of *GTA*, where *GTA* equals total assets plus the allowance for loan and lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans)	0.10	0.08	0.09	0.10
Bank risk					
EARNVOL	Standard deviation of the bank's quarterly return on assets measured over the previous twelve quarters, multiplied by 100	0.12	0.12	0.11	0.12
CREDITRISK	Credit risk measure: calculated as the bank's Basel I risk-weighted assets and off-balance sheet activities divided by *GTA*. To reduce multicollinearity, this variable is orthogonalized in all analyses	0.61	0.72	0.66	0.61
ZSCORE	Distance to default: measured as the bank's return on assets plus the equity capital/*GTA* ratio divided by the standard deviation of the return on assets. To reduce multicollinearity, this variable is orthogonalized in all analyses	1.43	1.24	1.52	1.43
Bank size					
Ln(GTA)	Natural log of *GTA*	11.61	16.18	14.30	11.44
Bank holding company status					
D-MBHC	A dummy that equals 1 if the bank has been part of a multibank holding company over the past three years	0.44	0.95	0.81	0.42
D-OBHC	A dummy that equals 1 if the bank has been part of a one-bank holding company over the past three years	0.34	0.02	0.09	0.35
Mergers and acquisitions					
D-BANK-MERGE	A dummy that equals 1 if the bank was involved in one or more mergers over the past three years, combining the charters of two or more banks	0.09	0.64	0.43	0.07
D-DELTA-OWN	A dummy that equals 1 if the bank was acquired in the last three years, indicated by a change in top-tier holding company with no change in charter	0.09	0.06	0.10	0.09

Local market competition					
HERF	A bank-level Herfindahl index based on bank and thrift deposits (the only variable for which geographic location is publicly available). We first establish the Herfindahl index of the markets in which the bank has deposits and then weight these market indices by the proportion of the bank's deposits in each of these markets	0.21	0.15	0.16	0.21
SHARE-ML	Share of market bank and thrift deposits held by medium and large banks (*GTA* exceeding $1 billion)	0.32	0.58	0.56	0.31
Local market economic environment					
Ln(POP)	Natural log of weighted average population in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights	11.90	14.30	13.81	11.79
Ln(DENSITY)	Weighted average population density (natural log of population per square mile) in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights	4.68	6.50	6.15	4.60
INC-GROWTH	Weighted average income growth in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights	0.05	0.05	0.05	0.05
Fixed effects					
Time fixed effects	Set of dummies for all but one year				
Bank fixed effects	Set of dummies for all but one bank				

The exogenous variables are created using annual data and are three-year lagged averages (i.e., the average of three years prior to observation of the dependent variable), except for the risk measure, which is calculated using data on the previous twelve quarters. All of the annual lagged values are merger adjusted; the bank capital ratio and size are pro forma values, the mergers and acquisitions dummies simply take a value of 1 or 0 based on the combined experience of the banks in the case of mergers or acquisitions, and the local market competition and environment variables are weighted averages for the merging banks using their *GTA* values in constructing the weights. Sample period: 1993–2003. Sample means are provided for all banks, large banks (*GTA* exceeding $3 billion), medium banks (*GTA* $1 billion–$3 billion), and small banks (*GTA* up to $1 billion). All financial values are expressed in real 2003 dollars using the implicit GDP price deflator.

Data sources: Bank Call Reports, Bank Holding Company Y-9 reports, FDIC Summary of Deposits, NIC Database, Bureau of Economic Analysis, and U.S. Census Bureau.

three years of data may more accurately reflect the inputs into liquidity creation decisions.[27] All of the annual lagged values are merger adjusted. We collect information from the Federal Reserve Board's National Information Center (NIC) database on a bank's prior M&As, and use it to construct historical pro forma values.

4.2 Variable descriptions

The key exogenous variable is the lagged capital ratio. For our main analysis, we use *EQRAT*, the ratio of equity to *GTA*. Equity meets the most straightforward, narrow definition of capital as funds that cannot be easily withdrawn. *GTA* is the simplest measure of bank size, although it excludes off-balance sheet activities. *GTA* equals total assets plus the allowance for loan and lease losses and the allocated transfer risk reserve—two reserves held for potential credit losses—so that the full value of the loans financed and liquidity created by the bank on the asset side are included. In Section 6, we perform two robustness checks on the capital ratio. First, we replace *EQRAT* with an alternative capital ratio. Second, realizing that to some extent, a bank chooses its capital ratio, we use an instrumental variable approach to resolve any potential endogeneity problems.

We control for bank risk using three risk measures.[28] The first measure is earnings volatility (as in Berger et al. 2008, and Laeven and Levine forthcoming). *EARNVOL* is measured as the standard deviation of the bank's return on assets over the previous twelve (minimum: eight) quarters. The second measure is a bank's credit risk, a key risk of banks. *CREDITRISK* is calculated as a bank's Basel I risk-weighted assets and off-balance sheet activities divided by *GTA*. The third risk measure is the *z*-score, which indicates a bank's distance from default (e.g., Boyd, Graham, and Hewitt 1993). *ZSCORE* is measured as a bank's return on assets plus the equity capital/*GTA* ratio divided by the standard deviation of the return on assets. A higher *z*-score indicates that a bank is more stable. It is important to appropriately control for bank risk because a primary reason why banks hold capital is to absorb risk. The inclusion of risk measures helps to isolate the role of capital in supporting the liquidity creation function of banks from the role of capital in supporting banks' function as risk transformers. It is standard practice in the literature to include risk measures one at a time.[29] Nonetheless, we include all three risk measures in every regression in order to capture all of the information in all three measures in a single specification. However, because all three measures

[27] Using one-year lagged values weakens the significance of the results for large banks, but leaves our results for medium and small banks qualitatively unchanged.

[28] Since our analyses are performed at the bank level, risk measures typically used at the BHC level (including stock return volatility, bond ratings, and beta) cannot be used.

[29] See, e.g., Brockman and Turtle (2003); Acharya, Bharath, and Srinivasan (2007); John, Litov, and Yeung (2008); and Kadan and Swinkels (2008).

assess the same underlying unobservable variable (risk), there is a serious multicollinearity problem associated with introducing them simultaneously. We deal with this problem by orthogonalizing two of the risk measures.[30] In all of the analyses reported in the article, we include *EARNVOL*, orthogonalized *CREDITRISK*, and orthogonalized *ZSCORE*. (For simplicity, we use the terms *CREDITRISK* and *ZSCORE* instead of orthogonalized *CREDITRISK* and orthogonalized *ZSCORE* throughout.) Since our approach is a departure from the standard approach of introducing risk measures one at a time, we also run the base regressions by alternatively including these three risk measures individually. The results are qualitatively similar to those reported in the article and are available upon request.

To control for bank size, we include the natural log of bank size, *Ln*(*GTA*), in every regression, as well as running the regressions separately for large, medium, and small banks. The natural log is used for all of the continuous exogenous variables that may take on large values to avoid potential specification distortions, given that the dependent variables are generally in the [0,1] interval.[31]

We control for the bank's bank holding company (BHC) status with two variables: *D-MBHC*, a dummy variable that equals one if the bank has been part of a multibank bank holding company (MBHC) in any of the past three years and zero otherwise, and *D-OBHC*, a dummy variable that equals one if the bank has been part of a one-bank holding company (OBHC) in any of the past three years and zero otherwise. BHCs and other banks in the same BHC may serve as internal capital markets to provide capital in times of stress. This view is supported by both regulation and the literature.[32]

We also control for the bank's merger and acquisition history. The *D-BANK-MERGE* and *D-DELTA-OWN* dummies indicate whether a bank was involved in a merger or acquisition over the past three years, where a merger is defined as the combination of bank charters into an institution with a single set of books, and an acquisition is defined as a case in which the bank's top-tier holding company changed with no change in charter status. Controlling for mergers and acquisitions is important because banks often substantially alter their lending behavior following such events.

To construct controls for local market competition and economic environment, we define the local market as the Metropolitan Statistical Area (MSA)

[30] We regress *CREDITRISK* on *EARNVOL*, *ZSCORE*, and all of the control variables. The residuals of this regression represent the variation in *CREDITRISK* not captured by *EARNVOL*, *ZSCORE,* or the other explanatory variables. We follow a similar procedure for *ZSCORE.*

[31] For example, based on our preferred "cat fat" measure, liquidity creation divided by *GTA* (our dependent variable) is in the [0,1] interval 90.5% of the time.

[32] U.S. regulations require BHCs to be a source of strength for the banks they own and require other banks in the same BHC to cross-guarantee the other bank affiliates. Empirical research finds, for example, that bank loan growth depends on the BHC (e.g., Houston, James, and Marcus 1997).

or non-MSA county in which the offices are located.[33] For banks with offices in more than one local market, we use weighted averages across these markets, using the proportion of the bank's deposits in each of these markets as the weights.[34] To control for local market competition, we include *HERF*, the Herfindahl index of concentration for the market or markets in which the bank is present. We base *HERF* on the market shares of both banks and thrift institutions, given that thrifts compete vigorously with banks for deposits. We also include *SHARE-ML*, the local market share of medium and large institutions, to allow for the possibility that banks of different sizes may compete differently. It is important to control for local market competition because various studies have shown that market concentration affects credit availability (e.g., Petersen and Rajan 1995) and that the loan portfolios of large and small banks are markedly different (e.g., Berger et al. 2005). Hence, competition likely affects liquidity creation through both the amount and types of loans a bank extends and the way it funds its activities.[35] To control for local market economic conditions, we include the log of population *Ln(POP)*, the log of population density *Ln(DENSITY)*, and income growth *INC-GROWTH*.

5. Regression Results

In this section, we present our regression results. We first present our main results and find that the relationship between capital and liquidity creation differs for large, medium, and small banks. We then investigate why the results differ by size class using the components of liquidity creation. In all cases, we examine whether the findings are consistent with the economic intuition discussed earlier. In Section 6, we conduct a number of robustness checks.

Before proceeding, we note the important distinction between the liquidity creation weight on capital and the regression coefficient on lagged capital. We assign a weight of $-½$ to equity when forming our liquidity creation measures, the dependent variables in the regressions. This does not imply that when we regress the dollar amount of liquidity creation (normalized by *GTA*) on the lagged equity ratio, *EQRAT*, the coefficient on *EQRAT* should necessarily be negative or close to -0.5. Rather, the measured effect depends on bank behavior. For example, if banks with more lagged equity capital extend significantly more illiquid loans and hold significantly fewer liquid assets than banks with lower levels of capital, we may find a positive association between lagged capital and liquidity creation.[36]

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[33] In some cases, we use New England County Metropolitan Areas (NECMAs) in place of MSAs, but for convenience, we use the term MSA to cover both MSAs and NECMAs.

[34] We use shares of deposits because this is the only banking service for which geographic location is publicly available.

[35] We obtain similar regression results if we exclude the local market competition variables.

[36] A potential concern about our regression specification is that current bank equity is included in our dependent variable (liquidity creation divided by *GTA*), while the lagged equity ratio is our key exogenous variable. To

5.1 The net effect of capital on liquidity creation for large, medium, and small banks

Panels A, B, and C of Table 5 contain the regression results for large banks (*GTA* exceeding \$3 billion), medium banks (*GTA* \$1 billion—\$3 billion), and small banks (*GTA* up to \$1 billion), respectively. All of our regressions include the full set of control variables and have time and bank fixed effects, but the results are similar if we control only for size and include fixed effects (not shown for brevity's sake).

The results in panel A of Table 5 suggest that for large banks, the relationship between capital and liquidity creation is positive and significant when liquidity creation includes off-balance sheet activities, i.e., when we use our "fat" liquidity creation measures ("cat fat" or "mat fat"). The magnitude of the coefficient on the lagged equity capital ratio in the "cat fat" regression, 1.146, suggests that large banks with a 1 percentage point higher equity capital ratio for the prior three years (i.e., an increase in *EQRAT* of 0.01) create additional liquidity of over 1 percentage point of a large bank's *GTA*, which appears to be a substantial effect. Using the "nonfat" measures, capital is not significantly correlated with liquidity creation, suggesting that off-balance sheet activities constitute an important part of the effect of capital on liquidity creation for large banks. The *EQRAT* coefficients in the "cat" and "mat" specifications are of similar magnitude, suggesting that use of maturities in place of categories for loans has little impact on the measured net effect of capital.

The results for medium banks in panel B of Table 5 are mixed. For these banks, the relationship between capital and liquidity creation is positive and not significant for the "fat" measures and negative and marginally significant for the "nonfat" measures.

The results in panel C of Table 5 suggest that for small banks, the relationship between capital and liquidity creation is negative, in sharp contrast to the positive or mixed relationship found for large and medium banks. All of the coefficients on the lagged capital ratio are negative and significant at the 1% level, yielding a fairly clear result that is robust across the liquidity creation measures. Using our preferred "cat fat" measure, the magnitude of the coefficient on the lagged equity capital ratio, −0.330, suggests that small banks with a 0.01 higher *EQRAT* create less liquidity by about a third of a percentage point of their *GTA*. As for the large banks, the magnitudes of the net effect of capital on liquidity creation are similar for the "cat" and "mat" measures for small banks. However, a key difference for small banks is that the "fat" and "nonfat" magnitudes are also similar. The inclusion of off-balance sheet activities makes little difference to the net effect of capital on liquidity creation, reflecting the lesser role of these activities for small institutions.

address this, we also construct a liquidity creation measure that excludes equity and obtain similar results (see Section 6.3).

Table 5
The effect of capital on liquidity creation

	Panel A: Regression results for large banks				Panel B: Regression results for medium banks				Panel C: Regression results for small banks			
	cat fat/ *GTA*	cat nonfat/ *GTA*	mat fat/ *GTA*	mat nonfat/ *GTA*	cat fat/ *GTA*	cat nonfat/ *GTA*	mat fat/ *GTA*	mat nonfat/ *GTA*	cat fat/ *GTA*	cat nonfat/ *GTA*	mat fat/ *GTA*	mat nonfat/ *GTA*
EQRAT	1.146	0.465	1.171	0.490	0.219	−0.438	0.260	−0.397	−0.330	−0.341	−0.394	−0.405
	(3.23)***	(1.22)	(3.19)***	(1.31)	(0.29)	(−1.83)*	(0.37)	(−1.71)*	(−7.26)***	(−8.73)***	(−9.90)***	(−11.83)***
EARNVOL	−0.129	−0.103	−0.128	−0.102	0.025	−0.034	0.037	−0.023	−0.019	−0.012	−0.013	−0.005
	(−2.48)**	(−2.24)**	(−2.32)**	(−2.16)**	(0.29)	(−1.19)	(0.38)	(−0.72)	(−3.54)***	(−2.42)**	(−2.30)**	(−1.02)
CREDITRISK	−0.018	0.013	−0.008	0.024	0.043	0.023	0.056	0.036	−0.002	−0.003	−0.021	−0.022
	(−1.03)	(1.23)	(−0.38)	(1.89)*	(1.76)*	(1.65)*	(2.12)**	(2.06)**	(−0.72)	(−1.28)	(−7.40)***	(−8.58)***
ZSCORE	0.006	0.011	0.000	0.004	0.008	0.008	0.006	0.006	−0.003	−0.003	−0.002	−0.002
	(0.82)	(2.16)**	(0.02)	(0.89)	(1.98)**	(2.43)**	(1.32)	(1.63)	(−4.82)***	(−5.18)***	(−3.51)***	(−3.61)***
Ln(GTA)	−0.018	0.013	−0.008	0.024	0.043	0.023	0.056	0.036	−0.002	−0.003	−0.021	−0.022
	(−1.03)	(1.23)	(−0.38)	(1.89)*	(1.76)*	(1.65)*	(2.12)**	(2.06)**	(−0.72)	(−1.28)	(−7.40)***	(−8.58)***
D-MBHC	0.004	−0.005	0.012	0.002	−0.004	−0.001	−0.004	−0.001	0.010	0.010	0.014	0.013
	(0.38)	(−0.96)	(1.03)	(0.30)	(−0.71)	(−0.24)	(−0.80)	(−0.34)	(5.82)***	(6.39)***	(7.83)***	(8.41)***
D-OBHC	0.090	0.099	0.099	0.109	0.021	0.026	−0.004	0.001	0.033	0.032	0.034	0.033
	(0.74)	(1.10)	(0.84)	(1.24)	(0.66)	(1.13)	(−0.12)	(0.03)	(10.82)***	(11.37)***	(10.65)***	(10.99)***
D-BANK-MERGE	0.004	−0.005	0.012	0.002	−0.004	−0.001	−0.004	−0.001	0.010	0.010	0.014	0.013
	(0.38)	(−0.96)	(1.03)	(0.30)	(−0.71)	(−0.24)	(−0.80)	(−0.34)	(5.82)***	(6.39)***	(7.83)***	(8.41)***
D-DELTA-OWN	−0.026	0.021	−0.001	0.046	−0.097	−0.053	−0.106	−0.062	0.019	0.015	0.020	0.016
	(−0.50)	(0.53)	(−0.02)	(1.06)	(−2.21)**	(−1.98)**	(−2.11)**	(−1.85)*	(3.90)***	(3.42)***	(3.84)***	(3.30)***
HERF	−0.027	−0.241	0.107	−0.106	−0.270	−0.176	−0.113	−0.020	0.032	0.028	0.008	0.005
	(−0.12)	(−1.31)	(0.45)	(−0.57)	(−1.89)*	(−1.45)	(−0.68)	(−0.15)	(2.15)**	(2.13)**	(0.52)	(0.34)
SHARE-ML	−0.026	0.021	−0.001	0.046	−0.097	−0.053	−0.106	−0.062	0.019	0.015	0.020	0.016
	(−0.50)	(0.53)	(−0.02)	(1.06)	(−2.21)**	(−1.98)**	(−2.11)**	(−1.85)*	(3.90)***	(3.42)***	(3.84)***	(3.30)***
Ln(POP)	0.803	−0.361	0.665	−0.498	−0.318	−0.372	−0.249	−0.303	0.080	0.039	0.035	−0.006
	(1.42)	(−1.26)	(1.10)	(−1.58)	(−1.11)	(−2.07)**	(−0.77)	(−1.31)	(4.09)***	(2.24)**	(1.78)*	(−0.31)
Ln(DENSITY)	−0.089	−0.020	−0.043	0.026	−0.015	−0.022	−0.019	−0.026	0.017	0.015	0.010	0.008
	(−1.50)	(−0.95)	(−0.62)	(0.80)	(−0.29)	(−0.56)	(−0.35)	(−0.63)	(2.64)***	(2.60)***	(1.48)	(1.25)

INC-GROWTH	0.803	−0.361	0.665	−0.498	−0.318	−0.372	−0.249	−0.303	0.080	0.039	0.035	−0.006
	(1.42)	(−1.26)	(1.10)	(−1.58)	(−1.11)	(−2.07)**	(−0.77)	(−1.31)	(4.09)***	(2.24)**	(1.78)*	(−0.31)
Constant	−0.149	−0.143	−0.051	−0.045	−0.332	−0.160	−0.415	−0.242	0.053	0.041	0.318	0.306
	(−0.42)	(−0.60)	(−0.13)	(−0.17)	(−0.77)	(−0.53)	(−0.87)	(−0.66)	(1.32)	(1.14)	(7.76)***	(8.04)***
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1804	1804	1804	1804	2132	2132	2132	2132	80,062	80,062	80,062	80,062
Adjusted R-squared	0.82	0.85	0.81	0.85	0.76	0.90	0.72	0.88	0.89	0.89	0.88	0.87

This table presents our main regression results. The dependent variable is the dollar amount of liquidity a bank has created, calculated using the four liquidity creation measures as defined in Table 1, normalized by *GTA*. *GTA* equals total assets plus the allowance for loan and lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans). Panels A, B, and C contain the results for large banks (*GTA* exceeding \$3 billion), medium banks (*GTA* \$1 billion–\$3 billion), and small banks (*GTA* up to \$1 billion), respectively.

EQRAT is the equity capital ratio (total equity capital as a proportion of *GTA*). *EARNVOL* is the standard deviation of the bank's quarterly return on assets measured over the previous twelve quarters, multiplied by 100. *CREDITRISK* is a credit risk measure, calculated as the bank's Basel I risk-weighted assets and off-balance sheet activities divided by *GTA*. This variable is orthogonalized to avoid multicollinearity. *ZSCORE* is the distance to default, measured as the bank's return on assets plus the equity capital/*GTA* ratio divided by the standard deviation of the return on assets. This variable is orthogonalized to avoid multicollinearity. *Ln(GTA)* is the log of *GTA*. *D-MBHC* and *D-OBHC* are dummy variables that equal 1 if the bank has been part of a multibank holding company or a one-bank holding company over the prior three years. *D-BANK-MERGE* is a dummy that equals 1 if the bank was involved in one or more mergers over the past three years, combining the charters of two or more banks. *D-DELTA-OWN* is a dummy that equals 1 if the bank was acquired in the last three years, indicated by a change in top-tier holding company with no change in charter. *HERF* is a bank-level Herfindahl index based on bank and thrift deposits (the only variable for which geographic location is publicly available). We first establish the Herfindahl index of the markets in which the bank has deposits and then weight these market indices by the proportion of the bank's deposits in each of these markets. *SHARE-ML* is the share of market bank and thrift deposits held by medium and large banks (*GTA* exceeding \$1 billion). *Ln(POP)* is the natural log of weighted average population in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. *Ln(DENSITY)* is the weighted average population density (natural log of population per square mile) in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. *INC-GROWTH* is the weighted average income growth in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. All regressions are run with both time fixed effects and bank fixed effects.

The sample period is 1993–2003. t-statistics based on robust standard errors clustered by bank are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

In sum, we find that for large banks, capital and liquidity creation are positively correlated when we use measures that include off-balance sheet activities, while this relationship is insignificant when we exclude those activities. For small banks, capital and liquidity creation are negatively correlated using all of our measures, while for medium banks, the relationship is mixed. Thus, the data suggest that, consistent with our economic intuition, the "risk absorption" hypothesis dominates for large banks when off-balance sheet activities are included and the "financial fragility-crowding out" hypothesis strongly dominates for small banks. The two effects are largely offsetting for medium banks. We next investigate what drives these differences.

5.2 Why is the net effect of capital on liquidity creation different by bank size class?

To understand more deeply why the relationship between capital and liquidity creation differs by bank size class, we examine the relationship between capital and the individual components of liquidity creation (e.g., liquid, semiliquid, and illiquid assets). Specifically, we use the individual components based on our "cat fat" liquidity creation measure normalized by *GTA* as dependent variables in our regressions.

Panels A, B, and C of Table 6 show the coefficients on *EQRAT* from these regressions for large, medium, and small banks, respectively. All of the control variables from the full specification are included in these regressions, but are not shown in the interest of brevity. Importantly, since liquidity creation equals the weighted sum of the individual components (using the ½ , 0, and −½ liquidity creation weights discussed above), the weighted sums of the *EQRAT* coefficients on the individual liquidity creation components in Table 6 equal the coefficient on *EQRAT* using the "cat fat" measure in Table 5.[37] Therefore, the *EQRAT* coefficients in the individual component regressions help us understand which components of liquidity creation yield the different results for large, medium, and small banks.

The results in panel A of Table 6 suggest that for large banks, lagged capital is positively related with liquidity creation on the asset side of the balance sheet, as well as off the balance sheet. Banks with higher lagged capital ratios have significantly more illiquid assets, fewer liquid assets, and more illiquid guarantees. These positive effects of capital are partially offset by the fact that large banks with higher lagged capital ratios have significantly higher capital ratios in the current period (i.e., the coefficient on *EQRAT* in the equity/*GTA* regression is positive and significant). Thus, the positive relationship between lagged capital and liquidity creation calculated using our "cat fat" measure in panel A of Table 4 is the net result of the positive relationship between

[37] For example, for large banks, $\frac{1}{2} * 0.356 + 0 * 0.186 + (-\frac{1}{2}) * (-0.541) + \frac{1}{2} * 0.191 + 0 * (-0.276) + (-\frac{1}{2}) * (-0.195) + (-\frac{1}{2}) * 0.353 + \frac{1}{2} * 1.353 + 0 * (-0.664) + (-\frac{1}{2}) * 0.000 + (-\frac{1}{2}) * (-0.009) = 1.146$.

Table 6
The effect of capital on the components of liquidity creation

	Assets/*GTA*			Liabilities/*GTA*			Equity/*GTA*	Guarantees/*GTA*			Derivatives/*GTA*
	Illiquid	Semiliquid	Liquid	Liquid	Semiliquid	Illiquid	Illiquid	Illiquid	Semiliquid	Liquid	Liquid
Weight	½	0	−½	½	0	−½	−½	½	0	−½	−½
Panel A: Regression results for large banks											
EQRAT	0.356	0.186	−0.541	0.191	−0.276	−0.195	0.353	1.353	−0.664	0.000	−0.009
	(1.77)*	(1.42)	(−2.85)***	(0.58)	(−1.41)	(−0.99)	(2.69)***	(2.19)**	(−1.70)*	(0.20)	(−0.87)
Observations	1804	1804	1804	1804	1804	1804	1804	1804	1804	1804	1774
Adjusted R-squared	0.88	0.85	0.84	0.85	0.87	0.80	0.70	0.76	0.74	0.44	0.34
Panel B: Regression results for medium banks											
EQRAT	0.097	0.000	−0.097	−0.506	−0.113	0.083	0.480	1.304	0.043	0.000	−0.010
	(0.43)	(0.00)	(−0.44)	(−2.21)**	(−0.46)	(1.25)	(4.28)***	(1.02)	(0.93)	(0.28)	(−1.59)
Observations	2132	2132	2132	2132	2132	2132	2132	2132	2132	2132	2132
Adjusted R-squared	0.76	0.90	0.72	0.88	0.88	0.75	0.89	0.94	0.92	0.90	0.89
Panel C: Regression results for small banks											
EQRAT	−0.003	−0.153	0.156	−0.184	−0.161	−0.018	0.357	0.023	−0.001	0.001	0.000
	(−0.07)	(−6.60)***	(4.40)***	(−8.01)***	(−5.90)***	(−3.25)***	(21.02)***	(0.83)	(−0.22)	(1.53)	(0.35)
Observations	80,062	80,062	80,062	80,062	80,062	80,062	80,062	80,062	80,062	80,062	78,595
Adjusted R-squared	0.91	0.89	0.86	0.88	0.87	0.73	0.84	0.84	0.54	0.20	0.36

This table presents regression results. The dependent variables are the dollar amounts of the individual liquidity creation components normalized by *GTA*. The dollar amount of liquidity created is calculated using our preferred "cat fat" liquidity creation measure as defined in Table 1. *GTA* equals total assets plus the allowance for loan and lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans).

Panels A, B, and C contain the results for large banks (*GTA* exceeding \$3 billion), medium banks (*GTA* \$1 billion–\$3 billion), and small banks (*GTA* up to \$1 billion), respectively. All panels show only the coefficients on *EQRAT* (total equity capital as a proportion of *GTA*) in the interest of parsimony, although the regressions include all the exogenous variables from the full specification as defined in Table 4. All regressions are run with both time fixed effects and bank fixed effects.

The sample period is 1993–2003. t-statistics based on robust standard errors clustered by bank are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

lagged capital and assets and illiquid guarantees being larger than the negative relationship with current capital. The insignificant relationship between lagged capital and liquidity creation calculated using the "cat nonfat" measure in panel A of Table 4 occurs because the positive relationship between lagged capital and illiquid guarantees is excluded—the positive relationship between lagged capital and assets approximately offsets the negative relationship with current capital.

The findings in panel A of Table 6 are also consistent with the economic intuition that the "risk absorption" effect is relatively strong for large banks. Higher capital allows large banks to bear significantly more portfolio risk, and the data suggest that they do so. Large banks with higher capital hold more risky illiquid assets such as commercial loans and risky illiquid guarantees such as loan commitments, and fewer relatively safe liquid assets such as treasuries.

Panel B of Table 6 suggests very different effects for medium banks. Banks with higher lagged capital ratios tend to have fewer liquid liabilities. The negative relationship between lagged capital and liquid liabilities approximately offsets the positive relationship between lagged capital and current capital, yielding the overall insignificant effect for our "cat fat" measure.

Panel C of Table 6 reveals that similar to large and medium banks, small banks with higher lagged capital ratios have significantly higher capital ratios in the current period. However, in stark contrast to large banks, for small banks, capital is negatively related with liquidity creation on the asset and liability sides of the balance sheet, and essentially unrelated to liquidity creation off the balance sheet. Small banks with higher lagged capital ratios have significantly more liquid assets and fewer liquid liabilities. Thus, the effect of lagged capital is consistently negative for small banks, as opposed to the positive effect for large banks, because the negative effect on current capital is augmented by negative effects of capital on the asset and liability sides, and is not offset by a positive effect off the balance sheet.[38]

The results in panel C of Table 6 are also consistent with the economic intuition that the "financial fragility-crowding out" effect is relatively strong for small banks. On the asset side, lagged capital is not positively related with illiquid assets, but instead is positively related with liquid assets. This is consistent with the spirit of the financial fragility arguments put forth in Diamond and Rajan (2000, 2001). Capital reduces the financial fragility needed to commit to monitoring its borrowers. As a result, banks with higher lagged capital ratios may invest more in liquid assets, rather than increasing their loans. On the liability side, lagged capital is negatively related to liquid liabilities, consistent with the "crowding out" of transactions deposits as in Gorton and Winton (2000).

[38] Lagged capital also has a negative effect on illiquid liabilities (which enhances liquidity creation), but the effect is small.

6. Robustness Issues

In Section 5, we found that, based on our preferred "cat fat" measure of liquidity creation, the relationship between capital and liquidity creation is positive and significant for large banks (when off-balance sheet activities are included), insignificant for medium banks, and negative and significant for small banks. We now examine the robustness of these main findings to (1) using an alternative method to measuring off-balance sheet bank liquidity creation; (2) using an alternative way of establishing which assets are securitizable; (3) excluding equity from the liquidity creation measure; (4) using an alternative capital ratio; (5) splitting the sample by bank holding company status, wholesale versus retail orientation, and merger status; and (6) using an instrumental variable approach. We show that our main results are qualitatively unchanged.

6.1 Using an alternative method to measuring off-balance sheet liquidity creation

Our liquidity creation measures are based on the ease, cost, and time for customers to obtain liquid funds from the bank, and the ease, cost, and time for banks to dispose of their obligations in order to meet these liquidity demands. An alternative would be to use the probability or frequency with which the bank or customers actually liquefy the items and obtain liquid funds. We argue that the ability or option to obtain funds when needed or desired is more important than the actual drawdown frequency. This is also what the theories suggest: banks create liquidity on the balance sheet because they give depositors a liquid claim to their funds (i.e., the option to withdraw funds when needed) instead of forcing them to hold illiquid loans directly (e.g., Diamond and Dybvig 1983). Similarly, banks create liquidity off the balance sheet through guarantees that allow customers the option to draw down liquid funds when needed (e.g., Kashyap, Rajan, and Stein 2002).

Despite our reservations, we construct a liquidity creation measure that incorporates the frequency with which customers obtain liquid funds on off-balance sheet guarantees. Our alternative liquidity creation measure is identical to our "cat fat" measure, except that we multiply the dollar amount of illiquid off-balance sheet guarantees by 0.30, the observed frequency of drawdown as documented in recent research (Sufi 2007).[39]

Using this alternative "cat fat" measure, we find that liquidity creation of the banking sector is about one-third lower than using our preferred "cat fat" measure in every year and amounts to \$1.869 trillion in 2003 (not shown for brevity). The overall pattern of liquidity creation, however, is fairly similar to the "cat fat" pattern.

In panel A of Table 7, we regress the dollar amount of liquidity creation using this alternative "cat fat" measure normalized by *GTA* on *EQRAT* and

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[39] Sufi (2007) uses data on letters of credit and loan commitments over 1996–2003, which corresponds closely with our sample period, and finds that conditional on having a letter of credit or a loan commitment, the probability of drawdown over this time period was approximately 30% in every year.

Table 7
The effect of capital on liquidity creation based on three alternative methods of measuring liquidity creation

	Regression results based on a "cat fat" liquidity creation measure which								
	Panel A: Measures off-balance sheet liquidity creation differently			Panel B: Uses an alternative way to establishing which assets are securitizable			Panel C: Excludes equity		
	Large banks *LC/GTA*	Medium banks *LC/GTA*	Small banks *LC/GTA*	Large banks *LC/GTA*	Medium banks *LC/GTA*	Small banks *LC/GTA*	Large banks *LC/GTA*	Medium banks *LC/GTA*	Small banks *LC/GTA*
EQRAT	0.672	−0.238	−0.338	1.251	0.259	−0.380	0.747	0.259	−0.212
	(1.96)*	(−0.68)	(−8.33)***	(3.58)***	(0.36)	(−8.80)***	(2.30)**	(0.36)	(−6.39)***
EARNVOL	−0.111	−0.017	−0.014	−0.147	0.019	−0.021	−0.103	0.019	−0.013
	(−2.52)**	(−0.46)	(−2.82)***	(−2.62)***	(0.21)	(−3.75)***	(−2.01)**	(0.21)	(−2.75)***
CREDITRISK	0.355	0.370	0.437	0.533	0.524	0.482	0.266	0.524	0.433
	(5.80)***	(5.39)***	(40.08)***	(5.32)***	(2.64)***	(40.09)***	(4.05)***	(2.64)***	(39.24)***
ZSCORE	0.009	0.008	−0.003	0.004	0.007	−0.003	0.009	0.007	−0.002
	(1.80)*	(2.37)**	(−5.12)***	(0.53)	(1.68)*	(−4.16)***	(1.76)*	(1.68)*	(−2.70)***
Ln(GTA)	0.004	0.029	−0.003	−0.013	0.046	−0.021	0.019	0.046	−0.019
	(0.39)	(1.81)*	(−1.11)	(−0.72)	(1.94)*	(−7.39)***	(1.71)*	(1.94)*	(−7.80)***
D-MBHC	0.075	0.034	0.014	0.053	0.014	0.016	0.079	0.014	0.014
	(0.74)	(1.67)*	(5.55)***	(0.42)	(0.44)	(5.48)***	(0.85)	(0.44)	(5.15)***
D-OBHC	0.096	0.025	0.032	0.092	0.004	0.035	0.094	0.004	0.030
	(0.98)	(1.01)	(11.31)***	(0.73)	(0.12)	(11.02)***	(1.06)	(0.12)	(10.61)***
D-BANK-MERGE	−0.003	−0.002	0.010	0.009	−0.004	0.013	−0.001	−0.004	0.012
	(−0.39)	(−0.43)	(6.25)***	(0.80)	(−0.77)	(7.51)***	(−0.11)	(−0.77)	(7.65)***
D-DELTA-OWN	−0.018	−0.002	−0.003	−0.010	0.023	−0.004	−0.014	0.023	−0.003
	(−1.27)	(−0.17)	(−2.10)**	(−0.47)	(0.76)	(−2.52)**	(−1.02)	(0.76)	(−2.28)**
HERF	−0.176	−0.206	0.029	0.121	−0.175	0.028	−0.048	−0.175	0.023
	(−0.98)	(−1.71)*	(2.15)**	(0.54)	(−1.12)	(1.86)*	(−0.28)	(−1.12)	(1.72)*
SHARE-ML	0.008	−0.066	0.016	−0.037	−0.109	0.014	0.015	−0.109	0.009
	(0.21)	(−2.21)**	(3.60)***	(−0.68)	(−2.24)**	(2.77)***	(0.36)	(−2.24)**	(1.97)**
Ln(POP)	0.035	0.017	0.006	0.070	0.007	0.008	0.006	0.007	0.008
	(1.29)	(0.61)	(1.64)	(1.17)	(0.19)	(2.10)**	(0.25)	(0.19)	(2.14)**
Ln(DENSITY)	−0.040	−0.020	0.015	−0.072	−0.008	0.012	−0.007	−0.008	0.010
	(−1.42)	(−0.49)	(2.64)***	(−1.18)	(−0.15)	(1.91)*	(−0.32)	(−0.15)	(1.75)*

INC-GROWTH	0.009	0.062	0.086	0.012	0.025	0.074	−0.043	0.025	0.056
	(0.42)	(3.44)***	(38.87)***	(0.48)	(0.99)	(30.26)***	(−1.87)*	(0.99)	(25.45)***
Constant	0.672	−0.238	−0.338	1.251	0.259	−0.380	0.747	0.259	−0.212
	(1.96)*	(−0.68)	(−8.33)***	(3.58)***	(0.36)	(−8.80)***	(2.30)**	(0.36)	(−6.39)***
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1804	2132	80,062	1804	2132	80,062	1804	2132	80,062
Adjusted R-squared	0.85	0.88	0.89	0.82	0.75	0.88	0.85	0.75	0.86

This table presents regression results. The dependent variable is *LC*/*GTA*, the dollar amount of liquidity a bank has created (calculated using alternative "cat fat" liquidity creation measures as explained below) normalized by *GTA*. *GTA* equals total assets plus the allowance for loan and lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans). Panel A shows results for an alternative method to measuring off-balance sheet liquidity creation (discussed in Section 7.1). Panel B shows results for an alternative way to establishing which assets are securitizable (discussed in Section 7.2). Panel C shows results based on a liquidity creation measure which excludes equity (discussed in Section 7.3). All panels show results for large banks (*GTA* exceeding $3 billion), medium banks (*GTA* $1 billion–$3 billion), and small banks (*GTA* up to $1 billion).

EQRAT is the equity capital ratio (total equity capital as a proportion of *GTA*). *EARNVOL* is the standard deviation of the bank's quarterly return on assets measured over the previous twelve quarters, multiplied by 100. *CREDITRISK* is a credit risk measure, calculated as the bank's Basel I risk-weighted assets and off-balance sheet activities divided by *GTA*. This variable is orthogonalized to avoid multicollinearity. *ZSCORE* is the distance to default, measured as the bank's return on assets plus the equity capital/*GTA* ratio divided by the standard deviation of the return on assets. This variable is orthogonalized to avoid multicollinearity. *Ln(GTA)* is the log of *GTA*. *D-MBHC* and *D-OBHC* are dummy variables that equal 1 if the bank has been part of a multibank holding company or a one-bank holding company over the prior three years. *D-BANK-MERGE* is a dummy that equals 1 if the bank was involved in one or more mergers over the past three years, combining the charters of two or more banks. *D-DELTA-OWN* is a dummy that equals 1 if the bank was acquired in the last three years, indicated by a change in top-tier holding company with no change in charter. *HERF* is a bank-level Herfindahl index based on bank and thrift deposits (the only variable for which geographic location is publicly available). We first establish the Herfindahl index of the markets in which the bank has deposits and then weight these market indices by the proportion of the bank's deposits in each of these markets. *SHARE-ML* is the share of market bank and thrift deposits held by medium and large banks (*GTA* exceeding $1 billion). *Ln(POP)* is the natural log of weighted average population in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. *Ln(DENSITY)* is the weighted average population density (natural log of population per square mile) in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. *INC-GROWTH* is the weighted average income growth in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. All regressions are run with both time fixed effects and bank fixed effects.

The sample period is 1993–2003. t-statistics based on robust standard errors clustered by bank are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

the other exogenous variables. As shown, based on this alternative method to measuring liquidity creation, we obtain consistent results: the coefficient on *EQRAT* is positive for large banks, negative for small banks, and insignificant for medium banks.

In principle, this methodology could be applied to all bank activities. For example, the drawdown frequency is 1 for loans since customers have already received liquid funds. However, constructing measures using this methodology is difficult, since data on the frequency of drawdown or sale are unavailable for many activities. More importantly, the use of drawdown rates goes directly against the liquidity creation theories, which argue that banks create liquidity by giving customers the option to obtain liquid funds when needed or desired.

6.2 Using an alternative way of establishing which assets are securitizable

The amount of liquidity a bank creates is affected by the bank's ability to securitize its assets. Our "cat" liquidity creation measures incorporate this by classifying loan categories that are relatively easy to securitize (residential real estate loans and consumer loans) as semiliquid and all other loan categories as illiquid.[40] Our "cat" measures do not incorporate, however, the fact that the ability to securitize assets has developed greatly over our sample period. In every loan category, a larger fraction of loans was securitized in 2003 than in 1993. We now construct an alternative "cat fat" liquidity creation measure that takes this development into account.

Our alternative "cat fat" measure is identical to the "cat fat" measure described in Section 2, except for the way we classify loans. For each loan category, we obtain year-end U.S. Flow of Funds data on the total amount of loans outstanding and the total amount of loans securitized. We use these data to calculate the fraction of loans that has been securitized in the market in each year. Following Loutskina (2006), we then assume that each bank can securitize that fraction of its own loans. To give an example, in 1993, \$3.1 trillion in residential and real estate loans were outstanding in the market, and 48.4% of these loans were securitized. If a bank has \$10 million in residential and real estate loans in that year, we assume that 48.4% thereof can be securitized, and hence, we classify \$4.84 million of these loans as semiliquid and the remainder as illiquid.

We raise two reservations regarding this alternative approach for our purposes. First, it uses the actual amount of securitization, whereas the theories suggest that the ability to securitize matters for liquidity creation, not the amount securitized. Second, this alternative approach assumes that each bank securitizes the same fraction of loans in a particular category, even though in practice major differences may exist across banks. That is, when we assume that 48.4% of all residential and real estate loans can be securitized in 1993, one

[40] Our "mat" measures classify loans entirely based on maturities and hence do not take differences in securitizability into account.

bank may have securitized virtually its entire residential real estate portfolio in that year, while another bank may have securitized nothing.

Using this alternative approach, the banking sector created more liquidity, but the growth pattern is similar to the "cat fat" pattern described in Section 3. Based on this alternative measure, liquidity creation equaled \$1.843 trillion in 1993 and increased by about 70% to \$3.168 trillion in 2003.

The regression results presented in panel B of Table 7 reinforce our prior findings. That is, for large banks, the relationship between capital and liquidity creation is positive and significant. For small banks, the relationship between capital and liquidity creation is negative and significant. For medium banks, the relationship is again statistically insignificant.

6.3 Excluding equity from the measurement of liquidity creation

Our regression specification is inspired by the theories of bank liquidity creation. These theories argue that banks create liquidity when illiquid assets are transformed into liquid liabilities, not when they are transformed into illiquid claims such as equity. The theories also suggest that equity may affect a bank's ability to create liquidity. For example, having more equity capital may allow a bank to extend more illiquid loans. However, as noted in Section 5, a potential concern about our regression specification is that current bank equity is included (with a weight of $-½$) in our dependent variables, while the lagged equity ratio is our key exogenous variable. To ameliorate this potential concern, we create an alternative "cat fat" liquidity creation measure that excludes equity. This measure does not penalize banks for funding part of their activities with equity capital. As a result, the measured amount of liquidity creation is higher for all banks, and this increase is greatest for banks that hold the most capital. We rerun our regressions using this alternative measure.

The results shown in panel C of Table 7 suggest that our main findings are robust to the exclusion of equity from our dependent variable. The coefficient on *EQRAT* is again positive and significant for large banks, insignificant for medium banks, and negative and significant for small banks.

6.4 Using an alternative capital ratio

In our main analysis, we use *EQRAT*, the ratio of equity to *GTA*, as our key exogenous variable. We now replace *EQRAT* with *TOTRAT*, the ratio of total capital (as defined in the Basel I capital standards) to *GTA*. Total capital includes equity plus limited amounts of other financial instruments, such as long-term subordinated debt.[41,42]

[41] Before 1996, banks were not required to report total capital, and from 1996 to 2000, banks with total assets less than \$1 billion were not required to report total capital if they indicated on the Call Report that their total capital exceeded 8% of adjusted total assets. We estimate the missing numbers using a special Federal Reserve program based on other Call Report information.

[42] Note that we do not use the official Basel I total risk-based capital ratio, which is defined as total capital divided by risk-weighted assets, where risk-weighted assets is the weighted sum of assets and off-balance sheet activities, with the weights based on the perceived credit risk of each activity. This capital ratio is clearly endogenous and its use would result in significant bias, since our dependent variable, bank liquidity creation, is also a weighted sum of assets and off-balance sheet activities (as well as liabilities).

One motivation for using this alternative capital ratio is to see if there is a different effect of regulatory capital from conventional equity capital on liquidity creation. A second motivation is to allow for a broader definition of capital in line with some of the theoretical studies. For example, Diamond and Rajan (2000, 2001) indicate that capital in their analysis may be interpreted as either equity or long-term debt, sources of funds that cannot run on the bank.

The results based on this alternative capital ratio are shown in Table 8 and are qualitatively similar to our main results. The relationship between capital and liquidity creation is positive and significant for large banks, statistically insignificant for medium banks, and negative and significant for small banks.

6.5 Splitting the sample by bank holding company status, wholesale versus retail orientation, and merger status

In all of the regression results presented thus far, we have split our sample only by size. In Section 3, however, we also split our sample by bank holding company status, wholesale versus retail orientation, and merger status, and showed that substantial time-series and cross-sectional variation exists among these banks in terms of their ability to create liquidity. We now test the robustness of our main results by rerunning our regressions by size class for MBHC

Table 8
The effect of capital on liquidity creation based on an alternative capital ratio

	Large banks cat fat/*GTA*	Medium banks cat fat/*GTA*	Small banks cat fat/*GTA*
TOTRAT	1.696	0.048	−0.343
	(4.48)***	(0.05)	(−9.16)***
EARNVOL	−0.136	0.024	−0.019
	(−3.15)***	(0.37)	(−4.87)***
CREDITRISK	0.506	0.582	0.465
	(7.43)***	(3.46)***	(59.19)***
ZSCORE	0.007	0.009	−0.003
	(1.38)	(1.76)*	(−6.95)***
Ln(GTA)	−0.008	0.040	−0.003
	(−0.69)	(0.67)	(−1.39)
D-MBHC	0.079	0.007	0.016
	(0.82)	(0.54)	(18.42)***
D-OBHC	0.045	0.000	0.000
	(0.46)	(0.00)	(0.00)
D-BANK-MERGE	0.006	−0.003	0.009
	(0.64)	(−0.53)	(7.62)***
D-DELTA-OWN	−0.012	0.018	−0.003
	(−0.62)	(0.54)	(−3.22)***
HERF	0.028	−0.259	0.031
	(0.17)	(−0.64)	(3.23)***
SHARE-ML	−0.007	−0.100	0.019
	(−0.20)	(−1.90)*	(6.26)***
Ln(POP)	0.081	0.014	0.006
	(2.84)***	(0.47)	(2.22)**

(*continued overleaf*)

Table 8
(Continued)

	Large banks cat fat/*GTA*	Medium banks cat fat/*GTA*	Small banks cat fat/*GTA*
Ln(DENSITY)	−0.087	−0.018	0.017
	(−2.95)***	(−0.42)	(3.78)***
INC-GROWTH	0.993	−0.320	0.078
	(2.67)***	(−1.36)	(5.30)***
Constant	−0.346	−0.272	0.062
	(−1.48)	(−0.34)	(2.34)**
Time fixed effects	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes
Observations	1804	2132	80,062
Adjusted *R*-squared	0.78	0.67	0.88

This table presents regression results using an alternative capital ratio (discussed in Section 7.4). The dependent variable is cat fat/*GTA*, the dollar amount of liquidity a bank has created (calculated using our preferred "cat fat" liquidity creation measure as defined in Table 1) normalized by *GTA*. *GTA* equals total assets plus the allowance for loan and lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans). Results are shown for large banks (*GTA* exceeding \$3 billion), medium banks (*GTA* \$1 billion–\$3 billion), and small banks (*GTA* up to \$1 billion).

TOTRAT is the ratio of total capital (as defined in the Basel I capital standards) to *GTA*. *EARNVOL* is the standard deviation of the bank's quarterly return on assets measured over the previous twelve quarters, multiplied by 100. *CREDITRISK* is a credit risk measure, calculated as the bank's Basel I risk-weighted assets and off-balance sheet activities divided by *GTA*. This variable is orthogonalized to avoid multicollinearity. *ZSCORE* is the distance to default, measured as the bank's return on assets plus the equity capital/*GTA* ratio divided by the standard deviation of the return on assets. This variable is orthogonalized to avoid multicollinearity. *Ln(GTA)* is the log of *GTA*. *D-MBHC* and *D-OBHC* are dummy variables that equal 1 if the bank has been part of a multibank holding company or a one-bank holding company over the prior three years. *D-BANK-MERGE* is a dummy that equals 1 if the bank was involved in one or more mergers over the past three years, combining the charters of two or more banks. *D-DELTA-OWN* is a dummy that equals 1 if the bank was acquired in the last three years, indicated by a change in top-tier holding company with no change in charter. *HERF* is a bank-level Herfindahl index based on bank and thrift deposits (the only variable for which geographic location is publicly available). We first establish the Herfindahl index of the markets in which the bank has deposits and then weight these market indices by the proportion of the bank's deposits in each of these markets. *SHARE-ML* is the share of market bank and thrift deposits held by medium and large banks (*GTA* exceeding \$1 billion). *Ln(POP)* is the natural log of weighted average population in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. *Ln(DENSITY)* is the weighted average population density (natural log of population per square mile) in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. *INC-GROWTH* is the weighted average income growth in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. All regressions are run with both time fixed effects and bank fixed effects.

The sample period is 1993–2003. *t*-statistics based on robust standard errors clustered by bank are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

members, OBHC members, and independent banks; banks with wholesale and retail orientations; and banks with and without recent M&A activity.

The results are shown in Table 9. For large banks, the coefficient on *EQRAT* is positive and statistically significant (except for the small subsample of independent banks, which has only fifty-four observations). For medium banks, the coefficient on *EQRAT* is positive and significant for OBHC members, and not significant for any of the other subsamples. For small banks, the coefficient is negative in all cases, and significant in all but one case. Thus, our main findings are generally robust to splitting the data by bank holding company status, wholesale versus retail orientation, and merger status.

Table 9
The effect of capital on liquidity creation for banks in each size class split by bank holding company status, wholesale versus retail orientation, and merger status

	MBHC members	OBHC members	Independent banks	Wholesale banks	Retail banks	Recent M&A activity	No recent M&A activity
	cat fat/*GTA*	cat fat/*GTA*	cat fat/*GTA*	cat fat/*GTA*	cat fat/*GTA*	cat fat/*GTA*	cat fat/*GTA*
Panel A: Regression results for large banks							
EQRAT	1.314	3.924	−0.365	1.709	0.553	1.275	1.261
	(3.74)***	(2.01)*	(−0.39)	(3.74)***	(1.80)*	(2.35)**	(2.12)**
Observations	1717	33	54	1255	549	1152	652
Adjusted R-squared	0.80	1.00	0.96	0.87	0.78	0.82	0.90
Panel B: Regression results for medium banks							
EQRAT	0.762	0.853	0.316	0.216	−0.107	0.366	0.321
	(0.64)	(1.94)*	(0.42)	(0.26)	(−0.29)	(0.88)	(0.32)
Observations	1722	187	223	1246	886	920	1212
Adjusted R-squared	0.70	0.96	0.95	0.73	0.93	0.94	0.72
Panel C: Regression results for small banks							
EQRAT	−0.380	−0.196	−0.282	−0.370	−0.231	−0.340	−0.345
	(−2.85)***	(−3.10)***	(−4.49)***	(−6.16)***	(−3.50)***	(−1.51)	(−7.42)***
Observations	33,864	28,426	17,772	55,314	24,748	5392	74,670
Adjusted R-squared	0.88	0.91	0.93	0.90	0.90	0.93	0.90

This table presents regression results. The dependent variable is cat fat/*GTA*, the dollar amount of liquidity a bank has created (calculated using our preferred "cat fat" liquidity creation measure as defined in Table 1) normalized by *GTA*. *GTA* equals total assets plus the allowance for loan and lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans).

The sample is split in three ways. First, by bank holding company status: multibank holding company (MBHC) member, one-bank holding company (OBHC) member, and independent bank. Second, by wholesale versus retail orientation: banks with below versus above average number of branches. Third, by merger status: banks that engaged in M&A activity during the previous three years versus banks that did not engage in M&A activity recently.

Panels A, B, and C contain the results for large banks (*GTA* exceeding \$3 billion), medium banks (*GTA* \$1 billion–\$3 billion), and small banks (*GTA* up to \$1 billion), respectively. All panels show only the coefficients on *EQRAT* (total equity capital as a proportion of *GTA*) in the interest of parsimony, although the regressions include all the exogenous variables from the full specification as defined in Table 4. All regressions are run with both time fixed effects and bank fixed effects.

The sample period is 1993–2003. t-statistics based on robust standard errors clustered by bank are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

6.6 Using an instrumental variable approach

All the analyses presented so far suggest that, based on our preferred "cat fat" liquidity creation measure, the relationship between capital and liquidity is positive and significant for large banks, and negative and significant for small banks. We have been careful thus far to interpret our results merely as showing strong correlations consistent with the theories rather than as evidence of a causal relationship, even though our main analysis used three-year lagged average values of capital to mitigate potential endogeneity concerns.[43] We now address this endogeneity issue more directly. Specifically, we use an instrumental variable approach to examine whether our statistically significant results about the positive relationship between capital and liquidity creation for large banks and the negative relationship between capital and liquidity creation for small banks represent the causal effects of capital on liquidity creation for large and small banks.[44]

Since we have panel data and use time and bank fixed effects in all of the regressions presented so far, we should also use fixed effects in our instrumental variable regressions.[45] We can do so if the instruments show sufficient variation over time. Provided this is the case, in the first stage, we will regress our potentially endogenous variable, *EQRAT*, on an instrument and all of the control variables and time and bank fixed effects. In the second stage, we will regress liquidity creation (using our preferred "cat fat" measure) divided by *GTA* on the predicted value for *EQRAT* from the first stage and all the control variables and fixed effects.

An instrument must satisfy two requirements. First, to be valid, the instrument should be correlated with the amount of lagged capital (once the effects of the other exogenous variables have been netted out), but should not directly affect the amount of liquidity a bank creates. Second, as noted above, since we want to include bank fixed effects in the regressions, it is important that the instrument shows sufficient variation within a bank's observations over time. We select two instruments: the first one meets both requirements, while the second one meets only the first requirement. Regressions that include the

[43] In an earlier version of the article, we also investigated whether omitted variables could drive our results. For example, increased corporate governance pressures over time may have forced management of small banks to more aggressively court deposits and create liquidity, causing the observed negative relationship between capital and liquidity creation for these banks. To address this, we tested whether the negative effect is stronger for small banks in the second half of the sample period and examined whether capital ratios of small banks decreased over time. The results of these analyses were inconsistent with the alternative corporate governance explanation of our results.

[44] An alternative way to establish causality would be to shock banks with more capital (e.g., by imposing higher capital requirements) and examine the effect on liquidity creation. This is not possible for us, however, since such exogenous shocks did not occur during our sample period.

[45] We explained in Section 4.2 why it is important to include time and bank fixed effects in the main regressions. Our use of fixed effects in OLS and IV regressions is in line with the recent literature (e.g., Rajan and Zingales 1998; Anderson and Reeb 2003; Desai, Foley, and Hines 2004; Berger et al. 2008; Klapper, Laeven, and Rajan 2006). Although many papers do not elaborate on the first-stage regressions, it is clear from Levitt (2002) and Faulkender and Petersen (2006) that they explicitly include fixed effects in this stage.

instrument that meets both requirements are therefore carried out following the approach highlighted above. After discussing our instruments, we explain our approach for regressions that use the other instrument.

Our first instrument is *EFF-TAX*, the state income tax rate a bank has to pay. Since interest on debt is tax deductible while dividend payments are not, banks that operate in states with higher income tax rates are expected to have lower equity ratios, keeping all else equal. Furthermore, there is no reason to believe that the state income tax rate directly affects liquidity creation. Similar to Ashcraft (2008), we use the effective income tax rate to be paid on $1 million in pretax income as our instrument.[46,47] If a bank operates in multiple states, we use the bank's weighted average state income tax rate, calculated using the share of deposits in each state (relative to the bank's total deposits) as weights.[48]

Our second instrument is *SENIORS*, the fraction of seniors (people aged sixty-five and over) in the markets in which a bank is active. Seniors own larger equity portfolios than the average family. According to the Survey of Consumer Finances, families headed by a senior were slightly less likely to own stock (36.1% owned stock versus 47.5% of all families), but the dollar value of the stock portfolio of those that did own stock was roughly three times as large ($81,200 versus $27,000 for the average family) (see Bucks, Kennickell, and Moore 2006).[49] Furthermore, using U.S. data, Coval and Moskowitz (1999) document that investors have a strong preference for investing close to home. They find that this preference is greater for firms that are smaller, more highly levered, and those that produce goods that are not traded internationally. In combination, this evidence suggests that banks—particularly small banks—that operate in markets with more seniors have easier access to equity financing and hence, will use more equity financing. We calculate the fraction of seniors using county- and MSA-level population data from the 2000 decennial Census.[50]

[46] In each state (except Ohio), the highest tax bracket starts at or below $1 million in pretax profits: when we use the marginal tax rate on $1 million in pretax profits as our instrument, we obtain similar results. In Ohio, banks pay 0.015 times the book value of their stock. However, for comparability reasons, we use the corporate income tax rate to calculate Ohio taxes.

[47] In contrast to Ashcraft (2008), we use the income tax rate banks have to pay rather than the corporate income tax rate. These rates differ in ten states. To illustrate, in South Dakota, corporations did not pay income tax between 1993 and 2003, while banks paid 6%. In North Dakota, corporations paid 10.35%, while banks were taxed at 7%. Also, unlike Ashcraft (2008), we do not average the tax rate over our sample period. This ensures that we do not use forward-looking data in our regressions.

[48] It would be preferable to use the share of pretax income earned in each state as weights, but Call Reports (and other data sources) do not provide these data.

[49] These calculations are based on data from the triennial Survey of Consumer Finances in 1995, 1998, 2001, and 2004, as presented in Tables 3 and 6 in Bucks, Kennickell, and Moore (2006). In particular, we compare average values for families headed by a senior (65–74-year-olds and 75-year-olds and above) with values for an average family.

[50] Becker (2007) uses Survey of Consumer Finances data to show that seniors also hold more deposits than the average family, and hence uses the fraction of seniors as an instrument for deposits of small banks. However, the impact of age on deposits is dwarfed by the impact of age on equity holdings. For example, in 2001, the median value of transaction accounts plus CDs for families headed by seniors was $13,400 (65–74-year-olds) and $15,900 (75-year-olds and up) versus $6000 for all families. In contrast, the median value of stock held by

Panel A of Table 10 examines the extent to which the instruments vary. The data suggest that there is substantial time-series variation for the tax rate for both size classes. We therefore use the entire sample and include time and bank fixed effects in all the analyses in which we employ the effective tax rate. The fraction of seniors shows sufficient variation in the cross section, but not over time since we only have information on the fraction of seniors from the 2000 Census. In the analyses that use *SENIORS*, we therefore do not use the entire sample and do not include time and bank fixed effects. Rather, we use liquidity creation data only from the year 2001 and lagged values of the instrument (i.e., the 2000 Census values) and the other exogenous variables.

Panel B of Table 10 shows the results of our first-stage regressions. The state income tax rate has a significantly negative effect on capital for large banks, consistent with Ashcraft (2008). The tax rate does not significantly affect capital at small banks, potentially because the tax benefit of debt may be outweighed by safety and soundness considerations that induce those banks to hold higher capital ratios. The fraction of seniors has a significantly positive effect on capital for small banks. It does not significantly affect capital at large banks, possibly because these banks are not limited by geography in terms of their access to a variety of funding sources.

Panel C of Table 10 contains the second-stage instrumental variable regression results. For completeness, we show results for both size classes using both instruments. However, since the first-stage results showed that the tax rate can only be used as an instrument for large banks while the fraction of seniors can only be used as an instrument for small banks, we focus our attention on those two regressions. When we use instruments for capital, our results are consistent with our earlier findings. The effect of capital on liquidity creation is positive and statistically significant for large banks, and negative and significant for small banks.

For both large and small banks, the coefficients on *EQRAT* are larger when we use instruments, suggesting that the effect of capital on liquidity creation is several times the previously estimated effect. Using similar logic as in Levitt (1996), this suggests that in our main liquidity creation regressions, *EQRAT* is correlated with the residuals, inducing a bias toward zero in our coefficient estimates. When we use instruments for capital, we obtain consistent estimates.[51] However, since we had no *a priori* reason to believe that our *EQRAT*

families headed by seniors was $58,800 (65–74-year-olds) and $41,000 (75-year-olds and up) versus $17,900 for all families. Values are calculated as the likelihood of holding a particular asset times the median dollar value of the holdings of those that do own that asset. The underlying data are from the 2001 Survey of Consumer Finances as presented in Tables 5B and 6 in Aizcorbe, Kennickell, and Moore (2003).

[51] Levitt (1996) finds that the number of prisoners has a negative effect on crime that is five times larger when he uses instruments for the prison population. He argues that the coefficients in his original regressions are too low because the number of prisoners is negatively correlated with the residuals and that he obtains consistent estimates when he uses instruments.

Table 10
The effect of capital on liquidity creation based on instrumental variable regressions

Panel A: Summary statistics on the instruments

	Large banks	Small banks	Fraction of seniors	Large banks	Small banks
Same tax rate in all years	31%	62%	Minimum	0%	0%
Tax rate changes >10%	44%	23%	Average	12%	14%
Tax rate changes >20%	19%	13%	Maximum	23%	35%

Panel B: First-stage regression results

	Instrument: *EFF-TAX*		Instrument: *SENIORS* (2001 data only)	
	Large banks *EQRAT*	Small banks *EQRAT*	Large banks *EQRAT*	Small banks *EQRAT*
EFF-TAX	−0.003	0.000		
	(−2.48)**	(1.44)		
SENIORS			−0.024	0.060
			(−0.27)	(3.66)***
Observations	1752	79,228	143	6493

Panel C: Second-stage regression results

	Instrument: *EFF-TAX*		Instrument: *SENIORS* (2001 data only)	
	Large banks cat fat/*GTA*	Small banks cat fat/*GTA*	Large banks cat fat/*GTA*	Small banks cat fat/*GTA*
EQRAT (instrumented)	4.820	−9.604	9.804	−2.531
	(1.75)*	(−1.45)	(0.25)	(−3.08)**
Observations	1752	79,228	143	6493

This table contains results from our instrumental variable approach for large banks (*GTA* exceeding $3 billion), and small banks (*GTA* up to $1 billion). *GTA* equals total assets plus the allowance for loan and lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans). Panel A shows summary statistics on the instruments. Panel B contains first-stage regression results. The dependent variable is *EQRAT*, total equity capital as a proportion of *GTA*. Panel C shows second-stage regression results. In these regressions, the dependent variable is cat fat/*GTA*, the dollar amount of liquidity a bank has created (calculated using our preferred "cat fat" liquidity creation measure as defined in Table 1) normalized by *GTA* and *EQRAT* is alternatively instrumented with *EFF-TAX* and *SENIORS*.

EFF-TAX is the effective state income tax rate a bank has to pay on $1 million in pretax income (see Ashcraft 2006). All regressions that include *EFF-TAX* are run with both time fixed effects and bank fixed effects. *SENIORS* is the fraction of seniors in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. The fraction of seniors is calculated using county- and MSA-level population data from the 2000 decennial Census. All regressions that include *SENIORS* are run with liquidity creation data only from the year 2001 and lagged values of the instrument (i.e., the 2000 Census values) and the other exogenous variables; since these are cross-sectional rather than panel regressions, time fixed effects and bank fixed effects are not included.

Panel B shows only the coefficients on the instruments, and panel C shows only the coefficients on *EQRAT* (total equity capital as a proportion of *GTA*) in the interest of parsimony, although the regressions include all the exogenous variables from the full specification as defined in Table 4 (except that bank and time fixed effects are excluded when *SENIORS* are used as the instrument).

The sample period is 1993–2003. *t*-statistics based on robust standard errors clustered by bank are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

coefficients were understated in our main regressions, we are hesitant to put too much weight on this explanation.[52]

7. Conclusion

According to banking theory, banks exist because they create liquidity and transform risk. Our understanding of the liquidity creation role is hampered by the absence of comprehensive liquidity creation measures. The first contribution of this article is the development of four bank liquidity creation measures. Our second contribution is that we use our measures to gain a deeper insight into banks' role as liquidity creators. We determine the magnitude of bank liquidity creation, its intertemporal patterns, its cross-sectional variation, characteristics of high and low liquidity creators, and examine the relationship between liquidity creation and bank value. Our third contribution is that we use our measures to study an issue of significant research and policy relevance—the effect of bank capital on liquidity creation—and thereby test the predictions of recent theories about the relationship between capital and liquidity creation.

Our calculations suggest that liquidity creation by the U.S. banking sector exceeded \$2.8 trillion as of 2003 based on our preferred liquidity creation measure, and nearly doubled in real terms between 1993 and 2003. Interestingly, banks create only about half of their liquidity on the balance sheet, highlighting the importance of off-balance sheet liquidity creation. Large banks (gross total assets exceeding \$3 billion) create 81% of the liquidity while comprising only 2% of all banks. Multibank holding company members, retail banks, and recently merged banks create most of the industry's overall liquidity and show the greatest growth in liquidity creation over time. Liquidity creation is also positively associated with bank value.

When we test the relationship between capital and liquidity creation, we find empirical support for both the theories which predict that higher capital may suppress liquidity creation and those which suggest that higher capital may enhance banks' ability to create more liquidity. Based on our preferred "cat fat" liquidity creation measure, the relationship between capital and liquidity creation is positive and significant for large banks, insignificant for medium banks, and negative and significant for small banks. We perform a variety of robustness checks and find consistent results.

Our finding that the relationship between bank capital and bank liquidity creation differs by bank size raises interesting policy issues. It is well known that regulators impose capital requirements on banks for safety and soundness reasons. Our findings suggest that while regulators may be able to make banks safer by imposing higher capital requirements, this benefit may have associated

[52] Because our liquidity creation measure includes current capital, we also rerun the instrumental variable regressions with our liquidity creation measure that excludes capital as a robustness check. While we lose statistical significance for large banks, the results are similar for small banks.

with it reduced liquidity creation by small banks, but enhanced liquidity creation by large banks.

Our liquidity creation measures may also be used to address a number of other interesting issues that are beyond the scope of this article, but may be pursued in future research. Does liquidity creation affect economic growth? How do monetary policy initiatives by central banks, changes in deposit insurance, and other policy innovations affect liquidity creation? How does liquidity creation differ across nations? How much liquidity do banks create compared to nonbank financial intermediaries? How much liquidity do banks create relative to financial markets, and what are the complementarities, if any, in liquidity creation between banks and capital markets? Addressing these questions holds the promise of substantially improving our understanding of the liquidity creation function of banks and how it affects the economy.

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Deposits and Relationship Lending

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We empirically examine whether access to deposits with inelastic rates (core deposits) permits a bank to make contractual agreements with borrowers that are infeasible if the bank must pay market rates for funds. Such access insulates a bank's costs of funds from exogenous shocks, allowing it to insulate its borrowers against exogenous credit shocks. We find that, controlling for loan market competition, banks funded more heavily with core deposits provide more loan rate smoothing in response to exogenous changes in aggregate credit risk. Thus we provide evidence for a novel channel linking bank liabilities to relationship lending.

Empirical explorations of the theory of the banking firm have documented a number of characteristic and distinctive features of bank lending.[1] A durable lending relationship, in which the bank gains information about the borrowing firm, has been shown to be valuable both to small firms [Petersen and Rajan (1994), Berger and Udell (1995)] and to large firms [Lummer and McConnell (1989), Slovin, Sushka, and Polonchek (1993)]. In particular, continuing relationships are associated with lower loan rates, less stringent collateral requirements, and a lower likelihood of credit rationing. There is substantial evidence that banks are specialists in providing contractual flexibility and reducing the costs of financial distress for borrowing firms [e.g., Gilson, John, and Lang (1990), James (1995, 1996), Preece and Mullineaux (1996), and Cantillo and Wright (1997)]. Bank loan rates also appear to

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[1] See Bhattacharya and Thakor (1993) and Thakor (1996) for excellent critical reviews of the theory of intermediation. Nakamura (1993b), Berlin (1996), and Berger and Udell (1998) provide reviews of the recent empirical literature on bank lending.

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move in a smoother fashion than do market interest rates, which Berger and Udell (1992) have interpreted as evidence of implicit risk-sharing agreements.

However, the empirical literature is nearly silent on one of the central questions in the theory of intermediation: How are these typical lending behaviors related to the structure of the bank's liabilities, if at all?[2] Our article provides empirical evidence for an explicit link between banks' liability structure and their distinctive lending behavior. We provide evidence on a particular link that relates bank market power in deposit markets to the types of loan contracts (explicit or implicit) that banks and their borrowers can feasibly forge.[3] In our view, *core deposits,* like demand and savings deposits, which are largely rate inelastic, have historically insulated bank funding costs against economic shocks. In turn, core deposits have permitted banks to insulate borrowers against these shocks through implicit multiperiod contracts that insure borrowers against adverse credit shocks. There are multiple ways that a bank might insulate borrowing firms against adversity, but we examine one particular mechanism — loan rate smoothing. Specifically we propose that banks with more core deposits smooth firms' borrowing costs in the face of adverse aggregate credit shocks. Although risk-averse firms would clearly value this type of insurance, so would risk-neutral firms seeking to avoid costly asset liquidation or the forgone investment opportunities that might accompany sudden spikes in borrowing costs.

We test this hypothesis using a rich dataset, the Federal Reserve's Survey of Terms of Bank Lending to Business, which provides quarterly information about contract terms of loans made by a large sample of banks, and data from the quarterly Report of Condition and Income (Call Report) on these banks' balance sheets. Our empirical results provide support for the hypotheses that (i) banks offer borrowers insurance against credit shocks, and (ii) banks with greater access to core deposits provide more insurance to borrowers.

We proceed as follows. In Section 1 we present a model to illustrate our hypotheses and discuss the related literature. In Section 2 we describe the data and present our main empirical results. In this section we also discuss

[2] One (indirect) approach to this question is to examine the differences between bank loans and other types of private debt, which *might* then be related to differences in the intermediaries' liabilities. The literature has yet to settle the question of whether bank loan agreements and other private debt agreements have different announcement effects [see Billet, Flannery, and Garfinkel (1995)]. In a related vein, Carey, Post, and Sharpe (1998) have compared both loan terms and borrower characteristics in a sample that includes both bank loan agreements and finance company loan agreements. Although they find differences, notably that finance company borrowers are riskier, none of the differences have yet been linked directly to the differences in the structure of bank and finance company liabilities.

[3] Nakamura (1993a) and Mester, Nakamura, and Renault (1998) present empirical evidence for another view, the "checking account hypothesis," associated with Black (1975) and Fama (1985). According to this hypothesis, checking accounts provide information about borrowing firms' transactions, which in turn provide information about the firms' financial health.

and reject alternative interpretations of our main findings — especially the possibility that the results are driven by unobserved changes in the credit risk of the borrowing populations at low and high core deposit banks. Finally, we conclude in Section 3, where we relate our results to the recent trend toward disintermediation, in which commercial banks have lost market share to other types of intermediaries that hold securities rather than loans.

1. Models and Hypotheses

1.1 An illustrative model

The idea that banks optimally make loans that do not break even period by period is a well-established one in the literature on bank uniqueness. We present a simple illustrative model to clarify our argument regarding the relationship between bank contracting practices and their access to core deposits.[4] Although our claim is that a distinctive feature of bank lending is that banks' access to core deposits facilitates multiperiod agreements with borrowers, our view can be conveyed in a stylized way by examining a model with a single loan transaction.

1.1.1 The basic setup. We focus on the contracting behavior of a single firm and a bank — both of which are risk neutral. There are two time periods. At the beginning of period 0, the firm and the bank share a common prior belief about the state of the economy in period 1, denoted by the random variable $s \in \{d, u\}$; that is, the economy will experience a downturn (d) in period 1 with probability p or an upturn (u) with probability $1 - p$. Both the firm and the bank learn the realization of s at the outset of period 1. The state of the economy is both observable and verifiable.

At the beginning of period 1, the firm needs to invest \$1 to continue production. At the end of period 1 the firm can feasibly produce revenue R_s, $s \in \{u, d\}$, with $R_u > R_d = 0$, without liquidating any assets, but can also generate additional revenue by liquidating assets.[5] Denote the value of the firm's assets — which include future investment opportunities — by $A(k)$, where $k \in [0, K]$ denotes the additional cash generated by liquidating assets.[6] Thus $A_k(k) < 0$. When we say that the firm liquidates assets, we have in mind any activity that reduces the value of future production activities to generate revenue today, and there is no presumption that the firm is in default when it liquidates assets. Since we are concerned about potentially

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[4] Other models of relationship lending include Sharpe (1990), Rajan (1992), Petersen and Rajan (1995), and Boot and Thakor (1999). None of these emphasizes the relationship between competition in the market for bank liabilities and the lending behavior of banks.

[5] The assumption that $R_d = 0$ simplifies things without loss of essential insights.

[6] For simplicity we assume that the state of the economy can affect the value of the firm's assets only through the liquidation decision, although the liquidation decision may be state dependent.

inefficient liquidation, we assume that liquidating assets to produce revenue reduces the total value of the firm, ex post, that is,

$$\frac{d(k + A(k))}{dk} = 1 + A_k(k) < 0, \tag{1}$$

We consider a highly stylized and simplified liability structure. The bank is fully funded by deposits, which the bank acquires after the realization of the state of the economy at the outset of period 1 and which are paid off at the end of period 1. The bank has access to q (< 1) dollars of low-cost *core deposits*, with exogenous interest rate factor D, which is independent of the state of the economy. The bank can also acquire *purchased funds* — for which it must pay the market interest rate factor D_s, with

$$D_d > D_u \quad \text{and} \quad pD_d + (1 - p)D_u > D. \tag{2}$$

Thus the cost of purchased funds is state dependent, and their expected cost is higher than that for core deposits.

Our stylized liability structure is intended to capture the following ideas. The cost of equity capital is higher than that of deposits, so the bank holds the regulatory minimum level of capital. Setting the capital ratio at zero is of no special significance. What is important is that the bank cannot profitably write state-contingent contracts with enough investors at the beginning of period 0 to *fully* insulate the borrower against the need to liquidate assets.[7] The higher cost of purchased funds in an economic downturn compared with their cost in an economic upturn reflects an *economy-wide* risk premium that the bank must pay in competitive funding markets. Such a premium is typical at the beginning of a downturn.

The following parametric restrictions hold:

$$R_u > D_u,\ D_d > 0, \quad \text{and} \quad K > qD + (1-q)D_d. \tag{3}$$

The first two inequalities say that a bank financed solely with purchased funds need not require the firm to liquidate assets in an upturn, but in a downturn such a bank must force the firm to liquidate assets so that depositors can be paid off — remembering that $R_d = 0$. The third inequality ensures that a bank financed with at least q dollars of core deposits will be able to pay off depositors, whatever the state of the economy.

1.1.2 Equilibrium loan contracts. At the beginning of period 0, the firm and the bank have a binding state-contingent contract with two loan-rate

[7] Note that the bank can write fully state-contingent contracts (including equity claims) with its borrowers. The reason inefficient liquidation cannot be avoided is that the bank cannot obtain fully state-contingent liabilities. The assumption that state-contingent loan contracts are perfectly enforceable is for narrative purposes only. We actually have in mind implicit contracts that may not be perfectly enforceable.

factors, $\{r_u, r_d\}$, which implicitly define two liquidation levels, $\{k_u, k_d\}$. The firm's expected profit under this contract is

$$\Pi^f = p\,[R_d + k_d + A(k_d) - r_d] + (1-p)\,[R_u + k_u + A(k_u) - r_u] \quad (4)$$

and the bank's expected profit is

$$\Pi^b = pr_d + (1-p)r_u - [pC_d(q) + (1-p)C_u(q)]\,, \quad (5)$$

where $C_s(q) \equiv qD + (1-q)D_s$ denotes the bank's cost of funds in state s, $s \in \{u, d\}$.

The optimal contract will maximize the joint profits of the bank and the firm. Since liquidating assets always reduces firm value [by condition (1)], any optimal contract will reduce liquidation costs to a minimum. Given the parametric restrictions in condition (3), no assets need to be liquidated in an upturn, but assets will typically need to be liquidated in a downturn (unless q is very high).

Then the optimal contract will always satisfy

$$k_u^* = 0 \quad \text{and} \quad r_d^* = k_d^* = C_d(q). \quad (6)$$

Condition (6) says that assets will be liquidated only in a downturn and that the firm will be required to liquidate just enough assets to pay off depositors.

We assume that the bank is a Bertrand competitor in the loan market, taking the structure of its liabilities as given. In this setting, the optimal contract solves

$$\max_{r_d, r_u} \Pi^f(r_d, r_u), \quad (7)$$

subject to condition (6) and

$$pr_d + (1-p)r_u \geq pD_d + (1-p)D_u \equiv D^e. \quad (8)$$

condition (8) is a participation constraint, which says that the bank must expect to make as much revenue from lending as it could from investing in securities that pay market interest rates (with expected return D^e). This constraint ensures that the bank captures rents from its core depositors, although Bertrand competition guarantees that it captures no further rents from borrowers. Thus these Bertrand-competitive banks do earn positive profit, a return on the fixed factor of production (core deposits), to which they have exclusive access. We discuss constraint (8) further below.

Substituting expressions (4), (6), and (8) into expression (7) we calculate the optimal contract

$$r_d^* = C_d(q) \quad \text{and} \quad r_u^* = \frac{D^e - pk_d^*}{1-p}. \quad (9)$$

The loan rate in a downturn is just high enough to cover the bank's cost of funds. In an upturn, the loan rate is set so that condition (8) is satisfied with equality. We can now derive our main prediction: the loan rate profile — the difference in the rates paid in downturns and upturns — is flatter for banks that have more core deposits. From Equation (9),

$$\frac{d(r_d^* - r_u^*)}{dq} = \left(\frac{1}{1-p}\right)\frac{dk_d^*}{dq} = \left(\frac{1}{1-p}\right)[D - D_d] < 0, \qquad (10)$$

where the inequality follows, since core deposits are cheaper than purchased funds. Intuitively, a bank with more core deposits receives lower net revenue in the downturn because its lower cost of funds permits the bank to offer the firm a lower loan rate to reduce the inefficient liquidation of assets. Thus it charges a higher rate in the upturn to satisfy the participation constraint in condition (8).

In our Bertrand market, where the bank has an outside investment option — investing in securities — the expected loan rate charged to a borrower is not affected by the bank's access to core deposits. This follows, since the loan contract yields expected revenue just high enough to cover the bank's expected *market* return, which is independent of q. That is, from the bank's participation constraint, condition (8),

$$pr_d^* + (1-p)r_u^* = D^e, \qquad (11)$$

and D^e is independent of q.

1.1.3 Discussion. In our model the bank's access to core deposits allows it to insulate the firm against credit shocks as part of an optimal contract. To keep things as simple as possible we have cast the contracting problem in a static setting, but the essential features of our optimal contract would carry over in a straightforward way to an intertemporal model with aggregate credit shocks. The key is that the bank is free to charge concessionary rates in bad times and compensatory rates in good times. If a bank can offer below-market rates on deposits, it has more freedom to offer loan rates that do not break even period by period — a type of cross-subsidization between depositors and borrowers facilitated by the bank. The more relaxed budget constraint facilitates relationship building and flexibility in the pricing of loans. A bank forced to pay market rates for its funds simply has less freedom to demand of the borrower anything but the single-period profit-maximizing loan rate.

We view two features of our illustrative model as potentially objectionable. The first is our assumption that the loan market is perfectly competitive, an assumption that is clearly unrealistic for many small and medium-size borrowers. The second is that the bank has an outside investment option

— investment in market securities — that allows it to capture rents on its captive depositors and prevents competition in loan markets from forcing banks to pass through some of these rents to borrowers in the form of lower average loan rates.[8]

Allowing imperfectly competitive loan markets or permitting banks' cost of funds $C(q)$ to affect the distribution of rents between the bank and the borrower would not affect our main result: that the equilibrium contract will involve loan rate smoothing and that the degree of smoothing will be positively related to the bank's available core deposits. The joint profit-maximizing contract — which requires a flatter loan rate profile — will be the equilibrium contract across a wide range of market structures and distributions of the contractual surplus. Thus we make the following prediction, which we formalize and test in Section 2:

Hypothesis. An exogenous increase in aggregate credit risk will lead to a smaller increase in loan markups for firms borrowing from banks with higher levels of core deposits than from banks with lower levels of core deposits.

The exact relationship between a bank's core deposits and the *average loan rate*, however, depends on the fine details of the model of competition, and we do not expect the loan rate to be independent of core deposit levels as in our simple model. In general, higher core deposits can have two opposing effects on average loan rates. Core deposits permit the bank to reduce inefficient liquidation of assets, which increases total contractual surplus. Holding constant the bargaining power between the bank and the borrower, this will tend to raise average loan rates. But the distribution of the contractual surplus may be affected by the bank's core deposit level. In models where the bank's cost of funds affects its threat point in bargaining over the average loan rate, more core deposits can lower the bank's bargaining power, which will tend to reduce the average loan rate.[9] Thus we do not have any general predictions relating core deposits and average loan rates.

1.2 Related literature

The introduction has already highlighted some of the connections between our model and preceding empirical work in the theory of intermediation.

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[8] Empirically this second assumption amounts to the belief that banks could profitably offer depositors transactions services while investing in a portfolio of Treasury securities. (Of course, our simple model takes no account of the costs of offering transactions services.) It is unlikely that a bank portfolio composed purely of Treasury securities could be profitable, since even money market funds, which offer less extensive and costly transaction services than banks, hold approximately 40% of their portfolios in commercial paper rather than having their entire portfolios in Treasuries.

[9] For example, in a symmetric Bertrand duopoly, higher core deposit levels imply lower average loan rates.

Our work has particularly close links to three recent articles. Allen and Gale (1997) present a general equilibrium model in which a bank-centered financial system permits intertemporal risk sharing that would be impossible in a decentralized market. As in our model — where captive depositors facilitate intertemporal wealth transfers — Allen and Gale's optimal allocation can be supported only in a world where agents have limited market power.[10]

An important contribution is Petersen and Rajan (1995), who present and test a model with a flavor similar to our own. In their article, banks make low interest rate loans to high-risk customers as part of a long-term implicit contract, a type of intertemporal insurance contract against shocks to a firm's credit risk. These intertemporal insurance contracts are feasible *only* if the bank has ex post monopoly power in loan markets.

They test their model of relationship lending using data on small business firms. Using the age of the firm as a proxy for firm creditworthiness and the Herfindahl index for the local deposit market as a proxy for the degree of competition in loan markets, Petersen and Rajan show that in markets with a higher Herfindahl index, loan rates fall more slowly over a firm's life. In other words, when a bank has monopoly power, it can offer a firm a lower-than-competitive rate early in the firm's life and then make up for this by charging a higher-than-competitive rate later in the firm's life.

There are a number of differences between our work and Petersen and Rajan's. Most important, we focus on market power in the deposit market, rather than the loan market, as the source of loan rate smoothing. Also, we examine shorter-term intertemporal contracts than do Petersen and Rajan. In our empirical results, loan rate smoothing occurs (roughly) over a business cycle, a period significantly shorter than the lifetime of a firm.[11] Despite the differences, we view our approaches — and viewpoints — as complementary.[12] The main point of both articles — that the set of feasible loan contracts depends in an essential way on the degree of competition — is similar.

As noted above, Berger and Udell (1992) have shown that bank loan rates are less volatile than market interest rates, but they make no attempt to relate smoothing to banks' liability structure. Also, our main concern is with loan rate smoothing to insulate firms against adverse credit shocks rather than interest rate shocks.[13]

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[10] Although Allen and Gale show that a system of intertemporal transfers may yield a Pareto improvement over the market outcome, we make no such claim about the bank in our model.

[11] Given the relatively short-term and repetitive nature of our intertemporal trades, we do not feel that enforceability concerns are as burdensome as in the long-term relationships in Petersen and Rajan.

[12] Petersen and Rajan have detailed information about the borrowing firms over time, but only fragmentary information about their lenders. We have information about a changing pool of loans over time — an imperfect proxy for the borrowing firms — but very detailed information about their lenders.

[13] Nonetheless, we find that banks with higher core deposit ratios also provide more insurance against interest rate shocks, as we discuss later.

2. Empirical Strategy

2.1 The data

Our two main sources of data are the Federal Reserve's quarterly Survey of Terms of Bank Lending to Business (STBL) and the Reports of Condition and Income (Call Reports). Since 1977 the STBL has collected detailed microeconomic data on bank loan characteristics from a stratified sample of approximately 340 banks. In the first week of the second month of each quarter, each bank in the sample provides individual data on every business loan it made on a particular day (or number of days). This dataset provides a remarkably rich source of information on bank contracting practices, as they vary across banks and over time. All balance sheet data for the banks in our sample come from the Call Reports, which banks file quarterly.

From the complete dataset we constructed a panel that includes 126 banks that reported in each quarter from the first quarter of 1977 through the fourth quarter of 1989. Our panel excludes all surveyed banks that disappeared through failure or merger during the period. We exclude these banks because we do not want any smoothing results to be driven by banks that engaged in excessively risky investment strategies that ultimately led to failure. For example, a bank that is a poor monitor will tend to have a riskier portfolio — and a higher likelihood of failure — and the lack of monitoring may also lead to pricing that is insensitive to risk. The period following 1989 witnessed major changes in the sample of reporting banks through failures and mergers, so, to retain a relatively large and representative panel, we ended our sample period in 1989.[14]

2.2 Empirical tests

Our regressions take the following general form:

$$\begin{aligned}\text{MARKUP}_{ibt} = {} & a_0 + a_1\text{CORE DEPOSIT RATIO}_{bt} + a_2\text{CREDIT RISK}_{bt} \\ & + a_3\text{CREDIT RISK}_{bt} \times \text{CORE DEPOSIT RATIO}_{bt} \\ & + a_4\text{CONTROL VARIABLES}_{ibt}. \qquad (12)\end{aligned}$$

The subscripts refer to loan i from bank b made in time period t. In all regressions the dependent variable is the *markup* over the risk-free rate paid by the borrowing firm. More specifically, this is the difference between the loan rate and the rate on a Treasury security with duration equal to that of the loan. (Table 1 summarizes our definitions of variables.)

[14] For example, in 1996Q3, 73 banks in the panel remained. During the 1980s, small banks were more likely than large banks to have dropped from the sample either because of failure or merger or from lack of reporting in a quarter. Thus our panel is skewed toward the larger banks in the survey. But this effect should bias our results against finding a relationship between core deposits and loan rate smoothing, since we expect that implicit contracting practices are more likely to be important for small banks and small borrowers.

Table 1
Variable definitions

Variable	Definition
markup	Loan rate minus rate on a Treasury security with the same duration as that of the loan, where duration is calculated as given below.
core deposit ratio	Bank's deposits with denominations less than \$100,000 as a fraction of total liabilities.
Credit-risk variables:	
quality spread	Yield on Baa-rated long-term bonds minus yield on Aaa-rated long-term bonds (Moody's ratings).
state unemployment	Unemployment rate in the state in which the bank is headquartered.
GDP growth	Growth rate of real GDP (1982 dollars) in the quarter (saar).
employment growth	Growth rate of payroll employment in the quarter (saar).
Credit risk × core deposit ratio:	
core deposit ratio × quality spread	
core deposit ratio × state unemployment	
core deposit ratio × GDP growth	
core deposit ratio × employment growth	
Bank-specific control variables:	
charge-offs-2	Bank's net charge-offs in the second year after loan is granted/total loans.
charge-offs-3	Bank's net charge-offs in the third year after loan is granted/total loans.
loans/deposits	Bank's total loans/total deposits.
equity/assets	Bank's total equity capital/total assets.
total assets	Bank's total assets in millions of 1982 dollars.
Herfindahl	Weighted average of Herfindahl indexes in all deposit markets in which bank gets deposits, where weights are the fraction of deposits bank gets from the market.
Contract terms:	
face value	Face value of the loan in millions of 1982 dollars.
duration	Duration of the loan in years. Before 1982 the frequency of interest compounding was not included in the STBL dataset, so for these loans duration = maturity (if a maturity date was stated for the loan) and duration = 1/365 (if no maturity date was stated for the loan). (We also reran regressions calculating duration assuming frequency of interest compounding was monthly using the maturity indicated if a maturity date was stated for the loan or maturity = 1/12 if no maturity date was stated for the loan. This alternative yielded similar results.)
collateralized	= 1 if the loan is collateralized and 0 otherwise.
commitment	= 1 if the loan is made under a preexisting commitment and 0 otherwise.
fixed base rate	= 1 if loan has a fixed base rate and 0 otherwise.
Other variables:	
trend	Linear time trend.
money market rate	Rate on a Treasury security with the same duration as that of the loan, where duration is calculated as given above.
above prime	= 1 if loan rate is above or equal to the prime rate on the day loan was made and 0 otherwise.
fraction collateralized-\$	Percent of a bank's loan volume in a quarter that is collateralized.
fraction collateralized-#	Percent of a bank's number of loans in a quarter that are collateralized.
one-year T-bill rate	Quarterly average rate on one-year Treasury bills.

In our regressions we test the hypothesis that banks more heavily financed with core deposits provide borrowers with better insurance against adverse shocks to their creditworthiness. According to our hypothesis, the coefficient on the interaction term between credit risk and core deposits, a_3 in Equation (12), should be negative, because banks with more core deposits are better able to protect their borrowers against shocks to their borrowing costs.

Our measure of the *core deposit ratio* is deposits with denominations less than \$100,000 as a fraction of total liabilities.[15] We report the results based on two alternative measures of core deposits. Our preferred measure is the three-year average of the bank's core deposit ratio, where the average is taken over the calendar year prior, the current year, and the calendar year after the loan is made. For example, for any loan made in any quarter of 1977, we use the bank's average core deposit ratio over 1976Q1–1978Q4. The bank's expected longer-term liability structure, rather than transient changes in its liability structure, should be more important for the bank's strategic decisions, such as loan pricing policy. The three-year average is meant to capture the bank's expectation regarding its longer-term liability structure. We choose a three-year period because it allows for some time variation in the core deposit measure and it does not seem to be an unreasonable estimate of the horizon over which a bank concerned about lending relationships would set its loan pricing policy.[16]

As an alternative measure of core deposits we use the bank's one-year lagged core deposit ratio, that is, the loan markup at time t is regressed on the bank's core deposit ratio one year prior to t. The bank's liability structure and pricing policy are (at least partly) endogenous strategic decisions, and the lagged core deposit ratio should alleviate any concerns about endogeneity problems. It should be noted that we see no straightforward reason to expect that endogeneity would bias the coefficient on the cross-term between the core deposit ratio and credit risk in one way or the other. Since the lagged core deposit ratio does not capture the bank's expectations about its longer-term liability structure, we prefer our three-year average measure of core deposits.[17]

Because there is no one accepted measure of exogenous credit risk, we consider four alternative measures, each of which has certain benefits and drawbacks. Our preferred measure is the *quality spread*, which is the dif-

[15] We have also performed all of our regressions using an alternative, narrower measure of core deposits, which includes deposits with denominations under \$100,000 less small time deposits. The results are substantially the same in terms of the level of significance and magnitudes of the coefficients, and we report here only the results for the broader measure.

[16] For comparison, we also performed regressions using a longer-term measure of the bank's liability structure — average core deposits over the entire sample period. As we discuss in Section 2.3.2, our results remain intact using this measure.

[17] In Section 2.3.2 we also discuss results using the contemporaneous core deposit ratio as an alternative to the lagged core deposit ratio. The results are very similar, so endogeneity does not appear to be a concern.

ference between yields on Baa-rated and Aaa-rated long-term bonds; it averages 1.36% over our sample period. This measure has the advantage of being forward looking, but may be a better measure of credit risk for borrowers who have access to national bond markets than for the majority of firms that borrow in local markets. The quarterly growth in GDP and the quarterly growth in employment are also aggregate measures that are inversely related to credit risk; over our sample period, GDP growth averages 2.8 percentage points and employment growth averages 2.4 percentage points. The main drawback of these measures is that they are contemporaneous rather than forward-looking indicators of risk. To make it easier for the reader to interpret and compare our results, we report them in terms of $-1 \times$ *GDP growth* and $-1 \times$ *employment growth*, since both GDP growth and employment growth are positively related to credit risk. Note that all three aggregate measures of credit risk vary over time but not across banks.

In contrast, our final credit risk measure — the unemployment rate in the state in which the bank is headquartered (*state unemployment*) — exploits the cross-sectional nature of our data. The average unemployment rate over our sample period and states is 6.9%, but the rates are quite variable across banks and time — the minimum range in state unemployment rates across the states represented in any quarter in our sample is 5.3 percentage points, while the maximum range is 11.3 percentage points, and the mean range is 8.0 percentage points. One drawback, however, is that the state unemployment rate is not likely to be a good measure of credit risk for firms that operate in national and international markets.[18] Further, we have some concern that it is a lagging measure of economic conditions.

The control variables can be divided into three groups. The first group includes *bank-specific variables*. The most important function of these variables is to proxy for factors related to the bank-specific component of default risk. In particular, we hope to proxy for changes in the bank's credit screening policy and the riskiness of the bank's portfolio, which are ultimately unobservable. First, we include bank-specific dummy variables in those regressions using measures of credit risk that do not vary by bank, that is, in regressions using quality spread, $-1 \times$ GDP growth, or $-1 \times$ employment growth. Because the state unemployment rate varies across banks and because there are many cases where there was only one bank in a state that responded to the survey, we report results that do not include bank-specific dummy variables when state unemployment is used as our measure of credit risk.[19]

[18] The state unemployment rate was available beginning in 1979Q1 for all states except North Carolina, where it was available beginning in 1985Q1. Thus the regressions using the state unemployment rate were estimated over the 1979Q1–1989Q4 period (and in the 1979Q1–1984Q4 subperiod, these regressions exclude loans made by the two banks in our sample that were headquartered in North Carolina).

[19] Indeed, the bank-specific dummy variables explain more than 94% of the variation in state unemployment rates over the sample. We did, however, rerun these regressions with bank-specific dummy variables, and

We include a direct proxy for bank-specific default risk, the bank's net charge-offs in the second year after the loan is granted as a fraction of total loans (*charge-offs*-2) and net charge-offs in the third year after the loan is granted as a fraction of total loans (*charge-offs*-3). Note that we use *future* charge-offs, as we assume that looser screening should manifest itself with higher charge-offs in the future, not contemporaneously. We also include the loan-to-deposit ratio (*loans*/*deposits*) and equity-to-asset ratio (*equity*/*assets*), either using the one-year lagged value or three-year average value (consistent with the core deposit ratio). Higher loan-to-deposit ratios and lower equity-to-asset ratios may be associated with riskier portfolio strategies. Our measure of bank size is ln(*total assets*) in ln(millions of 1982 dollars), which proxies for scale-related components of lending costs; we also use either the one-year lagged value or three-year average value. Finally, we include the *Herfindahl index* for the bank's deposit market. Although our preferred measure of market power is core deposits, there is evidence that market concentration generates monopoly power for some types of deposits [see Berger and Hannan (1989)]. Also, for smaller borrowers in our sample, loan-market concentration may be related to deposit-market concentration. If this is true, the Herfindahl index may also control for the bank's monopoly power in loan markets.[20]

The second group of control variables includes *contract variables*. We recognize that these contract terms are offered as a package along with the loan rate and that, to some extent, the loan rate and other contract terms are jointly determined. However, we believe that the degree of substitutability among contract terms may be small in practice. Accordingly, we view the other contract terms as controls for borrower-specific default risk, as well as controls for other borrower-specific lending costs. The contract variables include the ln(*face value*) in ln(millions of 1982 dollars) and the *duration* of the loan, as well as a set of dummy variables that indicate whether the loan is *collateralized*, whether it was made under a preexisting *commitment*, or whether it has a *fixed base rate*.[21]

One last contractual variable is of special importance: whether the loan was made at a rate above or below the prime rate on the day the loan

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only one specification had a qualitative change in either the significance level or the sign of the coefficient on the cross-term between the core deposit ratio and the state unemployment rate. The coefficient on the cross-term was positive when we include *both* bank-specific dummy variables and year-specific dummies.

[20] Hannan (1991) finds evidence that the deposit market Herfindahl index is positively related to loan rates on small loans. Note that Petersen and Rajan (1995) interpret the deposit-market Herfindahl as a measure of loan-market concentration.

[21] Whether the loan was part of a participation was not reported on the STBL until 1982Q3; therefore it could not be included as a control variable. In preliminary regressions using a hold-out sample of 200 loans chosen randomly each quarter, we performed estimations over a shorter period (1982Q3–1989Q4) and included this variable. Unlike most of the other contract terms, it was significant in only two of our four regressions (using GDP growth and employment growth). As we discuss below, the contract-term variables can be omitted without qualitative changes to our results. (We excluded the loans in our hold-out sample when performing the regressions reported here to alleviate pretesting concerns.)

was made.[22] We view the above-prime and below-prime loan markets as essentially different markets [see Brady (1985)]. Below-prime borrowers often have access to national markets, and many have access to money markets. Above-prime borrowers are more bank dependent and are unlikely to have access to money markets. Table 2 shows difference-in-means and difference-in-medians tests for some characteristics of loans made to the two samples; it is immediately clear that above- and below-prime loans are very different, being made to different types of customers and, for the most part, by different types of banks. Below-prime loans are larger, less likely to be collateralized, of shorter duration, and more likely to be made at a fixed rate. They are also more likely to be made by larger banks with somewhat lower core deposit ratios.[23]

Close banking relationships are much less likely to be important — or feasible — for our below-prime borrowers, and our theory concerns relationship lending and insurance against credit-risk shocks. (This is not to say that there are no relationships between large borrowers and their banks, only that routine insulation against credit shocks is not likely to be an important feature of such relationships.) Hence we look for evidence in the subsample of above-prime loans.[24] Below we discuss some robustness tests that address concerns about whether a potential bias is introduced by selecting a sample based on loan prices, given that the dependent variable in the regression is the loan rate markup.

We include a simple linear time trend (*trend*). This is a crude attempt to control for secular changes in banking markets over the period that may not be captured by our risk measures and market rate measures.[25] Finally, we also include the *money market rate*, the rate on the Treasury security with the same duration as that of the loan, since markups may vary with interest rate levels. Since both the markup and the money market rate are defined for securities of equal duration, this specification also permits the shape of the yield curve to affect the loan markup. The variable may also serve

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[22] We use the business day prime rate as reported in the Federal Reserve Board's H.15 statistical release and not the bank-specific prime rates reported on the STBL database. The business day prime rate is the one quoted by a majority of the major banks surveyed by the Federal Reserve.

[23] For the subperiod 1982Q3–1989Q4, when banks reported on the STBL whether the loan was part of a participation, below-prime loans were more likely to be participated. The averages for the below-prime loans disguise a surprising degree of variability among the below-prime borrowers that we found in the sample. Most notably, there are several small, below-prime, collateralized loans made by banks with high core deposit ratios.

[24] We did estimate our regressions using the below-prime sample of loans and found little support for credit-risk smoothing; the coefficient on the cross-term between the core deposit ratio and credit risk was significantly positive for the quality spread and $-1 \times$ employment growth regressions, insignificantly negative for the $-1 \times$ GDP growth regression, and significantly positive in the state unemployment rate regression, when either one-year lagged or three-year average control variables were used. Not surprisingly, across all the specifications, an F-test rejects the null hypothesis of pooling the above-prime and below-prime loans, with a p-value of 0.0001.

[25] Below we discuss alternative specifications to control for time.

Table 2
Difference in means and medians tests between above-prime loan and below-prime loan sample

		Above-prime loans	Below-prime loans
Number of loans		627,499	83,982
markup	Mean	4.13%*	1.58%*
	Median	3.88%*	1.75%*
	SD	1.87%	1.97%
duration	Mean	0.4133 years*	0.3969 years*
	Median	0.1945 years*	0.0833 years*
	SD	0.7332 years	1.068 years
collateralized	Mean	63.16%*	40.68%*
commitment	Mean	59.36%*	56.75%*
face value[a]	Mean	$259,800*	$3.294 million*
	Median	$29,640*	$149,300*
	SD	$1.922 million	$9.916 million
fixed base rate	Mean	27.99%*	69.27%*
total assets[a]	Mean	$22.74 billion*	$28.16 billion*
	Median	$ 5.30 billion*	$ 6.35 billion*
	SD	$40.48 billion	$41.62 billion
equity/assets	Mean	5.671%*	5.586%*
	Median	5.618%*	5.453%*
	SD	1.372%	1.379%
loans/deposits	Mean	77.93%*	77.16%*
	Median	77.22%*	75.72%*
	SD	14.48%	14.80%
core deposit ratio	Mean	56.50%*	49.26%*
	Median	59.42%*	51.78%*
	SD	18.58%	20.90%

* Corresponding values for above-prime sample and below-prime sample are significantly different at the 1% or better level.
[a] In 1982 dollars.

as an indicator of the stance of monetary policy (especially as the average duration in our sample is under six months and the median duration is under three months).

2.3 Empirical findings

Since our sample size is so large in our main regressions — more than 600,000 loans — discussions of statistical significance at conventional levels would convey little information. Most of our variables are significant at levels well below 0.01%.[26] Accordingly we focus on the signs of the coefficients and on their economic significance. We will note, however, when important variables are insignificant at conventional levels. In some of the regressions in Section 2.4, the unit of observation is the bank's portfolio in a particular year, rather than a particular loan. In these regressions,

[26] In Section 2.3.2 we discuss the results when we allow for correlation across the loans of a given bank in a given quarter. If such a correlation exists, our OLS estimates will understate the standard errors of the coefficient estimates and therefore overstate their degree of significance.

with just over 6,500 observations, discussions of statistical significance at conventional levels are still meaningful.

2.3.1 Estimation results. Our results are consistent with the hypotheses that banks insulate firms against the costs of adverse shocks to their creditworthiness and that access to core deposits increases banks' ability to offer such insurance. Tables 3 and 4 present results using the three-year average core deposit ratio and other control variables and one-year lagged core deposit ratio and other control variables, respectively. (Columns (1)–(4) correspond to our four measures of exogenous credit risk: the quality spread, $-1 \times$ GDP growth, $-1 \times$ employment growth, and the state unemployment rate.) First, note that each of our measures of credit risk is significantly positively related to the loan markup. Second, note that the coefficient on the cross-term between our measures of core deposits and credit risk has the predicted negative sign in every case. Thus banks with greater access to core deposits provide smoother rates in response to credit shocks.

Further, the magnitudes of the credit-risk insurance are economically meaningful: Using our regressions, we compared the change in the loan markup implied by a one standard deviation increase in credit risk at banks with low and high core deposit ratios. For example, in the three-year average specification, a one standard deviation change in quality spread (0.45 percentage points) would raise the markup 48 basis points more for the bank with the minimum core deposit ratio in our sample than for the bank with the maximum core deposit ratio.[27] Similarly, for the three-year average specifications, the difference in the change in markup between a bank with the minimum core deposit ratio and a bank with the maximum core deposit ratio is 34 basis points when the state unemployment rate is used to measure credit risk, 52 basis points when $-1 \times$ employment growth is used, and 54 basis points when $-1 \times$ GDP growth is used. For the one-year lag specifications, these differences are 12 basis points when the state unemployment rate is used to measure credit risk, 13 basis points when the quality spread is used, 36 basis points when $-1 \times$ employment growth is used, and 54 basis points when $-1 \times$ GDP growth is used.[28] These numbers are economically meaningful, and they are not unreasonable, since the mean markup charged on above-prime loans in our sample is 413 basis points.[29]

[27] In our sample, the minimum and maximum three-year average core deposit ratios are 0.075 and 0.97, respectively, and the minimum and maximum one-year lagged core deposit ratios are 0.082 and 0.99, respectively.

[28] Over our sample period, a one standard deviation change in the state unemployment rate is 2.3 percentage points; in the quality spread, 0.45 percentage points; in employment growth, 2.4 percentage points; and in GDP growth, 3.8 percentage points.

[29] Consider a similar thought experiment. Over the 1977Q1–1989Q4 period, both the three-year average and one-year lagged core deposit ratios of money-center banks averaged about 0.25. Both of these ratios

Table 3
Regression results for above-prime loan sample: three-year averages of core deposit ratio and controls[a]

Dependent variable: markup

	(1) Quality spread	(2) $-1 \times$ GDP growth	(3) $-1 \times$ employment growth	(4) State unemployment
Number of of loans	627,499	627,499	627,499	531,536
Adjusted R^2	0.3266	0.3020	0.3799	0.1473
Credit-risk variables:				
quality spread	2.592* (177.9)			
$-1 \times$ GDP growth		0.002580* (156.7)		
$-1 \times$ employment growth			0.005464* (212.1)	
state unemployment				0.001368* (33.97)
Core deposit ratio:				
core deposit ratio	0.002857* (5.395)	−0.04502* (−100.8)	−0.02888* (−66.26)	0.005633* (11.22)
Credit risk $\times$ core deposit ratio:				
core deposit ratio $\times$ quality spread	−1.186* (−47.06)			
core deposit ratio $\times$ $-1 \times$ GDP growth		−0.001575* (−54.30)		
core deposit ratio $\times$ $-1 \times$ employment growth			−0.002426* (−53.93)	
core deposit ratio $\times$ state unemployment				−0.001665* (−25.08)
Contract terms:				
duration	−0.006310* (−228.3)	−0.006293* (−223.6)	−0.005998* (−225.9)	−0.006558* (−198.6)
ln(face value)	−0.001555* (−120.9)	−0.001749* (−133.6)	−0.001707* (−138.4)	−0.001546* (−102.8)
collateralized	0.001978* (44.72)	0.001677* (37.27)	0.001901* (44.82)	0.001213* (23.10)
commitment	−0.002711* (−55.66)	−0.003167* (−63.89)	−0.003001* (−64.22)	−0.001984* (−36.12)
fixed base rate	0.002173* (40.86)	0.001286* (23.78)	0.001600* (31.39)	0.001076* (17.30)

averaged 0.87 for the quarter of the banks in our sample with the highest ratios. The difference in the change in markup implied by a one standard deviation increase in our credit-risk measures between these two groups of banks are as follows: for the three-year average specifications, the difference is 23 basis points when the state unemployment rate is used to measure credit risk, 33 basis points when the quality spread is used, 35 basis points when $-1 \times$ employment growth is used, and 37 basis points when $-1 \times$ GDP growth is used. For the one-year lag specifications, these differences are 8 basis points when the state unemployment rate is used to measure credit risk, 9 basis points when the quality spread is used, 24 basis points when $-1 \times$ employment growth is used, and 37 basis points when $-1 \times$ GDP growth is used.

Table 3
(continued)

	(1) Quality spread	(2) $-1 \times$ GDP growth	(3) $-1 \times$ employment growth	(4) State unemployment
Bank-specific control variables:				
loans/deposits	-0.02307^*	-0.01756^*	-0.01384^*	-0.005970^*
	(-72.06)	(-54.02)	(-45.11)	(27.11)
equity/assets	0.09884^*	-0.003076	0.01720^*	-0.05521^*
	(23.98)	(-0.733)	(4.343)	(-19.61)
charge-offs-2	0.01231^*	-0.04476^*	-0.01023^*	-0.01120^*
	(4.335)	(-15.53)	(-3.762)	(-3.644)
charge-offs-3	0.02725^*	0.07183^*	0.04669^*	0.06342^*
	(11.29)	(29.26)	(20.17)	(24.87)
ln(total assets)	0.002666^*	-0.006126^*	-0.002747^*	-0.001050^*
	(22.21)	(-51.61)	(-24.49)	(-40.76)
Herfindahl index	$1.007 \times 10^{-6*}$	$1.223 \times 10^{-6*}$	2.808×10^{-9}	$1.166 \times 10^{-6*}$
	(9.742)	(11.63)	(0.028)	(33.89)
Other control variables:				
trend	0.000149^*	0.000203^*	0.000061615^*	-0.000214^*
	(65.52)	(88.62)	(27.80)	(-67.65)
money market rate	-0.04272^*	0.01623^*	-0.061198^*	-0.009273^*
	(-51.08)	(20.23)	(-76.53)	(-8.537)

[a] Bank-specific dummy variables are included in the quality spread, $-1 \times$ GDP growth, and $-1 \times$ employment growth regressions; an intercept is included in the state unemployment regression; these coefficients are not reported but are available from the authors. Regressions use the three-year averages of the core deposit ratio, ln(total assets), loans/deposits, and equity/assets.
Significant at the *1% and ** 5% levels.
t-statistics in parentheses.

Notice that, in general, the effect of core deposits on smoothing is larger when the three-year average specification is used. We believe our three-year average core deposit measure better reflects a longer-term planning horizon, which is relevant to a relationship lender. Hence we believe the larger estimate is a better measure of the true economic impact of core deposits on smoothing.

The signs on the coefficients of the contractual variables are consistent with prior findings in the literature and economic sense. They are also consistent with our view that the contractual terms are largely exogenous proxies for borrower risk rather than endogenously determined substitutes with the loan rate markup. For example, collateralized loans, spot loans, and smaller loans are all made at higher rates, indicating that they are proxies for higher borrower risk.

2.3.2 Robustness tests. We have already mentioned some of our robustness tests. To simplify our presentation in discussing these, we will say that results are "qualitatively similar" only when the sign and significance of the coefficient on the cross-term between core deposits and credit risk remain unchanged for all four measures of credit risk. We will note explicitly all

Table 4
Regression results for above-prime loan sample: one-year lagged values of core deposit ratio and controls[a]

Dependent variable: markup

	(1) Quality spread	(2) −1 × GDP growth	(3) −1 × employment growth	(4) State unemployment
Number of loans	627,499	627,499	627,499	531,536
Adjusted R^2	0.3242	0.2963	0.3770	0.1444
Credit-risk variables:				
quality spread	2.277* (157.4)			
−1 × GDP growth		0.002626* (159.7)		
−1 × employment growth			0.005172* (201.9)	
state unemployment				0.000742* (19.32)
Core deposit ratio:				
core deposit ratio	0.02299* (48.71)	−0.03175* (−86.35)	−0.009817* (−27.15)	0.004367* (8.927)
Credit risk × core deposit ratio:				
core deposit ratio × quality spread	−0.3292* (−13.08)			
core deposit ratio × −1 × GDP growth		−0.001543* (−53.96)		
core deposit ratio × −1 × employment growth			−0.001652* (−36.86)	
core deposit ratio × state unemployment				−0.000606* (−9.418)
Contract terms:				
duration	−0.006378* (−230.6)	−0.006413* (−227.2)	−0.006060* (−227.9)	−0.006513* (−196.7)
ln(face value)	−0.001542* (−119.7)	−0.001735* (−132.0)	−0.001701* (−137.6)	−0.001527* (−101.5)
collateralized	0.001835* (41.44)	0.001660* (36.73)	0.001860* (43.75)	0.001234* (23.46)
commitment	−0.002726* (−55.85)	−0.003054* (−61.34)	−0.002895* (−61.80)	−0.001938* (−35.26)
fixed base rate	0.002068* (38.82)	0.001207* (22.23)	0.001595* (31.20)	0.001046* (16.82)

cases in which the sign of the coefficient changes or its level of significance declines. (All of the results reported here are available from the authors.)

Our results are robust to the use of alternative specifications of the core deposit ratio and other control variables. Using the average of a bank's core deposit ratio over the entire period (and comparable measures for the other controls), we obtained qualitatively similar results.[30] We also reestimated

[30] When we used a bank's average core deposit ratio over the entire period and also included the deviation

Table 4
(continued)

	(1) Quality spread	(2) $-1 \times$ GDP growth	(3) $-1 \times$ employment growth	(4) State unemployment
Bank-specific control variables:				
loans/deposits	-0.002532^*	-0.008200^*	-0.01169^*	0.000465^{**}
	(-9.727)	(-30.84)	(-46.68)	(2.231)
equity/assets	0.03435^*	0.008579^{**}	-0.02227^*	-0.056442^*
	(10.38)	(2.544)	(-7.007)	(-21.95)
charge-offs-2	0.01653^*	-0.050028^*	-0.005245	-0.002709
	(5.798)	(-17.26)	(-1.921)	(-0.880)
charge-offs-3	0.01280^*	0.07421^*	0.05237^*	0.06043^*
	(5.327)	(30.33)	(22.74)	(23.77)
ln(total assets)	0.006999^*	-0.002807^*	0.001007^*	-0.000712^*
	(63.23)	(-25.67)	(9.766)	(-28.85)
Herfindahl index	$1.257\times10^{-6*}$	$9.789\times10^{-7*}$	$-2.02\times10^{-7**}$	$7.93\times10^{-7*}$
	(12.25)	(9.333)	(-2.050)	(23.00)
Other control variables:				
trend	0.000036733^*	0.000119^*	0.000009119^*	-0.000259^*
	(17.20)	(55.37)	(4.438)	(-84.09)
money market rate	-0.02671^*	0.027571^*	-0.053300^*	-0.003319^*
	(-32.65)	(34.89)	(-67.29)	(-3.049)

[a] Bank-specific dummy variables are included in the quality spread, $-1 \times$ GDP growth, and $-1 \times$ employment growth regressions; an intercept is included in the state unemployment regression; these coefficients are not reported but are available from the authors. Regressions use the one-year lagged values of the core deposit ratio, ln(total assets), loans/deposits, and equity/assets.
Significant at the *1% and **5% levels.
t-statistics in parentheses.

the regressions using the contemporaneous values of the core deposit ratio and other controls and obtained qualitatively similar results to those obtained when the one-year lagged core deposit ratio and control variables were used. This suggests that endogeneity is not much of a problem. Our results are also not qualitatively affected by dropping the contract-term variables, that is, the loan's size and duration and whether the loan is collateralized, made under a prior commitment, or made at a fixed rate. Thus there is no evidence that the endogenous determination of nonprice contract variables and the markup is driving our empirical results. Also, reestimating the equations with an alternative measure of core deposits, namely, deposits less than \$100,000 minus small time deposits as a fraction of liabilities, again yielded qualitatively similar results.[31]

of the bank's ratio in a period from this average, the cross-terms with credit risk of each of these measures was significant, indicating that each period's core deposit ratio provides information and not just the average. In all cases except when $-1 \times$ employment growth is used to measure credit risk, the signs on both cross-terms are significantly negative. When $-1 \times$ employment growth is used, the coefficient on the cross-term involving the average core deposit ratio is significantly negative; the coefficient on the cross-term involving the deviation is significantly positive, but it is smaller in absolute size.

[31] It might be argued that this alternative definition of core deposits is less contaminated by changes in

The results presented above include a simple time trend as a control for secular changes in financial structure and conditions that are not picked up in our variables that vary over time. We reestimated our regressions including dummy variables for each year and found no qualitative change in our results.[32] Finally, because the state unemployment rate varies over banks and time, we reestimated its corresponding regressions for each of the 44 quarters from 1979Q1 to 1989Q4 separately. Our results are weaker but still lend some support to those reported above, especially when the three-year average core deposit ratio and controls are used.[33]

We have reported ordinary least-squares estimates, but to the extent that the errors across a given bank's loans in a given quarter are correlated, the standard errors on the OLS coefficient estimates will be understated and the significance of the OLS coefficient estimates will be overstated. To address this concern we reestimated the regressions after averaging each variable across all of a bank's loans in a quarter, so there was one observation per bank per quarter. In all cases, the sign of the coefficient on the cross-term remained negative. For our preferred specification — the three-year averages — there was no lowering of significance levels on the cross-terms except when the state unemployment rate was used (the p-value rose to 0.02 from 0.0001). For the one-year lag specification, the coefficients on the cross-term when quality spread was used and when state unemployment was used became insignificant (the p-values were 0.3048 and 0.6066, respectively).

We investigated any potential bias in the results reported in Tables 3 and 4 that may have been caused by selecting our sample of loans based on the loan rate, that is, whether the loan was priced above the prime rate, while using markup as our dependent variable. First, we reestimated the regressions for the full sample of loans, including both above- and below-prime loans. This yielded qualitatively similar results to our above-prime sample, which is not surprising, since there are many more above-prime loans than below-prime loans. (F-tests reject this pooling with a p-value of 0.0001 in all cases.) We also estimated the regressions for loans priced two percentage points or more above the prime rate without a qualitative

regulation that occurred in October 1982 (e.g., the introduction of MMDA accounts).

32 We also reestimated our regressions including dummy variables for each quarter. Because quality spread, $-1 \times$ GDP growth, and $-1 \times$ employment growth vary only by quarter and not by bank or loan, we dropped these variables from the regressions. When credit risk was measured by the state unemployment rate, we included it in the regression. Our results were qualitatively similar in all regressions except those involving quality spread; when credit risk is measured by quality spread, the sign of the coefficient on the cross-term remains the same, but the coefficient is not significantly different from zero.

33 When the three-year average was used, the interaction term between core deposits and unemployment was negative in 25 of the 44 regressions, and in 20 of these significantly so at the 10% or better level. In 14 of the remaining 19 regressions, the coefficient was significantly positive at the 10% or better level. The specifications using the one-year lagged core deposit ratio and controls are neutral, showing an even split of 22 negative and 22 positive cross-terms, with 17 significant negative and 16 significant positive coefficients.

change in results.

Although we feel that the above- and below-prime breakdown best captures the theoretical distinction between bank-dependent firms — to which our theory applies — and firms that routinely borrow in public markets, the size of the borrowing firm is an alternative way of capturing the same idea. We do not have information on borrower size. But we do know the size of the loans and that smaller borrowers tend to receive smaller loans. Thus, if our theory holds, we expect to find credit-risk smoothing for the smaller loans. To test this we reestimated our regressions for loans in the bottom third of the loan size distribution (just over 241,000 loans), and we found that banks with higher core deposits engage in more credit-risk smoothing, that is, the cross-term between credit risk and the core deposit ratio is negative, as it was for the above-prime loan sample. We also estimated the regressions for loans in the top third of the size distribution and found that the signs of the cross-terms were much more mixed, with the cross-term being positive in the one-year lag distributions, and significantly so except when $-1\times$ employment growth is used as the credit-risk measure. This is consistent with a portion of the larger loans being made to borrowers who are less in need of the credit-risk smoothing offered by banks.

A final test of robustness is to see whether our regressions support other results that have been fairly well supported in the literature. In particular, many studies have shown that loan rates are sticky in response to shocks to money market rates, that is, that banks seem to provide interest rate smoothing to their borrowers [see, e.g., Berger and Udell (1992)]. Our results are generally supportive of this finding. As reported in Tables 3 and 4, the coefficient on the money market rate is significantly negative except when $-1\times$ GDP growth measures credit risk. This implies stickiness, as it indicates that the markup on the loan decreases as market rates increase.[34]

2.4 Other interpretations

We have argued that our empirical results are consistent with the hypothesis that banks with greater access to core deposits can and do offer distinctive services compared to banks heavily dependent on purchased funds. In particular, core deposits have allowed banks to insulate bank-dependent borrowers from credit shocks.

[34] Although the results are not shown here, we also investigated whether banks more heavily financed with core deposits provide borrowers with better insurance against interest rate shocks, by estimating a regression that included an interaction term between core deposits and the money market rate in place of the interaction term between core deposits and credit risk (we used the quality spread as our measure of credit risk and we included bank-specific dummy variables). In the three-year average specifications, the derivative of the markup with respect to the money market rate is negative for all values of the core deposit ratio greater than 20%, and in the one-year lag specification, it is always negative. Since fewer than 5% of the observations in the panel have core deposit ratios less than 20%, this suggests that nearly all banks are smoothing interest rate shocks; moreover, the degree of smoothing is greater for banks with higher core deposits.

Alternative hypotheses are consistent with some of our results. The first is the Petersen and Rajan (1995) view that the smoothing of loan rates is the effect of monopoly power in *loan markets* rather than in deposit markets. We believe that loan market power is unlikely to explain the relationships we find between loan markups and banks' core deposit ratios. We include Petersen and Rajan's indicator of loan market power — the Herfindahl index for bank deposits — as a control variable in all of our regressions. We also have other controls for variations in the market power of the firm and the bank, specifically bank size and loan size, and by considering only above-prime loans we severely restrict the sample variation in loan market power. After all of these controls, we retain economically and statistically significant effects for the bank's core deposits. Finally, there is little reason to believe that our core deposit variable is acting as a proxy for loan market power. Without a direct measure of loan market power, this hypothesis is impossible to test directly. But using the bank's deposit market Herfindahl index as an imperfect proxy for loan market concentration, we find a positive, but not particularly large, correlation coefficient of 0.44 between the core deposit ratio and the Herfindahl index. As a further check, we investigated whether adding a cross-term between the Herfindahl index and credit risk in the regressions would affect the coefficient on the cross-term between the core deposit ratio and credit risk. In no case did this happen — across the specifications, the sign, magnitude, and significance level of the cross-term between the core deposit ratio and credit risk were unchanged by the addition of the cross-term between the Herfindahl index and credit risk.

A second class of alternative explanations is that our results are being driven by a systematic relationship between changes in the relative riskiness of banks' portfolios and their core deposit ratios. There are two basic variants of this explanation, a demand-side and a supply-side version.

In the demand-side version there is a relative decline in demand for loans from smaller or higher-risk firms when aggregate risk increases. Since smaller firms borrow disproportionately from smaller banks, which also tend to have high core deposit ratios, the borrowing population might become disproportionately safer at banks with high core deposit ratios. But our regressions control for both bank size and loan size, so it is highly unlikely that our empirical findings are being driven by this kind of change in demand. Nonetheless, these types of demand-side effects are addressed in tests reported below. Note that we are not denying that demand for loans falls disproportionately at small banks, only that our regressions have explicit controls for this effect.

In the supply-side version, the negative correlation between core deposits and the sensitivity of loan rate markups to exogenous changes in credit risk is the result of incomplete controls for the severity of bank credit screens. It should be noted that we have multiple controls for borrower risk in our regressions and that the robustness of our results to dropping contract terms supports our interpretation of these terms as exogenous indices of borrower risk. Further, the highly significant coefficients on subsequent charge-offs provide strong evidence that our proxy for the severity of the bank's credit screen *does* capture the intended effect. Also, the bank-specific dummy variables act as controls for bank-level differences in credit screening policies. Finally, our restriction to above-prime loans restricts the importance of "flight to quality" effects in our results by limiting any potential change in the share of bank loans made to firms with access to public markets.

Of course, our controls are not perfect. If banks with high core deposit ratios systematically respond to an increase in aggregate credit risk by tightening their credit standards more than banks with lower core deposit ratios, the markups they charge to borrowers would be expected to increase less than the markups charged by banks with lower core deposit ratios. Thus one would expect to see a negative correlation on the cross-product between credit risk and core deposits, as we found, but it need not be related to banks providing insurance against credit risk.

This scenario is consistent with two views in the literature. Kashyap and Stein (1995) argue that banks that are more heavily funded by deposits, especially small banks, face more daunting external finance constraints. If so, such banks might respond to external shocks to credit risk by increasing the severity of their credit screens as part of a restriction in the supply of credit.[35] Keeley (1990) argues that banks with higher charter values are deterred from taking on risk. Since high core deposit ratios are an indicator of banks' monopoly power in deposit markets, they also indicate higher charter value. This again implies that banks with higher core deposit ratios might react to an increase in credit risk by tightening their credit screens more than banks with lower core deposit ratios. It is important to note that to make an alternative supply-side interpretation of our results, it does not suffice to make the plausible claim that credit screens are more stringent for banks with higher core deposit ratios. One must make the stronger (and less immediately plausible) claim that such banks *increase* the severity of their credit screens *disproportionately* compared with lower core deposit banks when aggregate credit risk increases. Further, one must claim that the core deposit ratio proxies for banks' risk preferences in ways not already taken into account by our existing controls.

To test whether any of these alternative stories explain our results, we estimated the following regressions for our panel of 126 banks:

$$\begin{aligned}\text{PORTFOLIO RISK}_{bt} = {} & a_0 + a_1\text{CORE DEPOSIT RATIO}_{bt} + a_2\text{CREDIT RISK}_{bt} \\ & + a_3\text{CREDIT RISK}_{bt} \times \text{CORE DEPOSIT RATIO}_{bt} \\ & + a_4\text{CONTROL VARIABLES}_{bt}. \qquad (13)\end{aligned}$$

[35] Although this interpretation is consistent with Kashyap and Stein's model, their own work is concerned with the effects of monetary tightening rather than the effects of changes in aggregate credit risk.

We examined four PORTFOLIO RISK variables: the proportion of a bank's loan volume or number of loans, respectively, that are collateralized (*fraction collateralized*-$ and *fraction collateralized*-#), since collateralized loans may indicate riskier loans [as shown by Berger and Udell (1990)],[36] and the ratio of charge-offs in the second and third years, respectively, after loans were made to total loans (*charge-offs*-2 and *charge-offs*-3), since future charge-offs indicate riskier loans. The CREDIT RISK variables included the quality spread, $-1\times$ GDP growth, $-1\times$ employment growth, and the state unemployment rate. The CONTROL VARIABLES included the intercept, the time trend, the Herfindahl index, the equity-to-asset ratio, ln(total assets), the one-year Treasury-bill rate, and the loan-to-deposit ratio. Again, we measured the core deposit ratio, equity-to-asset ratio, loan-to-deposit ratio, and ln(total assets) as either three-year moving averages or one-year lags, and we included bank-specific dummy variables for all measures of credit risk except the state unemployment rate.[37]

Note that unlike our earlier regressions, the dependent variables reflect features of the bank's portfolio of loans rather than the loans individually, so our sample size drops dramatically, and conventional significance levels have meaning.

For brevity, in Table 5 we present the estimated coefficients only for the variable of interest, the interaction term (CREDIT RISK $\times$ CORE DEPOSIT RATIO). A significantly negative coefficient would indicate that as credit risk increases, banks with higher core deposit ratios take on less risk, which would support alternative explanations for our results. However, as shown in the top panel of Table 5, this occurred only three times in either the three-year average specification or one-year lag specification: in the charge-offs-2 regression when either $-1\times$ GDP growth or $-1\times$ employment growth was used to measure credit risk, and in the charge-offs-3 regression when $-1\times$ GDP growth measured credit risk. Instead, the cross-terms involving quality spread and state unemployment are always significantly *positive* at the 5% level or better, indicating that banks with higher core deposit ratios were taking on *more* risk, not less. Thus these results are generally unsupportive of the alternative interpretation of our previous results. We also used an alternative specification, replacing the trend variable with year-specific dummy variables, and found qualitatively similar results.[38]

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[36] We obtained qualitatively similar results when using the fraction of collateralized *above-prime* loans.

[37] Using the bank-specific dummy variables with state unemployment raises the R^2 of the regressions, but the dummy variables explain most of the variation in state unemployment, confounding the interpretation of the cross-term of interest. Note, however, that whether the bank-specific dummies are included or not has no effect on the sign or significance of the cross-term.

[38] It may be worth mentioning that we do not view our results as evidence against either Kashyap and Stein's (1995) view that smaller banks are more credit constrained than larger banks or Keeley's (1990) view that bank risk taking is inversely related to charter value.

Table 5
Portfolio-risk regression results for the panel[a]

	(1) Fraction collateralized-#	(2) Fraction collateralized-$	(3) Charge-offs-2	(4) Charge-offs-3
3-year moving averages[b]				
core deposit ratio × quality spread	902.3* (2.952)	518.4** (2.448)	0.4240* (3.772)	0.8503* (6.471)
Adjusted R^2	0.4813	0.5837	0.3222	0.3250
core deposit ratio × −1 × GDP growth	−0.3027 (−0.849)	−0.2831 (−1.145)	−0.000284** (−2.168)	−0.000401* (−2.604)
Adjusted R^2	0.4793	0.5817	0.3216	0.3185
core deposit ratio × −1 × employment growth	0.6413 (1.101)	0.3068 (0.766)	−0.000538** (−2.536)	−0.000127 (0.508)
Adjusted R^2	0.4798	0.5826	0.3232	0.3174
core deposit ratio × state unemployment	3.920* (4.744)	2.012* (2.988)	0.001688* (5.509)	0.002788* (7.675)
Adjusted R^2	0.2693	0.1621	0.1271	0.1065
1-year lagged values[c]				
core deposit ratio × quality spread	996.7* (3.23)	524.5** (2.455)	0.2257** (2.006)	0.6344* (4.719)
Adjusted R^2	0.4810	0.5837	0.3324	0.3062
core deposit ratio × −1 × GDP growth	−0.1739 (−0.490)	−0.2048 (−0.834)	−0.000363* (−2.808)	−0.000434* (−2.806)
Adjusted R^2	0.4789	0.5823	0.3327	0.3029
core deposit ratio × −1 × employment growth	0.8220 (1.415)	0.4301 (1.070)	−0.000871* (−4.130)	−0.000386 (−1.522)
Adjusted R^2	0.4794	0.5831	0.3363	0.3018
core deposit ratio × state unemployment	4.005* (4.953)	1.639* (2.489)	0.001711* (5.723)	0.002592* (7.273)
Adjusted R^2	0.2658	0.1596	0.1278	0.0978

[a] Regressions also include trend, loans/deposits, equity/assets, ln(total assets), Herfindahl index, one-year Treasury-bill rate, core deposit ratio; the quality spread, −1 × GDP growth, and −1 × employment growth regressions also include bank-specific dummy variables; the state unemployment regressions include an intercept; these coefficients are not reported but are available from the authors. Regressions involving quality spread, −1 × GDP growth, and −1 × employment growth are estimated using 6,414 observations; those involving state unemployment rate use 5,358 observations.

[b] Regressions use the three-year moving averages of the core deposit ratio, ln(total assets), loans/deposits, and equity/assets.

[c] Regressions use the one-year lagged values of the core deposit ratio, ln(total assets), loans/deposits, and equity/assets.

Significant at the *1%, **5%, and ***10% levels.

t-statistics in parentheses.

One might be concerned that the lack of significance in some of the cross-terms shown in Table 5 is due to reduced degrees of freedom (compared with our loan-based regressions reported in Tables 3 and 4), but this does not appear to be the case. Since the variables measuring the share of collateralized loans are the only ones used in Equation (13) that are derived from the STBL, and all the others instead come from the Call Reports, we were also able to estimate the charge-offs-2 and charge-offs-3 regressions for the full set of all banks that existed over our sample period 1977Q1–1989Q4, whether they were STBL reporters or not.[39] In these regressions, which used 8,788 banks, we again find no support for the view that banks with higher core deposit ratios took on less risk — few, if any, cross-terms show a significant negative sign, and those involving quality spread and the state unemployment rate continue to show significant positive signs.

3. Conclusion

In this article we investigated empirically a particular channel of bank "uniqueness" linking the structure of bank liabilities to bank lending behavior. To our knowledge this channel has not been explored previously. Specifically we have examined the hypothesis that access to core deposits permits a bank to make contractual agreements with borrowers that are infeasible if the bank must pay market rates for its funds. Access to core deposits insulates a bank's cost of funds from exogenous shocks. In turn, the bank can insulate its borrowers against exogenous credit shocks as part of a multiperiod implicit relationship.

Using a large sample of loans from the Federal Reserve's Survey of Terms of Bank Lending to Business, we find convincing evidence for our story. Specifically we find that banks more heavily funded with core deposits provide borrowers with smoother loan rates in response to exogenous changes in aggregate credit risk. Thus we provide support for a view that has become prevalent among banking scholars: that part of the distinctive character of bank lending is that firms and banks form multiperiod lending relationships, in which loans need not break even period by period. A unique feature of our results is that they provide evidence that banks' access to core deposits has been one of the foundations of relationship lending.

Our findings may also provide a partial answer to a question that is one of the underlying motivations for the current research: How can we explain the banking sector's shrinking share of intermediated funds (disintermediation) and the shift toward intermediaries that hold securities rather than loans (securitization)?[40] Our answer is that declining demand for deposits has not

[39] We did omit some outliers and some observations with missing values, leaving a sample of 8,788 banks. We could estimate the equation using all these banks when we did not include bank-specific dummy variables; unfortunately computer constraints precluded us from estimating with the full set of banks when we included bank-specific dummy variables, so in these cases we selected a random sample of 1,000 banks. Without year dummy variables we found no significantly negative coefficients on the cross-terms. With year dummies we found only four instances of significantly negative coefficients (at the 10% or better level): for either the three-year average specification or one-year lag specification, in the charge-offs-2 regression when $-1 \times$ GDP growth or $-1 \times$ employment growth is used. Thus results for the 1,000-bank subsample support our other results.

[40] For empirical evidence on these trends see Boyd and Gertler (1994) and Houston and James (1996). Empirical work on the causes of disintermediation is sparse. It includes Becketti and Morris (1992) and Laderman (1993).

only raised banks' cost of funds — which directly reduces the supply of bank loans — but it has also reduced the feasibility of relationship lending by banks — reducing the firms' demand for bank loans as they have become less distinctive. Thus one reason the banking sector has been shrinking is that bank loans have become less special as banks have lost access to core deposits.

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Alternative Information Sources and the Information Content of Bank Loans

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ABSTRACT

This paper examines the information content of bank loan agreements. We differentiate borrowers according to financial analysts' percentage earnings forecast errors and most recent forecast revisions. The empirical results suggest that banks rely on other indicators as initial screening devices to determine where to best deploy their evaluation and monitoring efforts. If these other indicators are reliable and signal-improving prospects, banks do little further investigation. However, if the indicators are noisy and signal-declining prospects, banks have incentives to expend resources to investigate the borrowers, resulting in the production of valuable information.

RECENT THEORIES OF FINANCIAL intermediation concentrate on the role of banks in reducing informational asymmetry. Leland and Pyle (1977) suggest that informational asymmetries may be the primary reason that intermediaries exist. Campbell and Kracaw (1980) demonstrate that an important function of financial intermediation is the production of information. Diamond (1984) develops a model which shows that financial intermediaries can exist simply because they provide an efficient means of evaluating and monitoring borrowers. These information transmission theories argue that banks provide unique information production services in an imperfect capital market. They suggest that banks know more about the prospects of the firms they lend to than do others. Thus, bank loan agreements should convey useful information to the market.

A number of researchers empirically examine the uniqueness of bank loans. Fama (1985) approaches the issue by examining the rates on certificates of deposit and other high-grade commercial papers. He concludes that since bank borrowers bear the cost of reserve requirements, there must be something special about bank loans. James (1987) conducts an event study around the announcement of bank credit agreements and reports a significantly positive two-day announcement return. His results provide evidence support-

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ing the uniqueness of bank loans, since other types of corporate financing generate either negative or zero excess returns.

Lummer and McConnell (1989) extend the previous empirical research by dividing credit agreements into different categories. Specifically, they find that favorably revised credit agreements generate significantly positive returns, while unfavorably revised credit agreements result in significantly negative returns. In addition, they find no significant announcement returns for new credit agreements. They interpret these results as evidence that banks enter new credit agreements with no information advantage relative to other investors. However, as banks continue the credit relationships with their customers, they gain access to inside information which gives them a relative information advantage.

In this paper, we reexamine the information content of bank loans by addressing two issues. First, while other researchers focus on the information production role of banks only, we recognize that parties other than banks also perform evaluation and monitoring roles. Consequently, if these other information sources can sufficiently resolve informational asymmetries, bank loan announcements should convey little pertinent information to the market. However, if these other sources produce noisy signals, or face a disadvantage relative to banks in information production, then bank loan announcements should convey useful information to market participants. Second, we wish to determine whether banks expend equal efforts in evaluating all borrowers. It is conceivable that banks first use indicators from other sources to screen the borrowers and then decide how to allocate investigation resources.

Two theoretical arguments are made in this respect. Boyd and Prescott (1986) develop a model which shows that banks should evaluate firms with good prior information. They assume that the net expected return from evaluating good type firms is higher than that of investing in good type firms unconditionally. On the other hand, the cost of evaluating bad type firms exceeds the expected return from doing so. Therefore, in equilibrium banks only evaluate good type firms and invest the remaining funds unconditionally in bad type firms. On the other hand, Berlin and Loeys (1988) show that the value of monitoring and investigation depends on the prior probability of the firm type and the reliability of the indicator of the firm type. They argue that monitoring when the indicator is good can be valuable only when both the prior probability of a good project and the informativeness of the indicator are quite low. However, both models imply that investors' reactions to bank loan announcements should differ according to the nonbank indicators of firm type and the reliability of these indicators. Significant market reactions should be observed only for those firms that the market believes banks thoroughly scrutinize.

To examine the aforementioned issues, we divide our sample according to whether financial analysts' percentage earnings prediction errors are high or low, and whether the most recent earnings forecast revisions are positive, unchanged, or negative. We find that bank loans convey more information when the analysts' forecast errors are high. Moreover, banks produce little information when the most recent earnings forecast revision is positive. Further, the information content of bank loans is most significant when both the analysts' forecast errors are high and their most recent earnings forecast revisions are unchanged or negative. These results support the notion that banks rely on other information sources to determine where to best deploy their evaluation efforts. If the nonbank indicators are reliable and reflect improving expected performance, banks do little further investigation. However, if these indicators are noisy and reflect declining expected performance, banks have incentives to thoroughly scrutinize the borrowers.

In the remainder of the paper, Section I describes the data and methodology, Section II discusses the empirical findings, and Section III contains concluding remarks.

I. Data and Methodology

A search of the *Wall Street Journal* (*WSJ*) for the period January 1977 to December 1989 yields the initial sample of announcements of bank loan agreements between U.S. corporations and U.S. or foreign banks.[1] Inclusion in the final sample requires that several criteria be met. First, there must be no other significant announcements appearing in the *WSJ* about the firm—such as earnings reports, equity issuance, or dividend changes—on the day of or the day before the bank loan announcement. Second, the firm's daily stock price must be available on the Center for Research in Security Prices data tapes or in the *ISL Daily Stock Price Guide*. Third, financial analysts' forecasts of the firm's earnings must be available on the Institutional Broker's Estimate System (I/B/E/S) data tape. Finally, actual earnings per share must be available on either the I/B/E/S tape, the COMPUSTAT Industrial tapes, or in *Moody's Earnings Report*. These restrictions result in a final sample of 491 observations.

Following Lummer and McConnell, bank loans are first divided into new and revised credit agreements. The loan is classified as new if the *WSJ* article indicates that the agreement is new or there is no indication that it is a revision, extension, or replacement of an existing credit agreement; otherwise, the loan is classified as revised. The revised loans are then further divided into three categories based on whether the terms of the credit agreements are revised favorably, unfavorably, or mixed. We use the same four loan terms employed by Lummer and McConnell to categorize the loans. These four credit terms are the time until maturity, the dollar amount, the relative interest rate, and any protective covenants of the credit arrangement. Information regarding the terms of the loans is gathered from the *WSJ* articles describing the loan agreements.

The favorable group contains credit agreements in which one or more of the following occurs: (1) the maturity is lengthened; (2) the interest rate is

[1] The sample was collected by reading the "Financing Business" section of the *WSJ* and an on-line search via Dialog Services. The Initial sample contained 1,389 bank loan announcements.

reduced; (3) the dollar value of the loan is increased; or (4) the protective covenants are made less restrictive. The mixed group contains those credit agreements where some of the terms are revised favorably while others are revised unfavorably. For example, the dollar value of the loan may be increased, but the covenants made more restrictive. The unfavorable group contains credit arrangements in which at least one of the terms is revised unfavorably and no terms are revised favorably.

We use the composite mean of financial analysts' forecasts of annual earnings from the I/B/E/S tape as a measure of nonbank information. Given the importance of earnings information in security selection and performance evaluation, it is expected that predictions of corporate earnings should provide significant information to the market. Indeed, empirical evidence shows that financial analysts' forecasts do convey important information to investors (Gonedes, Dopuch, and Penman (1976); Givoly and Lakonishok (1980)). The I/B/E/S earnings forecasts are compiled monthly, typically on the third Thursday of each month. Thus, this date serves as the cutoff point for determining the forecasts made before and after the credit announcements.

The first measure constructed is the analysts' percentage prediction errors for the earnings of firms for the previous fiscal year. The absolute value of the difference between the analysts' composite mean earnings forecast made in the final month of the previous fiscal year and the actual earnings for that year is divided by the absolute value of the composite mean earnings forecast. All the firms are then ranked according to this percentage prediction error and divided into two groups. Firms with low prediction errors represent firms for which the financial analysts have sufficient information to accurately predict their future performances. For these firms, little residual informational asymmetry should remain after the release of the financial analysts' earnings forecasts. Conversely, firms with high prediction errors represent firms whose future performances cannot be accurately predicted by the financial analysts. Thus, significant informational asymmetry remains for these firms even after the analysts' forecasts are known.

Next, the two most recent financial analysts' composite mean forecasts of the current fiscal year's earnings are used to develop an indicator of firm types. Firms are grouped into three categories according to the difference in the composite mean earnings forecasts between the two most recent periods. The three groups are respectively firms whose earnings forecasts are revised upward, revised downward or unchanged. Firms with upward mean earnings forecast revisions represent firms whose earnings are expected to exceed previous expectations. Similarly, unchanged forecasts indicate firms whose earnings prospects remain the same, and downwardly revised forecasts represent firms whose earnings prospects are poorer than previously thought. This indicator represents the unanticipated change in the market expectation of a firm's future performance and serves as a nonbank indicator of relative firm type.

The announcement effects of bank credit agreements are examined for the overall sample as well as each of the subsamples formed using the aforementioned measures. The event window is a two-day period including the day on which the bank loan agreement appears in the *WSJ* and the previous day. The event study methodology follows Dodd and Warner (1983).[2]

II. Empirical Results

The first column of Table I allows comparison of our results to those of James and Lummer and McConnell. For the entire sample, the two-day mean abnormal return is 0.32 percent, which is significantly different from zero at the 5 percent level. Similarly, for their overall samples, James reports an average excess return of 1.93 percent, and Lummer and McConnell report an average excess return of 0.61 percent. The abnormal return for new loan agreements is insignificant, but the abnormal return of 0.49 percent for revised credit agreements is significantly positive at the 5 percent level. However, the mean abnormal returns for the two groups are not significantly different. This is consistent with the results of Lummer and McConnell who also report an insignificant excess return for new loans, and a significant excess return of 1.24 percent for revised loans. Favorably revised loans in our sample produce a significant positive abnormal return of 0.75 percent, and unfavorably revised agreements exhibit a significant negative excess return of −1.82 percent. Similarly, Lummer and McConnell report a significant mean excess return of 0.87 percent for favorably revised loans and −3.86 percent for unfavorably revised loans. These results confirm the earlier findings that the process of monitoring and evaluation by banks conveys useful information to the market.

A. Reliability of Other Information Sources

We place borrowers into two groups based on the absolute value of the financial analysts' percentage earnings forecast errors for the fiscal year prior to the bank loan agreements. The hypothesis is that the low prediction error firms have relatively lower informational asymmetry remaining after the release of the financial analysts' earnings forecasts than do firms in the high prediction error group. This implies that stock price reactions to bank loan announcements for the high prediction error firms should be more significant than for firms with low prediction errors.

The second and third columns of Table I contain significance tests for excess returns classified by percentage earnings forecasts errors. For new loans, the abnormal return for the low prediction error group is

[2] Firm excess returns for each day of the event period represent market model residuals. Market model parameters are estimated over a period beginning 170 days before and ending 21 days prior to the announcement date. Standardized prediction errors are determined by dividing the prediction errors by the standardized error of the forecast which is obtained by adjusting the standard deviation of each firm's returns from the estimation period for the possibility of a variance shift in the market during the event period and the length of the estimation period. The test statistic is distributed unit normal and is obtained by adding the standardized cumulative prediction errors (the sum of the two event day standardized prediction errors adjusted for the number of days) across firms and adjusting for the number of firms.

Table I

Mean Excess Returns for Bank Credit Agreement Announcements during 1977 to 1989 Subdivided by Financial Analysts' Percentage Forecast Errors

Excess returns are defined as market model prediction errors. The sample is subdivided by the absolute value of financial analysts' percentage earnings forecast errors. Z-statistics and sample sizes are in parentheses. Significance levels are based on one-tail tests for favorably and unfavorably revised loans and new loans, and two-tail tests for others.

Bank Loan Type	Full Sample	Low Financial Analysts' Prediction Errors	High Financial Analysts' Prediction Errors
All	0.3243	0.0444	0.6031
	(2.31[b]; 491)	(0.28; 245)	(2.99[a]; 246)
New	0.2648	−0.0499	0.6039
	(1.24; 187)	(−0.07; 97)	(1.85[b]; 90)
Revisions	0.3610	0.1062	0.6026
	(1.97[b]; 304)	(0.41; 148)	(2.35[b]; 156)
Favorable revisions	0.7528	0.1461	1.4719
	(3.04[a]; 236)	(0.37; 128)	(4.10[a]; 108)
Mixed revisions	1.1176	1.7509	0.5477
	(1.84[c]; 19)	(1.94[c]; 9)	(0.66; 10)
Unfavorable revisions	−1.8198	−1.7036	−1.8554
	(−2.92[a]; 49)	(−1.55[c]; 11)	(−2.49[a]; 38)

[a] Denotes significance at the 1 percent level.
[b] Denotes significance at the 5 percent level.
[c] Denotes significance at the 10 percent level.

−0.05 percent, which is not significantly different from zero. However, the abnormal return for the high prediction error group is 0.60 percent, which is significantly positive at the 5 percent level. Difference in means tests show that the excess returns of the two groups are significantly different at the 10 percent level. This result hints that Lummer and McConnell's conclusion that banks enter new credit agreements with no information advantage relative to other market participants may require a qualification. It is likely that banks examine new borrowers more carefully when other indicators of firm performance are less reliable. Thus, granting new loans to these firms conveys more information to the market. Similarly, for favorably revised loans, the excess return is insignificant for the low prediction error group, but significantly positive (1.47 percent) at the 1 percent level for the high prediction error group. Also, the mean excess return of the high prediction error group is significantly higher than that of the low prediction error group at the 1 percent level. For unfavorably revised loans, the excess return for the high prediction error group is −1.86 percent, which is significantly negative at the 1 percent level. Interestingly, however, the abnormal return for the low prediction error group is also significant at the 10 percent level, and the mean excess returns for the low and high prediction error groups are insignificantly different. There are two possible explanations for this result. First, regardless of the reliability of other indicators, banks may expend more resources to investigate poorly performing firms. Second, banks may be reluctant to revise credit arrangements unfavorably. As a result, an unfavorable loan revision would always be interpreted as bad news.

The above results lend support to the notion that when the firm's future prospects are predictable in terms of other indicators, the process of evaluation and monitoring by banks conveys little additional information. When other information sources fail to provide reliable indicators of the firm's future performance, however, the evaluation and monitoring process of financial intermediaries provides useful information to capital market participants.

B. Change in Expected Performance of Borrowers

We next examine the lending process to infer whether banks expend equal efforts to investigate all borrowers. We divided firms into three groups (upward, downward, or unchanged revision) according to the difference between the two most recent financial analysts' earnings forecasts. This change in the analysts' earnings forecasts yields a nonbank indicator of relative firm type which represents the unanticipated change in the market expectation of a firm's future performance.

Table II presents summary statistics for borrowers categorized by the difference between the two most recent financial analysts' earnings forecasts. Casual observation shows that a larger percentage of the bank loans in our sample are extended to firms whose expected performances were recently adjusted downward by the financial analysts. Approximately 38 percent of the firms that later received bank loans exhibit negative earnings forecast revisions prior to the bank credit agreements, while only about 29 percent of the loans were made to firms whose expected earnings forecasts were revised upward.

The first column of Table III contains significance tests of excess returns grouped by the change in the financial analysts' composite mean forecast.

Table II

Summary Statistics for Changes in Financial Analysts' Earnings Forecasts

Financial analysts' earnings forecast changes are computed as the difference between the two most recent composite mean earnings forecasts reported prior to the bank credit announcements during 1977 to 1989.

Bank Loan Type	Number of Financial Analysts' Earnings Revisions			Mean of Percent Change in Earnings Forecast
	Positive	Unchanged	Negative	
All loans	143	162	186	−6.43
New loans	56	68	63	−3.43
Revised loans	87	94	123	−8.28
Favorable revision	72	68	96	−7.50
Mixed revision	3	6	10	−8.53
Unfavorable revision	12	20	17	−12.15

Table III

Mean Excess Returns for Bank Credit Agreement Announcements during 1977 to 1989 Subdivided by Financial Analysts' Earnings Forecast Revisions and Percentage Forecast Errors

Excess returns are defined as market model prediction errors. The sample is categorized by the change in financial analysts' earnings forecasts for the two most recent periods preceding the credit agreement and the absolute value of financial analysts' percentage forecast errors. Z-statistics and sample sizes are in parentheses. Significance levels are based on one-tail tests for favorably and unfavorably revised loans and new loans, and two-tail tests for others.

Bank Loan Type	Full Sample	Low Prediction Error	High Prediction Error
Panel A: Firms Which Received *Positive* Earnings Forecast Revisions from Periods −2 to −1.			
New loan	0.0441	0.0212	0.0687
	(0.41; 56)	(−0.01; 29)	(0.60; 27)
Favorable revision	0.3009	−0.0268	0.6109
	(0.96; 72)	(0.18; 35)	(1.16; 37)
Mixed revision	3.2113	—	3.2113
	(1.06; 3)		(1.06; 3)
Unfavorable revision	0.1980	−0.6241	0.3624
	(0.55; 12)	(−0.16; 2)	(0.67; 10)
Panel B: Firms Which Received *Unchanged* Earnings Forecast Revisions from Periods −2 to −1.			
New loan	0.1959	0.1876	0.2041
	(0.49; 68)	(0.13; 34)	(0.42; 34)
Favorable revision	0.8460	0.0022	1.7408
	(1.81[b]; 68)	(0.19; 35)	(2.41[a]; 33)
Mixed revision	−0.5127	1.3571	−2.3826
	(0.67; 6)	(1.47; 3)	(−0.52; 3)
Unfavorable revision	−1.8692	−1.1322	−1.9511
	(−1.97[b]; 20)	(−0.21; 2)	(−2.01[b]; 18)
Panel C: Firms Which Received *Negative* Earnings Forecast Revisions from Periods −2 to −1.			
New loan	0.5353	−0.3481	1.5709
	(1.24; 63)	(−0.24; 34)	(2.23[b]; 29)
Favorable revision	1.0257	0.3372	2.0766
	(2.42[a]; 96)	(0.26; 58)	(3.52[a]; 38)
Mixed revision	1.4677	1.9478	0.7476
	(1.43; 10)	(1.39; 6)	(0.57; 4)
Unfavorable revision	−3.1861	−2.1753	−3.8936
	(3.28[a]; 17)	(−1.74[b]; 7)	(−2.82[a]; 10)

[a] Denotes significance at the 1 percent level.
[b] Denotes significance at the 5 percent level.

Panel A contains results for firms which received positive earnings forecast revisions. The announcement returns for all loan types are insignificant. This insignificance contrasts with the findings of Lummer and McConnell, who contend that favorable bank loan revisions signal good news, and unfavorable revisions signal bad news. Panel B contains the results for firms whose earnings forecasts were unchanged. For favorably revised loans, the excess return is significantly positive at the 5 percent level. For unfavorably revised loans, the abnormal return is significantly negative at the 5 percent level. Panel C shows results for firms whose earnings forecasts were negatively revised. For new loans, the excess return is higher than those in the other two panels, although the difference is insignificant. For favorably revised loans, the abnormal return is 1.03 percent, which is significantly positive at the 1 percent level. For unfavorably revised loans, the excess return is -3.19 percent, which is significantly negative at the 1 percent level. Based on the type of credit agreement, t-statistics show no difference in the excess returns of unchanged and negative earnings forecast revision groups. Thus, we combine the unchanged and negative earnings forecasts into groups based on the type of credit agreement, and compare the mean excess returns of the combined groups with those of the positive earnings forecast groups. For favorably revised loans, the mean excess return for the combined group is significantly higher than that of the positive earnings forecast group at the 10 percent level. For unfavorably revised loans, the mean excess returns of the two groups are significantly different at the 5 percent level.

These results indicate that the market does not react in the same way to the announcements of bank loans made to firms whose expected performance has been recently revised upward by financial analysts. One reason could be that financial analysts do a good job of screening firms which have improving future prospects. A more compelling explanation is that banks use other indicators of a firm's expected performance, such as analysts' forecasts, as initial screening devices. If the indicators are good, banks do little further investigation. Thus, the announcements of bank loans to these firms convey little additional information to the market. Alternatively, if the indicator is negative or "stale"—such as a negative or unchanged earnings forecast revision—banks spend resources to further investigate the firm. Thus, useful information is produced.

In sum, the above findings fail to support the model developed by Boyd and Prescott (1986), which shows that banks should evaluate better type firms and invest the residual funds randomly in poorer type firms without evaluation. On the contrary, the above results provide preliminary evidence that banks concentrate their evaluation and monitoring activities on poorly performing borrowers.

C. *Information Reliability and Change in Expectations*

The results in the previous section suggest that banks expend differential efforts in investigating borrowers. Combining this argument with the informational asymmetry argument results in the following predictions. When the analysts' revisions are positive, the banks do little further investigation regardless of the level of the remaining informational asymmetry. When the indicator is unchanged or negative, banks expend effort and thus produce credible information. However, it seems reasonable that banks spend more resources to investigate the high prediction error firms since more information remains to be revealed. Thus, the significance of the market's reaction is expected to be greatest for high prediction error firms following either unchanged or negative financial analysts' earnings forecast revisions.

The second and third columns of Table III synthesize the previous analyses by grouping firms based on their earnings predictability, type of credit agreement, and most recent earnings revision. Panel A contains results for firms that recently received positive earnings forecast revisions. Once again, the excess returns for all loan types are insignificantly different from zero. The mean excess returns are also insignificantly different across prediction error groups, which adds credence to the argument that banks produce little or no new information for firms with improving performance.

Panel B covers firms whose earnings forecasts did not change. Regardless of the type of credit agreement, the excess returns are insignificant for firms in the low prediction error group. For the high prediction error group, the abnormal return is insignificant for new loans. However, favorably and unfavorably revised loans exhibit significant excess returns of 1.74 percent and -1.95 percent respectively. Difference in means tests show that the mean abnormal return of favorably revised loans in the high prediction error group is significantly higher than that of the favorably revised loans in the low prediction error group at the 5 percent level. Panel C contains abnormal returns for firms with recently downward earnings forecast revisions. Once again, the market only reacts significantly to favorably revised agreements in the high prediction error group. The mean excess return for this high prediction error group is 2.07 percent, which is significant at the 1 percent level, and is significantly greater (5 percent level) than the mean excess return of the low prediction error group. Note, however, that the abnormal returns of unfavorably revised loans are significantly negative for both high and low prediction error groups, and the difference in means test shows that the abnormal returns of the two groups are not significantly different. This is consistent with the differential investigation hypothesis which suggests that banks will investigate when the indicator is bad even if the indicator is reliable. Further, there is some evidence that banks are reluctant to negatively revise credit agreements. This is first supported by the relatively small number of negative revisions of credit agreements by banks in the sample. In addition, the strong negative reaction by the market to unfavorably revised loans in the negative analysts' forecasts category suggests that the market considers an unfavorable credit agreement revision to be very bad news. This is true even when the indicator of the firm's performance is reliable.

Mean excess returns for favorably revised loans are insignificantly different between the unchanged and the negative earnings revision groups.

However, the mean excess returns for favorably revised loans following either unchanged or negative financial analysts revisions are significantly greater than that of favorably revised loans following positive analysts' earnings revisions. Likewise, the mean excess returns of unfavorably revised loans following either unchanged or negative analysts' earnings revisions are significantly less than that of unfavorably revised loans following positive earnings forecast revisions. In contrast, in the low prediction error group the excess returns for favorably revised loans do not vary significantly across financial analysts' earnings forecast revisions.[3]

The evidence of new loans tells a similar story. Panel C shows that new loans generate significantly positive abnormal returns only when the analysts' forecasts are negative and the forecasting errors are high. The mean excess return for these new loans is significantly greater (at the 5 percent level) than those of both the negative forecast–low prediction error new loans and the other high prediction error new loans. In fact, the mean abnormal return for these negative forecast revision–high prediction error new loans is significantly higher than that of all other new loans at the 5 percent level. This again is consistent with the indicator type and reliability argument. Further, if managers of these firms believe that their firm is actually better than the financial analysts have indicated, they will be willing to supply the banks with any additional information necessary to support their contention. Thus, for this subset of firms banks could be privy to information that other information producers are not. Since only the better firms in this group would actually receive loans, the granting of new loans to these firms serves as a positive signal to the market.

In sum, the empirical evidence supports the information and differential bank investigation arguments which suggest that the strongest stock price effects should be found in the high prediction error–negative forecast revision groups. Our results are also consistent with the argument of Berlin and Loeys (1988). They suggest that monitoring when the indicator is good can be valuable only when both the prior probability of a good project and the informativeness of the indicator are quite low. Numerous studies have shown that financial analysts' earnings forecasts provide relatively accurate predictions of firms' future performances (e.g., O'Brien, 1988). Therefore, with a reasonably reliable indicator, banks are better off evaluating the poorly performing firms if the probability of firms with positive indicators being bad is small. Further, if the monitoring cost is the same for both types, the net benefit would be greater if banks evaluate poorer firms due to the avoidance of costs from inefficient liquidation.

[3] For unfavorable loan revisions in the low prediction error group, the mean excess returns for firms with unchanged or negative analysts' earnings forecast revisions are more negative than the mean excess return of the positive revision group, but the numbers are too small for valid difference in means tests.

D. Multivariate Analysis

We employ multivariate regressions to further examine possible factors affecting announcement period returns. The regressions allow us to control for firm size, existence of a bond rating, and the number of financial analysts forecasting each firm's earnings.[4] The dependent variable is the two-day announcement period excess return. The independent variables are the book value of assets,[5] a dummy variable taking the value of 1 if the firm has an existing bond rating at the time of the bank loan announcement and 0 otherwise, the number of financial analysts forecasting each firm's earnings, and various dummy variables representing our previous classification scheme. Regressions are estimated for the full sample, the sample of new credit agreements, and the sample of revised agreements. Since cross-sectional stock returns exhibit heteroscedasticity we use White's (1980) heteroscedasticity-consistent covariance matrix estimator in all of the regressions, but the results do not differ significantly from those obtained using ordinary least squares.

The regression results are shown in Table IV. In both full sample regressions, the classification dummy variables exhibit coefficients and significance levels which are very comparable to the results of the earlier analyses, and remain virtually the same whether or not the control variables are included. In addition, the test statistics for the control variables suggest that firm size, existence of a bond rating, and the number of analysts forecasting a firm's earnings do not significantly affect the excess returns of the bank loan announcements. When we divide the sample into new loans and revised loans the results remain virtually unchanged.

E. Sensitivity Analysis

We perform several tests to determine the sensitivity of our results to the chosen methods of measuring residual informational asymmetry and firm types. In addition, we examine whether the categorization variables serve as proxies for size or exhibit time series or industry clustering effects.

Two alternative methods of determining forecast errors are used. First, the sample is divided based on the current fiscal year's prediction errors as described previously. Second, the forecast errors for the three previous fiscal years are computed. Due to the presence of outliers, the firms' forecast errors are ranked separately each year. The three yearly rankings for each firm are then averaged, and the firms are placed into high and low prediction error

[4] The control variables represent proxies for information asymmetry. Information arguments suggest that the abnormal returns should be more positive for favorably revised loans and more negative for unfavorably revised loans when information asymmetry is high. To control for this fact, whenever the bank loan revision is unfavorable, the control variables are multiplied by -1. In regressions not shown, we also included variables similar to those used by Lummer and McConnell (i.e., revolving or term loan, secured versus unsecured, number of lenders, maturity, value of agreement), but find no significance for these variables.

[5] Similar results obtain when the market value of equity is used to proxy for firm size.

groups, accordingly. Use of these alternative ranking methods yields similar results. Forecasts for the next fiscal year and long-term growth are used, but do not significantly alter the results.

O'Brien (1988) shows that financial analysts tend to overestimate firms' earnings. If this bias is consistent for all firms, ranking and classification of firm types using the analysts' forecasts should still reflect the true rankings. There is reason to believe that increasing the number of analysts making forecasts should reduce the bias, but our analysis shows that the number of analysts forecasting a firm's earnings is not related to the stock price reaction. Since O'Brien shows that the median forecast exhibits the smallest bias, we also use the median forecast to segregate the sample. The results obtained using this measure do not differ from those shown. Further, previous studies have indicated that there is serial correlation in consensus forecasts due to the fact that some analysts have not revised their forecasts to incorporate the most recent available information. However, if the information that is not reflected is neither systematically good nor bad, the firm type classification scheme should not be adversely affected.

It is possible that a large firm or one with existing bond ratings would have more information available to market participants. Therefore, we explore the possibility that our high/low prediction error classification proxies for variables such as firm size or existence of a bond rating. We compare the book value of total assets and the market value of common equity for firms in the high and low prediction error groups. Difference in means tests show no difference in firm size between the two groups. Next, we compare the mean prediction errors of firms with and without bond ratings and find no significant difference. We also examine the number of firms classified as high/low prediction error firms based on whether a bond rating exists, and find no significant difference across the two groups.

Further, to detect if there is time series clustering of the earnings forecast errors in our sample, we calculate the proportion of firms classifed as exhibiting high/low forecast errors each year. A simple plot of this series of proportions shows no sign that the proportions are different across years. Since we divide our sample into two groups based on prediction errors, absent time series clustering these proportions should not differ significantly from one-half. Tests confirm that the proportions do not differ significantly from one-half. We also examine the possibility of industry clustering, but find that no particular industry (determined by using two-digit Standard Industrial Classification codes) has an abnormally high number of firms classified as high or low prediction error firms.

To ensure that our indicator of firm types does not proxy for firm size, we compare the book value of assets and the market value of equity across different groups. The tests show no significant differences between any of the groups. Further, no particular industry contains predominantly more firms receiving one type revision than another, and the existence of a bond rating appears to have no significant relationship in the classification scheme. Finally, no particular month contains an abnormally higher than expected number of positive, unchanged, or negative forecast revisions.

Table IV

Regression Tests on Excess Returns for Bank Credit Agreements

Regressions are estimated with two-day excess returns as dependent variables and various continuous and dummy variables as independent variables for bank credit agreements during 1977 to 1989. All test statistics are computed using White's (1980) heteroscedasticity-consistent covariance matrix. Significance levels are based on one-tail tests for favorably and unfavorably revised loans and new loans, and two-tail tests for others.

	Coefficient of Variable in Percent (t-Statistic in Parentheses)			
Variable	Regressions with Full Sample of Credit Agreements		Regression with New Credit Agreements	Regression with Revised Credit Agreements
Intercept	0.1871 (0.88)	0.1636 (0.58)	0.4295 (1.16)	0.1171 (0.29)
Bond rating (1 if rating exists, 0 otherwise)	—	−0.1244 (−0.29)	−0.7319 (−1.27)	0.1630 (0.26)
Total assets (in billions)	—	0.000329 (1.28)	0.000478 (1.24)	0.000324 (0.95)
Number of analysts	—	−0.0000372 (−0.16)	−0.0478 (−1.52)	0.0154 (0.46)
New, high prediction error, negative forecast revision[d]	1.3838 (1.80)[b]	1.3723 (1.78)[b]	1.6608 (2.55)[a]	—
Favorable, high prediction error, unchanged forecast revision[e]	1.5537 (2.14)[b]	1.4756 (2.02)[b]	—	1.3696 (1.68)[b]

III. Conclusions

Financial intermediation theory based on information production states that banks may play a unique role in the alleviation of informational asymmetries. We find that banks supply significant information to the market only in certain instances. The results suggest that banks rely upon other indicators as initial screening devices to determine where to expend their evaluation and monitoring efforts most efficiently. If these indicators are "good," banks do little further investigation. However, if the indicators are negative or unchanged, banks have incentives to expend resources to further investigate the firms. Furthermore, the incentives to further scrutinize are greatest when the indicators are noisy or unreliable. These results fail to support the model developed by Boyd and Prescott (1986) which shows that banks should evaluate better type firms and invest the residual funds randomly in poorer type firms. Instead, the findings are consistent with the argument of Berlin and Loeys (1988) which suggests that with a reasonably reliable indicator (e.g. financial analysts' earnings forecasts) banks are better

Table IV—*Continued*

Variable	Coefficient of Variable in Percent (*t*-Statistic in Parentheses): Regressions with Full Sample of Credit Agreements		Regression with New Credit Agreements	Regression with Revised Credit Agreements
Favorable, high prediction error, negative forecast revision[f]	1.8895 (2.77)[a]	1.8264 (2.68)[a]	—	1.6517 (2.11)[b]
Unfavorable, high prediction error, unchanged forecast revision[g]	−2.1382 (−2.21)[b]	−2.1139 (−2.11)[b]	—	−1.9701 (−1.97)[b]
Unfavorable, high prediction error, negative forecast revision[h]	−4.8110 (−3.57)[a]	−4.7774 (−3.37)[a]	—	−4.4306 (−2.75)[a]
Unfavorable, low prediction error, negative forecast revision[i]	−2.2075 (−1.53)[c]	−1.9141 (−1.48)[c]	—	−1.7446 (−1.50)[c]
Adjusted R^2	0.0582	0.0607	0.0389	0.681

[a] Denotes significance at the 1 percent level.
[b] Denotes significance at the 5 percent level.
[c] Denotes significance at the 10 percent level.
[d] Dummy variable equals 1 for firms with new bank loans, high analysts' prediction errors, and recent negative earnings' forecast revisions. Otherwise, the variable equals 0.
[e] Dummy variable equals 1 for firms with loans favorably revised by the banks, high analysts' prediction errors, and recent unchanged earnings' forecast revisions. Otherwise, the variable equals 0.
[f] Dummy variable equals 1 for firms with loans favorably revised by the banks, high analysts' prediction errors, and recent negative earnings' forecast revisions. Otherwise, the variable equals 0.
[g] Dummy variable equals 1 for firms with loans unfavorably revised by the banks, high analysts' prediction errors, and recent unchanged earnings' forecast revisions. Otherwise, the variable equals 0.
[h] Dummy variable equals 1 for firms with loans unfavorably revised by the banks, high analysts' prediction errors, and recent negative earnings' forecast revisions. Otherwise, the variable equals 0.
[i] Dummy variable equals 1 for firms with loans unfavorably revised by the banks, low analysts' prediction errors, and recent negative earnings' forecast revisions. Otherwise, the variable equals 0.

off evaluating the poorer type firms if the probability of firms with positive indicators being bad is small.

In general, our results support Lummer and McConnell's contention that banks enter new credit agreements with no information advantage relative to others. However, this may not be the case for certain new borrowers whom banks have greater incentives to investigate and who have incentives to supply the banks with "additional" information to prove that the recent "negative" indicators are flawed. Also, Lummer and McConnell suggest that as time progresses banks gain access to more "inside" information about the firms with whom they deal. While this may be the case, the mere access to "inside" information does not imply its utilization. Since information gathering and investigation is costly, banks will further scrutinize only when the expected benefits exceed the expected costs.

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Does secondary loan market trading destroy lenders' incentives?*

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Abstract

In this paper we investigate whether the secondary market trading of syndicated loans compromises the quality of bank lending practices. We compare the performance of borrowers of traded loans following the initial trading event against the performance of borrowers of non-traded loans following loan issuance. We also investigate whether the relative performance of traded versus non-traded loans varies with the reputation of the lead arranger of syndication and with loan purpose. We measure performance by borrowers' accounting performance and default risk. For loans originated by reputable lead arrangers, we find evidence that borrowers of traded loans actually perform better than borrowers of non-traded loans do. Thus, loan sales appear to have a *positive* effect on reputable arrangers' incentives to monitor and screen borrowers. For loans originated by lower reputation lead arrangers, we find some evidence that the performance of borrowers of traded loans is worse than that of borrowers of non-traded loans and that borrowers of traded loans engage in earnings management behavior. These results are consistent with breakdowns in due diligence by non-reputable arrangers on loans anticipated to be sold. We also document that restructuring purpose loans (loans with a primary purpose of takeover, LBO, MBO or recapitalization) perform worse relative to other loans, regardless of whether or not they are traded.

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1. Introduction

A central question surrounding the recent financial crisis is the extent to which the "originate-to-distribute" model of bank credit undermined banks' incentives to screen and monitor borrowers. Under originate-to-distribute models, banks originate loans, earn fees in the process, and then distribute the loans to other investors through securitization, syndication or outright sale. This basic model applies to a wide range of transaction classes where textured differences in transaction structures can generate different performance implications. While much recent research focuses on the role played by loan securitization processes in mortgage loan markets, this issue is also of vital importance in the corporate loan market, which is characterized by loan syndication and the trading of loans on the secondary loan market.

The main objective of this paper is to investigate whether the secondary market trading of syndicated corporate loans compromises the quality of bank lending practices. In particular, we examine whether secondary loan sales, by potentially separating the loan originator from the ultimate bearer of default risk, reduce lenders' incentives to ex-ante screen loans and monitor them ex-post, or whether they increase lenders' incentives to exploit their private information by initiating and distributing poor quality loans. Our fundamental research strategy compares the performance of borrowers of traded loans following the initial trading event against the performance of borrowers of non-traded loans following loan issuance.[1] Performance is measured using borrowers' accounting performance (EBITDA to total assets and interest coverage ratio) and default risk.

We also explore the possibility that the influence of secondary market trading on bank lending practices differs across particular subsets of loans due to variation across those subsets in

[1]For traded syndicated loans, the initial trading event typically occurs within one to three months of loan origination. For this reason we compare the performance of traded loans after the initial trading event against non-traded loans following loan origination.

lenders' incentives to screen and monitor loans. We first investigate the extent to which the relative performance of traded versus non-traded loans varies with the reputation of the lead arranger of the syndication.[2] Reputational concerns of the lead bank have been posited as a key mechanism to mitigate asymmetric information and incentives problems in the syndicated loan market. Existing literature documents that more reputable arrangers are more likely to syndicate loans and are able to sell off a larger portion of a loan to syndicate participants (Dennis and Mullineaux, 2000, and Sufi, 2007). Thus, it is plausible that breakdowns in arrangers' incentives would be more likely to occur for loans syndicated by lower reputation arrangers than for loans syndicated by higher reputation arrangers.[3]

Second, we investigate whether restructuring purpose loans (loans with a primary purpose of takeover, LBO, MBO or recapitalization) underperform relative to other loans. Restructuring purpose loans are typically associated with significant changes in a borrower's capital structure and operations, increasing uncertainty regarding the borrower's future prospects. This heightened uncertainty may generate a significant information advantage for lead arrangers relative to outside investors, as lead arrangers have access to important private information regarding a borrower. Further, restructuring purpose loans generate upfront fees of up to 2.5% of the total loan commitment, which are significantly higher than fees for other loan types. Higher loan origination fees in conjunction with a significant information advantage could present lenders' with a strong motive and fertile opportunities to originate and then sell low quality restructuring loans on the secondary loan market. In addition, syndicated loans have played a central role in the recent LBO wave, suggesting that lending standards for the origination of restructuring

[2] In the primary syndicated loan market, loan deals are characterized by the existence of a lead arranger who establishes a relationship with the borrowing firm, negotiates the terms of the contract, organizes a syndicate of participant lenders and performs primary monitoring and enforcement responsibilities.

[3] Throughout the paper, we use the terms "highly reputable arranger" ("less reputable arranger") and "reputable arranger" ("non-reputable arrangers") interchangeably.

purpose loans could also be adversely affected by high institutional investor demand for these loans (Axelson et al., 2007, and Ivashina and Kovner, 2008).

The extent to which loan sales lead to a breakdown in lenders' incentives to screen and monitor borrowers remains an open question in the literature. On one hand, Pennacchi (1988) and Gorton and Pennacchi (1995) suggest that after a loan or some portion of it is sold on the secondary market, the lender is less motivated to continue the loan's monitoring. Specific to syndicated loans, Berndt and Gupta (2009), focusing on stock returns, document that borrowers whose loans are sold in the secondary market significantly underperform other bank borrowers on a risk-adjusted basis over the three year period following the sale of their loan. Based on these results they draw the inference that loan trading adversely affects lenders' incentives to screen and monitor traded loans.[4]

On the other hand, participants in the secondary loan market are highly sophisticated players and are unlikely to be systematically fooled by originating banks.[5] In addition, syndicated loan contracts contain features specifically designed to mitigate agency problems with respect to loan trading. Drucker and Puri (2009) document that at loan origination, lenders anticipate that a given loan will ultimately be sold in the secondary market and include more restrictive covenants in the traded loans' contract, relative to the contracts of loans not anticipated to be sold. Drucker and Puri (2009) also document that borrowers benefit from these more restrictive covenants by increasing their access to loans and achieving more durable

[4] In a critique of Berndt and Gupta (2009), Duffee (2009) argues that definitive conclusions cannot be drawn from differences in mean stock returns across borrowers with and without actively traded loans and that "no sensible investor could fail to consider the adverse selection and moral hazard implications of the loan-sale market."

[5] Kroszner and Rajan (1994), who investigate potential conflicts of interest in the securities underwriting activities of banks prior to the passage of Glass-Steagall in 1933, also support the proposition that investors can see through banks' incentives. They document that not only did the securities underwritten by banks not underperform relative to those underwritten by investment banks, but also that there were systematic differences in the types of securities underwritten by these intermediaries. Kroszner and Rajan (1994) argue that these findings are a manifestation of sophisticated market participants discounting securities issued by banks that experience substantial conflicts of interest.

lending relationships. Further, as we argued earlier, reputation plays a significant role in the syndicated loan market. Gopalan et al. (2009) show that defaults by a lead arranger's borrowers adversely affect its subsequent lending activity, consistent with a loss of reputation. Such a loss of future business can impose substantial costs on lead banks due to a loss in lucrative fee income and opportunities to cross-sell other fee based business (see Ivashina and Kovner, 2008, on this later point). Thus, the extent to which secondary market loan sales generate breakdowns in lenders' incentives to screen and monitor loans, if at all, is ultimately an empirical question. In this paper, we provide substantial new evidence on this issue.

We first examine the behavior of loan prices following the initial trading event for the subset of loans traded on the secondary market. We find that loans are initially sold at roughly par.[6] The fact that loans do not initially trade at a substantial discount is consistent with market participants not viewing the event of a loan's sale on the secondary market as evidence of an incentive breakdown. Interestingly, we find that on average, the prices of traded loans decrease in the three years subsequent to their initial trading date. Further, loans originated by reputable lead arrangers deteriorate significantly less after the initial trading than those issued by less reputable arrangers, and loans issued to support corporate restructuring deteriorate significantly more than loans issued for other purposes. While intriguing, this pricing data does not directly speak to the question of whether secondary market trading adversely affects lead arrangers' screening and monitoring incentives or whether this effect is more pronounced for the loans of non-reputable arrangers and for restructuring loans. Such a conclusion must be based on a direct comparison of the performance of traded loans to that of non-traded loans.

[6] We exclude loans that are distressed (traded at below 90 percent of par value) at the initial trading date from the analysis. Distressed loans at the initial trading date are quite rare; out of 2,811 traded loan facilities, 109 have been distressed at the initial sale.

We systematically compare the performance of borrowers of traded loans against the performance of borrowers of non-traded loans across a range of key performance measures over a three year period following a loan issuance or sale. Comparing loans originated by high reputation lead arrangers, we find no evidence that borrowers of traded loans perform poorly relative to borrowers whose loans are not traded. In fact, we actually find evidence that in terms of accounting performance borrowers of traded loans perform better than borrowers of non-traded loans. In terms of credit quality, the performance of borrowers of traded loans is indistinguishable from that of borrowers of non-traded loans. Thus, loan sales, if anything, have a *positive* effect on reputable arrangers' incentives to monitor and screen, leading to higher quality loans being sold to uninformed investors in the secondary loan market.[7]

With respect to loans originated by lower reputation lead arrangers, we find some evidence that borrowers of traded loans perform poorly relative to borrowers of non-traded loans. For profitability and interest coverage measures we find that the performance of borrowers of traded loans is similar to that of borrowers of non-traded loans, while with respect to credit ratings, we find that the performance of borrowers of traded loans is worse than that of borrowers of non-traded loans. We also find evidence consistent with earnings management behavior by borrowers in the period leading up to loan origination and trading. These result are consistent with breakdowns in due diligence by non-reputable arrangers relative to loans anticipated to be sold.

Finally, we document that across accounting performance measures, restructuring purpose loans perform worse relative to loans issued with a refinancing or general corporate purpose, regardless of whether or not they are traded. In terms of credit quality, restructuring purpose

[7]Greenbaum and Thakor (1987) argue that in the presence of asymmetric information about borrower quality, better quality assets will be sold (securitized) by originating banks and poorer quality assets will be retained on the bank's balance sheet. Greenbaum and Thakor's (1987) argument follows from a signaling story in which borrowers signal their quality through the choice of loan insurance coverage. However, as we discuss below, our finding of the better performance of traded versus non-traded loans only holds for loans originated by high reputation lead banks.

loans do not underperform relative to other loans for both traded and non-traded samples. This evidence suggests that loan trading is not the main driver of the poor performance of restructuring purpose loans.

Our study contributes to a substantial body of empirical literature that examines how loan contracts are structured to mitigate agency problems.[8] Prior studies demonstrate that the reputation of the lead arranger and the proportion of the loan retained by the lead arranger at origination play a key role in mitigating adverse selection and moral hazard problems.[9] Our study in essence examines whether the sale of loans in the secondary market allows lead arrangers to unwind incentives established by the original syndicate structure.[10] We also demonstrate that reputation is a powerful mechanism in mitigating arrangers' incentives problems associated with loan sales.

Further, our paper complements the recent stream of research on lenders' incentives associated with the securitization of loans. This includes Keys et al. (2008 and 2009), Mian and Sufi (2008), Purnanandam (2008), Doms et al. (2007), Dell`Ariccia et al. (2009) and Demyanyk and Van Hemert (2008), who examine the securitization of mortgage-backed securities. In a recent study, Benmelech et al. (2009) investigate whether securitization is associated with incentive breakdowns in the corporate loan market by examining the performance of individual loans held by collateralized loan obligations (CLOs) following securitization. Related to our findings on traded versus non-traded loans, Benmelech et al. (2009) document that securitized loans perform no worse than unsecuritized loans in terms of accounting returns, credit rating

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[8] Important contributions include Simons (1993), Dennis and Mullineaux (2000), Lee and Mullineaux (2004), Jones et al. (2005), François and Missonier-Piera (2005), Sufi (2007), Ball et al. (2008), Wittenberg-Moerman (2008) and Ivashina (2009).

[9] Pertinent theory underpinning these agency problems includes Leland and Pyle (1977), Diamond (1984), Gorton and Pennacchi (1995) and Holmström and Tirole (1997), among others.

[10] It is possible that lead arrangers can unwind incentives even without secondary market selling by, for example, hedging the default risk of the retained loan proportion via credit derivatives (e.g., Duffee and Zhou, 2001, Ashcraft and Santos, 2007, and Parlour and Plantin, 2008). We do not address this issue in this paper.

changes, and market-assessed probability of default. They do however find that loans originated by a bank that also acts as the CLO underwriter show signs of underperformance.

Our paper is also related to the literature on the "specialness" of bank loans.[11] The development of an active secondary market for syndicated loans has raised concerns that this trading option could potentially diminish the special monitoring role played by banks. Gande and Saunders (2008) directly examine this issue, documenting that new loan announcements are associated with a positive borrower stock price announcement effect even when a borrower's loans trade on the secondary market.[12] We directly extend this literature by investigating the impact of secondary trading on borrowers' post-sale accounting performance and credit quality.

Finally, we contribute to the regulatory debate on the "originate-to-distribute" model of bank credit. In the aftermath of the recent crisis the calls for increased regulation abound. For example, Berndt and Gupta (2009) propose regulatory restrictions on loan sales, increased disclosure, and a loan trading exchange with a clearinghouse. However, while the originate-to-distribute model may have a dark side, it also provides potential benefits by enhancing the credit risk management of financial intermediaries and by creating liquidity in the credit markets. Such benefits should be preserved to the extent possible, and so it is crucial that any regulatory changes be based on sound empirical evidence. Our findings suggest that calls for sweeping regulations on loan sales are premature. Our evidence shows that loan sales are not inherently bad for incentives and that for loans issued by reputable lead arrangers—the majority of traded loans—loan sales actually have a positive impact on banks' incentives to monitor and screen.

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[11] A number of studies have shown that announcements of bank loans elicit positive short-term abnormal returns for the borrowers, in contrast to the announcement effect of most other forms of corporate financing, such as common stock, preferred stock, straight debt, convertible debt, etc. See James and Smith (2000) and Gande and Saunders (2008) for comprehensive reviews of this literature. In addition, many theoretical models highlight the unique monitoring functions of banks (e.g., Diamond, 1984, Ramakrishnan and Thakor, 1984, and Fama, 1985).

[12] Dahiya, Puri, and Saunders (2003) find a negative announcement effect for the sale of a borrower's loans by its lenders. This result is likely to be explained by the high proportion of distressed loans in the study's research sample.

The remainder of the paper is organized as follows. Section 2 provides a description of the syndicated loan market and discusses the structure of information distribution in this market. Section 3 presents our predictions. Section 4 describes the data and sample. Section 5 presents our empirical findings. Section 6 offers concluding remarks.

2. The primary and secondary syndicated loan markets

The U.S. syndicated loan market provides borrowers with an alternative source of financing to high-yield bonds and relationship-based bilateral bank loans. The syndicated loan market is one of the main sources of financing for U.S. companies (Yago and McCarthy, 2004, and LSTA, 2007). Since 1999, U.S. firms have obtained over $1 trillion in new syndicated loans each year. Syndicated lending represents more than fifty percent of corporate financing originated in the U.S., and of the top 500 non-financial firms in the COMPUSTAT universe, 90 percent rely on syndicated loan financing (Weidner, 2000, and Sufi, 2007).

A syndicated loan is a private debt security that also has the features of a public debt, such as credit ratings and an active secondary market. The loan is a floating rate debt issue, priced at a specified interest rate spread above a reference rate, such as Prime, LIBOR and Certificate of Deposit; the loan is always a senior debt instrument. The syndicated loan is provided by a group of lenders and it is structured and managed by one or several banks known as arrangers (Standard & Poor's, 2007). While each of the syndicate lenders is responsible for only a portion of the total loan, the loan is governed by a common contract. The terms of the loan are identical for all members of the syndication; participants' unanimity is required to change the principal terms of the contract.

After the close of primary syndication, syndicated debt instruments can be traded on the secondary market. Loan sales are structured either as assignments or participations, with investors usually trading through loan trading desks at large underwriting banks. In a sale via assignment, the buyer becomes a direct signatory to the loan. In participation, the original lender remains the holder of the loan and the buyer is taking a participating interest in the existing lender's commitment (Standard & Poor's, 2007). The vast majority of loan sales in the secondary loan market are performed via assignment.

The secondary loan market expanded even faster than the primary market: from a trading volume of $8 billion in 1991, the secondary loan market has increased to a trading volume of $510 billion in 2008. Leveraged loans (loans rated below BBB- or Baa3 or unrated and priced at the spread equal to or higher than 150 basis points above LIBOR) represent the fastest growing part of the secondary loan market. Institutional investors, such as loan participation mutual funds (prime funds), Collateralized Loan Obligations (CLOs), hedge funds, pension funds and finance companies constitute the main secondary market participants.[13] Institutional investors are primarily attracted to the leveraged segment of the secondary loan market.

Prior research documents that syndicate lenders anticipate selling loans on the secondary market at the loan origination (Guner, 2006, and Drucker and Puri, 2009). This proposition is supported by our sample data because the vast majority of the traded loans become traded shortly after origination. 75 percent of traded loans become traded within three months of origination and 90 percent of the traded loans became traded within six months of origination.

The origination and ongoing maintenance of syndicated loans depends crucially on borrowers providing lenders with confidential information (e.g., Dennis and Mullineaux, 2000, and Sufi, 2007). The arranger and syndicate participants receive confidential information provided by the borrower, including timely financial disclosures, covenant compliance

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[13] Prime funds are mutual funds that invest in leveraged loans. The CLOs purchase assets subject to credit risk, such as syndicated loans, and securitize them as bonds of various degrees of creditworthiness.

information, amendment and waiver requests, financial projections, and plans for acquisitions or dispositions (Standard and Poor's, 2007). While this information is critical to evaluating a firm's financial health, it is usually either unavailable to outside investors or only becomes available after a considerable delay when a firm files with the SEC or issues a press release. Because syndicated loans are not considered securities and are thus not governed by the Securities Acts of 1933 and 1934 (LSTA, 2007, Chapter 2), informed lenders can trade on material non-public information.[14] This raises a concern that the lenders can exploit their privileged access to private information by originating and selling poor quality loans on the secondary loan market.

Loan Syndications and Trading Association's (LSTA) guidelines address this concern and suggest that market participants should trade in a manner consistent with the appropriate standards of professional integrity and fair dealing. In particular, an informed participant would be expected to offer to reveal syndicate confidential information to a counterparty, unless the informed participant reasonably believes that the counterparty has already been informed or the counterparty is sophisticated and understands the nature and importance of syndicate confidential information.[15] While this mechanism is expected to reduce the information advantage of the arranger of syndication, it is subject to two limitations.

First, investors on "the public side" may not be eligible to receive syndicate confidential information. More specifically, if an investor wants to retain the option to trade a borrower's public securities, he cannot receive material non-public information. Rule 10b-5 under the

[14] Information has been defined as "material" for purposes of U.S. securities laws in circumstances where: (i) there is a "substantial likelihood" that a "reasonable investor" would consider the information important in making an investment decision; (ii) the disclosure of the information would be "viewed by the reasonable investor as having significantly altered the 'total mix' of information made available;" or (iii) the disclosure of the information is "reasonably certain to have a substantial effect on the market price of the security." See LSTA (2007) for further discussion of material non-public information.

[15] Syndicate confidential information is nonpublic information which the borrower intends to disclose only to syndicate members and potential syndicate members. Potential syndicate members can receive syndicate confidential information upon compliance with the applicable confidentiality requirements.

Exchange Act prohibits the purchase or sale of a security on the basis of material nonpublic information about that security or its issuer, in breach of a duty of trust or confidence that is owed directly, indirectly, or derivatively to the issuer of that security, its shareholders, or any other person who is the source of the information. To retain an option to trade a borrower's public securities, some participants employ so-called "Chinese walls," designed so that the groups on "the private side" of the firm receive all confidential materials and agree not to trade in the public securities of the issuers for whom they receive private information nor to share this information with "the public side" of the firm. Another strategy commonly used by secondary market traders is to voluntarily keep the whole firm on "the public side" by agreeing not to receive any material non-public information provided by the borrower.[16] Because investors on "the public side" do not receive syndicate confidential information, lead arrangers have a considerable information advantage relative to these investors.

Second, soft information collected by the lead arranger in the process of screening and monitoring the borrower is not available to uninformed investors. Soft information, such as an assessment of a firm's management, is acquired by the lender through ongoing personal communication with the borrower. Soft information cannot be easily documentable or verified and therefore cannot be credibly communicated to a third party (Stein, 2002, and Berger et al., 2005). In addition, because soft information is costly to process, the arranger may have an incentive not to disclose such information in order to retain an informational advantage.

In this paper, by examining the performance of traded loans relative to non-traded loans, we provide evidence on whether lenders exploit their information advantage, leading to low quality loans being sold on the secondary market.

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[16] For example, information providers for loan deals now require investors to self-declare whether they are public or private investors before they gain access to loan documents. Investors who identify themselves as on the public side have access only to loan documents that the arranger deems appropriate for public investors (Sargent, 2005).

3. Implications of reputation and loan purpose for arrangers' incentives

As noted earlier, our objective is to investigate whether the secondary market trading of syndicated corporate loans compromises the quality of bank lending practices. To answer this question we empirically examine the extent to which traded loans underperform relative to non-traded loans. In addition, we also explore the possibility that the influence of secondary market trading on bank lending practices differs across particular subsets of loans due to variation in lenders' incentives to screen and monitor loans. We consider two fundamental partitioning variables. First, we examine whether the performance of traded loans relative to non-traded loans varies with the reputation of the lead arranger of syndication. Second, we examine whether the loan's restructuring purpose, as opposed to other purposes, affects the relative performance of traded versus non-traded loans.

Reputation of the arranger of syndication

The arranger negotiates the loan agreement, coordinates the documentation process, recruits loan participants and performs primary monitoring and enforcement responsibilities (Dennis and Mullineaux, 2000, and Lee and Mullineaux, 2004). The syndicate participants typically rely on information provided by the arranger (Jones et al., 2005). Gorton and Haubrich (1990) and Gorton and Pennacchi (1995) emphasize the importance of the bank's reputation. They show that reputation serves as an implicit guarantee in loan sales with no recourse, a common practice in the sale of syndicated loans.[17]

Highly reputable arrangers are large financial institutions with strong monitoring incentives, and extensive expertise and advanced technologies for monitoring borrowers. The

[17] These papers analyze the bilateral lender-borrower relationship and therefore refer to the reputation of the selling bank. In the syndicated market setting, where the arranger manages a number of syndicate lenders, we conjecture that the reputation of the arranger dominates the reputation of the other members of the syndication, including the seller, in a specific transaction. Rajan (1998) also suggests that buyers trust the selling bank in a secondary loan sale, because of the importance of maintaining the bank's reputation.

importance of the arranger’s reputation in monitoring the borrower and mitigating incentive problems is supported by evidence that more reputable arrangers are more likely to syndicate loans and are able to sell off a larger portion of a loan to the participants (Dennis and Mullineaux, 2000, Lee and Mullineaux, 2004, and Sufi, 2007). The literature interprets these findings as consistent with the proposition that the arranger’s status is a certification of the borrower’s financial conditions. A recent paper of Gopalan et al. (2009) shows that defaults by a lead arranger's borrowers adversely affect its subsequent lending activity, further motivating the importance of the arranger’s reputation. Thus, to the extent that secondary market trading creates a breakdown in arrangers’ incentives, it would seem more likely to occur in the subset of loans syndicated by lower reputation arrangers rather than those of the higher reputation arrangers. We examine this possibility by partitioning loans into two groups, higher reputation lead arrangers and lower reputation leads, and compare the performance of traded and non-traded loans within these partitions.

We consider a loan to be issued by a reputable arranger if it is syndicated by one of the top six arrangers, based on the arranger’s average market share in the primary syndicated loan market. The market share is measured by the ratio of the amount of loans that the financial intermediary syndicated as a lead arranger to the total amount of loans syndicated on the primary loan market over the research sample period from 1998 to 2006.

Restructuring purpose loans

We also partition loans on the basis of the purpose of the loan, differentiating between restructuring and non-restructuring loans, on the premise that any potential breakdowns in arrangers’ incentives would be more likely to occur for restructuring loans rather than for non-restructuring loans. In motivating this premise we note first that restructuring purpose loans -

loans with the primary purpose of takeover, LBO, MBO and recapitalization - generally involve high risk transactions related to substantial changes in a borrower's capital structure, and are thus associated with higher uncertainty regarding the borrower's future performance. Such higher uncertainty is likely to be associated with a significant information advantage for lead arrangers relative to outside investors, as a lead arranger has access to important private information. Compounding the issue, restructuring purpose loans generate arranger (upfront) fees of up to 2.5% of the total loan commitment, significantly higher than the fees paid for refinancing and general corporate purpose loans (Standard and Poor's, 2007). These higher loan origination fees in conjunction with the information advantage discussed above could present lenders' with a strong motive and fertile opportunities to originate and then sell low quality restructuring loans on the secondary loan market.

Finally, lending standards could also be adversely affected by the 2003-2007 boom in the LBO market. The majority of LBO transactions have been financed by syndicated loans; in recent years they typically comprised over 40% of the capital structure of large LBOs. This generated high institutional investor demand for these loans (Axelson et al., 2007, Ivashina and Kovner, 2008, Kaplan and Strömberg, 2008, and Ivashina and Sun, 2009).[18] A "hot market" for restructuring loans could induce a more severe breakdown in lenders' incentives to screen and monitor. Analogously, a decline in lending standards in the subprime mortgage market has been linked with the rapid expansion of this market. In particular, it has been documented that the standards declined more significantly in the areas that experienced larger subprime credit booms (Dell'Ariccia et al., 2008, and Keys et al., 2009).

[18] The increase in the institutional investor demand was translated into a significant decrease in the interest rate on leveraged buyout financing. The average All-in-drawn spread (spread paid over Libor) on LBO loans decreased from 375 basis points in 2001 to 250 basis points in 2007. In addition, at the peak of the LBO boom, it took fewer than 23 days for an LBO loan to be fully funded by institutional investors (Ivashina and Sun, 2009).

4. Sample, data and descriptive statistics

4.1. Data sources and sample selection

We use data from the Loan Trade Database (LTD) and the DealScan database, provided by the Loan Pricing Corporation (LPC). Since 1998, LTD has provided the indicative loan bid and ask price quotes on syndicated loans traded on the secondary loan market and, according to LPC, covers 80 percent of the trading volume of the secondary loan market in the U.S. The price quotes are reported to LPC by trading desks at institutions that make a market in these loans. Bid and ask prices are quoted as a percent of par and are aggregated across market makers. In addition to price coverage, the database provides the quote date and the number of market makers reporting indicative price quotes to LPC. DealScan covers a majority of the syndicated loan issues in the U.S. and provides a wide range of loan characteristics, such as interest rate, amount, maturity, seniority, purpose, covenants and syndicate structure.

We obtain firm characteristics from COMPUSTAT. Firms' senior debt ratings, watchlist additions and outlook changes (at the firm level) are retrieved from the S&P historical database. If the S&P historical database does not cover a particular firm, we retrieve the Moody's, Fitch or DPR senior debt rating from Mergent Fixed Income Securities Database (FISD).

Panel A of Table 1 summarizes the sample selection process of the traded syndicated loans employed in the analysis. By matching the LTD and the DealScan databases, we identify 7,350 traded loans over the period from June 1998 to December 2006. From this sample we eliminate loans to non-U.S. firms and those not issued in U.S. dollars. We subsequently match the sample borrowers with the COMPUSTAT database. Firstly, we merge the databases by tickers available on DealScan. To improve the identification, we manually match the rest of the sample firms with COMPUSTAT/CRSP by name, industry and state location. Finally, we eliminate facilities that lack sufficient loan- and firm-specific data. The remaining sample contains 2,811 facilities related to 924 borrowers (traded sample thereafter).

Panel B of Table 1 describes the selection of the non-traded syndicated loans used in our analysis. We motivate the choice of the non-traded sample by the following two considerations. First, 90 percent of the loans in the traded sample were syndicated starting in 1998. Second, the vast majority of the traded loans (75 percent) became traded within three months after origination. Therefore, the U.S. non-traded loans syndicated in the primary loan market over the period from 1998 to September 2006 are chosen as the most appropriate comparison group for the traded sample. We exclude from the analysis loans syndicated after September 2006 because the 2006 trading data may not be sufficient to correctly identify if these loans become traded on the secondary market.

For the period from 1998 to September 2006, DealScan reports 61,018 facilities outstanding to U.S. firms and issued in U.S. dollars. Merging this data with COMPUSTAT allows us to identify 22,332 facilities issued to public firms. Further excluding facilities with insufficient loan and firm data results in a sample of 10,627 facilities related to 2,173 borrowers (non-traded sample thereafter). The majority of the loans excluded due to insufficient data are related to the borrowers whose credit ratings are absent on both the S&P and FISD databases.

4.2. Descriptive Statistics

Panel A of Table 2 reports that traded loans have a median size of $220M and a median maturity of 67 months (detailed variable definitions are in Appendix A). 65 percent of the loans in the traded sample are syndicated by reputable arrangers; 48 percent are syndicated by a relationship lead arranger. In terms of loan purpose characteristics, 33 percent of the loans are issued with restructuring purposes, such as a takeover, LBO/MBO or recapitalization.

Institutional term loans represent 42 percent of the sample loans, consistent with the high involvement of institutional investors in loan trading (Yago and McCarty, 2004, and Standard & Poor's, 2007). 31 percent of the sample loans are revolvers. A typical sample loan is constrained by three financial covenants. The sample loans have, on average, 13 syndicate participants.

Firms in the traded sample are risky, with a mean and median S&P senior debt rating of BB-. 94 percent of the sample loans are issued to non-investment grade borrowers, consistent with the fact that leveraged loans represent the majority of loans traded on the secondary loan market (LSTA, 2007, and Wittenberg-Moerman, 2008). 10 percent of the sample loans are related to borrowers who are on the S&P negative watch list; 21 percent are related to borrowers with a negative outlook at the time of a loan origination.

Panel B presents summary statistics for the non-traded sample. Non-traded loans are characterized by a considerably shorter maturity than traded ones. The difference in loan maturity is likely to be driven by a large proportion of institutional loans in the traded sample; these loans have a significantly longer maturity relative to banking loans. 64 percent of the loans in the non-traded sample are syndicated by reputable arrangers and 53 percent are syndicated by a relationship lead arranger. Restructuring purpose loans represent 10.0 percent of non-traded facilities; their proportion in the traded sample is significantly higher. Only seven percent of the non-traded loans are institutional. Relative to the traded sample, a higher proportion of non-traded loans are revolvers (47 percent). Non-traded loans are also characterized by a smaller number of financial covenants and by a smaller number of lenders involved in the loan syndicate. On average, non-traded loans have a BBB- S&P senior debt rating.

Panels C and D provide the descriptive statistics for the subsamples based on arranger reputation. Loans syndicated by reputable arrangers are larger, have a shorter maturity, are more likely to be relationship loans and have a higher number of participants in the syndicate (which is likely to be driven by their larger size). As suggested by the *Interest-spread*, *Credit-rating* and *Speculative* variables, reputable arrangers' loans are issued to less risky borrowers relative to the borrowers of non-reputable arrangers' loans.

5. Empirical Results

5.1. Evolution of loan prices on the secondary loan market

Table 3 provides an analysis of how loan prices evolve on the secondary loan market from the initial trade transaction through the end of the third year subsequent to the year of the initial trade transaction. Panel A reports loan prices for periods of up to three years following the year of a loan's initial trade, while Panel B reports the distribution of changes in loan prices relative to a loan's average price over its first trading month. We exclude from this analysis (and all subsequent analyses) 109 loans that were distressed at the initial trading date (i.e., selling at less than 90 percent of par value).

Focusing first on the initial sale transaction (Row 1), we find that for the sample overall and across all partitions, loans initially trade at amounts that on average exceed 99 percent of par value. The absence of significant price discounting at initial sale suggests that the market does not interpret the act of selling a loan as evidence of enhanced moral hazard or adverse selection problems. Turning to the evolution of pricing after the initial sale, we see that for the total sample (Column 1), prices on average decline steeply over time. While loans initially sell at an average price of 99.22, by the end of the third year following initial sale loans are selling at an average price of 91.87. Note that this pervasive drop in loan prices cannot be attributed to the credit crisis. While our loan price data spans the period from June 1998 to December 2006, the crisis did not affect the syndicated loan market till mid-2007 (Ivashina and Scharfstein, 2009).

We find that the deteriorating price trend differs across subsamples. First, comparing the loans syndicated by reputable arrangers (Column 2) to the loans of the non-reputable arrangers (Column 3), we see that reputable arrangers' loans do not deteriorate as dramatically as do non-reputable arrangers' loans. While both initially trade at close to par, by the third year, loans issued by reputable arrangers trade at 93.01, while those with low reputation arrangers trade at 90.43. These prices are statistically different, as are the loan prices across these groups in both the first and second years subsequent to the initial trade. In Columns 5 and 6, we also document that restructuring loans deteriorate more dramatically than do other loan types.

Panel B provides a different view of the price evolution, but tells the same basic story as Panel A. For example, we see in Columns 4 and 5 that by the third year subsequent to the initial loan sale, 59.5 (38.8) percent of the loans of reputable arrangers experienced a decline (increase) in price versus 66.4 (30.2) percent of the loans of less reputable arrangers. Similarly, 61.0 (29.7) percent of restructuring purpose loans decline (appreciate) in value (Column 6) versus 57.6 (41.3) percent of non-restructuring loans (Column 7).

We perform two additional tests to verify the stability of these results. First, to verify that the reputation and restructuring effects do not subsume each other, we examine the evolution of loan prices for restructuring purpose loans across reputable and non-reputable arrangers. We find that when the loan sample is restricted to restructuring loans, loans issued by reputable arrangers continue to significantly outperform other loans starting from the first year after the initial loan sale (results are untabulated). Further, we find that restructuring purpose loans issued by non-reputable arrangers experience the weakest performance. By the end of the third year following the initial sale these loans trade at the average price of 89.60, which indicates that the majority of the restructuring purpose loans of non-reputable arrangers become distressed (i.e., selling at less than 90 percent of par value).

Second, we address the possibility that the observed price trend is driven by changes in the loan sample over time; while the loan price at sale is estimated for the sample of 2,702 facilities, the loan price in the third year following the initial sale is based on 728 facilities. When we restrict the sample to the 715 loans whose prices are available at each point in time that we examine, all inferences remain the same. In addition, our main findings remain unchanged when we perform an analysis separately for loans issued over the 1998-2003 and 2004-2006 periods.

To summarize, we find that on average prices of traded loans decrease subsequent to their initial trading date, and further, loans originated by reputable lead arrangers deteriorate significantly less than those issued by less reputable arrangers, while loans issued to support corporate restructuring deteriorate significantly more than loans issued for other purposes. While this pattern of deterioration in secondary loan prices is perhaps suggestive of loan sales adversely affecting lead arrangers' incentives, such a conclusion can only be made after directly comparing the performance of traded loans to that of non-traded loans. We address this next by conducting a series of analyses comparing the performance of traded loans to non-traded loans, controlling for a wide range of loan- and borrower-specific characteristics observable at the time of a loan's origination and sale. Because prices only exist for traded loans, we measure performance by accounting measures of performance and credit ratings.

5.2. Changes in a firm's accounting performance following a loan's sale or issuance

5.2.1. Comparative analysis of borrower profitability across traded and non-traded loans

Table 4 presents an analysis of changes in a firm's performance following a loan sale (for the traded sample) or loan issuance (for the non-traded sample). For traded syndicated loans, the initial trading event typically occurs within one to three months of loan origination in the primary market. It is for this reason we choose to compare the performance of traded loans after the initial trading event against the performance of non-traded loans following loan origination.

The general message of Panel A is that, for reputable arrangers, traded loans appear to perform *better*, if anything, relative to non-traded loans based on profitability measure. For the traded loans of reputable arrangers, mean profitability for the three years before the initial loan sale (Column 4) is indistinguishable from mean profitability for the three years after (Column 5), although we do see a drop in profitability for the non-traded loans of reputable arrangers (Column 9). In contrast, for non-reputable arrangers non-traded loans appear to perform better. Restructuring loans perform poorly in both the traded and non-traded samples.[19]

In Panel B, we examine the behavior of abnormal accounting accruals around the initial trading event, or around loan origination for non-traded loans. Our objective is to see if there is evidence of earnings management or aggressive accounting behavior more generally by borrowers in the period leading up to loan origination or trading. Such behavior would be characterized by positive (income increasing) abnormal accruals in the period prior to initial trading or origination, followed by negative abnormal accruals in the post period. For reputable arrangers, we find no evidence of extreme reversals of abnormal accruals for the borrowers of either traded or untraded loans. However, we find that in the three year period prior to the year of a loan sale, the borrowers related to the traded loans of non-reputable arrangers show, on average, significantly positive abnormal accruals (Column 4), while after the loan sale the abnormal accruals turn, on average, significantly negative (Column 5). This accruals reversal

[19]Because of COMPUSTAT data availability, we restrict the accounting performance analysis to loans initially sold/issued over the 1998-2004 period. For these loans, we have financial statement data for the three year period following the year of a loan's initial sale or issuance. To maintain consistency across empirical tests, we impose the same restriction when performing the credit quality analysis (see Section 5.3).

represents 1.7% of total assets and is statistically significant. No such reversal in accruals exists for the non-traded loans issued by non-reputable arrangers. This result suggests a breakdown in due diligence by non-reputable arrangers on loans anticipated to be sold, as the borrowers on these loans appear to engage in aggressive income-increasing accounting reporting in the period leading up to loan origination and trading.[20]

To extend the comparative analysis between the traded and non-traded sample, we examine the distribution of changes in a firm's profitability (Table 5). For traded loans, we measure the change in profitability over the three year period following the year of a loan sale relative to the three year period prior to that year. For non-traded loans, we estimate the change in profitability over the three year period following the year of the loan issuance relative to the three year period prior to that year. To perform this analysis, we restrict both the traded and non-traded samples to speculative loans, which represent the vast majority (94%) of traded loans. For traded loans, we find that the performance of borrowers related to loans of reputable arrangers is significantly better following the initial sale than the performance of borrowers related to loans of non-reputable arrangers (Panel A). For reputable arrangers, the borrowers experience a decrease (increase) in the ratio of EBITDA to total assets in 44.6 (55.4) percent of the cases, while for non-reputable arrangers, the decrease (increase) in profitability characterizes 56.3 (43.7) percent of the cases. No differences exist between these two groups for non-traded loans (Panel B). Consistent with prior analysis, borrowers associated with restructuring loans underperform relative to borrowers of other loan types, both for the traded and non-traded sample.

Comparing traded loans to non-traded loans, we find that for reputable arrangers the borrowers of traded loans actually perform better than the borrowers of non-traded loans (Panel

[20] Abnormal accruals can also capture abnormally positive operating performance that quickly mean-reverts in subsequent periods. However, this interpretation of abnormal accruals tests' results is also consistent with a breakdown in due diligence by non-reputable arrangers on loans anticipated to be sold.

C). For the borrowers of restructuring loans, there is no difference in performance across traded and non-traded loans, suggesting that secondary trading is not the main driver of poor performance of restructuring purpose loans.

5.2.2. Regression analysis

In Table 6, Panel A we present a regression analysis of the changes in borrower performance. We regress an indicator variable reflecting whether a firm has experienced a decrease in the average profitability over the three year period following the year of a loan's initial sale or issuance relative to the average profitability over the three year period prior to the year of a loan's initial sale or issuance, respectively, on a set of loan- and firm-specific characteristics (Columns 1-3). As an alternative measure of a borrower's performance, we examine changes in the interest coverage ratio (Columns 4-6). The importance of this ratio for lenders is exemplified by the fact that the interest coverage ratio is one of the most commonly used covenants in syndicated loan contracts. In particular, more than 90 percent of traded loans are subject to the interest coverage covenant.

We perform separate analyses for the traded and non-traded samples and for the pooled sample of loans, including both traded and non-traded loans. Our main variables of interest are *Reputable-arranger*, *Purpose-restructuring* and *Traded*. As noted above in the discussion of descriptive statistics in Table 2, there are differences in loan and firm characteristics across traded and non-traded loan subsamples (Panels A and B), and across reputable and non-reputable arranger subsamples (Panels C and D). It is thus important to control for these loan and firm characteristics to address the possibility that these characteristics are associated with changes in a borrower's performance.

In particular, we control for the loan's risk by including the borrower's credit rating, the interest spread on the loan at origination, an indicator variable reflecting whether a loan is institutional, and the number of lenders in the loan syndicate. Institutional loans are typically more risky and are characterized by a longer maturity and a back-end-loaded repayment schedule relative to the amortizing term loans issued by banks (Yago and McCarthy, 2004). A higher number of syndicate participants is typically associated with a higher transparency and a lower probability of borrower default (Sufi, 2007). Note that including the interest spread variable in the regression controls not only for a borrower's riskiness, but also for the pricing at loan origination of a borrower's expected performance.

We also control for the efficiency of ex-post monitoring of the borrower; we expect more efficient lenders' monitoring to be associated with a borrower's better future performance. In this respect, we include in the analysis the number of financial covenants imposed by the loan agreement and an indicator variable reflecting whether the loan is issued by a relationship lender. Financial covenants allow lenders to perform efficient monitoring of a borrower and are especially important for the monitoring of traded loans (Drucker and Puri, 2009, and Wittenberg-Moerman, 2009). However, because lenders impose more extensive covenants when a borrower is risky and informationally opaque (Bradley and Roberts, 2004, and Standard & Poor's, 2007), we cannot predict the sign of the coefficient on the financial covenants variable. Relationship lenders have previously transacted with the firm, and thus have extensive knowledge of the firm's operations as well as well-developed channels of communication with the firm's managers (Sufi, 2007, and Bharath et al., 2009), which should facilitate borrower monitoring.

It is important to note that we control in the regression analysis for all the main determinants of a loan's probability to be traded, as suggested by prior research. Drucker and

Puri (2009) and Wittenberg-Moerman (2009) find that loan riskiness, the number of covenants in a loan contract, the number of syndicate participants, the lead arranger's reputation, whether a loan has a restructuring purpose, whether it is institutional, and whether it is issued by a relationship lender are the primary characteristics associated with secondary loan trading.[21] In Section 5.4, we present alternative specifications to show that our results are robust to the selection issue between traded and non-traded loans.

We also include in the analysis a measure of a borrower's past profitability and an indicator variable reflecting whether a borrower has experienced losses prior to a loan's sale or issuance. While more profitable firms are more likely to continue performing well, the mean-reverting nature of earnings must be considered (e.g., Freeman et al., 1982, and Easton & Zmijewski, 1989). Further, we control for abnormal accruals in the period preceding loan origination and sale because the analysis in Table 4, Panel B suggests that positive abnormal accruals are strongly related to deterioration in a borrower's future profitability. Because of the differences in firm size across the different loan subsamples that we examine, we include this variable in the analysis.[22] Finally, to control for time-varying effects, we include year fixed effects.

Table 6 documents that for traded loans the probability of a future decrease in a borrower's performance is significantly lower for loans issued by reputable lead arrangers. This result holds both for the profitability and interest coverage performance measures. The reputation effect is also economically significant. Having a reputable arranger decreases the probability of a future decrease in a borrower's profitability (interest coverage ratio) by 12 (7) percent, which represents 24 (14) percent of the average probability that a borrower's profitability (interest coverage) will

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[21] Traded loans also have a longer maturity and are less likely to be revolvers. We find that these variables are insignificantly related to changes in a borrower's accounting performance and credit quality.

[22] A high correlation between borrower size and loan size prevents the simultaneous incorporation of both variables in the regression. The analysis incorporating loan size instead of firm size provides almost identical results.

deteriorate after the sale. For the non-traded loans, we find a less considerable reputation effect. Having a reputable arranger decreases the probability of a decrease in a borrower's profitability by 6 percent and does not affect the change in a borrower's interest coverage ratio.[23]

Consistent with the univariate analysis, we find that positive abnormal accruals in the three year period prior to a loan sale are strongly associated with future deterioration in a borrower's performance. This result further emphasizes the importance of the arranger's reputation, because non-reputable arrangers tend to sell the loans of borrowers who experience high positive abnormal accruals in the three years prior to a loan sale.

With regard to loan purpose, borrowers with restructuring purpose loans experience a significantly higher probability of a future decrease in the performance for both traded and non-traded loans. Economically, restructuring purpose loans are associated with a 7 (14) percent increase in the probability of deteriorating profitability (interest coverage ratio) after the sale for the traded loans; the effects for non-traded loans are almost identical. This evidence indicates that the poor quality of restructuring loans cannot be explained by loan sales' effect on the lenders' incentives to screen and monitor these loans.

For the total sample of traded and non-traded loans, for both performance measures used in the analysis, we find a negative and significant coefficient on the *Traded* variable. This result demonstrates that, controlling for borrower and loan characteristics, traded loans do not

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[23]Plausible reasons for the greater impact of reputation on the performance of traded relative to non-traded loans derive from the potential increase in the number of institutional syndicate participants after a loan becomes traded. Ivashina and Sun (2009), who explicitly examine changes in the syndicate structure based on loan renegotiation records, find that the number of institutional investors significantly increases as a result of a secondary market trading, with the size of an average syndicate increasing by 40%. A larger syndicate investor base can exacerbate the reputation losses associated with deterioration in a borrower's performance, as these investors will be wary of participating in subsequent deals syndicated by the arranger. While syndicate participants who join the syndicate in the primary market also rely on the arranger's due diligence, these participants' dependence on the arranger is likely to be less than it is for investors who join the syndicate via the secondary market as the former often have a prior relationship with the borrower, particularly if the borrower is informationally opaque (Sufi, 2007).

underperform non-traded loans. In fact, traded loans appear to have a lower probability of poor future accounting performance.

To further explore this finding, we examine the changes in borrower performance for the two subsamples based on the arranger reputation (Table 6, Panel B). As noted earlier, we control for differences in the observable loan and firm characteristics across reputable and non-reputable arranger subsamples, as documented in Panels C and D of Table 2. We find that the better accounting performance of traded loans that we document is due to the loans issued by reputable arrangers. For reputable arrangers, the probability that a borrower's future performance deteriorates is significantly smaller for traded than for non-traded loans. Economically, traded loans experience a 7.6 (8.3) percent smaller probability of a future decrease in a borrower's profitability (interest coverage), which represents 13 (17) percent of the average probability that a borrower's profitability (interest coverage) will deteriorate after the sale. This evidence indicates that loan sales have a positive effect on reputable arrangers' incentives to monitor and screen, leading to higher quality loans being sold to uninformed investors on the secondary market. Our inferences represent an important contrast to those of Berndt and Gupta (2009), who conclude that loan trading is unequivocally bad news for the future performance of a firm.

5.3. Changes in a firm's credit quality following a loan's sale or issuance

As an additional approach to measuring firm performance, we examine the changes in a borrower's credit quality following a loan's sale or issuance. For traded loans, we measure the change in a borrower's credit rating over the three year period following the year of a loan's initial sale relative to the credit rating at a loan's sale. For the non-traded loans, we estimate the change in a borrower's credit rating over the three year period following the year of the loan issuance relative to the credit rating at a loan's issuance.

Panel A of Table 7 reiterates the fact that the performance of borrowers related to the loans of reputable arrangers is significantly better than the performance of borrowers related to loans of non-reputable arrangers. In the third year following the year of a loan's initial sale, for reputable arrangers, the borrowers experience deteriorating (improving) credit ratings in 35.5 (30.4) percent of cases, while for non-reputable arrangers, the deteriorating (improving) credit ratings characterize 45.6 (25.9) percent of cases; these distributions are statistically different from each other. Further, we show that for non-reputable arrangers, the borrowers of traded loans significantly underperform relative to the borrowers of non-traded loans (Panel C).

Next, we examine whether our inferences hold when we control for loan- and borrower-specific characteristics that are likely to explain changes in a borrower's credit quality. We regress an indicator variable reflecting whether a firm has experienced a decrease in credit quality in the third year following the year of a loan's issuance or sale relative to a credit rating at the loan's initial sale or issuance, respectively, on the *Reputable-arranger, Purpose-restructuring* and *Traded* variables and a set of controls (Table 8). As in the accounting performance analysis, we control for a loan's riskiness and the efficiency of the ex-post monitoring of the borrower. In addition, we include variables reflecting whether a borrower was on the watchlist and outlook at the time of a loan's origination or initial trade.

Consistent with our inferences based on accounting measures of a borrower's performance, we find that for traded loans the probability of a future decrease in a borrower's credit quality is significantly lower for loans issued by reputable lead arrangers. In terms of economic significance, having a reputable arranger decreases the probability of a future deterioration in a borrower's credit rating by 6 percent, which represents 15 percent of the average probability that a borrower's credit rating will decrease after the sale. In contrast, no difference exists between loans issued by reputable versus non-reputable arrangers for non-traded loans, further emphasizing that the reputation effect is more significant for traded loans. With respect to restructuring purpose loans, controlling for borrower characteristics, we do not find that they underperform in terms of credit quality relative to other loans.

Another key analysis presented in Table 8 is the comparison between traded and non-traded loans. First, we find that the coefficient on the *Traded* variable is insignificant for the total sample of loans. Second, we examine the effect of loan trading separately for the loans issued by reputable and non-reputable arrangers. While we find that loan trading does not affect changes in the credit quality of borrowers related to reputable arrangers, we find that it adversely affects borrowers related to non-reputable arrangers. This evidence further demonstrates that reputation is a powerful mechanism in the secondary loan market.

5.4. Robustness tests

Selection issue

We further consider the selection issue between traded and non-traded loans. In our multi-variate analyses above (Tables 6 and 8) we address this issue by including in the regressions control variables that have been suggested by prior research as the primary characteristics of traded loans (Drucker and Puri, 2009, and Wittenberg-Moerman, 2009). In Table 9, we present the results from applying the "Heckman" selection model (Heckman, 1979). That is, we include in the profitability and credit rating regressions the inverse Mills ratio derived from a first stage estimation of the trade probability model. Panel A of Table 9 presents the estimation of the trade probability model; the results are consistent with those reported by prior studies.[24] As shown in

[24] Note that Panel A presents the trade probability model for the total sample of loans employed in the profitability test (Column 1 of Panel B). To obtain the inverse Mills ratio, the trade probability model was re-estimated for each of the models presented in Panel B. The decrease in the number of observations in Panel B relative to Tables 6 and 8

Panel B of Table 9, all of our results are robust to the inclusion of the inverse Mills ratio. In the untabulated analysis we perform the same analysis for the interest coverage regressions; all inferences remain the same.

Other robustness issues

We conduct a number of additional tests to verify the stability of our results. First, we address a concern that the arranger reputation effect is potentially explained by the loan fraction held by the arranger. If for traded loans, reputable arrangers keep a higher loan proportion than non-reputable arrangers do, the arranger's incentives to screen and monitor a borrower are likely to be driven by its higher loan exposure. In contrast to this proposition, we find that reputable arrangers keep a significantly smaller loan proportion than non-reputable arrangers do: reputable arrangers on average keep 31.1 percent of a loan, while non-reputable ones keep 38.5 percent (arranger proportion data is available for 18 percent of the loans in the traded sample). The significantly smaller proportion of a loan kept by reputable arrangers that we observe for our traded sample is consistent with Sufi's (2007) finding for the general syndicated loans sample.

Second, we explore whether reputable arrangers tend to hold a revolving facility of the borrower, while selling its institutional loans. Revolvers typically require more extensive monitoring of a borrower (Berger and Udell, 1995). We do not find that arrangers' holding of a non-traded revolving facility explains why the traded loans of reputable arrangers outperform the traded loans of non-reputable arrangers (results are untabulated). Third, we examine whether the reputation effect can be attributed, at least partially, to the relationship between the arranger and syndicate participants. If syndicate participants repeatedly transact with the arranger, the arranger is incentivized to efficiently screen and monitor a borrower to motivate the participants to invest

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is explained by the exclusion from the analysis loans missing maturity data, which is required for the trade probability model's estimation.

in the future deals it syndicates. Following Ivashina (2009), to measure arranger-participant relationships, for every syndicate participant, we estimate the number of previous relationships between the lead arranger and that participant over the five year period preceding the loan's issuance, relative to the total number of deals syndicated by the arranger during this period. Then, we average this relationship measure across all syndicate participants. We find that when the arranger-participant relationship variable is incorporated into the regression analysis, it does not affect changes in a borrower's performance, for either accounting-based or credit quality performance measures (results are untabulated).

Fourth, we repeat all the regression tests when we limit the non-traded sample to the loans of borrowers who do not have any traded loans during our sample period. For this purpose, we exclude 1,709 loans from the non-traded sample. The main variables of interest have similar statistical and economic significance to our primary specifications, and all inferences remain the same (untabulated). Fifth, to ensure that the credit crisis does not affect the empirical findings, we exclude from the analysis loans issued starting in 2004. For these loans, the three year period following the year of a loan's sale or issuance includes the year 2007; in 2007, borrowers' performance could be adversely affected by the credit crisis and the economic downturn. Our results are not sensitive to the exclusion of these loans.

Finally, for accounting performance tests, we examine whether our findings are sensitive to how we measure accounting performance. More specifically, in the profitability regressions, we use as a dependent variable the ratio of EBITDA to total assets in the three year period following loan sale or issuance instead of the indicator variable reflecting a change in the EBITDA ratio. Analogously, in the interest coverage regression, we use as a dependent variable the interest coverage ratio in the three year period following the loan sale or issuance. Our main findings and conclusions remain unchanged both for the traded and non-traded samples (untabulated).

6. Conclusions

The financial crisis that started in 2007 has re-energized debate over the extent to which the "originate-to-distribute" model of bank credit leads to breakdowns in bank lending practices. In this paper, we provide an analysis of performance outcomes associated with one important class of originate-to-distribute transactions, namely, syndicated loans. In particular, we examine whether loans that are originated in the primary market and ultimately traded in the secondary market perform worse than loans that are not traded. We also investigate to what extent the reputation of a loan's lead arranger is associated with the performance of traded loans relative to non-traded loans, or whether the restructuring purpose of the loan impacts relative performance.

We find that for loans originated by the reputable lead arrangers, the borrowers of traded loans actually perform better after the initial trading event than do borrowers of non-traded loans after origination. With respect to loans originated by lower reputation lead arrangers, we find that in terms of profitability and interest coverage measures, borrowers of traded loans do not underperform relative to borrowers of non-traded loans, but that they exhibit a weaker performance in terms of credit quality. For non-reputable arrangers we also find evidence of earnings management via abnormal accruals for the traded loan sample. In addition, we find that loans with the primary purpose of takeover, LBO, MBO or recapitalization perform worse relative to other loans, regardless of whether they are traded. Overall, we find that secondary loan market trading does not have an unequivocally adverse effect on lenders' incentives to ex-ante screen loans and monitor them ex-post. We also show that reputation is a powerful mechanism in mitigating the incentives problems generated by loan sales.

Appendix A: Variable definitions

Variables	Description
Abnormal-accruals	Abnormal accruals estimated by the modified Jones (1991) model, adjusted for the incorporation of the negative cash flow indicator variable (Ball and Shivakumar, 2006): $ACC_{it} = \alpha_0 + \alpha_1 CFO_{it} + \alpha_2 \Delta REV_{it} + \alpha_3 PPE_{it} + \alpha_4 DCFO_{it} + \alpha_5 DCFO_{it} * CFO_{it}$. The model is estimated for each 3-digit industry and provides the corresponding inputs for calculating the normal level of accruals for each borrower:. $NACC_{it} = \hat{\alpha}_0 + \hat{\alpha}_1 CFO_{it} + \hat{\alpha}_2 (\Delta REV_{it} - \Delta AR_{it}) + \hat{\alpha}_3 PPE_{it} + \hat{\alpha}_4 DCFO_{it} + \hat{\alpha}_5 DCFO_{it} * CFO_{it}$ .The abnormal accruals are computed by the difference between actual and normal accruals levels. The definitions of the variables are as follows. CFO_{it} is cash flow from operations of firm *i* in year *t*. $DCFO_{it}$ is an indicator variable taking the value of one if the firm's contemporaneous cash flow from operations is negative, zero otherwise. ACC_{it} is the accruals of firm *i* in year *t*, measured as earnings before extraordinary items less cash flow from operations. $\Delta \mathrm{Re}\, v_{it\ t}$ is a change in revenue of firm *i* in year *t:* $REV_{it} - REV_{i(t-1)}$. PPE_{it} is the gross property, plant and equipment of firm *i* in year *t*. ΔAR_{it} is the change in accounts receivable of firm *i* in year *t*: $AR_{it} - AR_{i(t-1)}$. All the variables (except the intercept and the indicator variable) are standardized by the average total assets.
Abnormal-accruals-mean	Traded sample: a borrower's average abnormal accruals over the three year period prior to the year of a loan's initial sale. Non-traded sample: a borrower's average abnormal accruals over the three year period prior to the year of a loan's issuance.
Credit-rating	The numerical equivalent of the senior debt rating. It is set as equal to one if the S&P senior debt rating is AAA, through 25 when the S&P senior debt rating is D. For firms not rated by S&P, we assign the Moody's senior debt rating, converted to an equivalent S&P rating. For firms not rated by S&P or Moody's, we assign the Fitch or DPR senior debt rating, converted to an equivalent S&P rating.
Covenant-financial	The number of financial covenants imposed by the loan agreement.
Facility-size	A loan's amount in millions.
Firm-size	Traded: a logarithm of the borrower's total assets in the year prior to the year of a loan's initial sale. Non-traded sample: a logarithm of the borrower's total assets in the year prior to a loan's issuance year.
Interest-coverage	Traded sample: the ratio of EBITDA to interest expense in the year prior to the year of a loan's initial sale. Non-traded sample: the ratio of EBITDA to interest expense in the year prior to a loan's issuance year.
Interest-coverage-mean	Traded sample: a borrower's average ratio of EBITDA to interest expense over the three year period prior to the year of a loan's initial sale. Non-traded sample: a borrower's average ratio of EBITDA to interest expense over the three year period prior to a loan's issuance year.
Interest-coverage-decrease	Traded sample: An indicator variable taking the value of one if a borrower has experienced a decrease in the average interest coverage ratio (the ratio of EBITDA to interest expense) over the three-year period following the year of a loan's initial sale relative to the average interest coverage ratio over the three year period prior to the year of a loan's initial sale, zero otherwise. Non-traded sample: An indicator variable taking the value of one if a borrower has experienced a decrease in the average interest coverage ratio over the three-year period following the year of a loan's issuance relative to the average interest coverage ratio over the three year period prior to the year of a loan's issuance, zero otherwise.
Interest-spread	The interest spread is based on the All-In-Drawn-Spread measure reported by DealScan. This measure is equal to the amount the borrower pays in basis points over LIBOR for each dollar drawn down, so it accounts for both the spread of the loan and the annual fee paid to the bank group. LPC always uses the LIBOR spread or the LIBOR-equivalent spread option to calculate the All-In-Drawn spread.

Variables	Description
Institutional	An indicator variable taking the value of one if the loan's type is term loan B, C or D (institutional term loans), zero otherwise.
Leverage	Traded sample: the ratio of the long-term debt to total assets in the year prior to the year of a loan's initial sale. Non-traded sample: the ratio of the long-term debt to total assets in the year prior to a loan's issuance year.
Loss-mean	Traded sample: An indicator variable taking the value of one if a borrower's average EBITDA over the three year period prior to the year of a loan's initial sale is negative, zero otherwise. Non-traded sample: An indicator variable taking the value of one if a borrower's average EBITDA over the three year period prior to the year of a loan's issuance is negative, zero otherwise.
Market-book	Traded sample: the ratio of the firm's market value to book value of common equity in the year prior to the year of a loan's initial sale. Non-traded sample: the ratio of the firm's market value to book value of common equity in the year prior to a loan's issuance year.
Maturity	The number of months between the loan's issue date and the date when the loan matures.
Number-of-lenders	Number of participants in the loan syndicate, including the arranger.
Outlook-negative	Traded sample: An indicator variable that takes the value of one if a borrower has a negative S&P outlook at the time of a loan's initial sale, zero otherwise. Non-traded sample: An indicator variable that takes the value of one if a borrower has a negative S&P outlook at the time of a loan origination, zero otherwise.
Outlook-positive	Traded sample: An indicator variable that takes the value of one if a borrower has a positive S&P outlook at the time of a loan's initial sale, zero otherwise. Non-traded sample: An indicator variable that takes the value of one if a borrower has a positive S&P outlook at the time of a loan's origination, zero otherwise.
Price	A loan's price on the secondary loan market. According to secondary loan market convention, loan price is measured by the loan bid price in the secondary trade.
Profitability	Traded sample: the ratio of EBITDA to total assets in the year prior to the year of a loan's initial sale. Non-traded sample: the ratio of EBITDA to total assets in the year prior to a loan's issuance year.
Profitability-mean	Traded sample: a borrower's average ratio of EBITDA to total assets over the three year period prior to the year of a loan's initial sale. Non-traded sample: a borrower's average ratio of EBITDA to total assets over the three year period prior to the year of a loan's issuance.
Profitability-decrease	Traded sample: An indicator variable taking the value of one if a borrower has experienced a decrease in the average profitability (the ratio of EBITDA to total assets) over the three-year period following the year of a loan's initial sale relative to the average profitability over the three year period prior to the year of a loan's initial sale, zero otherwise. Non-traded sample: An indicator variable taking the value of one if a borrower has experienced a decrease in the average profitability over the three-year period following the year of a loan's issuance relative to the average profitability over the three year period prior to the year of a loan's issuance, zero otherwise.
Purpose-restructuring	An indicator variable taking the value of one if the loan's primary purpose is takeover, LBO, MBO or recapitalization, zero otherwise. A loan with a primary purpose of recapitalization is a loan to support a material change in a firm's capital structure, often made in conjunction with other debt or equity offerings.
Rating-decrease	Traded sample: An indicator variable taking the value of one if a borrower has experienced a decrease in its credit rating in the third year following the year of a loan's initial sale relative to a credit rating at the loan's initial sale, zero otherwise. Non-traded sample: An indicator variable taking the value of one if a borrower has experienced a decrease in its credit rating in the third year following a loan's issuance relative to a credit rating at the loan's issuance, zero otherwise.

Variables	Description
Relationship-lending	An indicator variable taking the value of one if at least one of the loan's lead arrangers had been a lead arranger of the borrower's previous loans over the five year period preceding the loan's issuance date, zero otherwise.
Reputable-arranger	An indicator variable taking the value of one if the loan is syndicated by one of the top six arrangers, based on the arranger's average market share in the primary loan market. The market share is measured by the ratio of the amount of loans that the financial intermediary syndicated as a lead arranger to the total amount of loans syndicated on the primary loan market over the period from 1998 to 2006. In the case of multiple arrangers, we consider the highest market share across the arrangers involved in the loan transaction.
Revolver	An indicator variable taking the value of one if a loan's type is revolver, zero otherwise.
Speculative	An indicator variable taking the value of one if a borrower's credit rating is BBB- or below, zero otherwise.
Traded	An indicator variable taking the value of one if a loan is traded on the secondary loan market, zero otherwise.
Watch-negative	Traded sample: An indicator variable that takes the value of one if a borrower is on the S&P negative watch list at the time of a loan's initial sale, zero otherwise. Non-traded sample: An indicator variable that takes the value of one if a borrower is on the S&P negative watch list at the time of a loan origination, zero otherwise.
Watch-positive	Traded sample: An indicator variable that takes the value of one if a borrower is on the S&P positive watch list at the time of a loan's initial sale, zero otherwise. Non-traded sample: An indicator variable that takes the value of one if a borrower is on the S&P positive watch list at the time of a loan origination, zero otherwise.

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Table 1: Sample selection process

This table summarizes the sample selection process. Panel A presents the sample selection process of the traded sample. Panel B presents the sample selection process of the non-traded sample.

Panel A: Traded sample

Filters	Facilities Number	Facilities Percent
Total traded facilities	8,778	100.0
Intersection with the DealScan database	7,350	83.7
After elimination of facilities to non-U.S. firms and/or facilities issued in foreign currencies	6,614	75.3
Intersection with COMPUSTAT	3,186	44.9
After elimination of facilities with missing data	2,811	32.0

Panel B: Non-traded sample

Filters	Facilities Number	Facilities Percent
Syndicated loans to U.S. borrowers, in U.S. dollars, issued over the period from 1998 to September 2006	61,018	100.0
Intersection with COMPUSTAT	22,332	36.6
After elimination of 3,186 traded facilities	19,146	31.4
After elimination of facilities with missing data	10,627	17.4

Table 2: Descriptive statistics

This table provides descriptive statistics (see Table 1 for sample selection procedure). Panels A and B describe the characteristics of the traded and non-traded samples, respectively. Panels C and D describe the characteristics of the reputable-arranger and non-reputable-arranger samples, respectively. Variables are defined in Appendix A.

Panel A: Traded sample

Loan and Firm Characteristics	Number of observations	Mean	SD	Distribution 25%	50%	75%
Loan characteristics:						
Facility-size (in millions)	2,811	445.62	946.7	100.0	220.0	470.0
Maturity	2,761	64.65	22.07	59.00	67.00	83.00
Reputable-arranger	2,811	0.65				
Relationship-lending	2,726	0.48				
Purpose-restructuring	2,811	0.33				
Institutional	2,811	0.42				
Revolver	2,811	0.31				
Number-of-covenants	2,811	2.73	1.68	2.00	3.00	4.00
Number-of-lenders	2,811	12.83	14.01	5.00	9.00	16.00
Interest-spread	2,683	265.5	121.7	200.0	250.00	325.0
Credit risk characteristics:						
Credit-rating	2,811	13.39	2.83	12.00	13.00	14.00
Speculative	2,811	0.94				
Watch-negative (Watch-positive)	2,811	0.10 (0.05)				
Outlook-negative (Outlook-positive)	2,811	0.21 (0.09)				
Additional firm characteristics:						
Firm size (in millions)	2,709	6,122	21,250	684.5	1,485	4 ,248
Market-book	1,773	4.61	10.48	1.33	2.13	3.57
Leverage	2,707	0.48	0.31	0.28	0.45	0.61
Profitability	2,609	0.12	0.11	0.08	0.11	0.16
Interest-coverage	2,577	6.41	14.41	1.76	2.80	5.02

Panel B: Non-traded sample

Loan and Firm Characteristics	Number of observations	Mean	SD	Distribution 25%	50%	75%
Loan characteristics:						
Facility-size (in millions)	10,627	492.5	953.5	100.0	250.0	500.0
Maturity	9,975	42.76	30.78	12.00	36.00	60.00
Reputable-arranger	10,627	0.64				
Relationship-lending	10,600	0.53				
Purpose-restructuring	10,627	0.10				
Institutional	10,627	0.07				
Revolver	10,627	0.47				
Number-of-covenants	10,627	1.33	1.57	0.00	1.00	2.00
Number-of-lenders	10,627	9.46	8.83	3.00	7.00	13.00
Interest-spread	9,191	153.3	136.9	50.0	112.5	225.0
Credit risk characteristics:						
Credit-rating	10,627	10.64	4.34	8.00	10.00	14.00
Speculative	10,627	0.55				
Watch-negative (Watch-positive)	10,627	0.08 (0.03)				
Outlook-negative (Outlook-positive)	10,627	0.14 (0.06)				
Additional firm characteristics:						
Firm size (in millions)	10,437	17,447	58,674	895.3	2,635	10 ,026
Market-book	8,472	3.23	3.98	1.42	2.11	3.40
Leverage	10,435	0.34	0.24	0.17	0.30	0.45
Profitability	9,924	0.12	0.09	0.08	0.12	0.16
Interest-coverage	9,712	8.88	15.01	2.39	4.52	8.92

Panel C: Reputable-arranger sample

Loan and Firm Characteristics	Number of observations	Mean	SD	Distribution 25%	50%	75%
Loan characteristics:						
Facility-size (in millions)	8,613	605.5	1,085	150.0	300.0	625.0
Maturity	8,200	45.10	27.66	12.00	48.00	60.00
Relationship-lending	8,527	0.56				
Purpose-restructuring	8,613	0.13				
Institutional	8,613	0.14				
Revolver	8,613	0.45				
Number-of-covenants	8,613	1.48	1.61	0.00	1.00	3.00
Number-of-lenders	8,613	11.62	10.97	4.00	9.00	16.00
Interest-spread	7,869	158.3	131.1	50.0	125	250.0
Traded	8,613	0.21				
Credit risk characteristics:						
Credit-rating	8,613	10.55	4.04	8.00	10.00	13.00
Speculative	8,613	0.57				
Watch-negative (Watch-positive)	8,613	0.09 (0.03)				
Outlook-negative (Outlook-positive)	8,613	0.16 (0.07)				
Additional firm characteristics:						
Firm size (in millions)	8,478	17,969	76,574	1,252	3,294	11 ,236
Market-book	6,722	3.45	4.22	1.50	2.23	3.61
Leverage	8,475	0.35	0.25	0.18	0.31	0.46
Profitability	8,123	0.13	0.08	0.08	0.12	0.16
Interest-coverage	7,984	9.07	15.34	2.50	4.55	8.87

Panel D: Non-reputable-arranger sample

Loan and Firm Characteristics	Number of observations	Mean	SD	Distribution 25%	50%	75%
Loan characteristics:						
Facility-size (in millions)	4,825	263.4	589.1	60.0	125.0	295.0
Maturity	4,536	51.8	34.57	29.00	57.00	71.00
Relationship-lending	4,799	0.45				
Purpose-restructuring	4,825	0.18				
Institutional	4,825	0.14				
Revolver	4,825	0.43				
Number-of-covenants	4,825	1.87	1.81	0.00	2.00	3.00
Number-of-lenders	4,825	7.55	8.12	2.00	5.00	10.00
Interest-spread	4,005	218.6	152.6	100	210	300.0
Traded	4,825	0.21				
Credit risk characteristics:						
Credit-rating	4,825	12.41	4.32	9.00	13.00	15.00
Speculative	4,825	0.74				
Watch-negative (Watch-positive)	4,825	0.07 (0.03)				
Outlook-negative (Outlook-positive)	4,825	0.15 (0.07)				
Additional firm characteristics:						
Firm size (in millions)	4,668	18,002	97,542	478	1,126	3 ,627
Market-book	3,523	3.09	4.42	1.27	1.92	3.03
Leverage	4,667	0.40	0.28	0.20	0.37	0.55
Profitability	4,410	0.12	0.11	0.07	0.11	0.16
Interest-coverage	4,305	7.04	14.01	1.78	3.18	6.29

Table 3: Evolution of loan prices on the secondary loan market

This table provides an analysis of the evolution of the loan prices on the secondary loan market. Panel A reports loan prices for the period up to three years following the year of a loan's initial sale. Row (1) reports the average loan price over the first trading month. Row (2) reports the average loan price for the period following the first trading month until the end of the year of a loan's initial sale. Row (3) reports the average loan price over the first year following the year of a loan's initial sale. Row (4) reports the average loan price over the second year following the year of a loan's initial sale. Row (5) reports the average loan price over the third year following the year of a loan's initial sale. Column (1) shows loan prices for the total sample. Columns (2)-(4) report loan prices for loans issued by reputable arrangers, non-reputable arrangers and the difference between the two. Columns (5)-(7) report loan prices for purpose-restructuring and non-purpose-restructuring loans and the difference between the two. Loan prices are measured as the average loan bid price over the relevant estimation period. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Panel B reports the distribution of the changes in loan prices relative to a loan's average price over the first trading month. Column 1 shows the number of loans for which prices decreased, did not change or increased following the first trading month until the end of the year of a loan's initial sale. Column 2 shows the distribution of a loan's price changes in the first year following the year of a loan's initial sale. Column 3 shows the distribution of a loan's price changes in the third year following the year of a loan's sale. Columns 4 and 5 partition the distribution of loan price changes in the third year following a loan's initial sale by the arranger's reputation. Columns 6 and 7 partition the distribution of loan price changes in the third year following the year of a loan's initial sale by loan purpose. The number in parenthesis is the percentage of total loans for that column. The bottom number in each column is the total number of loans for the column. The bottom number in parentheses is the percentage of all loans. The panel also presents chi-square statistics from tests of whether two distributions *within* the panel are different from each other. The number in parentheses is the chi-square statistic *p*-value. For example, the first test statistic provides evidence of whether the distribution of loan price changes for loans issued by reputable arrangers differs from the distribution of loan price changes for loans issued by non-reputable arrangers. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Variables are defined in Appendix A.

Panel A: Loan prices following a loan's sale

	Total sample (1)	Reputable-arranger (2)	Non-reputable-arranger (3)	Diff (4)	Purpose-restructuring (5)	Non-purpose-restructuring (6)	Diff (7)
Price at sale	99.22 (2,702)	99.24 (1,741)	99.18 (961)	0.06	99.16 (909)	99.25 (1,793)	-0.09
Price - Year	98.97 (2,702)	99.02 (1,741)	98.87 (961)	0.15	98.82 (909)	99.04 (1,793)	-0.23**
Price - Year +1	97.87 (2,157)	98.27 (1,372)	97.18 (785)	1.09***	96.88 (730)	98.38 (1,427)	-1.50***
Price - Year +2	94.92 (1,297)	95.94 (774)	93.42 (523)	2.52***	93.37 (487)	95.85 (810)	-2.48***
Price - Year +3	91.87 (728)	93.01 (407)	90.43 (321)	2.58***	90.89 (313)	92.61 (415)	-1.72*

Panel B: Distribution of loan price changes

	Year (1)	Year+1 (2)	Year+3 (3)	Reputable-arranger (4)	Non-reputable-arranger (5)	Purpose-restructuring (6)	Non-purpose-restructuring (7)
Price-decrease (% of Total)	1,154 (42.7%)	1,167 (54.1%)	466 (62.5%)	242 (59.5%)	213 (66.4%)	216 (61.0%)	239 (57.6%)
Price-no-change (% of Total)	688 (25.5%)	152 (7.1%)	18 (2.5%)	7 (1.7%)	11 (3.4%)	4 (1.3%)	14 (3.4%)
Price-increase (% of Total)	860 (31.8%)	838 (38.9%)	255 (35.0%)	158 (38.8%)	97 (30.2%)	93 (29.7%)	162 (41.3%)
Total (% of All)	2,702 (100%)	2,157 (100%)	728 (100%)	407 (55.9%)	321 (44.1%)	313 (43.0%)	415 (57.0%)

Chi-square tests of difference in distribution (*p*-value):

Reputable-arranger (4) vs. Non-reputable-arranger (5) 7.27** (0.026)

Purpose-restructuring (6) vs. Non-purpose-restructuring (7) 11.32*** (0.004)

Table 4: Changes in a firm's profitability following a loan's sale or issuance

This table presents an analysis of changes in a firm's performance. Panel A presents an analysis of changes in a firm's profitability (the ratio of EBITDA to total assets) following a loan's sale or issuance. Columns (1)-(6) describe the traded sample; Columns (7)-(9) describe the non-traded sample. The first set of columns (1-3) presents the mean profitability for the year before and after the year of a loan's initial sale, and the difference between the two. The second set of columns (4-6) presents the mean profitability for the three years before and after the year of a loan's initial sale, and the difference between the two. The third set of columns (7-9) presents the mean profitability for the three years before and after a loan's issuance year, and the difference between the two. The number in parentheses is the number of loans in the relevant category. Panel B presents an analysis of changes in a firm's abnormal accruals following a loan's sale or issuance. Abnormal accruals are estimated by the modified Jones (1991) model, adjusted for the incorporation of the negative cash flow indicator variable. Columns (1)-(6) describe the traded sample, Columns (7)-(9) describe the non-traded sample. The first set of columns (1-3) presents mean abnormal accruals in the year before and after the year of a loan's initial sale, and the difference between the two. The second set of columns (4-6) presents mean abnormal accruals for the three years before and after the year of a loan's initial sale, and the difference between the two. The third set of columns (7-9) presents mean abnormal accruals for the three years before and after a loan's issuance year, and the difference between the two. The number in parenthesis is the number of loans in the relevant category. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Variables are defined in Appendix A.

Panel A: Changes in a firm's profitability following a loan's sale or issuance

	Traded sample 1 year period			**Traded sample** 3 year period			**Non-traded sample** 3 year period		
	Before (1)	After (2)	Diff (3)	Before (4)	After (5)	Diff (6)	Before (7)	After (8)	Diff (9)
Total sample	0.128 (2,217)	0.123 (2,217)	0.004	0.127 (1,272)	0.124 (1,272)	0.003	0.138 (5,490)	0.127 (5,490)	0.011***
Reputable-arranger	0.121 (1,441)	0.121 (1,441)	0.000	0.123 (827)	0.125 (827)	-0.002	0.143 (3,573)	0.130 (3,573)	0.013***
Non-reputable-arranger	0.140 (776)	0.127 (776)	0.013**	0.135 (445)	0.122 (445)	0.012**	0.129 (1,917)	0.122 (1,917)	0.007***
Purpose-restructuring	0.149 (723)	0.129 (723)	0.020***	0.147 (418)	0.131 (418)	0.016***	0.152 (576)	0.135 (576)	0.017***
Non-purpose-restructuring	0.117 (1,494)	0.120 (1,494)	-0.003	0.117 (854)	0.121 (854)	-0.004*	0.137 (4,914)	0.127 (4,914)	0.010***

Panel B: Changes in a firm's abnormal accruals following a loan's sale or issuance

	Traded sample 1 year period			**Traded sample** 3 year period			**Non-traded sample** 3 year period		
	Before (1)	After (2)	Diff (3)	Before (4)	After (5)	Diff (6)	Before (7)	After (8)	Diff (9)
Reputable-arranger	0.002 (1,388)	-0.005 (1,388)	0.007	0.003 (783)	0.007 (783)	-0.004	0.014 (3,418)	0.013 (3,418)	0.002
Non-reputable-arranger	0.006 (701)	-0.003 (701)	0.009*	0.008 (409)	-0.009 (409)	0.017***	0.005 (1,779)	0.005 (1,779)	0.000
Purpose-restructuring	0.007 (655)	-0.009 (655)	0.016***	0.008 (384)	-0.005 (384)	0.012**	0.015 (538)	0.001 (538)	0.014***
Non-purpose-restructuring	0.002 (1,434)	-0.002 (1,434)	0.004	0.003 (808)	0.004 (808)	-0.001	0.011 (4,659)	0.011 (4,659)	0.000

Table 5: Distribution of a firm's profitability changes following a loan's sale or issuance

This table reports the distribution of changes in a firm's profitability (the ratio of EBITDA to total assets) following a loan's sale or issuance. Panel A provides the analysis of traded loans, while Panel B replicates this analysis for non-traded loans. Both samples are restricted to loans of speculative grade firms. In Panel A, Column 1 shows the number of loans related to firms for which profitability decreased or increased in the year following the year of a loan's initial sale relative to profitability in the year preceding the year of a loan's initial sale. Column 2 shows the number of loans related to firms for which mean profitability decreased or increased over the period of three years following the year of a loan's initial sale relative to the mean profitability over the three year period prior to the year of a loan's initial sale. Columns 3 and 4 partition the distribution of profitability changes over the three year period by the arranger's reputation. Columns 5 and 6 partition the distribution of profitability changes over the three year period by loan purpose. For Panel B, the columns show the distribution of profitability changes over the period following a loan's issuance year relative to the period prior to it. The top number in each cell is the number of loans. The number in parentheses is the percentage of total loans for that column. The bottom number in each column is the total number of loans for the column. The bottom number in parentheses is the percentage of all loans. Each panel presents chi-square statistics from tests of whether two distributions *within* the panel are different from each other. The number in parentheses is the chi-square statistic *p*-value. For example, in Panel A the first test statistic provides evidence of whether the distribution of profitability changes for firms with loans issued by reputable arrangers differs from the distribution of profitability changes for firms with loans issued by non-reputable arrangers. Panel C presents chi-square statistics from tests of whether the two distributions *across* panels A and B are different from each other. For example, Column 1 of Panel C provides the test statistic for whether the distribution of profitability changes over a one year period for the traded loans (presented in Column 1 of Panel A) is different from the distribution of profitability changes over a one year period for non-traded loans (presented in Column 1 of Panel B). ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Variables are defined in Appendix A.

Panel A: Traded sample restricted to speculative loans - Distribution of profitability changes following a loan's sale

	Year+1 (1)	Year+3 (2)	Reputable-arranger (3)	Non-reputable-arranger (4)	Purpose-restructuring (5)	Non-purpose-restructuring (6)
Profitability-decrease (% of Total)	978 (47.5%)	572 (48.8%)	335 (44.6%)	237 (56.3%)	219 (56.3%)	353 (45.1%)
Profitability-increase (% of Total)	1,083 (52.6%)	600 (51.2%)	416 (55.4%)	184 (43.7%)	170 (43.7%)	430 (54.9%)
Total (% of All)	2,061 (100.0%)	1,172 (100.0%)	751 (64.1%)	421 (35.9%)	389 (33.2%)	783 (66.8%)

Chi-square tests of difference in distribution (*p*-value):

Reputable-arranger (3) vs. Non-reputable-arranger (4)	14.75*** (0.000)
Purpose-restructuring (5) vs. Non-purpose-restructuring (6)	13.08*** (0.000)

Panel B: Non-traded sample restricted to speculative loans - Distribution of profitability changes following a loan's issuance

	Year+1 (1)	Year+3 (2)	Reputable-arranger (3)	Non-reputable-arranger (4)	Purpose-restructuring (5)	Non-purpose-restructuring (6)
Profitability-decrease (% of Total)	2,329 (49.8%)	1,435 (52.0%)	770 (52.6%)	665 (53.4%)	229 (59.6%)	1,206 (51.8%)
Profitability-increase (% of Total)	2,350 (50.2%)	1,276 (47.1%)	695 (47.4%)	581 (46.6%)	155 (40.4%)	1,121 (48.2%)
Total (% of All)	4,679 (100.0%)	2,711 (100.0%)	1,465 (54.0%)	1,246 (46.0%)	384 (14.2%)	2,327 (85.8%)

Chi-square tests of difference in distribution (*p*-value):

Reputable-arranger (3) vs. Non-reputable-arranger (4)	0.18 (0.673)
Purpose-restructuring (5) vs. Non-purpose-restructuring (6)	8.07*** (0.005)

Panel C: Difference in distribution of profitability changes between traded (Panel A) and non-traded loans (Panel B)

	Year+1 (1)	Year+3 (2)	Reputable-arranger (3)	Non-reputable-arranger (4)	Purpose-restructuring (5)	Non-purpose-restructuring (6)
Chi-square tests (*p*-value)	3.09* (0.079)	5.58*** (0.018)	12.56*** (0.000)	1.08 (0.298)	0.883 (0.347)	10.66*** (0.001)

Table 6: Changes in accounting performance controlling for loan and firm characteristics

This table presents a regression analysis of the changes in a firm's performance following a loan's sale or issuance. We regress the indicator variable reflecting whether a firm has experienced a decrease in performance (see column headings) on a set of loan- and firm-specific variables. For the traded loans, we measure the change in performance over the three year period following the year of a loan's initial sale relative to the three year period prior to the year of a loan's initial sale. For the non-traded loans, we estimate the change in performance over the three year period following the year of a loan's issuance relative to the three year period prior to the year of a loan's issuance. Panel A provides the analysis of the traded, non-traded and total loan samples. Panel B provides the analysis of the total loan sample, partitioned by the arranger's reputation.

$$Performance-decrease = \alpha + \beta_1 \text{Re}\,putable-arranger + \beta_2 Purpose-restructuring + \beta_3 Credit-rating + \beta_4 Interest-spread + \beta_5 Institutional + \beta_6 Number-of-lenders + \beta_7 Covenant-financial-count + \beta_8 \text{Re}\,lationship-lending + \beta_9 \text{Pr}\,ofitability-mean + \beta_{10} Loss-mean + \beta_{11} Abnormal-accruals-mean + \beta_{12} Firm-size + \beta_{13} Traded$$

We estimate each model with year fixed effects and cluster the standard errors at the firm level. Standard errors are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Variables are defined in Appendix A.

Panel A: Analysis of changes in a firm's profitability and interest-coverage ratio

Dependent variable: Performance-decrease	Pred. signs	Decrease in profitability			Decrease in interest coverage ratio		
		Traded (1)	Non-Traded (2)	Total (3)	Traded (4)	Non-Traded (5)	Total (6)
Reputable-arranger	-	-0.489**	-0.267**	-0.308***	-0.397**	-0.019	-0.053
		(0.22)	(0.12)	(0.11)	(0.20)	(0.11)	(0.11)
Purpose-restructuring	+	0.468*	0.386**	0.253*	0.514**	0.530***	0.530***
		(0.25)	(0.18)	(0.15)	(0.24)	(0.18)	(0.15)
Credit-rating	+	-0.037	-0.073***	-0.063***	-0.152***	-0.012	-0.027
		(0.05)	(0.02)	(0.02)	(0.05)	(0.02)	(0.02)
Interest-spread	+	-0.001	0.000	0.000	0.004***	0.002***	0.002***
		(0.00)	(0.00)	(0.00)	(000)	(0.00)	(0.00)
Institutional	+	0.154	-0.239	-0.030	0.115	-0.453**	-0.164
		(0.13)	(0.18)	(0.11)	(0.13)	(0.18)	(0.10)
Number-of-lenders	-	0.005	0.000	0.003	-0.006	0.004	0.001
		(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.00)
Covenant-financial-count	?	- 0.019	- 0.030	- 0.036	0.007	0.050	0.036
		(0.06)	(0.03)	(0.03)	(0.07)	(0.04)	(0.03)
Relationship-lending	-	0.003	-0.161*	-0.123	-0.137	-0.060	-0.072
		(0.18)	(0.08)	(0.08)	(0.17)	(0.08)	(0.08)
Profitability-mean	?	13.654***	6.687***	8.009***	4.053**	2.972***	3.142***
		(3.40)	(1.27)	(1.25)	(1.75)	(1.05)	(0.94)
Loss-mean	?	0.602	-1.056*	-0.463	-2.077**	-1.670***	-1.936***
		(0.92)	(0.57)	(0.55)	(0.97)	(0.58)	(0.54)
Abnormal-accruals-mean	+	4.291**	4.836***	4.287***	4.221*	4.406***	4.337***
		(2.11)	(1.25)	(1.20)	(2.33)	(1.17)	(1.15)
Firm-size	-	0.131	0.018	0.022	0.216**	0.062	0.088*
		(0.12)	(0.05)	(0.05)	(0.10)	(0.06)	(0.05)
Traded	?	-	-	-0.187*	-	-	-0.303**
				(1.11)			(0.12)
Psuedo R-Squared		14.4%	10.2%	11.2%	15.0%	8.2%	9.0%
# of loans		1,141	4,523	5,664	1,117	4,412	5,529

Panel B: Changes in a firm's performance as a function of arranger reputation

Dependent variable: Performance-decrease	Pred. signs	Decrease in profitability		Decrease in interest coverage ratio	
		Total Reputable-arranger (1)	Total Non-reputable-arranger (2)	Total Reputable-arranger (3)	Total Non-reputable-arranger (4)
Purpose-restructuring	+	0.285*	0.209	0.375**	0.780***
		(0.16)	(0.24)	(0.19)	(0.22)
Credit-rating	+	-0.044*	-0.099***	-0.022	-0.042
		(0.02)	(0.03)	(0.02)	(0.03)
Interest-spread	+	0.000	0.000	0.003***	0.002***
		(0.00)	(0.00)	(0.00)	(0.00)
Institutional	+	0.148	- 0.351**	-0.138	-0.194
		(0.13)	(0.16)	(0.13)	(0.16)
Number-of-lenders	-	0.001	0.009	0.000	0.002
		(0.00)	(0.01)	(0.00)	(0.01)
Covenant-financial-count	?	-0.020	-0.070	0.034	0.026
		(0.04)	(0.05)	(0.04)	(0.05)
Relationship-lending	-	-0.092	-0.156	- 0.094	-0.015
		(0.09)	(0.14)	(0.09)	(0.14)
Profitability-mean	?	8.474***	6.833***	3.307***	2.587*
		(1.41)	(2.03)	(1.12)	(1.41)
Loss-mean	?	-0.235	-0.834	-1.949***	-1.931***
		(0.78)	(0.74)	(0.67)	(0.77)
Abnormal-accruals-mean	+	5.390**	3.008**	4.677***	3.874**
		(1.64)	(1.47)	(1.48)	(1.55)
Firm-size	-	0.052	-0.050	0.118**	0.003
		(0.06)	(0.08)	(0.06)	(0.08)
Traded	?	-0.313**	-0.010	-0.334*	0.264
		(0.13)	(0.20)	(0.15)	(0.19)
Psuedo R-Squared		11.1%	10.2%	7.6%	13.0%
# of loans		3,832	1,832	3,748	1,781

Table 7: Distribution of credit rating changes following loan sale or issuance

This table provides an analysis of changes in a firm's credit rating following a loan sale or issuance. Panel A provides the analysis for traded loans, while Panel B replicates this analysis for non-traded loans. Both samples are restricted to the loans of speculative grade firms. For Panel A, credit rating changes are estimated relative to the credit rating at a loan's sale. Column 1 shows the number of loans related to firms for which the credit rating decreased or increased following a loan's sale and until the end of the year of a loan's initial sale. Column 2 shows the distribution of credit rating changes in the first year following the year of a loan's initial sale. Column 3 shows the distribution of credit rating changes in the third year following the year of a loan's initial sale. Columns 4 and 5 partition by arranger reputation the distribution of credit rating changes in the third year following the year of a loan's initial sale. Columns 6 and 7 partition by loan purpose the distribution of credit rating changes in the third year following the year of a loan's initial sale. For Panel B, the columns show the distribution of credit rating changes relative to the credit rating at a loan's issuance. The top number in each cell is the number of loans. The number in parentheses is the percentage of total loans for that column. The bottom number in each column is the total number of loans for the column. The bottom number in parentheses is the percentage of all loans. Each panel presents chi-square statistics from tests of whether two distributions *within* the panel are different from each other. The number in parentheses is the chi-square statistic *p*-value. For example, in Panel A the first test statistic provides evidence of whether the distribution of the credit rating changes of firms with loans issued by reputable arrangers differs from the distribution of the credit rating changes of firms with loans issued by non-reputable arrangers. Panel C presents chi-square statistics from tests of whether the two distributions *across* panels A and B are different from each other. For example, Column 1 of Panel C provides the test statistic for whether the distribution of credit rating changes following a loan's sale and until the end of the year of a loan's sale for the traded loans (presented in Column 1 of Panel A) is different from the distribution of credit rating changes following a loan's issuance and until the end of the year of a loan's issuance for non-traded loans (presented in Column 1 of Panel B). ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Variables are defined in Appendix A.

Panel A: Traded sample restricted to speculative loans - Distribution of credit rating changes following a loan's sale

	Year (1)	Year+1 (2)	Year+3 (3)	Reputable-arranger (4)	Non-Reputable-arranger (5)	Purpose-restructuring (6)	Non-Purpose-restructuring (7)
Rating-decrease	218	584	712	386	326	265	447
(% of Total)	(9.4%)	(23.4%)	(39.5%)	(35.5%)	(45.6%)	(40.6%)	(38.9%)
Rating-no-change	1,939	1,504	575	371	204	225	350
(% of Total)	(83.7%)	(60.2%)	(31.9%)	(34.1%)	(28.5%)	(34.5%)	(30.4%)
Rating-increase	161	412	516	331	185	163	353
(% of Total)	(7.0%)	(16.5%)	(28.6%)	(30.4%)	(25.9%)	(25.0%)	(30.7%)
Total	2,318	2,500	1,803	1,088	715	653	1,150
(% of All)	(100%)	(100%)	(100%)	(60.3%)	(39.7%)	(36.2%)	(63.8%)

Chi-square tests of difference in distribution (*p*-value):

Reputable-arranger (4) vs. Non-reputable-arranger (5) 18.50*** (<0.001)

Purpose-restructuring (6) vs. Non-purpose-restructuring (7) 7.21** (0.026)

Panel B: Non-traded sample restricted to speculative loans - Distribution of credit rating changes following a loan's issuance

	Year (1)	Year+1 (2)	Year+3 (3)	Reputable-arranger (4)	Non-Reputable-arranger (5)	Purpose-restructuring (6)	Non-Purpose-restructuring (7)
Rating-decrease	446	1,120	1,453	727	726	219	1,234
(% of Total)	(8.5%)	(20.4%)	(34.8%)	(34.3%)	(35.3%)	(34.9%)	(34.8%)
Rating-no-change	4,450	3,414	1,550	758	792	241	1,309
(% of Total)	(84.8%)	(62.3%)	(37.1%)	(35.7%)	(38.5%)	(38.4%)	(36.9%)
Rating-increase	371	949	1,174	637	537	168	1,006
(% of Total)	(7.0%)	(17.3%)	(28.1%)	(30.0%)	(26.1%)	(26.8%)	(28.4%)
Total	5,267	5,483	4,177	2,122	2,055	628	7,095
(% of All)	(100%)	(100%)	(100%)	(50.8%)	(49.2%)	(15.0%)	(85.0%)

Chi-square tests of difference in distribution (*p*-value):

Reputable-arranger (4) vs. Non-reputable-arranger (5) 8.19** (0.017)

Purpose-restructuring (6) vs. Non-purpose-restructuring (7) 0.81* (0.067)

Panel C: Difference in distribution of credit rating changes between traded (Panel A) and non-traded loans (Panel B)

	Year (1)	Year+1 (2)	Year+3 (3)	Reputable-arranger (4)	Non-Reputable-arranger (5)	Purpose-restructuring (6)	Non-Purpose-restructuring (7)
Chi-square tests	1.77	8.85**	6.13***	0.88	29.5***	4.51	15.97***
(*p*-value)	(0.413)	(0.012)	(0.013)	(0.643)	(<0.001)	(0.105)	(<0.001)

Table 8: Changes in credit quality controlling for loan and firm characteristics

This table presents a regression analysis of the changes in credit ratings following a loan's sale or issuance. We regress the indicator variable reflecting whether a firm has experienced a decrease in credit rating on a set of loan- and firm-specific variables. For the traded loans, we measure the change in credit ratings in the third year following the year of a loan's initial sale relative to a credit rating at the loan's initial sale. For the non-traded loans, we estimate the change in credit ratings in the third year following a loan's issuance relative to a credit rating at the loan's issuance.

$$Rating-decrease = \alpha + \beta_1 Reputable-arranger + \beta_2 Purpose-restructuring + \beta_3 Credit-rating + \beta_4 Watch-negative + \beta_5 Watch-positive + \beta_6 Outlook-negative + \beta_7 Outlook-positive + \beta_8 Interest-spread + \beta_9 Institutional + \beta_{10} Number-of-lenders + \beta_{11} Covenant-financial-count + \beta_{12} Relationship-lending + \beta_{13} Firm-size + \beta_{14} Leverage + \beta_{15} Profitability-mean + \beta_{16} Interest-coverage-mean + \beta_{17} Traded$$

We estimate each model with year fixed effects and cluster the standard errors at the firm level. Standard errors are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Variables are defined in Appendix A.

Dependent variable: Rating-decrease	Pred. signs	Traded (1)	Non-traded (2)	Total (3)	Total Reputable-arranger (4)	Total Non-Reputable-arranger (5)
Reputable-arranger	-	-0.275** (0.12)	-0.104 (0.10)	-0.149 (0.09)	-	-
Purpose-restructuring	+	-0.173 (0.20)	-0.084 (0.15)	-0.065 (0.12)	-0.311* (0.17)	0.250 (0.18)
Credit-rating	+	-0.161*** (0.04)	-0.158*** (0.02)	-0.155*** (0.02)	-0.143*** (0.02)	-0.174*** (0.02)
Watch-negative	+	0.897*** (0.31)	1.095*** (0.16)	1.043*** (0.16)	1.032*** (0.19)	1.043**** (0.24)
Watch-positive	-	-1.118** (0.46)	-0.404 (0.30)	-0.625** (0.28)	-0.654** (0.32)	-0.575 (0.44)
Outlook-negative	+	0.646*** (0.21)	0.734*** (0.13)	0.710*** (0.11)	0.762*** (0.13)	0.617*** (0.19)
Outlook-positive	-	-0.924** (0.36)	-0.698*** (0.23)	-0.749*** (0.22)	-0.847*** (0.29)	-0.625** (0.28)
Interest-spread	+	0.000 (0.00)	0.001* (0.00)	0.001 (0.00)	0.001 (0.00)	0.001 (0.00)
Institutional	+	-0.024 (0.12)	0.015 (0.15)	-0.018 (0.10)	0.020 (0.12)	-0.073 (0.15)
Number-of-lenders	-	-0.001 (0.01)	-0.002 (0.01)	-0.001 (0.00)	0.000 (0.00)	-0.003 (0.01)
Covenant-financial-count	?	0.108** (0.06)	0.033 (0.03)	0.050* (0.03)	0.040 (0.04)	0.043 (0.04)
Relationship-lending	-	-0.161 (0.16)	-0.166** (0.08)	-0.165** (0.07)	-0.122 (0.08)	-0.255** (0.12)
Firm-size	-	-0.099 (0.10)	-0.088* (0.05)	-0.096** (0.05)	-0.114** (0.06)	-0.084 (0.07)
Leverage	+	0.364 (0.33)	0.945*** (0.25)	0.772*** (0.21)	0.769*** (0.27)	0.666** (0.30)
Profitability-mean	-	-2.019 (1.25)	-2.437*** (0.82)	-2.241*** (0.70)	-3.265*** (0.99)	-0.971 (0.99)
Interest-coverage-mean	-	0.007** (0.00)	-0.002 (0.00)	-0.001 (0.00)	0.000 (0.00)	-0.003 (0.00)
Traded	?	-	-	0.073 (0.11)	-0.003 (0.13)	0.186* (0.11)
Psuedo R-Squared		9.5%	8.0%	7.8%	7.8%	9.0%
# of loans		1,451	5,443	6,894	4,515	2,379

Table 9: Changes in profitability and credit quality: controlling for selection between traded and non-traded loans

This table presents a regression analysis of the changes in a firm's profitability and credit ratings following a loan's sale or issuance, controlling for selection between traded and non-traded loans. Panel A presents a loan trade probability model. We regress an indicator variable reflecting whether a loan is traded on a set of loan- and firm-specific characteristics. In Panel B, we regress the indicator variable reflecting whether a firm has experienced a decrease in profitability or credit quality (see column headings) on a set of loan- and firm-specific variables and the inverse Milles ratio, as estimated by the trade probability model. For the traded loans, we measure the change in performance over the three year period following the year of a loan's initial sale relative to the three year period prior to the year of a loan's initial sale. For the non-traded loans, we estimate the change in performance over the three year period following the year of a loan's issuance relative to the three year period prior to the year of a loan's issuance. Note that Panel A presents the trade probability model for the total sample of loans employed in the profitability test (Column 1 of Panel B). To obtain the inverse Mills ratio, the trade probability model was re-estimated for each of the models presented in Panel B.

We estimate each model with year fixed effects and cluster the standard errors at the firm level. Standard errors are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Variables are defined in Appendix A.

Panel A: Trade probability model

Dependent variable: Traded	Pred. signs	Total sample
Reputable-arranger	+	0.095 (0.14)
Purpose-restructuring	+	0.880*** (0.18)
Credit-rating	+	0.184*** (0.02)
Institutional	+	1.429*** (0.17)
Number-of-lenders	+	0.018** (0.01)
Covenant-financial-count	+	0.391*** (0.04)
Relationship-lending	?	- 0.108 (0.11)
Revolver	-	-0.382*** (0.10)
Maturity	+	0.033*** (0.00)
Profitability-mean	?	1.732 (1.31)
Interest-coverage-mean	?	0.000 (0.00)
Leverage	+	1.608*** (0.31)
Firm-size	+	0.645*** (0.06)
Psuedo R-Squared		38.3%
# of loans		5,320

Panel B: Changes in a firm's profitability and credit quality following loan sale or issuance

Dependent variable: Performance-decrease	Decrease in profitability			Decrease in credit rating		
	Total (1)	Total Reputable-arranger (2)	Total Non-Reputable-arranger (3)	Total (4)	Total Reputable-arranger (5)	Total Non-Reputable-arranger (6)
Reputable-arranger	-0.321*** (0.11)	-	-	-0.155 (0.10)	-	-
Purpose-restructuring	0.393** (0.16)	0.429** (0.19)	0.369 (0.27)	-0.060 (0.13)	-0.231 (0.17)	0.130 (0.19)
Credit-rating	-0.039* (0.02)	-0.023 (0.03)	-0.077*** (0.03)	-0.149*** (0.02)	-0.124*** (0.03)	-0.184*** (0.03)
Interest-spread	0.000 (0.00)	0.000 (0.00)	0.000 (0.00)	0.001 (0.00)	0.000 (0.00)	0.001 (0.00)
Institutional	0.126 (0.14)	-0.238 (0.16)	-0.081 (0.23)	0.001 (0.12)	0.115 (0.15)	-0.227 (0.20)
Number-of-lenders	0.005 (0.00)	0.002 (0.00)	0.012 (0.01)	0.000 (0.00)	0.001 (0.00)	-0.004 (0.00)
Covenant-financial-count	0.012 (0.04)	0.024 (0.05)	- 0.018 (0.06)	0.047 (0.04)	0.065 (0.05)	-0.013 (0.06)
Relationship-lending	-0.134 (0.08)	-0.092 (0.10)	-0.179 (0.15)	-0.156** (0.07)	-0.130 (0.07)	-0.219* (0.12)
Profitability-mean	8.107*** (1.29)	8.472*** (1.46)	7.020*** (2.15)	-2.155*** (0.73)	-3.184*** (1.03)	-1.043 (1.06)
Loss-mean	-0.434 (0.55)	-1.189 (0.79)	-0.881 (0.71)	-	-	-
Abnormal-accruals-mean	4.378*** (1.21)	5.802*** (1.68)	2.953** (1.46)	-	-	-
Firm-size	0.079 (0.06)	0.089 (0.07)	0.041 (0.10)	-0.090 (0.06)	-0.076 (0.07)	-0.155* (0.09)
Watch-negative	-	-	-	1.058*** (0.16)	1.043*** (0.19)	1.051*** (0.25)
Watch-positive	-	-	-	-0.584** (0.28)	-0.605* (0.33)	-0.531 (0.44)
Outlook-negative	-	-	-	0.735*** (0.12)	0.793*** (0.14)	0.629*** (0.19)
Outlook-positive	-	-	-	-0.753*** (0.22)	-0.837*** (0.30)	-0.657** (0.28)
Leverage	-	-	-	0.777*** (0.23)	0.826*** (0.30)	0.531 (0.34)
Interest-coverage-mean	-	-	-	0.000 (0.00)	0.000 (0.00)	-0.003 (0.00)
Traded	-0.142 (0.12)	-0.279** (0.13)	0.058 (0.21)	0.104 (0.11)	0.032 (0.13)	0.207** (0.10)
Mills-ratio	0.238* (0.13)	0.175 (0.15)	0.333 (0.21)	0.027 (0.11)	0.139 (0.14)	- 0.185 (0.18)
Psuedo R-Squared	11.2%	11.3%	12.4%	7.7%	7.8%	8.8%
# of loans	5,320	3,610	1,710	6,575	4,313	2,262

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WHAT'S DIFFERENT ABOUT BANKS?*

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Negotiable certificates of deposit (CD's) trade in the capital market in competition with other securities like commercial paper and bankers' acceptances. If CD's must pay lenders competitive monetary interest, the reserve tax on CD's is borne by bank borrowers. Viability of the tax means there must be something special about bank loans that makes some borrowers willing to pay higher interest rates than those on other securities of equivalent risk. Moreover, there must be something special about banks that prevents other intermediaries from competing to assure that it never pays to finance loans with CD's.

1. Introduction

Banks are required to hold non-interest-bearing reserves against demand deposits. The banking literature treats the interests foregone on reserves as a tax on deposits. [See, for example, Black (1975).] The presumption is that banks earn the market interest rate on assets so the reserve tax falls on depositors. The viability of the demand deposit reserve tax is then explained in terms of special transactions services (redeemability for cash and the checking system for the transferring claims on wealth) that allow demand deposits to pay lower monetary interest than other securities of equivalent risk.

There is a problem in this conventional story about the incidence of the deposit reserve tax. Banks also finance assets with negotiable certificates of deposit (CD's). Although called 'deposits', negotiable CD's are transferable securities that trade in the capital market in competition with other similar instruments like commercial paper and bankers' acceptances. Unlike demand deposits, CD's provide no apparent transactions or liquidity services not also obtained from commercial paper or bankers acceptances. Thus, it seems reasonable to assume that CD's must yield lenders the same monetary interest as other securities of equivalent risk. The presumption is buttressed by table 1 which shows that during the 1967–83 period, average yields on high grade CD's and bankers' acceptances of the same maturity are almost identical. Likewise, the differences between average yields on CD's and commercial paper are trivial and not always of the same sign.

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Table 1

Average, continuously compounded yields to maturity on high-grade certificates of deposit, bankers' acceptances, commercial paper, and Treasury bills; January 1967 to May 1983; $N = 197$.[a]

Instrument	Maturity		
	1 month	3 months	6 months
Certificates of deposit (CD's)	8.14	8.28	8.35
Bankers' acceptances (BA's)	8.13	8.25	8.36
Commercial paper	8.25	8.32	8.34
U.S. Treasury bills	6.86	7.31	7.61

[a] The data for CD's, BA's, and commercial paper are from Part IV, Table 1, of the *Analytical Record of Yields and Yield Spreads*, published by Salomon Brothers. The monthly data in the *Analytical Record* are secondary market quotes from Salomon traders for high-grade CD's and bankers' acceptances and for commercial paper rated A1–P1. The monthly Treasury bill quotes are from the Center for Research in Security Prices of the University of Chicago. The CD quotes and the discount quotes for BA's, commercial paper, and Treasury bills are transformed into annualized continuously compounded yields to maturity. The yields for each month are then averaged across months to get the average annualized yields in the table.

Unlike commercial paper and bankers acceptances, however, CD's are subject to a reserve requirement. If CD's must pay competitive monetary interest, the reserve tax on CD's is borne by bank borrowers. Viability of the tax then means there must be something special about bank loans that makes some borrowers willing to pay higher interest rates than those on the other securities of equivalent risk. Moreover, there must be something special about banks that prevents other intermediaries, like insurance companies and finance companies, whose liabilities are not subject to reserve requirements, from competing with banks to assure that it never pays to finance loans with CD's.

This paper presents a simple analysis that accommodates reserve requirements on demand deposits and CD's.

2. Reserve requirements and competitive banking

Fig. 1 summarizes demand and supply conditions for a banking sector in which individual banks are assumed to be perfectly competitive with one another in making loans and issuing demand deposits. The figure is a bit unusual in that the vertical axis shows the difference between i_B, an interest rate for a bank asset or liability, and i_m, the interest rate observed in the capital market on a non-bank security with risk equivalent to the bank asset or liability. Table 2 summarizes the various interest rates or costs in the analysis.

2.1. The supply of loanable funds

The cost to banks of a unit of demand deposits, i_D, includes monetary interest paid to depositors, the cost of unreimbursed services to depositors, and the interest foregone because of the reserve requirement. The special transactions services of demand deposits (access to a ready inventory of bank cash and to the checking system of exchange) allow the banking sector to issue deposits for which the per unit cost i_D is less than the market interest rate i_m. By raising either direct or service interest paid on deposits (raising $i_D - i_m$), the banking sector can induce a larger aggregate supply. If direct interest payments on demand deposits are unregulated, the demand deposit supply curve is horizontal when direct interest equals the market rate i_m, for example, at the point k in fig. 1. Because of the reserve requirement, the total cost i_D of a unit of deposits in the region where the supply curve is horizontal exceeds the market interest rate i_m. If the direct interest on demand deposits is restricted to a rate below i_m, the demand deposit supply curve is upward sloping throughout (the curve SD in fig. 1) as long as depositors consider some bank services less than perfect substitutes for direct interest.

The CD supply curve in fig. 1 is horizontal. This is consistent with the assumption (buttressed by the evidence of table 1) that CD's must pay holders the same monetary interest as other securities of equivalent risk. However, the total cost i_{CD} of a unit of CD's exceeds the market rate i_m because of the CD reserve requirement. Since the cost of CD's in fig. 1 is pictured net of i_m, the

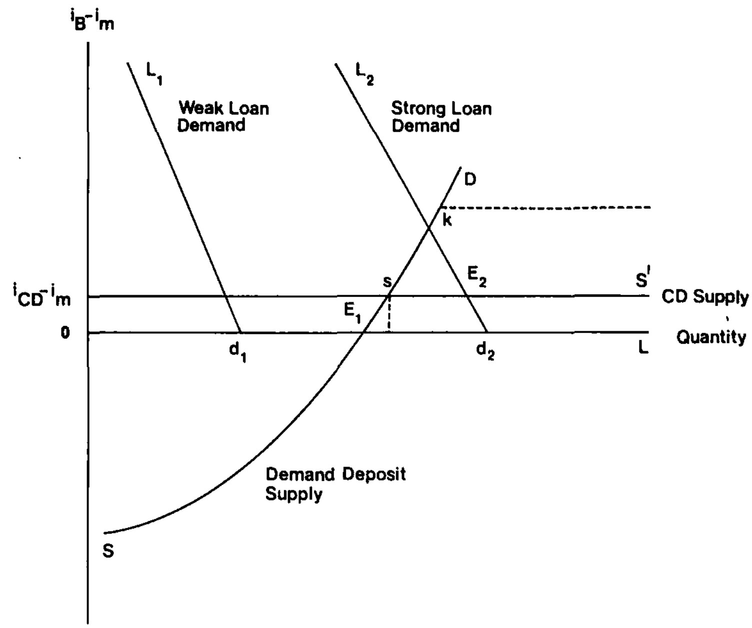

Fig. 1. Equilibrium in a competitive banking industry.

Table 2

Interest rate glossary.

Bank assets

i_m	= interest rate observed in the capital market on non-bank securities like commercial paper.
i_L	= interest rate charged on bank loans; does *not* include costs of making and monitoring loans.

Bank liabilities

i_D	= cost of a unit of demand deposits; includes (a) direct interest paid to depositors, (b) interest foregone (paid to the central bank) because of the deposit reserve requirement, and (c) deposit servicing costs not reimbursed by depositors.
i_{CD}	= cost of a unit of CD's; includes (a) direct interest paid to CD holders equal to what holders could get on non-bank securities of equivalent risk, (b) interest foregone (paid to the central bank) because of the CD reserve requirement, and (c) any issuing and maintenance costs.

CD supply curve can be horizontal even though the quantity of CD's issued by the banking sector can affect i_m.

Since the reserve requirement is higher for demand deposits than for CD's, there is an aggregate supply of demand deposits beyond which the cost of a unit of deposits exceeds that of a unit of CD's. This occurs at the point s in fig. 1. Below this point the industry supply curve for loanable funds is the demand deposit supply curve. At the point s, the banking sector switches from demand deposits to CD's. The aggregate supply curve for loanable funds is SsS'.

For simplicity the analysis of the supply of loanable funds is limited to demand deposits and CD's. However, the demand deposit supply curve can be interpreted as the aggregate of the supply curves for the class of liabilities (for example, small time deposits) that the banking sector does not issue in perfect competition with other suppliers. Moreover, the analysis is much the same when there are other classes of bank liabilities (for example, large time deposits) which, like CD's, are subject to reserve requirements but must yield holders the same return as non-bank securities of equivalent risk.

2.2. *Industry equilibrium*

2.2.1. *Strong loan demand*

Banks use CD's to finance loans when the loan demand schedule crosses the supply curve for loanable funds in the region where marginal supplies come from CD's, that is, to the right of the point s in fig. 1. The loan demand curve L_2 is an example.

The interest rate i_m is the market rate on securities with risks equivalent to those of bank loans. Assume that banks can buy all the open-market securities they want at the rate i_m. Thus, the demand curve for loanable funds becomes horizontal when it hits the quantity axis in fig. 1 (to the right of the point d_2 for the demand curve L_2).

With the loan demand curve L_2, industry equilibrium is at the point E_2. In this case (strong loan demand), equilibrium requires that banks issue loans to the point where the interest rate on loans, i_L, is equal to i_{CD}, the cost of a unit of CD's. Since banks always use the cheapest source of funds, they push demand deposits to the point where the cost of a unit of deposits, i_D, is also equal to i_{CD}.

The cost of a unit of CD's, i_{CD}, includes interest foregone because of the CD reserve requirement and the market interest rate i_m paid to CD holders. Since CD holders net the market rate i_m, the equilibrium condition $i_L = i_{CD}$ implies that the cost of the CD reserve requirement is borne by bank borrowers. Note that this is just an example of the standard result that an *ad valorem* tax is borne on the demand side when the supply curve is horizontal.

Perhaps more interesting, in equilibrium the banking sector issues deposits to the point where their cost is equal to the cost of CD's. The equilibrium condition $i_D = i_{CD} = i_L$ then implies that bank borrowers also bear the equivalent of the CD reserve requirement on the part of bank loans financed with demand deposits. This is in contrast to the conventional story in which demand depositors bear all the cost of the demand deposit reserve requirement. Moreover, since banks must cover all their lending costs, and since the loan rate i_L does not include the costs incurred by banks to issue and monitor loans, the condition $i_D = i_{CD} = i_L$ implies that such loan servicing costs must be borne by bank borrowers, in addition to the direct interest i_L charged on their loans.

Perhaps most important, the reserve requirement causes the cost of a unit of CD's to exceed the interest rate i_m on non-bank securities of equivalent risk. Thus, there must be something special about bank loans that makes some borrowers willing to pay interest rates greater than i_m on bank loans. Otherwise, CD's are not a viable means of financing loans. Moreover, there must be something special about banks that prevents other intermediaries, whose liabilities are not subject to reserve requirements, from competing with banks to assure that it never pays to finance bank loans with CD's. Some possible comparative advantages of banks as lenders are discussed in section 3.

2.2.2. Weak loan demand

The loan demand schedule L_1 in fig. 1 hits the quantity axis and becomes horizontal at the point d_1, to the left of the point E_1 where the demand deposit supply curve hits the axis. In this situation, the open-market interest rate i_m reigns supreme. The banking sector issues demand deposits to the point E_1 where the cost of a unit of deposits is $i_D = i_m$. Loans are issued to the point d_1 where the loan interest rate i_L is equal to i_m. The difference between the supply of deposits, E_1, and d_1 goes into some mix of loans and open-market securities. In this weak loan demand equilibrium, all bank assets are financed with deposits; banks issue no CD's.

Banks earn i_m on open-market securities. Thus, in addition to the interest rate $i_L = i_m$, borrowers again pay the service costs of making and monitoring their bank loans. I argue later, however, that monitoring services purchased from banks can actually help to explain the special attraction (comparative advantage) of bank loans for some borrowers.

The cost i_D of a unit of deposits in this weak loan demand equilibrium is also equal to the interest rate i_m on non-bank securities. However, i_D includes interest foregone on deposit reserves. Thus, an implication of $i_D = i_L = i_m$ is that the cost of the demand deposit reserve requirement is borne by depositors – the standard conclusion of the banking literature, for example, Black (1975). It is also an example of the standard conclusion that an *ad valorem* tax is borne by suppliers when an industry demand curve is infinitely elastic. We saw earlier, however, that the conclusion does not hold when bank loans are financed with both demand deposits and CD's. Then bank borrowers bear a part of the cost of the demand deposit reserve requirement equivalent to the cost of the CD reserve requirement.

Finally, there is an intermediate case where part of the demand deposit reserve tax is borne by bank borrowers even though banks do not finance loans with CD's. This occurs when the loan demand schedule crosses the demand deposit supply curve between the points E_1 and s is fig. 1.

2.3. *Side issues*

2.3.1. *Bank portfolio composition*

When banks finance in part with CD's, the cost of a unit of deposits or CD's is i_{CD}, and i_{CD} is greater than the return on open-market securities, i_m, because of the CD reserve requirement. Thus, CD financing implies that bank assets are concentrated in loans. Banks hold no open-market securities like Treasury bills. In fact, banks often issue CD's and hold open-market securities. This may in part result from the economics of deposit management. Since there are no active secondary markets for bank loans, an inventory of open-market securities that can be bought and sold at low cost can stand as a buffer between currency and loans to absorb unexpected variation in the redemption of demand deposits. In other words, holding some open-market securities lowers demand deposit servicing costs. Moreover, banks finance their holdings of Treasury securities in part with short-term repurchase agreements. Since repurchase agreements against Treasury securities are exempt from reserve requirements, financing Treasury securities in this way, while using CD's to finance loans, is consistent with the analysis.

At the end of 1983 commercial banks held \$186.9 billion in Treasury securities and \$250.6 billion in other securities. Repurchase agreements amounted to \$85.5 billion, which is not sufficient to explain the Treasury security holdings. (See *Federal Reserve Bulletin*, May 1984, tables 1.24 and 1.25.) Whether the difference between total security holdings and repurchase agreements can be explained by incentives to lower deposit redemption costs is an interesting topic for future research.

2.3.2. *Deposit insurance*

Deposit insurance lowers the return required by some holders of CD's. If the price for the insurance charged to banks is not actuarially fair, the insurance subsidy helps offset the cost of the CD reserve requirement. If the offset is complete, we can observe that banks issue CD's to purchase open-market securities. In this case, however, the cost of CD's does not exceed the open-market rate i_m, and most of the interesting differences between weak and strong loan demand equilibria, for example, conclusions about who bears the cost of the demand deposit reserve requirement, disappear.

Deposit insurance does not necessarily undermine the analysis. First, it's not clear that deposit insurance is underpriced, at least for the banking sector as a whole. Fairly priced insurance fits easily in the analysis. Second, CD's are insured up to \$100,000 to holders who qualify as physical persons, but negotiable CD's are commonly denominated in units of \$1,000,000 or more. Finally, table 1 shows that average yields on negotiable CD's are systematically higher than those on Treasury bills of the same maturity and almost identical to those on high-quality bankers' acceptances and commercial paper. Thus, insurance is not a dominant factor in the pricing of CD's.

3. Bank loans and contracting costs in organizations

When the banking sector finances loans with CD's, interest rates on bank loans are higher than those on other securities of equivalent risk because of the CD reserve requirement. Thus, for some borrowers there must be something special about bank loans. Moreover, on the supply side, there must be something special about banks that prevents other intermediaries, like insurance companies and finance companies, whose liabilities are not subject to reserve requirements, from competing with banks to assure that it never pays to finance loans with CD's. The discussion that follows suggests an explanation of the comparative advantages of banks as lenders in the context of the more general problem of minimization of information costs in organizations. In short, information costs are used to explain why the demand curves for bank loans in fig. 1 are downward sloping rather than horizontal.

3.1. Inside and outside debt

To understand the role of bank loans in an organization's information process, it is useful to draw a distinction between outside debt and inside debt. Inside debt is defined as a contract where the debtholder gets access to information from an organization's decision process not otherwise publicly available. The debtholder may even participate in the decision process, for example, on the organization's board of directors. Bank loans are inside debt, as are the other types of debt commonly classified as private placements. In contrast, outside debt is defined as publicly traded debt where the debtholder relies on publicly available information generated by the organization or information purchased by the organization (for example, independent audits and bond ratings). Publicly traded bonds, commercial paper, bankers acceptances, and, of course, bank CD's are in this category. These distinctions between inside and outside debt are similar to the distinctions between inside and outside equity in Jensen and Meckling (1976).

3.2. The advantages of short-term inside debt

Fama and Jensen (1983a, b) observe that the contracts of most agents in organizations promise fixed payoffs or incentive payoffs tied to specific measures of performance. Such fixed payoff contracts are typical for labor, raw materials suppliers, managers and debtholders. Equity holders then contract for the right to net cash flows, that is, the time series of differences between revenues and promised payoffs to other agents.

Lower information costs incurred by agents to monitor their contracts translate into lower prices for their services. Competition pushes an organization to provide information jointly useful for evaluating the contracts of different agents to avoid duplication of information costs among agents [Fama and Jensen (1985)].

Bank loans are especially useful to avoid duplication of information costs. Bank loans usually stand last or close to last in the line of priority among contracts that promise fixed payoffs. Bank loans are short-term and the renewal process triggers periodic evaluation of the organization's ability to meet low-priority fixed payoff contracts. Positive renewal signals from bank loans mean that other agents with higher-priority fixed payoff claims need not undertake similar costly evaluations of their claims. Bank signals are credible since the bank backs its opinions with resources, or by declining resources.

The value of the signals from a bank about the credit worthiness of an organization's fixed payoff contracts is attested by the fact that many organizations pay periodic monitoring fees for lines of credit from banks even though they do not take the resources offered. Indeed, large corporations often purchase lines of credit from banks for the sole purpose of providing a signal about outside debt (commercial paper) to be issued publicly rather than held by the bank.

Like outside equity, outside (publicly traded) debt is issued predominantly by large corporations. Fama and Jensen (1983a, b) argue that outside equity involves high information and contracting costs that make it an uneconomical means of financing for small organizations. A similar argument applies to outside debt. In contrast, individuals and organizations of all types and sizes finance with bank loans. This suggests that contracting costs for bank loans debt are lower for individuals and small organizations than contracting costs for outside debt. For individuals and small organizations it's cheaper to give one agent (the banker) direct access to the organization's decision process than to produce the range of publicly available information that makes outside debt a viable means of financing.

In short, since a bank loan is a low-priority claim and the banker has access to inside information, in large and small organizations periodic signals from short-term bank loans about an organization's credit worthiness lower the information costs of other agents in the organization.[1] Moreover, for small organizations (and individuals) information and contracting costs for inside debt like bank loans are lower than for outside debt. Thus, we can explain why organizations (and individuals) are willing to pay higher interest rates on inside debt than we observe in the open capital market on outside debt of equivalent risk.

3.3. The comparative advantage of banks as inside lenders

These arguments do not explain why the supply side of the picture ever allows banks to charge higher than open-market interest rates because the cost of the reserve requirement on CD's must be passed on to bank borrowers. If the CD reserve tax is viable, bank costs of making and monitoring some kinds of inside loans must be lower than the costs of other intermediaries (for example, insurance and finance companies) by at least the cost of the CD reserve requirement.

Black (1975) suggests that banks have a cost advantage in making loans to depositors. The ongoing history of a borrower as a depositor provides informa-

[1] The absence of active secondary markets for bank loans suggests that they are based in part on inside information which is costly to transfer. See also Leland and Pyle (1977) and Diamond and Dybvig (1983).

tion that allows a bank to identify the risks of loans to depositors and to monitor the loans at lower cost than other lenders. The inside information provided by the ongoing history of a bank deposit is especially valuable for making and monitoring the repeating short-term loans (rollovers) typically offered by banks. Information from an ongoing deposit history also has special value when the borrower is a small organization (or individual) that does not find it economical to generate the range of publicly available information needed to finance with outside debt or equity.

Two facts tend to support these arguments. First, banks usually require that borrowers maintain deposits (often called compensating balances). Second, banks are the dominant suppliers of short-term inside debt. The inside debt or private placements offered by insurance and finance companies (which do not have the monitoring information provided by ongoing deposit histories) are usually much longer-term than bank loans.

4. Conclusions

Although called deposits, negotiable CD's are transferable securities that trade in the capital market in competition with other similar instruments like commercial paper and bankers' acceptances. Since CD's provide no apparent transactions or liquidity services not also obtained from commercial paper or bankers' acceptances, it is reasonable to assume that CD's must yield lenders the same monetary interest as other securities of equivalent risk. The assumption is supported by the yield comparisons in table 1.

Unlike commercial paper and bankers' acceptances, CD's are subject to a reserve requirement. If CD's must also pay competitive monetary interest, then the reserve tax on CD's is borne by bank borrowers. Viability of the reserve tax then means there must be something special about bank loans that makes borrowers willing to pay higher interest rates than those on open-market securities (outside debt) of equivalent risk. I suggest that for individuals and for some organizations, especially small organizations that do not have outside equity, the contracting costs for inside loans like bank loans are lower than for outside debt. Moreover, in all types of organizations, signals from short-term bank loans about an organization's credit worthiness can lower the information costs of other contracts.

On the supply side, if it pays to finance bank loans with CD's, then contracting costs for bank loans must be sufficiently lower than contracting costs for short-term inside loans from other intermediaries to make up the cost of the CD reserve requirement. I use Black's (1975) argument that because bank borrowers are usually also depositors, a bank has a low-cost ongoing history of financial information that gives it a comparative cost advantage in making and monitoring repeated short-term inside loans.

In short, the CD reserve tax is borne by bank borrowers and its viability depends on special cost advantages of banks in servicing long-term depositor–borrowers. In contrast, the reserve tax on demand deposits is largely borne by depositors. Its viability depends on special transactions services (access to a ready inventory of bank cash and to the checking system for transferring claims on wealth) that allow deposits to pay lower interest than other securities of equivalent risk.

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The Pricing Effect of Certification on Syndicated Loans

by

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Abstract

To verify if a delegated monitor can certify its ability to perform its assigned tasks, we test whether syndicated loans in which a larger share of the facility is retained by the arranger have lower interest rates. For a large sample of syndicated loans in over 80 countries we find that this certification effect exists and is greater for facilities characterized by greater due diligence and monitoring efforts. Further, for listed companies the announcement effect of the new loan on the stock price is an increasing function of the portions of the loan retained by the arranger.

JEL-classification: G82, G14, G21
keywords: Bank lending, Syndicated loans, Certification, Event studies

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1 Introduction[*]

The last decade has witnessed rapid growth of the syndicated loan market. The volume of facilities granted worldwide increased more than seven-fold between 1993 and 2005, topping $2.3 trillion in 2005 (BIS, 2006). According to Sufi (2007), syndicated loans account for half of new lending to US corporations and generate more underwriting fees than either the equity or the bond market.

In a syndicated credit facility at least two lenders jointly offer a loan to a borrower. The tasks of organizing the syndication, monitoring and due diligence are not shared by all subscribers but are delegated to one or more arranger banks. A distinctive feature of the syndication process is the position of the arranger with respect to the borrower. When the borrower is seeking bidders for a facility, its interests conflict with those of the potential arranger. The former is on the buy side of the market, looking for the lowest possible price for the facility that it needs; the latter is on the sell side, looking

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to maximize its total revenues. But once the mandate has been awarded, the borrower and the arranger become partners in seeking a satisfactory result from the placement: the failure of the deal would not only leave the borrower without funds, but would also jeopardize the standing of the arranger.

Credit syndicates are therefore plagued by agency problems, because they add to the typical information asymmetry between borrowers and lenders that between the arranger and the other subscribers of the loan. Theoretical analysis on delegated monitoring (Leland and Pyle, 1977; Diamond, 1984; Holmström and Tirole, 1997) suggests that arrangers can mitigate these problems by contributing a larger share of their own assets to the overall funding, thereby certifying the accuracy of their screening and their commitment to proper monitoring and due diligence – in a word, putting their money where their mouth is. If this certification effect has value, then the interest rate on the facility should go down as the fraction retained by the arranger goes up, as Gorton and Pennacchi (1995) found for loan sales. This paper uses a sample of 2,951 syndicated credit facilities to borrowers in 59 countries between 1990 and 2001, to study the relationship between the structure of the credit syndicate and the interest rate.

This paper contributes to the literature on the effects of information asymmetries in lending contracts, showing that the delegated monitor of a credit syndicate, the arranger, can mitigate the cost impact of the agency problems by supplying a larger share of the facility. As the theoretical literature predicts, the effect of certification is greater when the agency problems are more severe, as when the borrower is more opaque or the loan requires stricter monitoring and due diligence. The paper also contributes to the literature on the uniqueness of bank loans (James, 1987), showing that the information generated by arrangers retaining a larger share of the loan goes beyond the lending syndicate to influence the magnitude of the announcement effect of new bank loans on borrowers' stock prices.

Although a number of papers have studied the effect of information asymmetries on the structure of loan syndicates, not much attention has been paid to the consequences of the syndicate's composition for the interest rate. A similar issue is addressed by Angbazo et al. (1998), who show that the spread on highly leveraged syndicated transaction loans is smaller when the arranger retains the largest share of any provider of funds. Ivashina (2005) addresses some potential issues of endogeneity in the reduced-form estimation of the effect of syndicate composition on interest rates, getting results consistent with the previous version of the present work (Casolaro et al., 2003).

The rest of the paper is organized as follows. Section 2 describes the institutional characteristics of the syndicated credit market and briefly reviews the recent empirical literature. Section 3 describes the data used in the empirical analysis; section 4 presents the model and the main results and sections 5 and 6 run robustness checks. Section 7 concludes.

2 The market for syndicated credit: institutional characteristics and some evidence to date

A syndicated credit facility is a loan originated by one or more arrangers that are responsible for screening and monitoring. The facility is split into brackets, possibly of different size, and offered to subscribers, who thus take the credit risk on their shares (Rhodes et al., 2000).

Syndicated loans are a hybrid form of private and public debt (see the seminal contribution of Dennis and Mullineaux, 2000). Like standard bank loans, they are much more flexible than public debt placements and are often tailored to the borrower's needs. Like bond issues, they can raise very substantial volumes of funds, and are placed among a potentially large number of institutions at harmonized conditions for all. Credit syndicates also have some features in common with loan sales, but crucially, unlike the latter, they establish a direct relationship between borrower and each subscriber from the outset.

There is overwhelming evidence of the fundamental role played by information asymmetries in shaping credit syndicates. Syndication is more likely when borrowers are more transparent, more closely linked to the arranger and less risky (Dennis and Mullineaux, 2000). The arranger's share is smaller when borrowers are less risky (Simons, 1993; Dennis and Mullineaux, 1994 and 2000; Lee and Mullineaux, 2004 and Jones et al., 2005) and when public information on them is available (Dennis and Mullineaux, 2000). The share retained is also smaller when arrangers have stronger links with the borrower or better reputation (Dennis and Mullineaux, 1994 and 2000; Lee and Mullineaux, 2004) and in countries where creditor rights and legal enforcement are stronger (Esty and Megginson, 2003). Finally, the response of borrowers' stock prices to the granting of a syndicated loan is a decreasing function of the number of lenders (Preece and Mullineaux, 1996).

Sufi (2007) observes that "when borrowing firms require more intense due diligence and monitoring (by a variety of measures) the lead arranger (informed lender) retains a larger share of the loan and forms a more concentrated syndicate". Since the lead arranger typically retains less of the loan when it has an information advantage over the other subscribers, Sufi also concludes that the *ex-ante* adverse selection problems are practically negligible and the correlation between opaqueness and concentration in credit syndicates is due mainly to *ex-post* moral hazard.

A less abundant strand of literature focuses on how syndication affects the interest rate charged. Angbazo et al. (1998) and Dennis et al. (2000) report evidence that rates are lower on syndicated facilities than on comparable loans by a single institution, consistent with a risk diversification effect in bank portfolios. Angbazo et al. (1998) also find that spreads on syndicated highly leveraged transaction loans are smaller when the arranger retains the largest share among all providers, consistent with a certification effect. Finally, Ivashina (2005) studies the relationship between retained share and interest rate in a framework similar to ours, while carefully addressing some potential problems of endogeneity. She uses two instruments for the share of the facility retained by the arranger: the change in the loss volatility of the arranger's portfolio induced by the additional loan, calculated from industry-level data on default correlations, and the bank's lending limit. Her results are consistent with those of the previous version of our present work (Casolaro et al., 2003).

3 Data and Summary Statistics

The empirical analysis is based on Loanware, a commercial data set by Dealogic Capital Data that records the large majority of lending transactions on which public information is available. We use data on 14,121 credit facilities around the world organized by a single arranger between 1990 and 2001 in which the interest rate is expressed as a spread over LIBOR.

Data on the shares of the credit facility retained by the arranger and subscribed by each provider are only available for 2,951 syndicates. Borrowers' balance-sheet data are obtained from Worldscope and those on stock prices from Datastream, both provided by Thomson Financial. These data are only available for 1,072 syndicated facilities granted to listed companies.

We report all results for both the samples for which the share of the facility retained by the arranger is known, i.e. both including and excluding borrowers' characteristics. We check that the coefficients of the common variables estimated for the larger sample – that including the facilities for which the portions of individual subscribers' are not known – are similar to those of the two narrower specifications.

Table 1 presents the summary statistics for the three samples. The credit facilities range in size from $200,000 to $15 billion and the distribution is skewed to the left: the mean is \$165 million and the median only \$65 million. The average spread on syndicated loans is 162 basis points over LIBOR, with a standard deviation of 96 basis points. The drawn return, which is the annual return (excluding up-front fees) that will accrue to a senior provider if the facility is fully drawn throughout its life, is just 1 basis point higher. The average maturity is slightly less than 4 years, with a lower median of just 3 years.

The statistics for the 2,951 contracts for which the share retained by the arranger and those subscribed by the individual participants are known are quite similar to those of the larger sample (panel B). On average, 30 per cent of the facility is retained by the arranger and 22 per cent of the remainder is subscribed by each provider. The summary statistics for the 1,072 contracts for which the borrowers' characteristics are also available are also not too dissimilar. These facilities are larger, an average of \$194 million, and their average spread over LIBOR (131 basis points) is 31 basis points lower than in the larger sample (panel C). However, the mean shares subscribed by the arranger and the providers are similar to those of the larger sample.

Consistent with Sufi (2007), the characteristics of loans that are likely to require more intense monitoring and due diligence diverge in some respects from the average. Smaller loans have a larger share retained by the arranger, higher interest rates, shorter duration, and typically fewer providers. Borrowers that accede to the syndicate market for the first time have significantly smaller leverage, but their loans are only slightly smaller, carry interest rates just a few basis points higher and have a retained share only slightly smaller than average. Finally, facilities that are used for defensive purposes in corporate control contests and thus require more intense monitoring are smaller, with slightly lower interest rates and a retained share similar to that of the average of the loans for which the purpose is known, but their borrowers have a greater leverage.

4 Certification Effects in the Pricing of Syndicated Credit

As the theoretical literature suggests, delegated monitors can mitigate the information problems by contributing more of their own assets to the overall funding (Leland and Pyle, 1977). In lending syndicates, arrangers can alleviate the problems by retaining a larger share of the credit facility, in this way certifying the value of their screening and their commitment to careful monitoring and due diligence. More effective certification by the arranger makes the other participants more willing to subscribe their brackets, thus lowering the interest rate. The empirical model presented in this section is designed to test whether interest rates on syndicated facilities are in fact a decreasing function of the share retained by the arranger.

4.1 The empirical model

The general specification that we test is the following:

$$i_{ijt} = a + ß\ retained_{ijt} + ?\ X_{ijt} + d\ Z_{jt} + ?\ T_t + e_{ijt} \qquad (1)$$

where i_{ijt} is the interest rate on a credit facility granted by arranger i to borrower j at time t, $retained_{ijt}$ is the logarithm of the share of the facility retained by the arranger, X_{ijt} is the set of control characteristics of the credit facility and of the syndicate structure, Z_{jt} is the set of control characteristics of the borrower j, T_t are time dummies and e_{ijt} is a white noise error term. The coefficient we are mainly interested in is *ß*, measuring the effect on the interest rate of the certification provided by arrangers that retain a larger share of the loan. The model is estimated by ordinary least squares. Robust standard errors are calculated using the procedure suggested by White (1980) and allowing for correlation between observations in each country (i.e., standard errors are clustered for all observations in the same country).

A potential drawback of estimating such a relationship in a reduced-form regression is that the syndicate structure and the interest rate are likely to be determined jointly. We deal with this problem by including a large number of controls for the direct effect on the rate of loan, borrower and lender characteristics. In selecting the factors that may influence interest rates, we go along with the previous literature, interpreting the loan contract as a contingent claim that can be valued by option pricing techniques (Smith, 1980).

In particular, our loan-specific controls are the size and the duration of the loan plus a large set of dummies for purpose, rating, currency, launch-market, renegotiations, presence of collateral, presence of options allowing time extensions, possibility of selling a share of the loan on the secondary market, and privately placed deals (club deals).

As borrower characteristics we include size (measured by net sales), leverage (the ratio between total debt and common equity) profitability (measured by operating profit margin, i.e., earnings before interest, taxes, dividends and amortization, EBITDA) and nationality.[1] For listed firms we also include the stock price volatility in the month before the facility is granted. In seeking for the best specification, we also verified that the stocks' betas and the Sharpe ratios had no other significant effects.

We also include an additional measure of syndicate concentration, the average share of the loan subscribed by each provider, and a proxy for the arranger's reputation, measured by a dummy for the three banks with the largest shares of the

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[1] Carey and Nini (2007) show that interest rate spreads on syndicated loans have strong market- and country-specific components. For this reason, in the empirical analysis we control for country-specific effects and run some robustness checks on a sample limited to US loans.

market for syndicated credit facilities, totaling nearly half the overall market (the fourth-largest has less than a 2 per cent share). Finally, we use time dummies to account for common macroeconomic characteristics.

Our controls still might not completely overcome the possibility of a correlation between the share of the loan retained by the arranger and omitted measures of borrower creditworthiness, which would directly affect the spread. If this were so, our estimates would suffer from an endogeneity bias. In fact, however, not only riskier loans carry higher interest rates, they also have larger retained shares (see, e.g., Simons, 1993, Lee and Mullineaux, 2004, and Sufi, 2007). The potential bias induced by not fully accounting for riskiness is therefore positive, working not in favor but against our ability to identify the certification effect. Further, we also estimate the model for the sample of borrowers that are least likely to benefit from the certification effect, in that their balance sheets are already public. This introduces an additional potential bias against the identification of the certification effect.

4.2 The results of the econometric analysis

Test variable. Panel A of Table 2 reports the results of the analysis on the sample of 14,121 credit syndicates for which data on the shares subscribed by individual participants are not available. Panel B reports the results for the 2,951 syndicates for which such information is known and Panel C for the 1,072 for which borrowers' characteristics are known. Even after the introduction of the additional controls, the coefficients on the variables common to the three specifications are not far different, indirectly confirming the robustness of the specification. In all cases the predictive power of the regression is fairly good, with corrected R-squares ranging from 0.42 for the largest sample, to 0.60 for the smallest sample, including a larger set of controls.

The results in panels B and C show that the degree of certification provided by the arranger has a significant effect on the interest rate. Not controlling for borrowers' characteristics, the coefficient of the logarithm of the share of the facility retained by the arranger is equal to -7.4 and significantly different from zero at the 1 per cent level. Conditioning on borrowers' characteristics, the effect is slightly larger, with a coefficient of -7.9, although the decrease in sample size reduces the absolute value of the coefficient when the additional controls are not included. Using the smaller sample and including all controls, an arranger that increases its retained share by one standard deviation from the mean, from 29 to 47 per cent (see Table 1), narrows the spread over LIBOR by almost 4 basis points.

The results support our hypothesis that arrangers can mitigate agency problems within syndicates by retaining a larger share of the loan, thereby implicitly guaranteeing the accuracy of their screening, monitoring and due diligence activities.

Control variables. The coefficient of the share of the credit facility subscribed by each provider (expressed in log value) is positive and significantly different from zero at the 5 per cent level in the specification without borrowers' controls, which is consistent with Sufi (2007). The coefficient is still positive but not significantly different from zero in the smaller sample of facilities for which borrower information is available, possibly because the implicit certification effect is less pronounced for these more transparent, listed borrowers.

The effect of reputation, proxied by the dummy for the three arrangers with the largest shares, is only borderline significant at the 10 per cent level in the larger sample and is not significant for firms whose balance-sheet information is readily available. Probably the reputation for ability to perform screening, monitoring, and due diligence is offset by these banks' power to exploit their market power and charge higher interest rates. For listed companies, the coefficient of reputation is no longer significant, possibly because in this case the stronger certification provided by the banks with better reputations is less relevant.

The coefficients of the other control variables are consistent with the findings of the literature on the determinants of interest rates on bank loans. Larger loans carry lower rates because they are granted to larger borrowers, which have lower default risk, greater bargaining power and more transparent financial conditions. Borrowers whose financial condition is more solid (lower leverage and higher EBITDA) and whose stock price volatility is lower are also less risky and so are charged lower interest rates. Consistent with the theoretical models of Flannery (1986) and Diamond (1991), interest rates are an increasing function of duration, the only exception being the few loans in our sample with a maturity longer than 60 months, the rates on which are similar to that on short-term facilities. Renegotiations of existing facilities have interest rates similar to all the others. Privately placed facilities (club deals) have lower interest rates, possibly because they are underwritten within groups of borrowers with stronger relationships, where agency problems are less serious. Credit facilities in which the subscribers are allowed to transfer part of the loan in the secondary market have relatively lower interest rates, in harmony with the hypothesis that this option favors lenders and may harm the borrower. The existence of an option to extend size or maturity, which favors the borrower and should therefore increase the cost of the loan, is instead found to lower the interest rate significantly, presumably because these options are made available to prime borrowers. Similarly, as has been found by Berger and Udell (1990) and John et al. (2003), among others, interest rates on secured loans are on average 30 basis points higher than on unsecured loans, supporting the thesis that banks require guarantees from riskier borrowers.[2]

4.3 Robustness checks

To check for robustness we estimate three additional specifications (results available from the authors upon request).

First, measuring the cost of the facility as the annual return that will accrue to a senior provider if the facility is fully drawn throughout its life (i.e., the drawn return) and

[2] The unreported control variables follow these patterns. The time dummies match the evolution of the syndicated loan market in the period from 1990 to 2001, as described by Rhodes et al. (2000). In the early '90s we observe an increase in interest rates, possibly due to the surge in risk during the economic recession in most developed countries and the losses incurred by major US banks. In the central part of the decade banks increased their capital, favoring an expansion in credit supply that resulted in years of declining rates. Starting from 1998, the strong increase in M&A activity and the effects of the Asian financial crisis caused a new surge in interest rates that lasted until 2001. As expected, loans with better credit ratings have lower interest rates. The difference in the interest rates between A and CC rated is in the order of 100 basis points. Facilities granted for refinancing, debt repayment and DIP financing exhibit a positive spread with respect to loans for other purposes.

therefore including all fees, except for those paid up-front, the results are almost identical to those reported above.[3]

Second, following the suggestion of a referee, we checked that our results are not affected by the fact that the other non-price terms (e.g., collateral, maturity, loan size, etc.) are determined together with the retained share, which induces a potential endogeneity bias. Excluding these controls, the coefficients are very close to those of Table 2, confirming that the bias is not substantial.

Finally, in order to control for potential endogeneity of the share of the facility retained by the arranger, we instrumented it with lender-specific fixed effects. In this case the coefficients are higher than in the ordinary least squares regression, confirming our intuition that, if anything, the potential endogeneity bias works against our findings.

5 Facilities requiring more intense due diligence and monitoring

If the negative effect of the retained share on the interest rate is due to a more credible commitment to monitoring and due diligence, then the coefficient should be greater in

[3] Information on up-front fees is available for fewer than ten contracts in our sample, but Angbazo et al. (1998) show that up-front fees and interest rates are complements, not substitutes. Hence, if banks normally charge lower interest rates in order to gain higher fees, their inclusion in the lenders' return would further strengthen our results.

absolute value for loans that require more intensive monitoring. To pin this mechanism down, we conduct a number of robustness checks, splitting the sample along dimensions related to the importance of the informational problems.

The first split is with respect to the size of the facility, because larger loans are typically granted to larger and more transparent borrowers (Berger and Udell, 2002, and Moerman, 2006). Following the convention of Gande et al. (1999), among others, we define small facilities as under $75 million. Panel A of Table 3 shows that for smaller facilities the coefficient of the retained share is -13.8, while for larger facilities it is -2.8. Both coefficients are statistically significant, and the difference between them is also significantly different from zero at the 5 per cent level. When the controls for borrowers' characteristics are included, the difference becomes even sharper and different from zero at the 1 per cent level. Similar results were found in an unreported regression in which we split the sample with respect to the size of the borrower.

The second split is with respect to the degree of activity of the borrowers in the syndicated credit market, because new entrants are less well known to potential participants, which amplifies the informational problems (Sufi, 2007). Panel A of Table 4 shows that for borrowers new to the syndicated market, the coefficient of the retained share is -10.1, while for returning borrowers it is smaller to two-thirds, -3.3. Because of the large standard error in the estimation of the coefficient for new borrowers, the difference between the coefficients in the sub-samples is significantly different from zero only at the 21 per cent level. Including borrowers' characteristics again improves the precision of the estimates, and the difference between the two coefficients is significantly different from zero at the 1 per cent level (panel B).

Finally, we consider a third sample split, with respect to the purpose of the facility, because loans for debt refinancing and recapitalization are usually used for defense in control contests and so need more intense monitoring (Denis, 1990). Table 5 shows that for facilities obtained for these purposes, the coefficient of the retained share is -7.7, as against -3.4 for all other purposes. The difference in this case is significant at the 1 per cent level (panel A). If we condition also on borrower characteristics, the difference turns out to be statistically insignificant, because of the large standard error in the estimate of the coefficient of loans for purposes other than refinancing and debt repayment.

Overall, the evidence confirms the hypothesis that the certification provided by an arranger of a syndicated facility is more important in the case of credit granted to new and small borrowers, which are typically more opaque and riskier, and for loans that require more intense due diligence and monitoring.

6 Effects on Stock Returns

When they retain a larger share of a credit facility, arrangers provide information to the other members of the syndicate. In principle, this information could be transmitted outside the syndication, to other markets. To test this hypothesis, we measure the announcement effect of syndicated loans on the stock market in relation to the retained share.

Quite an abundant literature has shown that borrowers' stock prices react positively to loan announcements (see, among many, James, 1987; Slovin et al., 1993; Best and Zhang, 1993; Lummer and McConnel, 1992; Billet et al., 1995; Gande and Saunders, 2006). Focusing specifically on syndicated loans, Preece and Mullineaux (1996) find that the effect is smaller when the number of lenders is larger. In this framework, another testable implication of the certification hypothesis we advance here is that the announcement effect is an increasing function of the share retained by the arranger.[4]

[4] We thank a referee for suggesting this test.

To test this hypothesis we have calculated the average cumulated abnormal returns (ACARs) on the next day after the announcement of the deal (as published by Loanware) and on that day and the following one. The announcement effect is smaller for facilities in which the arranger has retained less than the median portions (-0.22 and -0.10, respectively for one and two days' ACARs), larger for those in which it has retained more than the median portions (0.11 and 0.12, respectively), and larger still for those in which the arranger's retained portion is above the 90^{th} percentile (0.72 and 1.32).[5] In the case of facilities with a retained share above the 90^{th} percentile, the Z-statistics, computed using the methodology of Campbell et al. (1997, chapter 4), are positive and significantly different from zero at the 5 per cent level for ACARs calculated on the day of the announcement and at the 1 per cent level for those calculated on the announcement day and the following one.

In order to account for the fact that the effect of the announcement on the borrowers' stock price is likely to depend also on loan and borrower characteristics, we have estimated the following regression:

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[5] As it is customary in the literature, we calculate CARs as differences of the actual share price with respect to the value predicted by a market model estimated on the interval T_0–150, T_0–30 (where T_0 is the announcement date), using the appropriate market index for each country (e.g., Composite S&P500 for the US).

$$CAR_{ijt} = a + ß\ retained_{ijt} + ?\ X_{ijt} + d\ Z_{jt} + ?\ T_t + e_{ijt} \qquad (2)$$

where CAR_{ijt} is the market-adjusted abnormal return for the share price of borrower j at time t and all other variables are as in equation (1), with the inclusion of the interest rate on the credit facility expressed as a spread over the LIBOR as an additional explanatory variable.

The coefficient of the share retained by the arranger in the regression for the average abnormal returns on the day following the announcement is 0.55 (Table 6, panel A) and that in the regression for ACARs for the day of the announcement and the following day is 0.32 (panel B); both are significantly different from zero at the 1 per cent level.

These results not only further sustain our main hypothesis, they also suggest that the certification provided by the arrangers spreads outside the syndication, to other financial market participants**.**

7 Conclusion

We have run a direct test of banks' unique ability to mitigate informational asymmetries, by verifying that syndicated loans in which a larger share of the facility is retained by the arranger are judged as less risky by finance providers, and therefore carry lower interest rates. Following the predictions of Gorton and Pennacchi (1995) for loan sales, we have assumed that the degree of certification provided by the arranger is an increasing function of the share of the facility that it retains: the larger the share of the credit risk held by the arranger, the greater its incentive to evaluate and monitor the borrower.

Our empirical results confirm the certification effect, showing that syndicated facilities in which the arranger retains a larger share have lower interest rates. Moreover, the effect is more valuable for loans that require more intense due diligence and monitoring: those that are smaller, that are used for debt refinancing and recapitalization, or that go to smaller and less well known borrowers.

Finally, we have shown that the announcement of a syndicated loan has a positive effect on the borrowers' stock price and that this effect is an increasing function of the share retained by the arranger. This provides evidence that the certification effect is not restricted to the loan syndicate but goes beyond it to the financial markets.

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Table 1

Descriptive Statistics

Panel A refers to all credit facilities with a single arranger and for which the return is expressed as a spread over the London Interbank Offered Rate (LIBOR). Panel B refers to all credit facilities with a single arranger and for which the fraction retained by the arranger is available. Panel C refers to all credit facilities with a single arranger and for which the fraction retained by the arranger and borrowers' characteristics are available. Drawn return is the annual return expressed in basis point over the LIBOR that will accrue to a senior provider if the facility is fully drawn throughout its life. Spread is the margin expressed in basis points over the LIBOR. Amount is expressed in million of US dollars. Number of providers is the number of institutions that have participated in a facility as a provider of funds (including the arranger). Amount per provider is expressed in million of US dollars. The provider's share is the fraction of funds provided on average by the providers (excluding the arranger). The arranger's share is the fraction of funds provided by the arranger. Maturity is expressed in months. Sales and revenues are expressed in millions of US dollars. Leverage is the value of debt over that of common equity. Profitability (EBITDA) is the operating profit margin. Stock price volatility is the daily standard deviation of the stock price in the month before the facility is granted. Borrowers new to the market are those that, in the sample period analyzed, had not previously obtained a syndicated facility.

Variables	Obs.	Median	Mean	Std. Dev.	Min.	Max.
Panel A: All Credit Facilities with a single arranger						
Drawn return	14121	150.0	163.1	95.7	17.0	450.0
Spread	14121	150.0	161.7	95.5	16.6	450.0
Amount	14121	65.0	164.6	424.1	0.2	15000.0
Maturity (months)	12295	36.0	46.6	32.4	1.0	360.0
Panel B: Credit facilities with a single arranger and for which the information on the fraction retained by the arranger is available						
Drawn return	2951	137.5	149.4	93.0	17.0	450.0
Spread	2951	130.0	147.2	92.3	17.0	450.0
Amount	2951	85.0	178.2	408.3	2.8	12000.0
Arranger's share	2951	26.7	30.1	18.7	0.0	96.0
Number of providers	2951	5.0	6.9	6.5	2.0	93.0
Provider's share	2951	18.1	22.4	16.3	0.3	97.3
Maturity (months)	2818	48.0	48.8	28.8	1.0	321.0
Panel C: Credit facilities with a single arranger and for which the information on both the fraction retained by the arranger and borrowers' characteristics are available						
Spread	1072	110.0	130.5	85.4	17.5	450.0
Amount	1072	100.0	194.4	365.4	2.8	5207.0
Arranger's share	1072	25.7	29.0	17.8	1.1	92.1
Number of providers	1072	5.0	7.3	6.4	2.0	49.0
Provider's share	1072	17.2	21.2	15.0	0.3	89.3
Maturity (months)	1027	37.0	44.7	24.3	1.0	240.0
Net Sales or revenues	1072	448	2436	8471	7	121458
Leverage	1072	0.6	1.7	30.2	-130.3	967.4
Profitability (EBITDA)	1072	0.08	0.10	0.10	-0.40	0.67
Stock price volatility	1072	0.38	0.41	0.17	0.00	1.50

Table 1 continued

Variables	Obs.	Median	Mean	Std. Dev.	Min.	Max.
Panel C: Credit facilities with a single arranger and for which the information on both the fraction retained by the arranger and borrowers' characteristics are available						
Small credit facilities (<= $75 million)						
Spread	446	150.0	150.8	82.4	27.5	375.0
Amount	446	43.3	42.9	19.5	2.8	75.0
Arranger's share	446	40.0	39.6	16.4	3.5	87.0
Number of providers	446	3.0	3.6	2.0	2.0	16.0
Provider's share	446	27.1	30.7	15.6	6.0	89.3
Maturity (months)	428	36.0	42.1	22.4	2.0	120.0
Net Sales or revenues	446	244	1655	7244	7	107893
Leverage	446	0.58	0.92	4.72	-82.33	29.81
Profitability (EBITDA)	446	0.07	0.08	0.09	-0.40	0.67
Stock price volatility	446	0.42	0.44	0.16	0.11	1.50
Large credit facilities (> $75 million)						
Spread	626	90.0	116.0	84.5	17.5	450.0
Amount	626	160.0	302.3	447.8	75.8	5207.0
Arranger's share	626	18.7	21.5	14.6	1.1	92.1
Number of providers	626	7.5	9.9	7.1	2.0	49.0
Provider's share	626	12.0	14.4	10.0	0.3	73.6
Maturity (months)	599	48.0	46.5	25.4	1.0	240.0
Net Sales or revenues	626	831	2992	9212	9	121458
Leverage	626	0.66	2.21	39.26	-130.30	967.37
Profitability (EBITDA)	626	0.09	0.11	0.10	-0.33	0.59
Stock price volatility	626	0.36	0.38	0.16	0.00	1.25
Credit facilities to borrowers that are new into the market						
Spread	442	110.0	131.8	86.3	19.5	450.0
Amount	442	90.0	187.1	393.1	2.8	5207.0
Arranger's share	442	25.0	28.7	17.5	2.1	92.1
Number of providers	442	5.0	7.1	6.2	2.0	37.0
Provider's share	442	17.3	21.5	15.1	0.3	88.5
Maturity (months)	423	47.0	47.1	26.4	1.0	240.0
Net Sales or revenues	442	416	2618	10431	9	121458
Leverage	442	0.57	0.34	8.39	-130.30	29.81
Profitability (EBITDA)	442	0.09	0.10	0.09	-0.31	0.48
Stock price volatility	442	0.39	0.41	0.16	0.07	0.97
Credit facilities to borrowers that are not new into the market						
Spread	630	110.0	129.5	84.8	17.5	400.0
Amount	630	100.0	199.5	344.9	4.0	5000.0
Arranger's share	630	26.0	29.3	18.0	1.1	88.5
Number of providers	630	5.0	7.4	6.5	2.0	49.0
Provider's share	630	17.2	20.9	14.9	2.0	89.3
Maturity (months)	604	36.0	43.0	22.6	2.0	126.0
Net Sales or revenues	630	488	2307	6772	7	100330
Leverage	630	0.67	2.61	38.68	-8.78	967.37
Profitability (EBITDA)	630	0.08	0.10	0.10	-0.40	0.67
Stock price volatility	630	0.38	0.41	0.17	0.00	1.50

Table 1 continued

Variables	Obs.	Median	Mean	Std. Dev.	Min.	Max.
Credit facilities for refinancing, debt repayment and debtor in possession (DIP) financing						
Spread	512	125.0	139.4	84.9	17.5	425.0
Amount	512	100.0	198.7	341.3	3.4	5000.0
Arranger's share	512	25.0	28.0	17.6	1.1	88.5
Number of providers	512	5.0	7.7	6.9	2.0	49.0
Provider's share	512	16.7	20.6	15.0	2.0	89.3
Maturity (months)	486	38.0	43.9	21.4	2.0	119.0
Net Sales or revenues	512	432	1853	6438	9	107893
Leverage	512	0.71	2.75	43.44	-130.30	967.37
Profitability (EBITDA)	512	0.08	0.10	0.09	-0.18	0.67
Stock price volatility	512	0.39	0.41	0.17	0.00	1.19
Credit facilities for other purposes (excluding unknown purposes)						
Spread	292	125.0	141.5	91.9	20.0	450.0
Amount	292	101.6	241.9	481.5	3.5	5207.0
Arranger's share	292	23.6	27.7	18.4	2.0	92.1
Number of providers	292	6.0	7.5	5.9	2.0	30.0
Provider's share	292	15.8	20.2	14.8	0.3	77.1
Maturity (months)	285	42.0	46.8	30.4	1.0	240.0
Net Sales or revenues	292	557	3928	13071	11	121458
Leverage	292	0.56	0.54	5.18	-82.33	19.26
Profitability (EBITDA)	292	0.09	0.10	0.11	-0.40	0.48
Stock price volatility	292	0.38	0.42	0.18	0.00	1.50

Table 2

Effect on Spreads

The dependent variable is the interest rate on the syndicated facility expressed as a spread over the London Interbank Offered Rate (LIBOR). Panel A reports the results of estimating equation (1) for the entire sample of facilities with a single arranger. Panel B reports the results of estimating equation (1) for facilities with a single arranger and for which the fraction retained by the arranger is available. Panel C reports the results of estimating equation (1) for facilities with a single arranger and for which both the fraction retained by the arranger and the borrowers' characteristics are available. The arranger's share is the fraction of funds provided by the arranger. The provider's share is the fraction of funds on average provided by a single provider. Top3 is a dummy variable that takes value 1 if the arranger is one of the top 3 leaders in the market. The borrower's size is the value of net sales, expressed in million of US dollars. Leverage is the value of debt over that of common equity. Profitability is measured by the operating profit margin (EBITDA). Stock price volatility is the daily standard deviation of the stock price in the month before the facility is granted. Facility size is expressed in million of US dollars. Renegotiation is a dummy variable that takes value 1 if the facility is a renegotiation of an existing facility and 0 otherwise. Club is a dummy variable that takes value 1 if the loan is sold on a club base and 0 otherwise. Transfer is a dummy variable that takes value 1 if it is possible for a syndicate member to transfer part of the loan on the secondary market and 0 otherwise. Secured is a dummy variable that takes value 1 if the loan is backed by specific assets or revenues of the borrower and 0 otherwise. Extension is a dummy variable that takes value 1 if the facility provides an extension option. Standard errors, clustered for all borrowers in the same country, are reported in parentheses. The symbol *** indicates a significance level of 1 per cent or less; ** between 1 and 5 per cent; * between 5 and 10 per cent.

	Panel A:	Panel B:		Panel C:	
Variables	Entire sample	Sample where the Arranger's share is available		Sample where the Borrowers' characteristics are available	
Arranger's share (log value)			-7.42 ***	-7.13 ***	-7.85 ***
			(2.22)	(1.05)	(1.15)
Provider's share (log value)			6.49 **	4.93	2.18
			(3.14)	(3.46)	(2.79)
Top 3	-6.03 ***	-4.96	-5.09 *	1.08	-0.31
	(1.43)	*(3.10)*	*(3.10)*	(1.51)	(1.52)
Borrower's size (log value)					-6.59 ***
					(1.09)
Borrower's leverage					0.16 ***
					(0.00)
Borrower's profitability					-91.25 ***
					(27.32)
Stock price volatility					108.30 ***
					(7.58)
Facility size (log value)	-11.29 ***	-15.40 ***	-15.67 ***	-13.95 ***	-9.10 ***
	(0.60)	*(1.50)*	*(2.15)*	(1.58)	(1.74)
0-12 Months	-30.17 ***	-30.02 ***	-30.31 ***	-26.73 ***	-20.08 ***
	(2.93)	*(8.37)*	*(8.39)*	(7.25)	(6.72)
12-36 Months	-14.18 ***	-18.49 **	-17.95 **	-11.57 **	-8.93 *
	(2.58)	*(7.46)*	*(7.47)*	(4.66)	(4.50)
36-60 Months	1.41	-2.17	-2.06	-0.78	4.14
	(3.08)	*(7.96)*	*(7.97)*	(6.44)	(6.08)
60+ Months	-9.25	-29.89 **	-28.48 **	-52.17 *	-48.75
	(5.90)	*(12.88)*	*(13.09)*	(26.81)	(30.81)
Renegotiation	13.44	29.77	27.79	-9.79	-8.45
	(11.94)	*(18.51)*	*(19.22)*	(16.15)	(17.75)
Club	-6.46 *	-11.61 *	-11.99 *	-15.60 *	-11.17
	(3.46)	*(6.43)*	*(6.42)*	(8.25)	(10.59)
Transfer	-6.45 ***	-7.34 **	-7.23 **	-7.38 ***	-8.59 ***
	(1.67)	*(3.24)*	*(3.24)*	(1.28)	(1.17)
Extension	-9.55 ***	-17.19 ***	-16.58 ***	-18.31 ***	-15.64 ***
	(2.21)	*(3.71)*	*(3.71)*	(2.07)	(2.16)
Secured	39.20 ***	43.11 ***	42.48 ***	42.18 ***	33.01 ***
	(1.64)	*(3.29)*	*(3.29)*	(2.10)	(2.06)
No. of Observations	14,121	2,951	2,951	1,072	1,072
R-Square	0.419	0.496	0.500	0.539	0.596

Table 3

Effect on Spreads by Size of the Facility

The dependent variable is the interest rate on the syndicated facility expressed as a spread over the London Interbank Offered Rate (LIBOR). Panel A reports the results of estimating equation (1) for facilities with a single arranger and for which the fraction retained by the arranger is available. Panel B reports the results of estimating equation (1) for facilities with a single arranger and for which both the fraction retained by the arranger and the borrowers' characteristics are available. Each Panel reports, respectively, the results for small facilities (below US $75 million) and for large facilities (above US $75 million), and the value of the F-test on the significance of the difference of the coefficients between the two groups. The arranger's share is the fraction of funds provided by the arranger. The provider's share is the fraction of funds on average provided by a single provider. Top3 is a dummy variable that takes value 1 if the arranger is one of the top 3 leaders in the market. The borrower's size is the value of net sales, expressed in million of US dollars. Leverage is the value of debt over that of common equity. Profitability is measured by the operating profit margin (EBITDA). Stock price volatility is the daily standard deviation of the stock price in the month before the facility is granted. Facility size is expressed in million of US dollars. Renegotiation is a dummy variable that takes value 1 if the facility is a renegotiation of an existing facility and 0 otherwise. Club is a dummy variable that takes value 1 if the loan is sold on a club base and 0 otherwise. Transfer is a dummy variable that takes value 1 if it is possible for a syndicate member to transfer part of the loan on the secondary market and 0 otherwise. Secured is a dummy variable that takes value 1 if the loan is backed by specific assets or revenues of the borrower and 0 otherwise. Extension is a dummy variable that takes value 1 if the facility provides an extension option. Standard errors, clustered for all borrowers in the same country, are reported in parentheses. The symbol *** indicates a significance level of 1 per cent or less; ** between 1 and 5 per cent; * between 5 and 10 per cent.

	Panel A:			Panel B:		
Variables	Small Facilities (Less than US $75 million)	Large Facilities (More than US $75 million)	Difference Test (Small vs. Large Facilities)	Small Facilities (Less than US $75 million)	Large Facilities (More than US $75 million)	Difference Test (Small vs. Large Facilities)
Arranger's share (log value)	-13.75 **	-2.80 ***	4.74 **	-21.90 ***	-0.53	25.09 ***
	(5.73)	(0.97)		(4.51)	(0.94)	
Provider's share (log value)	5.68 **	1.78	1.66	9.20 *	-3.19	5.59 **
	(2.32)	(1.73)		(5.05)	(2.65)	
Top 3	-6.99 ***	-3.43 *	2.29	-2.01	-3.99	0.65
	(1.14)	(1.83)		(1.71)	(2.56)	
Borrower's size (log value)				-7.91 ***	-7.47 ***	0.05
				(1.88)	(0.63)	
Borrower's leverage				3.75 **	0.14 ***	4.63 **
				(1.73)	(0.00)	
Borrower's profitability				-4.94	-116.64 ***	2.69
				(76.99)	(17.85)	
Stock price volatility				89.05 ***	115.86 ***	3.61 *
				(14.79)	(4.74)	
Facility size (log value)	-15.20 ***	-11.49 ***	1.61	-12.30 ***	-3.24	16.09 ***
	(3.80)	(2.97)		(2.62)	(1.91)	
0-12 Months	-31.78 ***	-34.79 ***	0.14	-31.39 ***	-18.88 ***	3.83 *
	(7.09)	(2.74)		(4.11)	(4.84)	
12-36 Months	-19.83 ***	-20.70 ***	0.02	-33.72 ***	-6.01 ***	7.04 **
	(3.11)	(3.61)		(9.22)	(1.80)	
36-60 Months	-14.38 ***	2.71	12.11 ***	-5.27	4.40	0.44
	(4.14)	(2.39)		(7.15)	(8.22)	
60+ Months	-2.62	-21.24	0.74		-10.50	
	(16.95)	(15.72)			(19.18)	
Renegotiation	43.91	44.20				
	(35.56)	(26.96)				
Club	-2.48	-22.35 **	0.92	16.14	-21.86 *	4.73 **
	(12.64)	(10.57)		(9.41)	(12.19)	
Transfer	-14.27 ***	-0.87	53.98 ***	-6.43 **	-10.01 ***	1.02
	(2.54)	(2.59)		(2.83)	(1.65)	
Extension	-11.51 ***	-18.32 ***	17.72 ***	-18.74 ***	-14.17 ***	0.03
	(1.18)	(1.66)		(3.98)	(2.11)	
Secured	44.78 ***	38.93 ***	9.42 ***	32.59 ***	33.76 ***	0.01
	(1.21)	(1.35)		(4.80)	(2.47)	
No. of Observations	1,371	1,580		446	626	
R-Square	0,464	0,559		0.595	0.651	

Table 4

Effect on Spreads by Previous Presence in the Market

The dependent variable is the interest rate on the syndicated facility expressed as a spread over the London Interbank Offered Rate (LIBOR). Panel A reports the results of estimating equation (1) for facilities with a single arranger and for which the fraction retained by the arranger is available. Panel B reports the results of estimating equation (1) for facilities with a single arranger and for which both the fraction retained by the arranger and the borrowers' characteristics are available. Each Panel reports, respectively, the results for borrowers that are new into the syndicated credit market small and for the other borrower, and the value of the F-test on the significance of the difference of the coefficients between the two groups. The arranger's share is the fraction of funds provided by the arranger. The provider's share is the fraction of funds on average provided by a single provider. Top3 is a dummy variable that takes value 1 if the arranger is one of the top 3 leaders in the market. The borrower's size is the value of net sales, expressed in million of US dollars. Leverage is the value of debt over that of common equity. Profitability is measured by the operating profit margin (EBITDA). Stock price volatility is the daily standard deviation of the stock price in the month before the facility is granted. Facility size is expressed in million of US dollars. Renegotiation is a dummy variable that takes value 1 if the facility is a renegotiation of an existing facility and 0 otherwise. Club is a dummy variable that takes value 1 if the loan is sold on a club base and 0 otherwise. Transfer is a dummy variable that takes value 1 if it is possible for a syndicate member to transfer part of the loan on the secondary market and 0 otherwise. Secured is a dummy variable that takes value 1 if the loan is backed by specific assets or revenues of the borrower and 0 otherwise. Extension is a dummy variable that takes value 1 if the facility provides an extension option. Standard errors, clustered for all borrowers in the same country, are reported in parentheses. The symbol *** indicates a significance level of 1 per cent or less; ** between 1 and 5 per cent; * between 5 and 10 per cent.

	Panel A:			Panel B:		
Variables	New Borrower into the Market	Other Borrowers	Difference Test	New Borrower into the Market	Other Borrowers	Difference Test
Arranger's share (log value)	-10.07 *	-3.34 ***	1.57	-18.62 ***	-4.43 **	31.44 ***
	(5.41)	(0.71)		(3.15)	(1.56)	
Provider's share (log value)	10.37 ***	3.42 **	7.84 ***	0.90	4.38 **	0.33
	(2.38)	(1.58)		(5.82)	(1.68)	
Top 3	-6.46 ***	-1.03	5.14 **	2.13	-2.84 **	2.01
	(1.57)	(2.28)		(3.02)	(1.11)	
Borrower's size (log value)				-4.19	-7.70 ***	1.52
				(2.71)	(0.48)	
Borrower's leverage				0.89 ***	0.13 ***	40.62 ***
				(0.13)	(0.01)	
Borrower's profitability				-47.67 **	-128.79 ***	8.12 ***
				(22.57)	(30.52)	
Stock price volatility				109.26 ***	101.69 ***	0.45
				(9.28)	(5.00)	
Facility size (log value)	-14.59 ***	-14.66 ***	0.00	-12.42 ***	-10.06 ***	0.77
	(3.56)	(0.87)		(3.46)	(1.32)	
0-12 Months	-25.94 ***	-30.48 ***	0.50	-41.04 ***	-13.16 **	24.16 ***
	(4.06)	(4.40)		(3.54)	(4.87)	
12-36 Months	-3.22	-23.98 ***	20.66 ***	-19.45 ***	-6.26 ***	20.62 ***
	(3.44)	(2.38)		(3.36)	(1.98)	
36-60 Months	11.92 ***	-4.00 *	10.67 ***	-0.66	0.63	0.12
	(3.65)	(2.27)		(2.93)	(4.74)	
60+ Months	-18.24	-15.77	0.01	-101.85 **		
	(19.39)	(20.39)		(39.28)		
Renegotiation	35.28	2.93	0.34			
	(47.03)	(34.61)				
Club	-9.30	-15.70	0.20	-8.84	-10.81	0.02
	(7.05)	(13.92)		(19.38)	(8.48)	
Transfer	-9.38 ***	-2.56 *	3.12 *	-11.30 ***	-9.16 ***	0.98
	(3.09)	(1.33)		(2.43)	(0.87)	
Extension	-8.91 ***	-22.14 ***	20.29 ***	-7.06	-22.92 ***	9.11 ***
	(2.80)	(0.84)		(4.60)	(2.25)	
Secured	38.03 ***	44.39 ***	8.72 ***	29.78 ***	30.19 ***	0.01
	(1.58)	(1.43)		(3.84)	(1.69)	
No. of Observations	1,511	1,140		442	630	
R-Square	0,514	0,550		0.661	0.632	

Table 5

Effect on Spreads by Loan Purpose

The dependent variable is the interest rate on the syndicated facility expressed as a spread over the London Interbank Offered Rate (LIBOR). Panel A reports the results of estimating equation (1) for facilities with a single arranger and for which the fraction retained by the arranger is available. Panel B reports the results of estimating equation (1) for facilities with a single arranger and for which both the fraction retained by the arranger and the borrowers' characteristics are available. Each Panel reports, respectively, the results for facilities used for refinancing, debt repayment and debt in possession (DIP) financing and for the other facilities with known purpose, and the value of the F-test on the significance of the difference of the coefficients between the two groups. The arranger's share is the fraction of funds provided by the arranger. The provider's share is the fraction of funds on average provided by a single provider. Top3 is a dummy variable that takes value 1 if the arranger is one of the top 3 leaders in the market. The borrower's size is the value of net sales, expressed in million of US dollars. Leverage is the value of debt over that of common equity. Profitability is measured by the operating profit margin (EBITDA). Stock price volatility is the daily standard deviation of the stock price in the month before the facility is granted. Facility size is expressed in million of US dollars. Renegotiation is a dummy variable that takes value 1 if the facility is a renegotiation of an existing facility and 0 otherwise. Club is a dummy variable that takes value 1 if the loan is sold on a club base and 0 otherwise. Transfer is a dummy variable that takes value 1 if it is possible for a syndicate member to transfer part of the loan on the secondary market and 0 otherwise. Secured is a dummy variable that takes value 1 if the loan is backed by specific assets or revenues of the borrower and 0 otherwise. Extension is a dummy variable that takes value 1 if the facility provides an extension option. Standard errors, clustered for all borrowers in the same country, are reported in parentheses. The symbol *** indicates a significance level of 1 per cent or less; ** between 1 and 5 per cent; * between 5 and 10 per cent.

	Panel A:			Panel B:		
Variables	Debt Repayment	Other Facilities	Difference Test	Debt Repayment	Other Facilities	Difference Test
Arranger's share (log value)	-7.65 ***	-3.44 **	9.27 ***	-10.85 ***	-4.06	0.89
	(1.33)	(1.58)		(2.12)	(6.88)	
Provider's share (log value)	5.13 **	6.06 *	0.05	-0.19	-6.62 **	4.02 *
	(2.02)	(3.21)		(2.65)	(2.53)	
Top 3	-8.14 **	0.97	2.32	-2.35	28.70 ***	75.39 ***
	(3.70)	(3.28)		(1.64)	(3.53)	
Borrower's size (log value)				-1.21	-13.78 ***	13.57 ***
				(3.07)	(2.29)	
Borrower's leverage				0.15 ***	-0.50 ***	35.36 ***
				(0.01)	(0.13)	
Borrower's profitability				-79.81 **	-104.07	0.22
				(33.90)	(63.69)	
Stock price volatility				130.44 ***	77.69 ***	7.16 **
				(5.77)	(21.43)	
Facility size (log value)	-14.99 ***	-13.82 ***	0.30	-13.43 ***	-9.15 *	0.30
	(2.01)	(2.97)		(4.24)	(4.41)	
0-12 Months	-31.65 ***	-34.56 ***	0.07	-46.64 ***	-9.75	30.31 ***
	(3.97)	(9.87)		(3.19)	(8.71)	
12-36 Months	-8.07 **	-26.22 ***	6.80 **	-17.45 ***	10.44	20.97 ***
	(2.95)	(5.98)		(2.59)	(6.27)	
36-60 Months	11.10 **	-11.52 *	7.95 ***	2.50	3.84	0.03
	(4.08)	(6.74)		(2.61)	(7.27)	
60+ Months	-60.75 ***	-46.62 ***	0.39		27.76	
	(9.41)	(17.04)			(51.05)	
Renegotiation	29.29			-84.63 ***		
	(23.52)			(20.69)		
Club	0.78	-22.81 **	2.19	-20.54	-4.31	2.06
	(13.45)	(8.78)		(21.80)	(15.12)	
Transfer	-4.36 ***	-13.07 **	2.53	-9.25 ***	-10.54 *	0.12
	(0.59)	(5.70)		(2.29)	(5.27)	
Extension	-5.73 ***	-36.52 ***	120.08 ***	-9.56 ***	-20.54 **	3.09 *
	(1.03)	(3.23)		(1.49)	(7.36)	
Secured	44.31 ***	38.78 ***	1.87	41.93 ***	20.67 ***	34.68 ***
	(1.40)	(3.72)		(1.60)	(3.69)	
No. of Observations	1,286	913		512	292	
R-Square	0.502	0.604		0.633	0.710	

Table 6

Borrower's Average Cumulative Abnormal Returns – Multivariate analysis

Panel A reports the results of estimating equation (2) for cumulative abnormal return (CAR) in the day following the announcement [1]; panel B for average cumulative abnormal return (ACAR) in the day of the announcement and the following day [0,1]. CARs are calculated as differences of the actual share price with respect to the predicted price obtained from a market model estimated on the interval T_0–150, T_0–30 (where T_0 is the announcement date). Spread is the is the interest rate on the credit facility expressed as a spread over the London Interbank Offered Rate (LIBOR). The arranger's share is the fraction of funds provided by the arranger. The provider's share is the fraction of funds on average provided by a single provider. Top3 is a dummy variable that takes value 1 if the arranger is one of the top 3 leaders in the market. The borrower's size is the value of net sales, expressed in million of US dollars. Leverage is the value of debt over that of common equity. Profitability is measured by the operating profit margin (EBITDA). Stock price volatility is the daily standard deviation of the stock price in the month before the facility is granted. Facility size is expressed in million of US dollars. Renegotiation is a dummy variable that takes value 1 if the facility is a renegotiation of an existing facility and 0 otherwise. Club is a dummy variable that takes value 1 if the loan is sold on a club base and 0 otherwise. Transfer is a dummy variable that takes value 1 if it is possible for a syndicate member to transfer part of the loan on the secondary market and 0 otherwise. Secured is a dummy variable that takes value 1 if the loan is backed by specific assets or revenues of the borrower and 0 otherwise. Extension is a dummy variable that takes value 1 if the facility provides an extension option. Standard errors, clustered for all borrowers in the same country, are reported in parentheses. The symbol *** indicates a significance level of 1 per cent or less; ** between 1 and 5 per cent; * between 5 and 10 per cent.

Average Cumulative Abnormal Returns	Event Window			
	[1]		[0,1]	
Spread	0.002	*	0.004	***
	(0.001)		(0.001)	
Arranger's share (log value)	0.55	***	0.32	***
	(0.10)		(0.10)	
Provider's share (log value)	-0.68	***	-0.22	*
	(0.07)		(0.11)	
Top 3	0.39	***	0.01	
	(0.07)		(0.10)	
Borrower's size (log value)	0.07		0.03	
	(0.07)		(0.08)	
Borrower's leverage	0.004	***	-0.004	***
	(0.000)		(0.001)	
Borrower's profitability	0.48		3.02	
	(1.28)		(1.93)	
Stock price volatility	-0.29		0.27	
	(0.30)		(0.46)	
Facility size (log value)	-0.14	*	-0.15	*
	(0.07)		(0.09)	
0-12 Months	0.63	***	1.03	***
	(0.20)		(0.36)	
12-36 Months	0.83	***	0.61	**
	(0.13)		(0.25)	
36-60 Months	1.59	***	1.71	***
	(0.15)		(0.41)	
60+ Months	2.04		2.75	
	(1.50)		(1.64)	
Renegotiation	-6.30	***	-6.92	***
	(1.26)		(2.29)	
Club	0.44		0.22	
	(0.57)		(0.86)	
Transfer	-0.02		-0.32	***
	(0.06)		(0.05)	
Extension	0.23	***	0.45	***
	(0.07)		(0.16)	
Secured	-0.29	***	-0.61	***
	(0.08)		(0.15)	
No. of Observations	1,003		1,003	
R-Square	0.116		0.122	

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FINANCIAL INTERMEDIATION

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Andrew Winton

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ABSTRACT

The savings/investment process in capitalist economies is organized around financial intermediation, making them a central institution of economic growth. Financial intermediaries are firms that borrow from consumer/savers and lend to companies that need resources for investment. In contrast, in capital markets investors contract directly with firms, creating marketable securities. The prices of these securities are observable, while financial intermediaries are opaque. Why do financial intermediaries exist? What are their roles? Are they inherently unstable? Must the government regulate them? Why is financial intermediation so pervasive? How is it changing? In this paper we survey the last fifteen years' of theoretical and empirical research on financial intermediation. We focus on the role of bank-like intermediaries in the savings-investment process. We also investigate the literature on bank instability and the role of the government.

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I. Introduction

Financial intermediation is a pervasive feature of all of the world's economies. But, as Franklin Allen (2001) observed in his AFA Presidential Address, there is a widespread view that financial intermediaries can be ignored because they have no real effects. They are a veil. They do not affect asset prices or the allocation of resources. As evidence of this view, Allen pointed out that the millennium issue of the Journal of Finance contained surveys of asset pricing, continuous time finance, and corporate finance, but did not survey financial intermediation. Here we take the view that the savings-investment process, the workings of capital markets, corporate finance decisions, and consumer portfolio choices cannot be understood without studying financial intermediaries.

Why are financial intermediaries important? One reason is that the overwhelming proportion of every dollar financed externally comes from banks. Table 1, from Mayer (1990), is based on national flow-of-funds data. The numbers are percentages, so in the United States for example, 24.4% of firm investment was financed with bank loans during the 1970 - 1985 period. Bank loans are the predominant source of external funding in all the countries. In none of the countries are capital markets a significant source of financing. Equity markets are insignificant. In other words, if finance department staffing reflected how firms actually finance themselves, roughly 25 percent of the faculty would be researchers in financial intermediation and the rest would study internal capital markets.

As the main source of external funding, banks play important roles in corporate governance, especially during periods of firm distress and bankruptcy. The idea that banks "monitor" firms is one of the central explanations for the role of bank loans in corporate finance. Bank loan covenants can act as trip wires signaling to the bank that it can and should intervene into the affairs of the firm. Unlike bonds, bank loans tend not to be dispersed across many investors. This facilitates intervention and renegotiation of capital structures. Bankers are often on company boards of directors. Banks are also important in producing liquidity by, for example, backing commercial paper with loan commitments or standby letters of credit.

Consumers use bank demand deposits as a medium of exchange, that is, writing checks, using credit cards, holding savings accounts, visiting automatic teller machines, and so on. Demand deposits are securities with special features. They can be denominated in any amount; they can be put to the bank at par (i.e., redeemed at face value) in exchange for currency. These features allow demand deposits to act as a medium of exchange. But, the banking system must then "clear" these obligations. Clearing links the activities of banks in clearinghouses. In addition, the fact that consumers can withdraw their funds at any time has, led to banking panics in some countries, historically, and in many countries more recently.

Banking systems seem fragile. Between 1980 and 1995, thirty-five countries experienced banking crises, periods in which their banking systems essentially stopped functioning and these economies entered recessions. (See Demirgüç-Kunt, Detragiache, and Gupta (2000), and Caprio and Klingebiel (1996).) Because bank loans are the main source of external financing for firms, if the banking system is weakened, there appear to be significant real effects (e.g., see Bernanke (1983), Gibson (1995), Peek and Rosengren (1997, 2000)). The relationship between bank health and business cycles is at the root of widespread government policies concerning bank regulation and supervision, deposit insurance, capital requirements, the lender-of-last-resort role of the central bank, and so on. Clearly, the design of public policies depends on our understanding of the problems with intermediaries. Even without a collapse of the banking system, a credit crunch has sometimes been alleged to occur when banks tighten lending, possible due to their own inability to obtain financing. Also, the transmission mechanism of monetary policy may be through the banking system.

Basically, financial intermediation is the root institution in the savings-investment process. Ignoring it would seem to be done at the risk of irrelevance. So, the viewpoint of this paper is that financial intermediaries are not a veil, but rather the contrary. In this paper, we survey the results of recent academic research on financial intermediation.

In the last fifteen years, researchers have made significant progress in understanding the roles of financial intermediaries. These advances are not only theoretical. Despite a lack of data as rich as stock market prices, significant empirical work on intermediaries has been done. All of this work has contributed to a deeper appreciation of the role of banks in the savings-investment process and corporate finance, of the issues in crises associated with financial intermediation, and of the functioning of government regulation of intermediation. We concentrate on research addressing why bank-like financial intermediaries exist, and the implications for their stability. By bank-like financial intermediaries, we mean firms with the following characteristics:

1. They borrow from one group of agents and lend to another group of agents.
2. The borrowing and lending groups are large, suggesting diversification on each side of the balance sheet.
3. The claims issued to borrowers and to lenders have different state contingent payoffs.

The terms "borrow" and "lend" mean that the contracts involved are debt contracts. So, to be more specific, financial intermediaries lend to large numbers of consumers and firms using debt contracts and they borrow from large numbers of agents using debt contracts as well. A significant portion of the borrowing on the liability side is in the form of demand deposits, securities that have the important property of being a medium of exchange. The goal of intermediation theory is to explain why these financial intermediaries exist, that is, why there are firms with the above characteristics.

Others have cited additional important characteristics of bank-like financial intermediaries, but in our view these seem less important. For example, the maturity of the loan contracts is typically longer than the maturity of the debt on the liability side of the balance sheet, but that is essentially the third point above. Also, Boyd and Prescott (1986) assert that financial intermediaries lend to agents whose information set may be different from their own, in particular, would-be borrowers have private information concerning their own credit risk. Although this suggests a clear role for intermediaries, it is not clear that this is a necessary condition.

Empirical observation is the basis for the statement that intermediaries involve large number of agents on each side of the balance sheet and also for the view that the nature of the securities issued to borrowers and lenders are different. On the liability side of the balance sheet, intermediaries often issue a particular security to households, demand deposits, securities that serve as a medium of exchange. On the asset side of the balance sheet, bank loans are not the same as corporate bonds. Moreover, the structure of the bank loans does not mirror the bank's obligations in the form of deposits. Financial intermediaries with the above characteristics correspond most closely to commercial banks, savings and loans, and similar institutions. But, securitization vehicles and conduits also satisfy the above definition, blurring the distinction between intermediated finance and direct finance, a topic we return to below.

There are a number of issues in studying intermediation that are perhaps unique, compared to other areas of finance. First, there are issues of data. While governments often collect an enormous amount of data about banks, for example, in the U.S. there are the Call Reports that provide a massive amount of accounting information about commercial banks, there is a lack of price data. Thus, unlike other areas of finance, there is an almost embarrassing lack of essential information, prices of loans, of secondary loan sales, and so on. Researchers have been creative in finding data, however, as we discuss below. Other periods of history have also been intensively studied. Apparently, more so than other areas of finance, research in financial intermediation is intimately linked with economic history. In addition, other countries offer rich laboratories as banking systems vary across countries to a significant degree.

Second, in the study of financial intermediation, institutions, regulations, and laws are important. Banking systems have been influenced by laws and regulations for hundreds of years and it is difficult to make progress on many issues without understanding the enormous variation in banking system structures across countries and time, which is due to these laws and regulations. This is most apparent in the variety of industrial organization of banking systems around the world and through history. This variation is just beginning to be exploited by researchers and seems a likely area for further work.

Finally, intermediation is in such a constant state of flux that it is not much of an exaggeration to say that many researchers in financial intermediation do not realize that they are engaged in economic history. It is a challenge to determine whether there are important features of intermediation that remain constant across time, or whether intermediation is being fundamentally altered by securitization, loan sales, credit derivatives, and other recent innovations.

The paper proceeds as follows. We begin in Section II by discussing evidence on the uniqueness of banks and theories that seek to motivate the existence and structure of these financial intermediaries. Key issues include monitoring or evaluating borrowers, providing consumption smoothing and other types of liquidity, combining lending and liquidity provision as a commitment mechanism, and the coexistence of banks and markets.

In Section III we focus on the specifics of interaction between banks and borrowers. Key issues include the pros and cons of dynamic bank-borrower relationships, the relationship between loan structure and monitoring and between banking sector structure and monitoring, “credit cycles” and capital constraints, and the role of “non-traditional” bank activities such as equity investment.

In Section IV we focus on banking panics and the stability of the banking system. Key issues include evidence on the incidence of banking panics internationally and historically, the causes of panics, the role of bank coalitions in forestalling panics, whether banks are inherently flawed. Section V concerns bank regulation, deposit insurance, and bank capital requirements. Government intervention into banking is a fairly recent phenomenon, but has come to be a widely accepted role because of concerns about moral hazard problems emanating from deposit insurance. The paradigm of moral hazard is reviewed, with particular focus on the empirical evidence. Corporate governance in banks, capital requirements for banks, and other issues are also reviewed.

Finally, in Section V we summarize where all of this research leaves us, both in terms of our present understanding and in terms of directions for the future.

II. The Existence of Financial Intermediaries

The most basic question with regard to financial intermediaries is: why do they exist? This question is related to the theory of the firm because a financial intermediary is a firm, perhaps a special kind of firm, but nevertheless a firm. Organization of economic activity within a firm occurs when that organizational form dominates trade in a market. In the case of the savings-investment process, households with resources to invest could go to capital markets and buy securities issued directly by firms, in which case there is no intermediation. To say the same thing a different way, nonfinancial firms need not borrow from banks; they can approach investors directly in capital markets. Nevertheless, as mentioned in the Introduction, most new external finance to firms does not occur this way. Instead, it occurs through bank-like intermediation, in which households buy securities issued by intermediaries who in turn invest the money by lending it to borrowers. Again, the obligations of firms and the claims ultimately owned by investors are not the same securities; intermediaries transform claims. The existence of such intermediaries implies that direct contact in capital markets between households and firms is dominated. “Why is this?” is the central question for the theory of intermediation.

Bank-like intermediaries are pervasive, but this may not require much explanation. On the liability side, demand deposits appear to be a unique kind of security, but originally this may have been due to regulation. Today, money market mutual funds may be good substitutes for demand deposits. On the asset side, intermediaries may simply be passive portfolio managers, that is, there may be nothing special about bank loans relative to corporate bonds. This is the view articulated by Fama (1980). Similarly, Black (1975) sees nothing special about bank loans. Therefore, we begin with an overview of the empirical evidence, which suggests that there is indeed something that needs explanation.

A. Empirical Evidence on Bank Uniqueness

What do banks do that cannot be accomplished in the capital markets through direct contracting between investors and firms? There is empirical evidence that banks are special. Some of this evidence also attempts to discriminate between some of the explanations for the existence of financial intermediaries, discussed below.

To determine whether bank assets or liabilities are special relative to alternatives, Fama (1985) and James (1987) examine the incidence of the implicit tax due to reserve requirements. Their argument is as follows. Over time, U.S. banks have been required to hold reserves against various kinds of liabilities. In particular, if banks must hold reserves against the issuance of certificates of deposit (CDs), then for each dollar of CDs issued, the bank can invest less than a dollar. The reserve requirement acts like a tax. Therefore, in the absence of any special service provided by bank assets or bank liabilities, bank CDs should be eliminated by nonbank alternatives. This is because either bank borrowers or bank depositors must bear the tax. Since CDs have not been eliminated, some party involved with the bank is willing to bear the tax. Who is this party? Fama finds no significant difference between the yields on CDs and the yields on commercial paper and bankers acceptances. CD holders do not bear the reserve requirement tax and he therefore concludes that bank loans are special. James revisits the issue and looks at yield changes around changes in reserve requirements and reaches the same conclusion as Fama.

Another kind of evidence comes from event studies of the announcement of loan agreements between firms and banks. Studying a sample of 207 announcements of new agreements and renewals of existing agreements, James (1987) finds a significantly positive announcement effect. This contrasts with non-positive responses to the announcements of other types of securities being issued in capital markets (see James (1987) for the references to the other studies). Mikkelson and Partch (1986) also look at the abnormal returns around the announcements of different type of security offerings and also find a positive response to bank loans.[1] Table 2 provides a summary of the basic set of results. There are two main conclusions to be drawn. First, bank loans are the only instance where there is a significant positive abnormal return upon announcement. Second, equity and equity-related instruments have significantly negative abnormal returns. James (1987) concludes, "…banks provide some special service not available from other lenders" (p. 234).

The results of James are quite dramatic and many researchers followed up on them. Lummer and McConnell (1989) distinguish between new bank loan agreements and revisions to agreements already in place. Further, they classify announcements concerning existing agreements into announcements containing positive information and those containing negative information. This classification is based on whether the terms of the agreement (maturity, interest rate, dollar value, covenants) are revised favorably or unfavorably (some have both favorable revisions in some dimensions and unfavorable revision in others). They find no abnormal return to announcement of new agreements. Favorable renewals have significantly positive abnormal returns, while negative renewals have significantly negative abnormal returns. The strongest negative response comes when the bank initiates a loan cancellation. The strongest positive response is associated with loan renewals where there was previously public information suggesting the loan was in trouble. The results of Lummer and McConnell suggest that the bank is not producing information upon first contact with a borrower. Rather, the bank either learns information later or takes action later, and this is revealed when a loan is renewed or restructured. The results are consistent with the view that a continuing relationship with a bank can signal changes in value to capital markets.

Best and Zhang (1993) confirm Lummer and McConnell (1989). But, with a revised definition of "new" loans, Billet, Flannery, and James (1995) find no significant differences between initiation of loans and loan renewals. Slovin, Johnson, and Glascock (1992) and Hadlock and James (2000) also find no differences.

Slovin, Sushka, and Polonchek (1993) look at an interesting implication of the result that bank loans are somehow different than other securities. If loans are special, in some sense, then when a borrower's bank fails, does that adversely affect that borrower? To address this they examine share price responses of bank borrowers' shares upon the announcement of the failure of their bank, Continental Illinois. If banks are simply passive investors, and their loans are indistinguishable from bonds, then when there is a bank failure, borrowers simply go elsewhere to borrow funds. However, if there is a "customer relationship," then banks acquire private information about their borrowers and the bank's

[1] Slovin, Sushka, and Hudson (1988) find significantly positive announcement abnormal returns associated with the announcement of standby letters of credit. Preece and Mullineaux (1989) find that the reaction to loan agreements with insurance companies is similar to that for bank loan agreements. Also, see Mullineaux and Preece (1996).

failure would mean that this intangible asset is destroyed, causing borrowers losses. Slovin, Sushka, and Polonchek (1993) find that Continental Illinois borrowers incurred significantly negative abnormal returns (- 4.2% annually) during the bank's impending failure. This evidence is consistent with bank relationships being important, an issue discussed further below. Bernanke (1983) essentially argues that crisis in the U.S. banking system during the Great Depression can be viewed in the same way, causing real adverse effects for borrowers. Gibson (1995) studying the effects of the health of Japanese banks finds that investment is thirty percent lower by firms that have a Japanese bank that is weak.

Another area in which banks appear to be different from bondholders' concerns reorganization of firms in financial distress, though this depends on the characteristics of the particular sample studied. Gilson, John, and Lang (1990) find that the likelihood of a successful debt restructuring by a firm in distress is positively related to the extent of that firm's reliance on bank borrowing. The interpretation is that it is easier to renegotiate with a single bank, or small number of banks, than it is with a large number of dispersed bondholders, in which case there are free rider problems. However, Asquith, Gertner, and Scharfstein (1994), and James (1995), find that for firms with public debt outstanding, banks rarely make unilateral concessions to distressed firms. Franks and Torous (1994) study 45 distressed exchanges and 37 Chapter 11 reorganizations during the period 1983 to 1988. Unlike Gilson, John, and Lang (1990), Franks and Torous find that firms that successfully complete exchange offers do not owe significantly more of their long-term debt to banks. Franks and Torous' firms all have publicly traded debt and tend to be larger than the firms in the Gilson, Lang, and John sample. James (1996) partially reconciles some of these conflicting results. He finds that the higher the proportion of total debt held by the bank, the higher the likelihood the bank debt will be impaired, and so the higher the likelihood it participates in the restructuring. Banks do not act unilaterally when the firm has significant public debt outstanding because banks, as senior lenders, would be transferring wealth to the public debt holders in these cases.

In other countries, banks interact with borrowers in different ways than in the United States. Such examples offer another type of evidence on the ability of banks to provide valuable services that cannot be replicated in capital markets. Hoshi, Kashyap, and Scharfstein (1990a, b, 1991) find that firms in Japans in keiretsu, that is, firms with close times to banks, are less liquidity constrained compared to firms without such ties. Also, firms with close ties are able to invest more when they are financially distressed, suggesting the importance of a bank relationship. In Germany, Gorton and Schmid (1999) find that bank equity ownership improves the performance of firms. Also, see Fohlin (1998). We review more evidence on "bank relationships" in Section III below.

We conclude that financial intermediaries are producing services that are not easily replicated in capital markets. We turn now to the major theories that have been put forth as explanations for the existence of financial intermediation. These theories are not mutually exclusive.

B. Banks as Delegated Monitors

Diamond (1984) offered the first coherent explanation for the existence of financial intermediaries.[2] Diamond's intermediaries "monitor" borrowers. Since monitoring is costly, it is efficient to delegate the task to a specialized agent, the bank. The notion of monitoring borrowers has become an influential idea, which subsequent researchers have further developed.

Not only do Diamond's intermediaries contain most of the important elements of a theory of intermediation, discussed above, but he also identifies and solves a fundamental problem at the root of intermediation theory. That problem concerns the fact that whatever problem the intermediary solves to add value with respect to borrowers would seem to imply that lenders to the intermediary would face the same problem with respect to their lending to the intermediary. In Diamond (1984), the intermediary "monitors" borrowers on behalf of investors who lend to the intermediary. But, then it would appear that the lenders to the intermediary have to "monitor" the intermediary itself. How is this problem, which has come to be known as the "monitoring the monitor" problem, solved? Diamond (1984) was the first to recognize and then solve this problem.

In Diamond (1984) borrowers must be "monitored" because there is an ex post information asymmetry in that lenders do not know how much the firm has produced. Only the individual borrower observes the realized output of his project, so contracts cannot be made contingent on the output. Consequently, a lender is at a disadvantage because the borrower will not honor ex ante promises to pay unless there is an incentive to do so. The first possibility Diamond considers to solve this contracting problem is the possibility of relying on a contract that imposes nonpecuniary penalties on the borrower if his payment is not at least a certain minimum. This contract is costly because such penalties are imposed in equilibrium, reducing the utility of borrowers. If, instead, the lender had available an information production technology, then the information asymmetry could be overcome by application of this technology, at a cost. Perhaps this would be cheaper, and hence more efficient, than imposing nonpecuniary penalties. Diamond termed production of information about the borrower's realized output, at a cost, "monitoring."

The notion of "monitoring" in Diamond (1984) appears inspired by Townsend (1979), but there is a critical difference. In Townsend the lender must bear a cost to determine whether the borrower has the resources to repay the loan or not, a decision made after the borrower's project output has been realized and after a payment has been offered to the lender. That is, in Townsend, the decision by a lender to

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[2] For reasons of space, we do not survey the previous transaction cost-based literature. For surveys of this literature, see Benston (1976) and Baltensperger (1980).

monitor a borrower is made *after* the entrepreneur has made a payment to the lender; it is contingent on the amount of the payment. Hence, it is known as "costly state verification." In Diamond, however, monitoring is not state contingent and the cost must always be borne because, in Diamond, the monitoring cost must be incurred *before* the output realization of the borrower's project is known to anyone.

This difference between Townsend and Diamond, with respect to monitoring, leads to another difference. In Townsend, the costly state verification problem motivates the form of the contract between a borrower and lender: it is a debt contract (since random monitoring is assumed away; see Boyd and Smith (1994)). In Diamond, the optimal contract between the borrower and the lender is a debt contract in the absence of monitoring, but once monitoring is introduced, the optimal contract is undetermined. It is feasible for the contract to be an equity contract, for example. On the one hand, this does not matter for Diamond's basic argument, but, on the other hand, it seems potentially important for understanding why agents trading in markets cannot replicate the function of the intermediary, as we discuss further below.

The monitoring solution may dominate the contract that imposes nonpecuniary penalties, but it raises another problem. If a single borrower has many lenders, then each lender will have to bear the cost of monitoring, which in turn will lead to duplication of monitoring costs or free riding problems among individual lenders. This raises the prospect of a third solution. If the task of monitoring were delegated to a single agent, free riding and duplication of monitoring costs problems could potentially be eliminated. But if the lenders were to delegate the task of monitoring, then the same problem would still exist, but at one step removed. That is, the individual lenders would then face the task of monitoring the agent delegated to monitor the borrower(s). This is the problem of "monitoring the monitor." Diamond (1984) presents the first coherent theory of banking that solves the problem of monitoring the monitor.

To be more precise, the problem of "monitoring the monitor" is this: lenders to the intermediary can reduce monitoring costs if the costs of monitoring the intermediary are lower than the costs of lenders lending directly to borrowers and directly incurring the monitoring costs. Diamond's fundamental result is to show that as an intermediary grows large, it can commit to a payment to depositors that can only be honored if, in fact, the intermediary has monitored as it promised. If not, then the intermediary incurs nonpecuniary penalties, interpreted by Diamond as bankruptcy costs or loss of reputation.

To see the argument, we follow Williamson's (1986) presentation of the Diamond result; unlike Diamond, it does not rely on precise contractual specification of nonpecuniary penalties, which is rarely seen in practice. Williamson's monitoring technology follows Townsend, so Diamond's result does not depend on the timing of monitoring (that is, whether it is state contingent or not). A brief outline of the essential part of the Williamson model is as follows. Borrowers need resources to invest in their projects. They invest K units of endowment at date 0 and receive $K\tilde{w}$ at date 1, where $\tilde{w}$ is a random variable distributed according to the density f(w). As shown by Gale and Hellwig (1985), the optimal contract between the borrower and a lender is a debt contract. At date 1 borrower j has a realized return of w_j per unit invested. Borrower j pays the lending intermediary a gross rate of return $\overline{R}$ in a state, w_j, where there is no monitoring and $R(w_j)$ when there is monitoring. Define the set $B=\{w_j: R(w_j) < \overline{R}\}$ and $B^c=\{w_j: R(w_j) \leq \overline{R}\}$. Finally, let r denote the certain market return, required by risk neutral investors.

When the intermediary has m borrowers, each investing K, then the total return to the intermediary (before compensating depositors) is:

$$\pi_m = K \sum_{j=1}^{m} \min\{R(w_j), \overline{R}\}.$$

By the strong law of large numbers:

$$\underset{m \to \infty}{\text{plim}} \frac{1}{mK} \pi_m = \int_B R(w_j) dw_j + \int_{B^c} f(w_j) dw_j.$$

Consequently, since the intermediary's return must be at least the market return, r, if the following inequality holds:

$$\int_B R(w_j) f(w_j) dw_j + \overline{R} \int_{B^c} f(w_j) dw_j - (c/K) \int_B f(w_j) dw_j \geq r,$$

then, as the intermediary grows large, it can guarantee a certain return of r to its depositors.

If the intermediary is finite sized, that is, it lends to a finite number of borrowers, then depositors must monitor the intermediary to ensure that the intermediary, in turn, is monitoring the borrowers. Since monitoring is costly, and given the certain market return that must be obtained, the depositors must be compensated for these monitoring costs by the intermediary. Compensating the depositors for monitoring costs incurred, lowers the profitability (utility) of the intermediary. However, the central result of Diamond (1984) applies here, namely, that the depositors need not monitor an infinitely large intermediary because such a firm can achieve r with probability one. In the limit, depositors do not need to monitor the intermediary. The "monitoring the monitor" problem is solved by diversification.

One might object that, in practice, financial intermediaries are not infinitely diversified, and some credit risk is not diversifiable; also, it seems likely that a depositor finds it more difficult to monitor a large bank than to monitor a small bank. Krasa and Villamil (1992a,b) address these concerns. Suppose we modify Williamson (1986) by assuming that larger banks' returns are more costly to verify. If loan returns are stochastically independent of one another, Krasa and Villamil (1992a) apply the Large Deviation Principle to show that, so long as a depositor's cost of monitoring doesn't increase exponentially with bank size, the expected costs of monitoring a sufficiently large bank go to zero. Moreover, they show through examples that even relatively small banks (e.g., 32 loans) get enough gains from diversification to dominate direct lending. If some loan risk is systematic, the chance of bank failure is bounded away from zero as bank size grows (Krasa and Villamil, 1992b). In this case, since the cost of monitoring banks that fail is increasing in bank size, there is a bank size past which the increase in monitoring costs dominates marginal benefits from additional diversification. Moreover, this optimal size diminishes as the systematic component of loan risk increases.

Winton (1995a) addresses another issue, namely the role of bank capital. Suppose that the banker invests his own funds in the bank as “inside” equity capital. Being junior, such equity absorbs losses first, reducing the probability with which the bank defaults and depositors must monitor. Thus, bank capital is another mechanism for implementing delegated monitoring. Since the bankers’ capital is fixed, it will be most helpful for smaller banks; also, the relative importance of capital versus diversification increases as more loan risk is systematic.[3]

Of course, Diamond (1984) does not explain all the characteristics of intermediaries. But, he elegantly explains the existence of intermediaries, in particular, as coalitions, of borrowers and lenders, which dominate the alternative of direct investment by investors in securities issued by firms. The securities market fails in the sense that intermediation, centralization of the task of monitoring, is a lower cost solution to the ex post information asymmetry between borrowers and lenders. Diversification is critical to intermediation providing a lower cost solution because diversification is critical to reducing the monitoring the monitor problem. The textbook idea that individual investors can diversify nonsystematic risk on their own does not take into account the role diversification plays in allowing an intermediary to be monitored costlessly (in the limit).

Other papers that study banks as delegated monitors include Gorton and Haubrich (1987) and Seward (1990).

C. Banks as Information Producers

If information about investment opportunities is not free, then economic agents may find it worthwhile to produce such information. There will be an inefficient duplication of information production costs if multiple agents choose to produce the same information. Alternatively, a smaller number of agents could produce the information, becoming informed, and then sell the information to the uninformed agents. This, however, introduces the “reliability problem” originally identified by Hirshleifer (1971): it may be impossible for the information producer to credibly ensure that he has, in fact, produced the valuable information.

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[3] Winton (1995b) shows that further reductions in monitoring costs are possible if a class of “outside” equity holders is created, who are junior to depositors but senior to the banker.

A related problem concerns resale of the information. If an information producer could credibly produce valuable information, and then sell it to another agent, then there is no way to prevent the second agent from selling it to a third agent, and so on. In other words, purchasers of the information can sell or share the information with others without necessarily diminishing its usefulness to themselves. This is known as the "appropriability problem." The returns to producing the information could not all be captured by the information producer, possibly making the production of information uneconomic (see Grossman and Stiglitz (1980)). The resale and appropriability problems in information production can motivate the existence of an intermediary.

Leland and Pyle (1977) were the first to suggest that an intermediary could overcome the reliability problem. The intermediary can credibly produce information by investing its wealth in assets about which it claims to have produced valuable information. The starting point for Leland and Pyle (1977) is a single entrepreneur who has private information about an investment opportunity, but who has insufficient resources to undertake the investment. Since outside investors do not observe the entrepreneur's private information, there is an adverse selection problem. Leland and Pyle show that the entrepreneur's private information can be signaled by the fraction of equity in the project that the entrepreneur retrains, while he sells the remaining fraction to outside investors.[4] At the end of their paper, Leland and Pyle suggest that financial intermediaries might efficiently solve the reliability and appropriability problems inherent in information production by issuing securities and using the proceeds to invest in a portfolio of securities about which the intermediary has become privately informed. After deriving his delegated monitoring model, Diamond (1984) also derives a Leland and Pyle model in which diversification lowers the intermediary's signaling costs compared to the entrepreneur's costs.

Following Leland and Pyle, a number of papers, notably Campbell and Kracaw (1980), also argued that financial intermediaries might exist to produce information about potential investments, information that could not be efficiently produced in securities markets. Campbell and Kracaw (1980) show that appropriability and reliability problems can be eliminated if the information producer has a sufficient minimum amount of wealth to risk if he does not produce the information. To risk his own money requires that the intermediary actually invest on behalf of other agents. The paper, however, that most fully articulates the argument that coalitions of agents should form to produce information ex ante about potential investments is Boyd and Prescott (1986).

The underlying problem faced by agents in Boyd and Prescott (1986) is an information asymmetry that occurs prior to contracting and investing, resulting in an adverse selection problem. Agents are of different types and this information is private to each agent. Each agent, however, is

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[4] See also Kihlstrom and Mathews (1990) and Duffie and Demarzo (1999).

endowed with a technology to evaluate projects, that is, the technology can determine agent type. Ex ante information production can alleviate the adverse selection problem. This can be done in a market context, where an agent evaluates his own project, and then issues securities to investors that promise specified returns. Or, a coalition of agents can offer investors a claim on group returns. Financial intermediaries are coalitions of agents that evaluate projects, invest in those determined to be high-value projects, and share the returns from the portfolio of projects.

More specifically, the outline of the model is as follows. Agents live for two periods. Each agent is endowed with a project of unknown type (good or bad). Agents know their own type, so there is no opportunity to enter into contracts before knowing their types. Each project type can have a high or low return (good projects are more likely to realize the high return). An agent can expend his endowment either on producing information about a single project's type or as an investment in a single project, his own if he has not evaluated it or another agent's project. If a project is evaluated, then a noisy signal of true project type is received. Project evaluation and investment are publicly observable and verifiable, as are project returns, evaluation results, consumption outcomes, and contract terms.

An efficient outcome invests in as many good projects as possible. But, the difficulty in accomplishing this is that bad-type agents will want to mimic good-type agents, claiming that they are good, promising the same high return to investors as the good-type agents, and then hoping that their project realizes the high return. Indeed, there is such a securities market equilibrium, but it is one in which some bad-type projects are evaluated, by mimicking agents. This is inefficient.

The alternative is the financial intermediary coalition. The model is one of mechanism design. One interpretation of how to implement the equilibrium with the coalition (given by Boyd and Prescott) is as follows. Coalition members deliver their endowments to the coalition prior to investment. These endowments are used for project evaluation. Depositors are other agents who turn over their endowments to the coalition in exchange for a promised amount of consumption. The depositors give the coalition the right to invest in their project and to receive the entire project output, if the coalition desires. Project owners are promised very high returns if evaluation reveals a good project and if the realized return is high. Otherwise, depositors are promised an amount of consumption which is more than a bad-type agent could achieve on his own, but less than the promised amount for projects with a good evaluation and high realized returns. Members of the coalition are residual claimants and share profits equally.

The coalition's sharing rules induce truthful revelation of agent type. The coalition then evaluates good-type projects and funds each of these projects with a good evaluation. It uses the remaining proceeds to fund bad-type projects without evaluation. This is the critical point. The promised returns separate types, and since good types are relatively scarce, the coalition ends up funding some bad-type projects, but it does not waste resources evaluating those projects. This is why it dominates the securities market.

The intermediary dominates the securities market because the intermediary coalition can induce agents to truthfully reveal their type and this cannot be achieved in the securities market. Truthful revelation allows the coalition to avoid inefficiently evaluating some bad-type projects. The reason is that, by conditioning returns on the coalition's portfolio returns, rather than on the returns of a single project, the coalition can offer higher returns to bad-type agents, so they will participate in the coalition. The relative proportions of good-types and bad-types are also important. In particular, good-type agents must be scarce. Note also that it is important that a coalition be large because a small coalition may end up with so many good-type projects that they cannot all be funded. In the population, good-type projects are relatively scarce and this must be reflected in coalition membership. Thus, as in Diamond (1984), size of the coalition is critical for the argument.

The equilibrium concept in Boyd and Prescott is based on the core of an economy. That is, an allocation is an equilibrium if no large coalition of agents, with specified fractions of agent types, can achieve a different allocation, satisfying resource, consumption, incentive and other constraints, and make at least some agent type better off without reducing any other type's utility. Deviating coalitions are not allowed to attract higher than population proportions of type-i agents unless it makes them strictly better off. Although the solution of the model is standard in that it relies on the revelation principal, the equilibrium concept is less common in the finance and financial contracting literature. This may account for why this paper has not led to a successor literature in banking per se; instead, it has been more influential in macroeconomics, where the equilibrium concept has been taken up, though see the discussion of Williamson (1988), below.

Boyd and Prescott's intermediary has the characteristics of bank-like intermediaries identified in the introduction. Other researchers have pursued solutions to the problems of reliability and appropriability of valuable private information, but these other solutions do not involve bank-like intermediation. Two settings in particular have been examined. The first considers delegated portfolio management, i.e., a setting where a fund manager may claim to have superior information or superior ability and offers to invest on behalf of investors. The second considers the sale of valuable information about investments when the information producer does not invest on behalf of investors. A theory of intermediation must distinguish between firms that sell information, like rating agencies, firms that are delegated portfolio managers, like mutual funds or hedge funds, and bank-like financial intermediaries.

At the level of casual empiricism there are identifiable differences between these types of arrangements. A bank-like intermediary does not sell information that it produces. Rather, as in Boyd and Prescott, it uses the information internally to improve the returns to coalition members. This is very different from the case of a firm that sells information to investors, like a rating agency. Firms selling information face problems of reliability and appropriability, but they do not lend money. Purchasers of the information may lend in reliance on the information purchased, but they are then directly lending, not via an intermediary. A portfolio manager, claiming to have superior information, accepts investments from one set of agents and then uses the proceeds to invest in securities. This seems very similar to a bank-like intermediary. One difference is that the claims held by the investors do not have different state contingent payoffs than the payoff on the portfolio of claims chosen by the portfolio manager; essentially, the investors and the portfolio manager all hold equity claims in the portfolio.

In Bhattacharya and Pfleiderer's (1985) model, investors want to hire portfolio managers, but there are two sources of private information that make this difficult. First, investors must hire a manager from pool of managers with heterogeneous abilities. A manager or agent has the ability to receive an informative signal about the risky asset (there is also a riskless asset). Once a manager has been hired, he must be induced to truthfully reveal the signal he has received. However, once the principal has designed the contract and hired a manager, the manager/agent's only role is to transmit the information to the principal. There is no portfolio management by the manager/agent since the principal can directly invest using the information supplied by the manager/agent. There is no intermediary (nor do Bhattacharya and Pfleiderer claim that there is; the purposes of their paper are different).

Allen (1990) presents a model that distinguishes conditions under which information is sold to agents who then use the information to make investments from the case where the buyers of the information then act as intermediaries and resell the information. Essentially, reselling the information allows more of the value of the information to be captured. Because the initial information seller must distinguish himself from potential uniformed mimics, he faces a number of constraints. These constraints limit the amount of profit he can take in from selling the information. This is the basis for information resellers to enter the market; they find it profitable to resell the information rather than use it as a basis for their own investments because they can capture more of the value of the information. Here there is a type of intermediation: there are agents who buy information and then resell it. But, these agents do not invest on behalf of others.

Ramakrishnan and Thakor (1984) consider a setting in which firms issuing new shares to the public can hire an agent to produce information about their quality. Information production requires a costly, and unobservable, effort, so the information producer would like to avoid this cost if he can do so without being detected. There is an ex post noisy indicator of the information producer's effort choice, so compensation for information production can be linked to this indicator. Because information producers are risk averse, they would prefer to avoid the risk that the noise in the indicator prevents them from obtaining compensation for their efforts. The main point of Ramakrishnan and Thakor is that this risk is mitigated if one infinitely large intermediary is formed since this diversifies the risk associated with the effort indicator. The large intermediary is formed when information producers can costlessly monitor each other's efforts. (Millon and Thakor (1985) extend the analysis to the case where the internal monitoring is costly.) Ramakrishnan and Thakor's intermediary, however, does not accept funds for investment. Rather, it is a pure information seller. In this regard, also see Lizzeri (1999).

In general, the differences in settings where some agents would like valuable, but costly, information produced for investment purposes are subtle. In many models there is no need for the information seller to actually accept the funds that will be invested on the basis of the superior information. In Bhattacharya and Pfleiderer, Allen, and Ramakrishnan and Thakor, the information producer sells the information to investors, but does not need to actually invest the funds of the investors. In Boyd and Prescott the intermediary accepts deposits, produces information, and invests in projects based on the information produced. Only by conditioning the returns on the portfolio that is produced by the coalition can truthful revelation be induced.

A potentially important aspect of information production by banks concerns whether the information is produced upon first contact with the borrower or is instead learned through repeated interaction with the borrower over time. Another strand of the literature on banks as information producers argues that banks acquire (private) information over time through repeatedly lending to a borrower. The acquisition of this private information over time is known as a "customer relationship" and is discussed in Section III below.

D. Banks as Consumption Smoothers

Bryant (1980) and Diamond and Dybvig (1983) develop a role for bank liabilities, without stressing any particular features of bank assets. Bank liabilities do not function as a transactions medium. Rather, banks are vehicles for consumption smoothing; they offer insurance against shocks to a consumer's consumption path.

The Diamond and Dybvig model assumes that the payoffs from the available investment opportunities are inconsistent with the possible consumption paths desired by consumers. In particular, consumers have random consumption needs, and satisfying these needs may require them to prematurely end investments unless they save via intermediation so that they can to some extent diversify these consumption shocks. The model offers a view of the liability side of banking; the right to withdraw from the bank, prematurely ending investment in order to satisfy sudden consumption needs, corresponds with notions of how demand deposits actually work. The model also focuses on banking panics, a separate topic that we discuss in Section IV below.

The outlines of the Diamond and Dybvig model are as follows. There are three dates 0, 1, and 2 and a single good. The available technology allows one unit of investment to be transformed over two periods into $R>1$ units at the final date. If this investment is interrupted at the interim date, then it just returns the initial one unit. Importantly, the long-term investment only realizes a return over the initial investment if it reaches fruition at date 2. All consumers are identical initially, at date 0, but each faces a privately observable, uninsurable risk with regard to their preferences. At date 1, each consumer learns whether he cares only about consumption at date 1, an "early consumer," or only about consumption at date 2, a "late consumer." The problem is evident: consumers would like to insure themselves against the bad luck of being an early consumer. Without being able to write such insurance contracts, because consumer type is not observable, early consumers can do no better than consuming their single unit of endowment, which was invested in the investment technology but which is liquidated early. The lucky late consumers consume $R>1$.

Diamond and Dybvig (1983) argue that a bank can provide insurance against the risk of being an early consumer. Basically, a bank works as follows. At date 0 the bank opens and accepts "deposits" of endowment. The bank promises a fixed claim of r_1 per unit deposited will be paid out to consumers who withdraw at date 1. The return on a deposit that is not withdrawn at date 1, but is withdrawn at date 2, depends on how much was withdrawn at date 1. Suppose the fraction of consumers who will turn out to be early consumers is fixed and known. Then Diamond and Dybvig show that the return of r_1 can be set to the amount that an early consumer would achieve if there were complete insurance markets. So the bank can support the full-information risk-sharing equilibrium.

The Diamond and Dybvig model has important features of intermediaries and the real world environment. First, it incorporates the idea that consumers have uncertain preferences for expenditure streams, producing a demand for liquid assets. Furthermore, the modeling representation of this uncertainty, the technique of early and late consumers, has been very influential in its own right. Uncertainty about preferences for expenditure streams leads to the bank offering claims that look like demand deposits. This is combined with a second important feature, namely, real investment projects are irreversible, or at least costly to restart once stopped. A third important feature of the model is the idea that individual consumers have private information about the realization of their type, the realization of their preferred consumption stream. There is no credible way to truthfully reveal this information.

We now turn to some details about why insurance or securities markets cannot provide consumption smoothing or insurance against the risk of uncertain preferences for expenditure streams. In Diamond and Dybvig, an intermediary that issues demand deposits allows greater risk sharing than autarky. Diamond and Dybvig assume that demand deposits cannot be traded and do not consider other securities markets. Their model assumes a sequential service constraint, that is, a first-come-first-served ruled under which at date 1 the bank honors claims to withdraw in the order in which they are received until the bank runs out of resources to honor the claims. The remaining consumers seeking to withdraw receive nothing and the bank fails. We discuss models that motivate the sequential service constraint in Section IV below. Here, we simply note that the idea it attempts to capture is that consumers cannot coordinate to go to any securities market at the same time to trade; they are busy doing other things such as shopping, eating, sleeping, working, etc. Thus, Diamond and Dybvig's assumptions that demand deposits cannot be traded and that no other securities markets are open are not completely without foundation.

This point is important because Jacklin (1987) and Haubrich and King (1990) argue that the existence of Diamond and Dybvig intermediaries requires the restriction that consumers only have nontraded demand deposits available to them. Jacklin (1987) begins by asking, why does a securities market fail in the Diamond and Dybvig model? In order to highlight the importance of trading restrictions and preferences for Diamond and Dybvig's result that intermediation is the best insurance arrangement, he proposes an alternative arrangement that uses traded securities. Suppose that there are firms in Diamond and Dybvig that own the two-period production technology. Each firm raises capital by issuing dividend-paying shares at date 0. Consumers buy the shares, entitling them to set the production policy and to set dividend policy about the amount paid out to share owners at date 1. The "dividends" on Jacklin's equity are set to smooth income in exactly the desired way; they are not just pass-throughs from the firms. Shareholders of record at date 0 receive the dividend at date 1 and then can sell the share in a share market at date 1. At date 1 consumers learn their preferred consumption streams. Early consumers will want sell their shares ex dividend to late consumers. Jacklin shows that the social optimum obtains with this share market in place. Thus, the bank cannot do any better.

Jacklin goes on to show that the result that the intermediary cannot improve upon trading dividend-paying shares is not true in general. Recall that, in Diamond and Dybvig, some consumers find that they must consume early; it is all or nothing. If instead preferences are smooth, so that one type of consumer will learn that he has a stronger preference for earlier consumption than the other type, then it can happen that demand deposits dominate traded equity shares, but only under certain conditions. Furthermore, if demand deposits can be traded, then optimal risk sharing does not occur regardless of preferences. Finally, Jacklin argues that, if new assets can be introduced, individuals will deviate from either the demand deposit arrangement or from the economy with traded dividend-paying shares. These points lead Jacklin to conclude that the Diamond and Dybvig "demand-deposit" intermediary can only exist if trading restrictions limit consumers to the type of demand deposits that Diamond and Dybvig model. This highlights the importance of the sequential service constraint and its interpretation.

Haubrich and King (1990) revisit in detail the issue of financial intermediation in settings where agents are subject to privately observable income shocks. Their main conclusions are similar to Jacklin (1987), namely, that "demand deposits *uniquely* provide insurance only if there are restrictions on financial side exchanges, which may be interpreted as exclusivity provisions or regulations on security markets. If these restrictions cannot be implemented, then our environment does not rationalize banks" (p. 362; emphasis in original). They also make the useful distinction between two separate issues. One is the fact that the available investment technology is illiquid in the sense that no return is earned if the two-period investment is ended early. The other is that risk averse consumers with privately observable income shocks have a demand for insurance. They argue that a securities market is as good as banks in providing liquidity. In their model, the bank's comparative advantage is in providing insurance against private income shocks rather than providing liquidity per se, but that advantage still depends on trading restrictions.

Hellwig (1994) and von Thadden (1998) examine how banks function when additional considerations are introduced into Diamond and Dybvig's structure. Hellwig shows that if market returns at the interim (early-consumption) date are subject to systematic "interest-rate shocks," banks optimally do not provide insurance against such interest rate risk. Von Thadden shows that if depositors can join outside coalitions that engage in market activity, banks' ability to provide insurance is severely curtailed, and banks are more constrained as long-term investment opportunities are more reversible. Intuitively, ex ante insurance makes the return to holding deposits at the interim date deviate from returns available by directly investing, allowing arbitrage.

Diamond (1997) responds to Jacklin (1987), Haubrich and King (1990), Hellwig (1994), and von Thadden (1998) in a model with both banks and a securities market in which (by assumption) only a limited subset of agents participate in the market. The main focus of the paper is on the interactions between bank provision of "liquidity" and the depth of the market. As more agents participate in the securities market, banks are less able to provide additional liquidity.

Allen and Gale (1997) introduce a different smoothing role for financial intermediaries, namely, that they are unique in providing a mechanism for smoothing intertemporal intergenerational risks. Allen and Gale study the standard overlapping (risk averse) generations model with two assets, a risky asset in fixed supply and a safe asset that can be accumulated over time.[5] The risky asset lasts forever and pays out a random dividend each period. The safe asset consists of a storage technology. First, consider the market equilibrium in this economy. Perhaps counterintuitively, the safe asset is not a useful hedge

[5] Freeman (1988) and Qi (1994) introduce Diamond and Dybvig banks into an overlapping generations model, but do not consider intertemporal smoothing of risk.

against the uncertainty generated by the risky asset. Because the risky asset's returns are independently and identically distributed in any period, a representative young agent solves the same decision problem at any date. Old agents supply the risky asset inelastically, so the equilibrium price of the risky asset is constant and nonstochastic. Because the dividend is nonnegative, the safe asset is dominated and is not held in equilibrium.

This market equilibrium is in contrast with the portfolio allocation that would occur for an infinitely lived agent facing the same investment opportunities. Such an individual can self-insure against low dividend periods by holding a buffer stock of precautionary savings in the form of the safe asset. Intuitively, when the dividend is high, the individual saves some of the dividend for a "rainy day" when the dividend is low. In the overlapping generations setting, a social planner can make a Pareto improvement by following the same type of rule.

The market equilibrium in the overlapping generations model cannot achieve the allocation that the social planner could achieve because private agents cannot trade before they are born, while the social planner can, in effect, trade at all dates. In particular, the social planner trades ex ante, that is, before the realization of the path of dividends. A representative young agent, however, is born into a world where the dividend has just been realized. There is no willingness to implement insurance once the state is known. For example, suppose the dividend just realized is low. Then, the social planner would like to implement a transfer from the young to the old, to smooth their income. On the other hand, if the dividend just realized is high, then the social planner would like to transfer some of that to the current young. Some excess may be saved for the next period. These transfers insure that each generation receives the expected utility targeted by the social planner.

It is well known that markets are incomplete in overlapping generations models, but the point made by Allen and Gale is that a long-lived financial intermediary may be the institutional mechanism to provide for this intertemporal smoothing. The intermediary would hold all the assets and offer a deposit contract to each generation. After accumulating large reserves, the intermediary offers (almost) all generations a constant return on deposits, independent of the actual dividend realizations. How such an institution would be set up initially, and how it would be maintained when some agents will have incentives to renege on the arrangement, are not clear. Allen and Gale loosely interpret the institution as corresponding to German universal banks.

Consumption insurance that implements smooth patterns of intertemporal consumption plans is at the center of the model of consumer behavior of neoclassical economics. Another central notion concerns the use of "money" to facilitate exchange. The search models of money or models with cash-in-advance constraints attempt to explain why "money" exists. The notion of banks as consumption-smoothing institutions attempts to wed these two ideas. Bank liabilities are seen as claims that facilitate consumption smoothing. But, there is no notion of exchange in the model, no sense in which transactions are taking place where bank "money" is being used to facilitate the smoothing. Instead, agents are essentially isolated from each other; there is no trade with other agents where "money" buys goods. Rather agents fear missing out on long-term investment opportunities because of possible shocks to their preferences. Agents trade only with the bank.

E. Banks as Liquidity Providers

Bank liabilities function as a medium of exchange. This basic observation leads to ideas and models concerning "liquidity" that are quite distinct and perhaps more natural than viewing bank liabilities as allowing consumption smoothing. A medium of exchange is a set of claims or securities that can be offered to other agents in exchange for goods. Such claims can dominate barter and may dominate government-supplied money. What are the advantages of privately-produced trading claims to be a medium of exchange? One class of these models considers settings where agents cannot contract and trade with each other due their inability to meet at a single location. Without "money" they must barter, and this is clearly inefficient. This generates a need for a payments system, essentially a trading center or bank that can produce and net claims. A second notion of liquidity is related to the information properties of claims that are privately produced as a medium of exchange. The focus is on reducing trading losses that agents who need to consume face when other traders with private information seek to use this information to make trading profits. Yet a third notion of liquidity uses a setting where moral hazard problems limit firms' ability to borrow to meet unexpected investment needs. Because moral hazard limits the effectiveness of transactions between firms with excess liquidity and firms that need liquidity, a bank that provides contingent liquidity to those that need it can dominate a decentralized market.

The first view of banks as liquidity providers concerns the role of banks in the payments system. Freeman (1996a,b) models an environment where agents are spatially separated and the timing of transactions is such that they cannot simultaneously trade at a central location. The problem in the model is that some agents, buyers, wish to consume goods from other agents, but have no goods that the buyers want to offer these sellers in exchange. Nor do buyers have any money, though later at another location they will be able to sell their goods in exchange for money. So, buyers issue i.o.u.'s – promises to pay at the central location next period with fiat money – to the sellers. Fiat money is used to settle the debts, but money and private debt coexist. Now, at the central clearing location it may happen that all creditors and debtors arrive simultaneously, in which case clearing occurs directly. If arrival is not simultaneous, however, settling can take place through a clearinghouse. The clearinghouse accepts money in payment of i.o.u.'s and pays off i.o.u.'s presented. However, if creditors arrive first, then the clearinghouse must have some means of paying them before the debtors arrive. A basic point of Freeman is develop the notion of the clearinghouse issuing its own i.o.u.'s, bank notes for example, that can circulate and be redeemed for fiat money later.

Green (1997) builds on the Freeman model, arguing that a clearinghouse "netting by novation" can also achieve the efficiency gain in Freeman's model. In the same vein, McAndrews and Roberds (1999) model the efficiency gains from introducing banks that allow for centralized netting of claims. A bank can lend to firms via overdrafts. The firms are willing to accept payment in bank funds since the income funds can be used to repay the overdraft loan. Banks can provide "liquidity" to the extent that the payments they are requested to make are offsetting. Williamson (1992) also presents a model in which fiat money and private bank "money" coexist in equilibrium. Cavalcanti and Wallace (1999) study a random-matching model in which some agents, called banks, can produce information about the trading histories of other agents, called nonbanks. The equilibrium is one in which the banks issue and redeem private bank notes.

In these models, banks issue private money to facilitate their role in clearing transactions. This is related to the historical experiences during which banks actually did issue their own private money, notably during the American Free Banking Era, 1838-1863. During this period hundreds of different banks' monies circulated. Early economic historians and monetary theorists viewed the experience as a failure, arguing that it was marked by "wildcat banking" which justified a role for the government in the provision of a fiat currency. Following earlier work by Rockoff (1974, 1975), Rolnick and Weber (1982, 1983, 1984, 1985) reexamine failure rates over the cross section of states with different banking regimes and conclude that the period was not marked by such episodes. Gorton (1996, 1999) analyzes the prices of private bank notes and concludes that the market for banknotes worked well in pricing the risk of bank failure and in preventing wildcatting. Some experiences of Illinois, New York and Wisconsin during the Free Banking period are studied by Economopoulos (1988, 1990).

The pricing of free bank notes raises another issue concerning the production of liquidity. When offered a bank liability in exchange for goods, the seller of goods must recognize the risk that the bank can fail before the liability is honored. If some agents have private information about the likelihood of bank failure, they may be able to benefit from this when trading bank liabilities. An important property of a medium of exchange may well be that there is little or no such risk; that is, the value of the medium of exchange is independent of such considerations. But then it must be riskless in the sense that its value does not depend on the likelihood of the bank failing. This intuition is developed in the second view of liquidity, exemplified by Gorton and Pennacchi (1990).

Gorton and Pennacchi (1990) begin with a common assumption of financial market models, namely the existence of "noise traders" or "liquidity traders." Kyle (1985) originally introduced these traders as a reduced-form modeling device, following Grossman and Stiglitz (1980). These models do not explicitly examine the motives of these noise traders; instead, they are posited to conveniently trade and lose money, making it profitable for other traders to undertake costly information production. Implicitly, these models seem to assume larger settings in which agents face cash-in-advance constraints and suffer shocks to income or preferences, causing them to sell securities. These models assume symmetrically that there are also noise traders who have sudden urges to buy securities, though it is less clear what the source of this urge is exactly. Intuitively, these traders either sell securities at too low a price or buy securities at too high a price because they are uninformed and the prices at which securities are traded are not fully revealing.

Gorton and Pennacchi (1990) observe that these noise traders should recognize their problem, namely, that they lose money when they trade securities with better-informed traders. Consequently, they should demand securities with the property that when they are traded it is not possible for insiders to benefit at the expense of less informed traders. Thus, a security is said to be "liquid" if uninformed traders can sell it (unexpectedly) without a loss to more informed traders. The higher the variance of the value of a security, the greater the potential losses to insiders when uninformed traders must sell. If securities could be valued independently of information known only to the informed traders, then these securities would be highly desirable for trading purposes. Gorton and Pennacchi (1990) argue that splitting the cash flows of an underlying portfolio to create debt and equity can create such "liquid" securities, namely the debt. If the debt is riskless, then there can be no information advantage that other agents could possess. Uninformed agents with unexpected needs to sell securities can sell these securities to satisfy their liquidity needs. Financial intermediaries are the natural entities to create such securities, as they hold diversified portfolios of assets. Consequently, their debt should be used for transactions purposes.

Holmström and Tirole (1998) provide another rationale for intermediaries based on a third notion of "liquidity." They begin by deriving a demand for "liquidity" that emanates from firms rather than consumers. There are three dates in their model, 0, 1, and 2. At date 0 the entrepreneur running the firm raises outside financing. At date 1 there is a "liquidity shock" requiring the entrepreneur to invest more in the project if it is to obtain a return at date 2. After the realization of the liquidity shock, the decision to continue or not is made, followed by the entrepreneur's effort choice. If the project is continued, then an outcome is realized at date 2 and contract payments are made. Because there is a moral hazard problem in inducing the entrepreneur to expend effort, outside investors cannot be promised the full social value of the investment. The firm raises less financing than the first-best social optimum. If the firm can store the initial resources, then it faces a dilemma. It can reduce the amount it invests at date 0, to have an amount to hedge against a liquidity shock. Or, it can invest more at date 0, but then have less on hand if it needs more at date 1.

Now, suppose there is no storage and no aggregate uncertainty. The only way to transfer value across time is to use claims issued by firms. In general equilibrium, some firms will need resources at date 1 and some will not. A second-best arrangement would allow firms with large needs for resources at date 1 to utilize the market value of those firms with low needs at date 1. How would this actually work? A firm with a liquidity shock at date 1 cannot meet its needs by selling claims at date 1; it is too late to do that. Could the firm instead hedge against an adverse liquidity shock at date 1 by buying claims on other firms at date 0, and then selling those claims at date 1? There are two problems with this arrangement. First, if the moral hazard problem is severe enough, then a market in firm claims will not supply enough "liquidity." Second, there is an inefficient distribution of liquid assets (the claims that can be sold at date 1 by firms needing resources). Firms without adverse liquidity shocks end up holding claims at date 1 that they do not need.

An intermediary can provide liquidity by issuing claims to investors at date 0 on its value at date 2. At date 0 it contracts with each firm to provide a line of credit at date 1. The maximum credit line is incentive compatible with the entrepreneur making an effort.[6] Unlike claims in the financial market, which cannot be made contingent on a firm's liquidity shock, firms only draw on the credit line at date 1 to the extent that they need resources. If there is aggregate uncertainty, then this arrangement may not work, and there can be a role for a government bond market.

Both Gorton and Pennacchi (1990) and Holmström and Tirole (1998) have intermediaries creating securities that have desirable state contingent payoffs. In Gorton and Pennacchi, the bank creates demand deposits whose value does not depend on the state of the world. This security is in demand because its value is not state contingent and, therefore, uninformed traders will not lose to better-informed traders who know the state of the world. In Holmström and Tirole, the intermediary creates a security, the credit line, which is valuable because it is state contingent; it is only drawn on when a firm needs resources at the interim date. Capital market securities issued by firms cannot replicate this state-contingent payoff.

F. Banks as Commitment Mechanisms

An important question concerns why illiquid bank assets are financed by demand deposits that allow consumers to arrive and demand liquidation of those illiquid assets. Calomiris and Kahn (1991) and Flannery (1994) link the fragility of bank capital structures to the role of banks. These authors begin with the assumption that banks are somewhat opaque institutions, more so than nonfinancial firms.

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[6] Because the entrepreneur pays a fee at date 0 for the credit line, he can borrow at a lower rate at date 1 than if he issued securities at date 1. This lower rate leads to greater effort for any amount of borrowing.

Evidence for this opaqueness compared to nonfinancial firms can be found, for example, in Slovin, Sushka, and Polonchek (1992) and Morgan (2000). Calomiris and Kahn (1991) argue that bank demand deposits include the right to withdraw at anytime at par along with a sequential service constraint in order to control the risk taking activities of bankers. If information about the banker's decisions must be produced at a cost, then individual depositors who expend resources to produce the information will get into line to withdraw at the bank first. Because the sequential service constraint is a first-come-first-served rule, it rewards those depositors in line first, and so information-producing depositors will recover more than other depositors. This argument was the first to suggest that banks' capital structures are deliberately made fragile so as to commit to not engaging in certain activities. From this viewpoint, fragility is a positive attribute of banks. Jean-Baptiste (1999) also argues that the instantly callable feature of demand deposits is necessary as a device to discipline bankers.

Flannery (1994) makes a related argument. He argues that bank creditors cannot effectively control bank asset substitution because of the ease of flexibly altering the bank portfolio, but they can estimate a bank's riskiness at any point in time. To control bankers, short-term debt is used because changes in bank risk will be reflected in financing costs. Again, the basic point is that the capital structure of banks is designed to be fragile, so that it functions as a commitment mechanism. Flannery and Sorescu (1996) show empirically that bank debt prices do reflect bank risk.

Diamond and Rajan (2001) use this idea that fragility is a commitment device to construct a model of bank-like financial intermediation. In their model, entrepreneurs need to raise money from outside investors to finance their projects. The specific abilities of the entrepreneur are important for the project to generate high cash flows; that is, if the entrepreneur refuses to work, then the project is worth less when someone else runs it. Moreover, the entrepreneur cannot commit to stay with the project. A lender, however, can build a relationship by lending to entrepreneur and learning about the project. If this relationship lender "liquidates" the project by separating the entrepreneur from the project, then the project is worth less than it would be worth with the entrepreneur, but more than if it is run by someone other than the relationship lender.

Because the entrepreneur cannot commit to stay with the asset, Diamond and Rajan say that the asset is "illiquid." This "illiquidity" makes it possible for the entrepreneur to hold up the relationship lender. Because potential relationship lenders anticipate this holdup problem, the amount that the entrepreneur can borrow is limited. Lenders also have problems because they may face a realized liquidity shock at an interim date. If a relationship lender needed cash at the interim date, the project would have to be sold to a non-relationship investor in whose hands it is worth even less. The prospect of such a shock makes relationship lending expensive, if not prohibitive.

The consequences of this chain of illiquidity could be mitigated if the relationship lender could borrow against the full value of the loan when faced with a liquidity shock. But this requires that the relationship lender commit to not separate from the project in the future. Diamond and Rajan argue that a bank can achieve such a commitment by designing a fragile capital structure, as follows. If the relationship lender issues demand deposits that are subject to collective action problems among the depositors, then if the relationship lender threatens to withdraw from the project, depositors will run the bank and the relationship lender will receive no rents.

As Diamond and Rajan note, this fragile structure is not first-best if banks face undiversifiable liquidity shocks. In this case, runs may occur because of high liquidity demand rather than because of bank moral hazard. Diamond and Rajan (2000) use this problem to motivate the existence and optimal level of bank equity capital. We return to this point in Section III below.

G. Empirical Tests of Bank Existence Theories

Theories of the existence of bank-like financial intermediaries link banks' activities on the asset side of their balance sheets with the unique liabilities that banks issue on the liability side of their balance sheets. Such a link is important for establishing what it is that banks do that cannot be replicated in capital markets. As we have seen, these arguments take two linked forms. First, the banks' balance sheet structure may ensure that the bank has incentive to act as delegated monitor or information producer. Second, by virtue of holding a diversified portfolio of loans, banks are in the best position to create riskless trading securities, namely, demand deposits.

Two papers, in particular, construct empirical tests of hypotheses about links between the two sides of bank balance sheets. Berlin and Mester (1999) look for a link between bank market power in deposits markets and the types of loan contracts that the bank enters into with borrowers.[7] "Core deposits" are those deposits, demand deposits and savings deposits, which are mostly interest rate inelastic. To the extent that a bank has such core deposits, it can safely engage in long-term contracts with borrowers; in particular, it can smooth loan rates. Using a large sample of loans from the Federal Reserve's Survey of Terms of Bank Lending to Business, they find that banks that are more heavily funded through core deposits do provide borrowers with smoother loan rates in response to aggregate shocks.

Kashyap, Rajan, and Stein (2001) empirically analyze the link between loan commitments and demand deposits. While demand deposits are liabilities and loan commitments are assets, the two

[7] Hannan and Berger (1991) and Neumark and Sharpe (1992) provide evidence of bank monopoly power in the retail deposit market.

securities both commit the bank to potentially meet demands for cash. That is, depositors may withdraw their deposits and borrowers may draw on their loan commitments. To be prepared for such contingencies, each of these security types requires the bank to hold liquidity. As long as the demands for cash on loan commitments and on deposits are not perfectly correlated, there are economies of scale to holding cash against both types of contingencies. They find that banks make more loan commitments than other types of intermediaries and that, within the banking sector, banks with high ratios of transaction deposit to total deposits also have high ratios of loan commitments to total loans.

The dramatic increase in loan sales constitutes a challenge, both theoretically and empirically, to arguments concerning bank existence. In a loan sale, the cash flows from a loan on a bank's balance sheet are sold to investors in the capital markets, through issuance of a new security (a secondary loan participation). This seems paradoxical: the borrowing firm could have issued a security directly to the same investor in the capital markets without going to the bank, and yet chose to borrow from a bank. The above arguments for the existence of financial intermediation imply that the bank loan should not be resold because if it can be resold there is no incentive for the bank to screen ex ante or monitor ex post. Gorton and Pennacchi (1995) explore these issues empirically, testing for the presence of incentive-compatible arrangements that could explain loan sales. One of their main findings is that the bank keeps a portion of the cash flows that is consistent with maintaining incentives. The idea is that the bank faces the same incentives as it would have had the entire loan been kept on its balance sheet. There are now a number of papers on this subject, but the basic paradox of loan sales remains unexplained. Indeed, the paradox is somewhat deepened to the extent that banks can transfer the credit risk of their loans to third parties via credit default swaps. Market participants seem to rely on banks' incentives to maintain their reputations for monitoring, but the efficacy of this mechanism is largely unexplored.

H. Bonds versus Loans

If banks monitor borrowers in ways that cannot be accomplished by dispersed bondholders, or produce information that capital markets investors cannot produce, then how can bonds and loans coexist?[8] Why don't loans dominate bonds? This poses the question of the existence of bank loans in a different light. A number of authors have addressed this issue, attempting to differentiate between bonds and loans, in terms of their characteristics, but also in such a way that firms will demand both.

Detragiache (1994) presents a model in which firms use both bonds and loans. Bonds (or synonymously "public debt") cannot be renegotiated, while loans (synonymously "private debt") can be

[8] The idea that dispersed lenders cannot renegotiate effectively compared to a single lender, like a bank, is commonly assumed. Bolton and Scharfstein (1996) provide the theoretical foundation for this notion.

costlessly renegotiated. Loans are senior to bonds. Equity holders face an asset substitution problem at the initial date, and renegotiation with the bank or liquidation may occur at the interim date. In renegotiation only the senior lender, the bank, can forgive debt, so bank debt has a clear advantage. But bonds also have a role. The payoff to equity is decreasing in the amount of bonds and this helps to limit the incentive to engage in asset substitution at the interim date. Renegotiation allows equity to capture some surplus at the interim date, even if creditors are not satisfied, so risky projects can become attractive. But, if some debt is owed to creditors with whom it is impossible to renegotiate, equity's payoff is reduced and the incentive to engage in asset substitution is mitigated.

In Diamond (1991), new borrowers, i.e., young firms, borrow from banks initially. Then later, based on the credit record established while being monitored by a bank, the firm can issue bonds. There are three types of borrowers. Two of these types are fixed at either Good (G) or Bad (B) while the third can choose between Bad and Good (BG). Type refers to the value of the firm's project so that if the investors knew the firm's type, its debt would be priced accordingly. Over time, investors or the bank can learn the type of the firms with a fixed type by observing whether there has been a default. Diamond (1989), with the same model, shows that, over time, a surviving BG type has a "reputation" that is consistent with being a G type, and this makes the cost of funding so low that it always chooses the Good project. In Diamond (1991) reputation effects eliminate the need for future monitoring so G types can issue bonds. Also, B types cannot benefit from monitoring, so they issue bonds that are appropriately priced. The BG types borrow from banks, which then monitor them. This result explains the coexistence of bonds and loans, but not for the same firm.

In Bolton and Freixas (2000) bank loans are valuable to firms because, unlike bonds, bank loans can be renegotiated. The problem, however, is that bank capital is costly, which makes bank loans costly relative to bonds. Firms trade off the benefits of bank loans against the cost. Cantillo (1998) also considers the cost of banks in determining the choice between loans and bonds. Outside investors lend to firms but can only verify the firms realized returns at a cost, which is necessary if there is a default on the debt. Thus, the set-up is one of costly state verification following Townsend (1979). Banks, however, are better at performing the costly state verification; banks take less time to verify than do nonbank lenders. Nevertheless, banks do not dominate nonbank lenders because they too are firms, so their returns also require costly state verification. The more banks lend, for a given amount of equity, the more likely that consumers financing the bank will have to expend costs to verify the state of the bank. Again, this causes firms that are more likely to be in financial distress to choose bank loans, whereas firms that are less likely to be in financial distress choose direct lending.

Chemmanur and Fulghieri (1994) take a different approach. They assume that some firms are more likely to be in financial distress than others. Firm type is private information. Banks are valuable to these firms if they will commit more resources to evaluating firm type in financial distress. Banks can develop a reputation for doing this. Then firms with a high likelihood of needing a bank select banks that are more committed to adding value to distressed firms because of their reputation. Firms that have a low likelihood of being in financial distress issue bonds because they do not want to pool with the riskier firms. Banks are of high and low cost types in terms of their ability to evaluate firms. The game is repeated so that over time firms learn about bank type, corresponding to a "reputation."

Cantillo and Wright (2000) empirically investigate two large panel data sets of firms to investigate the choice of firms between bonds and loans. Their evidence is consistent with their model, in which large firms that are less likely to need banks as monitors and reorganizers in the event of financial distress issue bonds. Smaller firms rely more heavily on bank loans. These determinants of choice of lender are most important during downturns.

In the papers just discussed, firms generally choose between bank loans and bonds but do not mix the two. In Section III, we return to this issue in more detail and discuss two extensions – papers that focus on the optimal mix of bank loans and bonds, and papers that explore differences in the contractual features of these two funding sources.

I. Banks versus Stock Markets

The fact that some economies are more bank-dependent and have small or almost nonexistent stock markets raises the question of how these savings and investment organizations differ. Research on the roles of banks has been discussed above. But what function do stock markets perform? Do stock markets perform the same functions as banks, so that banks and stock markets are substitute institutions? These questions are implicitly posed by studies of Germany, for example, where the economy appears to be very successful, but where historically the economy has been organized around banks.[9] Little research has been done on these questions. In part, more economic history research is needed, but perhaps surprisingly it is also not so clear what role the stock market really performs.

Dow and Gorton (1997) present a model of the stock market in which stock prices serve two roles. First, informative stock prices can lead to efficient executive compensation. But stock prices are only informative if some traders are willing to trade on their information about projects that the firm is considering undertaking. Thus, informative stock prices have a second role: the firm can use information from stock prices in making capital budgeting decisions. In this way, the stock market performs both a screening role for projects and a monitoring role in the sense of performance-sensitive compensation. But

[9] The distinction between bank-based systems and stock market-based systems is not as stark as it is usually presented. In the case of Germany, for example, see Fohlin (1999).

Dow and Gorton show that a bank can also perform these roles, suggesting that banks and stock markets are alternative institutions in the savings/investment process.

By contrast, Allen (1993) and Allen and Gale (1999) argue that banks and stock markets are fundamentally different in the way that they process information. Stock markets can aggregate diverse opinions, particularly about new technologies, while banks are inherently conservative. The prediction is that stock market-based economies will embrace new technologies, while bank-based economies will be less dynamic. This appears consistent with casual observations about venture capital, and raises interesting questions about the differences between banks and venture capital.[10]

Baliga and Polak (2001) address the question of why financial systems with banks and with bonds arise and persist. They argue that an important distinction between the German and Anglo-Saxon financial systems concerns not the distinction between banks and stock markets, but between bank loans and bonds. They ignore equity because equity finance was unimportant quantitatively at the start of the industrial revolution, the period that they have in mind for their model. Their model is one of moral hazard on the part of borrowers. If a borrower is monitored (bank finance), then the first best outcome can be enforced, but at a cost. If the borrower is not monitored (bonds), then only a second best outcome can be achieved, but there is no monitoring cost. There are multiple equilibria that can be Pareto-ranked. Interestingly, the Anglo-Saxon system can only persist if it is efficient, but the economy can get stuck in an inefficient German system.

Levine (2000) and Levine and Zervos (1998) are examples of the latest empirical research to explore questions about bank-based systems and stock market-based systems. The general conclusion of this literature is that the level of financial development is more critical than the relative dominance of banks or stock markets. Nevertheless, these papers focus on questions of overall economic growth rather than cross-sectional effects on different industries or firms. Differential effects such as those predicted by Allen (1993) or Allen and Gale (1999) remain largely unexamined.

III. Interactions Between Banks and Borrowers

As discussed in the previous section, one view of banks as intermediaries focuses on their role as delegated monitors or evaluators of borrowers that hold loans as a way of making their monitoring credible. To make this basic point, however, initial models of delegated monitoring abstracted from a number of realistic complications. In terms of interaction between borrower and lender, monitoring or evaluation is a one-time affair, behavior is fixed ex ante by contract, and optimal loan contracts are quite simple. In terms of interaction among lenders, borrowers use only one lender, and if competition among

[10] See also Boot and Thakor (1997).

lenders is modeled at all, it is assumed that there are infinite numbers of perfectly diversified intermediaries offering identical terms.

Reality is much more complex. Loan contracts often include many pages of terms and conditions ("covenants"), and some banks hold equity claims on borrowers. Terms are often selectively enforced or renegotiated as bank and borrower interact repeatedly over time. Borrowers often obtain financing from multiple sources: even small firms may have trade creditors, and larger firms often use several bank lenders or mix bank finance with funding from dispersed investors. Indeed, many loan terms govern relations between the bank and other claimants. Banks are rarely perfectly diversified and face varying degrees of competition.

In what follows, we survey research on these issues. In order to narrow the field, we emphasize work that has appeared since the beginning of the 1990s; for a survey of some of the earlier work, see Bhattacharya and Thakor (1993). Moreover, we emphasize papers that focus on monitored finance – that is, papers in which some lenders have access to information that the investing public does not have. Because work on banks as underwriters has largely focused on potential conflicts of interest between banks and investors rather than its impact on bank borrowers per se, we reserve this topic for our discussion of regulation in Section V below. For reasons of space, we also abstract from work on how bank lenders may influence borrowers' industry structure. [11]

A. Dynamic Relationships and the Pros and Cons of Bank Monitoring

As noted above, early papers on delegated monitoring focused on one-time interaction between banks and borrowers and emphasized the savings from having a single investor monitor. Subsequent research has shown that a dynamic setting introduces additional pluses and minuses to delegated monitoring. On the plus side, long-term relationships between banks and borrowers allow for improved outcomes through implicit contracts enforced by concerns for reputation or future rents. On the minus side, a credible long-term relationship leaves bank and borrower locked in to one another, so the borrower may exploit the bank, the bank may exploit the borrower, or the borrower may find itself without needed funding if the bank suffers difficulties from the rest of its business. If these problems are severe, it may be better to forgo delegated monitoring entirely and rely instead on "arm's-length" finance from dispersed investors.

[11] Examples include how cross-shareholdings or board seats between firms and banks affect tradeoffs between improved industry coordination on the one hand (e.g., Da Rin and Hellmann, 1996) and harmful anticompetitive effects on the other hand (e.g., Cantillo Simon, 1998, Adams, 1999, Arping, 2001). Other papers on how banks influence borrowers' industry structure include Maksimovic (1990), Yosha (1995), Bhattarcharya and Chiesa (1996), Kanatas and Qi (2001), and Stomper (2001).

One of the first papers to recognize the potential gains from long-term interaction between banks and borrowers is Haubrich (1989). In single-period delegated monitoring models, there is some probability each period that the borrower will do poorly enough that the bank must monitor. Haubrich's insight is that, in a repeated relationship between bank and borrower, the bank can simply keep track of reports from the borrower and penalize the borrower if too many reports are bad. If both the bank and borrower are sufficiently patient (have discount rates close to zero), the threat of being penalized and losing funding access in the future is sufficient to make the borrower report truthfully, sparing the bank the need to monitor more closely. This is true even if the reports are not verifiable in a court of law – the relationship is sustained by a tacit ("implicit") agreement. To the extent that reviewing and tracking reports is still costly, there is still a gain to having a single bank lender rather than multiple lenders.

Boot, Greenbaum, and Thakor (1993) suggest another way in which long-term relationships and implicit contracting may reduce costs compared to explicit, completely specified contracts. They start with the observation that many bank-borrower arrangements give banks a great deal of flexibility: for example, credit lines often have clauses which let the bank renege on the credit line if the borrower's situation undergoes a "material adverse change." Since many of these lines are used to back commercial paper borrowings and are meant to be used when the borrower is having trouble refinancing its commercial paper, it is not clear why borrowers pay fees for such a credit line – and yet they do.

The key insight of Boot, et al. is that if the bank committed to honor the credit line no matter what, it might be forced to make good on its commitment in situations where its overall situation was weak, further weakening its financial position. The "material-adverse-change" clause allows the bank to renege in such situations. Nevertheless, the bank does not wish to renege all the time – if it did, market participants would not pay for its credit lines, hurting its future profits. By putting its reputation on the line, the bank is able to offer a product that lets it renege when its current situation is so severe that the hit to its reputation and future profits is less costly than honoring the commitment now. Of course, if this arrangement is to work, the bank must be sufficiently patient and must have future rents or quasi-rents that are sufficiently attractive; an increase in competition among banks would reduce such rents and jeopardize such implicit contracting.

There is some evidence that bank relationships do help borrowers through implicit contracting. Petersen and Rajan (1994) find that small firms that have been with their bank for a longer time (controlling for firm age) have greater access to credit, especially if they rely on a single bank rather than multiple banks. Berger and Udell (1995) find that a longer bank relationship (again controlling for firm age) lowers interest rates and collateral requirements on loan commitments. As noted in Section II, Hoshi, Kashyap, and Scharfstein (1990a,b, 1991) find that Japanese firms that are members of a *keiretsu* face lower costs of financial distress than those faced by non-member firms. Elsas and Krahnen (1998) find that troubled German firms are more likely to get additional financing if they have a "main bank" (*hausbank*) relationship.[12]

Petersen and Rajan (1995) suggest yet another way in which long-term relationships can benefit borrowers. Suppose that banks do not initially know which borrowers are good and which are bad, but do learn this over time as the firm establishes a track record for itself. Initially, firms can also unobservably choose projects with higher risk but lower returns, and their incentive to do so increases in the interest rate they are charged. If banks compete actively for loans, the rate they charge initially will reflect average credit quality, which may in turn be so high that even good firms choose risky projects, which in turn may lead to credit rationing (as per Stiglitz and Weiss, 1981). By contrast, if banks have some market power, then they can choose a lower rate initially, knowing that they can make up any losses by earning monopoly rents on good firms in the future; this in turn may reduce initial risk-shifting incentives and thus initial credit rationing.

Petersen and Rajan test their theory by regressing the rates that small businesses pay on their loans against a number of controls for firm risk and the Herfindahl index of the local banking market. Consistent with their theory, in highly concentrated banking markets, young firms are more likely to receive bank finance, and the rate of interest that firms pay declines more slowly over time, allowing banks to earn rents on survivors.[13]

The common theme of these papers is that long-term relationships increase contracting flexibility. Since the theoretic models rely on future rents or quasi-rents to maintain incentive compatibility, it follows that if increased competition among banks decreases rents, such competition should also undermine relationships. This in turn suggests a possible drawback to relationships: since bank-borrower relationships implicitly rely on lack of competition, they create an environment where the borrower is exposed to the bank's weakness or outright exploitative behavior, and vice versa.

The first paper to focus on the drawbacks of bank-borrower relationships is Sharpe (1990), who shows that a bank's monitoring activity may give it informational rents which in turn may distort borrower behavior. To see this, consider a firm's "inside" bank (one that already has a lending relationship with the firm). Based on the relationship, the inside bank will have some idea of the firm's

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[12] See also the references and discussion in Berger and Udell's (1998) review article on small firm finance.

[13] In related work, Fischer (2000) finds that German firms in more concentrated banking markets are less credit-constrained and transfer more information to their lender; also, banks provide more liquidity if they have received such information. Bonaccorsi di Patti and Dell'Ariccia (2001) examine the impact of local bank concentration on rates of firm creation in Italy. They find that less competitive banking markets have lower rates of firm creation on average, but the opposite is true in industries with low fixed assets, which they argue proxies for high asymmetric information. At a "macro" level, Cetorelli and Gambera (2001) examine how cross-country differences in banking sector concentration affects different industries' growth rates. They find that more concentrated banking sectors lower average growth rates, but do increase the growth rates of industries that have very high external finance needs.

eventual chance of success ("credit quality"); by contrast, banks that do not have a relationship with the firm ("outside banks") have not monitored and are thus relatively uninformed about the firm's credit quality. If outside banks were to offer rates that reflected average credit quality, only below-average firms would switch, and the outside banks would lose money on average. To protect themselves from this "Winner's Curse," these banks offer higher rates. This in turn lets the inside bank charge higher rates, letting it earn informational rents on above-average quality firms.[14] Higher borrowing rates discourage investment by good firms with established bank relationships. Moreover, even if initial competition for unattached borrowers causes banks to compete away these subsequent rents, this gives too much capital to firms that are unproven.

Rajan (1992) takes this analysis further in several ways. Unlike Sharpe, he explicitly models agency problems between a firm and its investors that may make delegated monitoring attractive. Specifically, a firm's eventual chance of success is determined by the unobservable costly effort of its entrepreneur. After this initial exertion of effort, an interim private and unverifiable signal reveals whether the firm will be successful or not; if not, it is efficient to liquidate the firm promptly rather than let it continue. If a single investor ("bank") holds the firm's debt, it also sees this signal, but free-rider problems are assumed to rule this out when investors are dispersed ("arm's-length finance").

First, if the bank holds short-term debt, it can threaten to liquidate the firm regardless of the interim signal, triggering renegotiation of the loan. If the bank's bargaining power in renegotiation is high, it can hold up the entrepreneur for a high share of any surplus; knowing this will happen, the entrepreneur underinvests in effort. Long-term bank debt removes the hold-up problem by removing the bank's ability to threaten to liquidate the borrower. The *borrower* can still initiate negotiations if liquidation is efficient, capturing a share of any liquidation proceeds. The drawback to this arrangement is that, ex ante, the borrower's incentive to put effort into assuring good future outcomes is reduced, since the borrower effectively gets some insurance against bad outcomes that lead to liquidation. If the bank has a lot of bargaining power, long-term bank debt is better: renegotiations favor the bank, so short-term debt would lead to excessively high rents whereas long-term debt gives the borrower little insurance against liquidation. When bank bargaining power is low, the opposite is true.

Second, Rajan considers the incentive effects of arm's-length finance from dispersed lenders. Since arm's-length lenders are poorly informed, their decisions to renew loans or demand immediate repayment forcing liquidation are not efficient. Moreover, since they will charge a rate to protect

[14] Strictly speaking, Sharpe's analysis of the Winner's Curse is incorrect, since he assumes that a pure strategy equilibrium in rate-setting exists. Broecker's (1990) analysis of bidding by multiple banks with private signals of borrower quality suggests that the equilibrium should involve mixed strategies (randomized rate-setting); this holds in Rajan's (1992) setting, and von Thadden (forthcoming) shows that this holds in Sharpe's setting as well. Nevertheless, the informed bank does earn positive rents on average, so Sharpe's basic intuition is correct.

themselves from inefficient continuation/liquidation decisions, the borrower's initial investment decisions may also be distorted. Nevertheless, for intermediate levels of bank bargaining power, arm's-length finance may dominate both types of bank finance.

Finally, Rajan endogenizes bargaining power by allowing for interim competition between an "inside" bank, which has monitored and knows the firm's situation, and uninformed "outside" banks. As in Sharpe (1990), the "Winner's Curse" lets the inside bank earn rents on average; the greater the information advantage, the greater the rents and thus the bank's effective bargaining power. If a firm's chance of success ("quality") is high, the inside bank's information advantage is small, and there is little difference between bank finance and arm's-length finance. At intermediate quality levels, bank finance dominates, while at lower quality levels, the informed bank's information advantage is so high that the benefits of efficient liquidation are outweighed by the bank's high rents and the entrepreneur's consequent underinvestment in effort.

Dinc (2000) examines how such informational rents affect banks' ability to sustain implicit relationship lending arrangements. In his model, it is ex ante efficient for bank lenders to commit to rescue firms that are distressed but not outright failures; however, because much of the benefits from such rescues flow to the entrepreneur, it is not in a bank's interest ex post to rescue the firm. Although the bank can be compensated by giving it higher payments when the firm is successful, in one-shot arm's-length lending, the bank always reneges on rescues ex post. In a repeated-game setting, so long as banks do not discount future profits too much, they may be able to establish reputations for rescuing distressed firms and so capture relationship rents. Such implicit contracting is impossible if too few banks compete: informational monopoly lets the lender set its rate so high that any additional gains to maintaining a good reputation are too small to prevent reneging. On the other hand, if too many banks compete, rents from maintaining a good reputation are reduced, and once again banks renege.[15] Thus, relationship lending can only be sustained for an intermediate number of banks.

As noted by Detragiache, Garella, and Guiso (2000), another implication of the "Winner's Curse" is that firms that rely on a bank may be hurt if that bank faces financial distress. Intuitively, a distressed bank may have difficulty supplying its good borrowers with sufficient credit for their needs. If instead these borrowers try to switch to new banks, the "Winner's Curse" problem will be especially severe because the inside bank's mix of loans is known to be worse than average. As a result, good borrowers of a distressed bank may find that additional financing is very expensive or perhaps even nonexistent.

[15] A key difference between Rajan (1992) and Dinc (2000) is that, in Rajan, only the inside bank has private information, so it alone earns informational rents; in Dinc, all competing banks get (costless) private signals, and in equilibrium they earn positive informational rents that decline with the number of banks.

In Section II, we noted that Slovin, Sushka, and Polonchek (1993) find evidence that Continental Illinois Bank's near-failure in 1984 had a significant negative impact on firms for whom Continental was the main bank. Moreover, since their results focus on firms with *some* access to public markets (those with publicly-traded stock), it seems likely that smaller firms without such access were hit even harder. Kang and Stulz (2000) find similar effects when examining how Japan's long-drawn banking crisis of the 1990s affected firms that were dependent on bank finance.

By themselves, these findings do not prove that bank relationships are wholly bad; after all, before the banks in these samples got into trouble, they may have been critical in funding their relationship borrowers. Nevertheless, to the extent that a relationship with a single bank leads to possible hold-up problems or overexposure to that bank's risk, firms may wish to establish multiple bank relationships, breaking a single bank's information monopoly and diversifying exposure to any one bank's risk.[16] Jean-Baptiste (2001) shows how multiple relationships mitigate the hold-up problem. Detragiache, Garella, and Guiso (2000) examine the diversification argument. They find that, when asymmetric information concerns are high, firms opt for multiple banks; the risk of being denied funding if the firm relies on a single bank that gets into trouble is too great. Similarly, the number of relationships should increase as bank fragility increases.[17]

Empirical tests of the number of bank relationships per firm yield mixed results. For example, using data on Italian firms, Detragiache et al. generally find support for their model's predictions: if bank liquidity shocks are high or bank size is low, firms are more likely to opt for multiple banks and more likely to have more relationships once they go to multiple banks. By contrast, Foglia, Laviola, and Reedtz (1998) examine Italian data and find that multiple bank relationships tend to be associated with greater borrower risk; however, they do not control for bank fragility. Similarly, Farinha and Santos (1999) examine Portuguese data and find that firms with greater growth opportunities, less liquidity, or greater bank dependence are more likely to switch to multiple bank relationships, all of which is consistent with reducing hold-up problems. Ongena and Smith (2000) examine how the number of bank relationships per firm varies across different countries. They find that, for low levels of bank fragility (measured by credit rating), the number of relationships per firm decreases as fragility increases, but the relationship does become positive at higher levels of bank fragility; however, they do not control for firm risk.

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[16] Carletti (2000) shows that having multiple banks has the drawback of decreasing each bank's incentive to monitor; however, total monitoring may increase if monitoring costs are sufficiently convex in monitoring intensity.

[17] If the probability of bank liquidity problems is very high, however, firms switching banks face *less* of an adverse selection problem: outside banks know that the firm is more likely to switch because its old bank had problems rather than because the firm is a "lemon." Thus, for high bank fragility, single banking may again dominate.

A final piece of evidence comes from Houston and James (1996), who examine the mix of bank debt and public (i.e., arm's-length) debt for a sample of publicly-traded U.S. firms. To the extent the hold-up problem of Sharpe (1990) and Rajan (1992) is significant, it is likely to be most costly for firms that have many growth opportunities that need funding, and so these firms should use more public debt. Conversely, if the hold-up problem is not an issue, the advantages of relationship lending should make bank debt more attractive for firms with greater growth opportunities. Houston and James find that firms with a single bank relationship tend to rely less on bank debt as growth opportunities are higher, but the opposite is true for firms with multiple bank relationships. This is consistent with the notion that having multiple bank relationships mitigates the hold-up problem.[18]

In sum, theory and evidence both suggest pros and cons to bank-borrower relationships. Benefits include increased flexibility and access to funding; drawbacks include hold-up problems and negative spillovers from bank fragility. Which of these is dominant depends critically on both the nature of the borrowing firm and the nature of the banks that the firm has access to. Increased competition among banks tends to undermine relationships, but too much monopoly power may have the same effect.

B. Monitoring and Loan Structure

The papers just discussed generally assume that a firm is funded either by one bank or by many dispersed lenders with loans of the same size, that a single bank lender costlessly monitors whereas dispersed lenders do not, and that any debt has a simple structure. We now discuss research that has focused on these missing details: how bank monitoring interacts with loan features and a borrower's overall financial structure.

As noted at the beginning of this section, bank loans are often quite complex, and the terms are often renegotiated over time. Moreover, if one compares bank loans and other privately-held debt with publicly-held bonds and notes, privately-held debt typically has more covenants and other terms and is much more likely to be renegotiated than publicly-held debt. These general facts make sense if banks are to be delegated monitors; after all, complex covenants are only useful if the lender observes whether these have been violated, and dispersed lenders will lead to duplication of effort and free-riding problems in monitoring. Similarly, renegotiation is likely to be inefficient if lenders are poorly-informed or dispersed ("arm's-length" lending); again, see Bolton and Scharfstein (1996).

These ideas have led to a more dynamic view of loan features. In the old view, best represented by Smith and Warner (1979), covenants and repayment schedules simply prevent borrowers from exploiting lenders. For example, a borrower may shift into a riskier line of business, capturing any

[18] For further references on the pros and cons of bank relationships, see the survey by Boot (2000).

increased upside over and above the promised payments on the debt while using limited liability to share any increased downside with the lender ("risk-shifting" or "asset-substitution"); a covenant forbidding change of business focus prevents this. In the new view, covenants and repayment schedules are tripwires which give an informed lender the right to threaten the borrower with default, after which renegotiation can occur. In our example, a lender faced with a borrower's proposal to change to a riskier line of business can make several choices. If the change is a reaction to deteriorating conditions, and the firm's assets are best used elsewhere, the lender can force default and liquidation. If the change is truly the best option, the bank can simply increase the interest rate to reflect increased risk, and perhaps tighten other terms to prevent any increased chance of future exploitation.

Berlin and Mester (1992) are among the first to model these issues. They show that the ability to renegotiate covenants can substantially improve their usefulness, because renegotiation allows the use of unverifiable information that the borrower and lender may have. If the borrower's actual situation is poor, the borrower can comply with the covenant, eschewing exploitative behavior and preventing default. If the borrower's actual situation is good, so that violating the covenant is actually good for overall firm value, the borrower can violate the covenant knowing that it will be in the lender's interest to renegotiate rather than allow default and associated costs to occur. As a result, in settings where lenders are concentrated (so that the lenders have more incentive to be informed and renegotiation is easier), covenants can be set more stringently, improving overall firm value on an ex ante basis. Since the value of allowing renegotiation increases with the ex ante risk of the borrower, private debt contracts should be more prevalent among riskier borrowers.

Berlin and Mester's work has some weaknesses. First, renegotiation is possible only when the covenant is tripped, so it is possible that the firm may actually be in trouble based on unverifiable information and yet its covenants are not violated. In such a case, a loan with short-term maturity would be better, since the bank could use all information (verifiable or not) in deciding whether to renew the loan or instead call for immediate repayment, triggering default. Second, the bank observes the borrower's condition at no cost, abstracting from the need to provide the bank with incentives to monitor. Subsequent research has addressed both issues.[19]

One problem with a short-term loan is the hold-up problem of Sharpe (1990) and Rajan (1992); indeed, Rajan shows that a severe hold-up problem may make long-term bank debt attractive. One can then think of long-term debt with covenants as a happy medium: unlike pure long-term debt, this gives

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[19] A more technical issue is that Berlin and Mester focus on the case where the verifiable information in covenants is almost perfectly correlated with the firm's actual (unverifiable) situation, ruling out comparative statics on the relative precision of verifiable information.

the bank *some* power to force renegotiation, but this power is limited to cases where verifiable information suggests that the firm is likely to be in trouble.

Rajan and Winton (1995) highlight another possible disadvantage of short-term loans: paradoxically, by restricting the bank's power to call for repayment, long-term debt with covenants may increase the bank's incentive to monitor in the first place. Suppose that a firm has a number of claimants besides the bank (trade creditors, shareholders, etc.). Two signals of the firm's condition are available: a free but noisy public signal, and a costly but more precise private signal that is only partially verifiable. If the public signal is not too noisy, a bank that holds short-term debt may prefer to rely on this signal; the bank would bear the entire cost of the private signal, but the benefits of more efficient continuation/liquidation decisions would accrue to all claimants. By allowing the bank to call the loan only when costly verifiable information suggests that the firm is in trouble, long-term debt with covenants forces the bank to observe the private signal. Of course, if the public signal is very imprecise (as for very young firms), even a bank with short-term debt will monitor; conversely, if the public signal is very precise, costly monitoring is unnecessary, and the firm can rely on publicly-held arm's-length debt. These results are consistent with the fact that firms that rely on long-term privately-placed debt tend to be larger and older than firms that rely on relatively short-term bank debt, whereas both types of firms tend to be smaller than firms that issue public debt.

Gorton and Kahn (2000) explore a different aspect of the dynamic nature of bank loans. Suppose that an entrepreneur who borrows money may engage in two forms of moral hazard: as in Rajan (1992), he may continue the firm when liquidation is more efficient, and he may also choose to increase the firm's risk in continuation even though this increase in risk is costly. There are situations where it is better to forgive some of the debt so as to deter additional risk-shifting rather than forcing liquidation, but this requires that the debt be held by a single lender so as to allow renegotiation. Even with a single bank lender, short-term debt may lead to excessive liquidation, and so it may be better to give the bank long-term debt with limited ability to call the loan early. The upshot is that, for bank debt, initial terms are not set to price default risk but rather are set to efficiently balance bargaining power in later renegotiation, and renegotiated interest rates may not be monotonic in firm risk.

Yet another strand of research has focused on how the need for bank monitoring affects the mix of bank debt and public debt and the allocation of maturity or seniority between these two groups of creditors. One early paper on this topic is Besanko and Kanatas (1993). As in Rajan (1992), entrepreneurs require outside financing, which then reduces their incentive to exert effort. A bank can force the entrepreneur to exert effort ("monitor") at a cost that is increasing in the effort level desired, but such monitoring is not contractible. Since the bank chooses monitoring levels without considering the entrepreneur's cost of effort, it is optimal to use some public debt as a way of reducing the bank's claim on the firm and thus its incentive to monitor excessively.

Besanko and Kanatas say little about the relative priority or maturity of bank and public creditors. A starting point for this topic can be found in the work of Diamond (1993a,b) and Berglöf and von Thadden (1994). In these papers, splitting a firm's financing into a short-term senior component and a long-term junior component creates a credible threat of liquidation: the firm's value in liquidation may be enough to satisfy short-term senior debtholders even if junior claimants would prefer to let the firm continue. An appropriate mix of short-term senior debt and long-term junior debt balances credible liquidation *threats* against *actual* inefficient liquidation in a way that either forces the firm to avoid risk-shifting (Berglöf and von Thadden) or minimizes the firm's total cost of capital (Diamond).

Although Diamond (1993b) argues that an active monitor should hold short-term senior debt and focus on deciding when to liquidate the firm, none of these papers explicitly analyze monitoring incentives. It is not immediately clear that active monitors should be senior; if a senior secured creditor's claim is safe regardless of what happens to the firm, the creditor will have no incentive to monitor. Models of costly state verification such as Winton (1995b) suggest that the investor with greatest monitoring skills or lowest costs should be most junior and thus monitor more often, and indeed, venture capital and other private equity funds hold relatively junior claims and monitor intensively.

On the other hand, bank loans are often secured, hence senior to other debt. If banks are active monitors, it follows that their security cannot make them completely safe. Rajan and Winton (1995) show that giving the bank collateral can improve monitoring incentives if the collateral's value is sensitive to inefficient continuation of the firm's current business strategy. In this case, the bank must monitor the firm's situation so that it can use the threat of calling the loan to force the firm to adopt a more conservative policy or even outright liquidation so as to preserve the value of the bank's collateral. Examples of collateral with this feature include inventory and accounts receivable, both of which may suffer drastic declines in value if the borrowing firm continues to run its operations inefficiently. By contrast, a loan secured by real estate whose value was independent of the firm's operations would give the bank little incentive to monitor.[20]

Although Rajan and Winton explore a mechanism where the bank's taking of additional collateral signals to public creditors that the borrower is in trouble, they do not examine the implications that this has for the optimal mix of public versus private debt. Repullo and Suarez (1997) focus on this mix in a

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[20] Along similar lines, Manove, Padilla, and Pagano (2001) show that if entrepreneurs have sufficiently high low-risk collateral, similar considerations undermine banks' incentives to screen good entrepreneurial projects from bad ones.

somewhat simpler setting. An entrepreneur borrows money now and exerts costly effort that increases his firm's chance of eventual success; if it does not succeed, the firm is worth zero. If the firm is liquidated at an interim date, proceeds are less than the initial investment amount, but this may still be better than letting the firm continue if initial effort is too low and the chance of failure is high. For a fixed cost, an investor can commit to monitor the entrepreneur's effort choice at this interim date.

If liquidation values are low or the entrepreneur has sufficient investable wealth, uninformed finance (arm's length debt or equity) is optimal. If liquidation values are high relative to the entrepreneur's wealth, it is optimal to have a single investor (bank) monitor and hold short-term debt, forcing liquidation if the entrepreneur does not exert enough effort. For intermediate levels, however, giving the bank all of the firm's debt does not achieve first-best effort: if the entrepreneur deviates slightly from this effort level, the bank's share of future proceeds in success is high enough that it prefers to let the firm continue rather than forcing liquidation. In this case, giving junior debt to arm's length investors restores the credibility of the bank's liquidation threat by shrinking the bank's share of future proceeds relative to its senior claim on liquidation proceeds. As liquidation value falls, the optimal mix of debt shifts towards public (junior) debt and away from private (senior) debt.

A weakness with this model is that it requires that the bank can commit to monitoring. Without commitment, the bank would not monitor if it knew that the entrepreneur would choose first-best effort for sure, and this lack of monitoring would in turn reduce the entrepreneur's effort incentives. Park (2000) examines monitoring choice when commitment is impossible. He shows that it is optimal to give the bank senior debt that is *not* fully collateralized, so that the bank is somewhat impaired when it forces interim liquidation. This gives the bank an incentive to monitor so that it only liquidates when liquidation is efficient. Even so, subject to this incentive constraint, it is best to use as little senior bank debt as possible; otherwise, as in Repullo and Suarez (1997), the liquidation threat is less credible. Note the contrast with the results of Besanko and Kanatas (1993). In Besanko and Kanatas, monitoring automatically forces the entrepreneur to exert effort, and the problem with too much bank debt is excessive monitoring. In Park, monitoring only forces effort through the liquidation threat, and too much bank debt undermines efficient liquidation.

Longhofer and Santos (2000) provide another motivation for making banks senior to other creditors, one that combines monitoring incentives with active benefits from relationship lending. For relationship lending to have value, the bank must have incentive not only to monitor the borrowing firm's situation but also to help the firm when times are bad but the firm is essentially sound, which is just when uninformed investors are unwilling to lend more money. If the bank had a junior claim, it might not be willing to advance the firm *additional* money in bad times. This is a version of the underinvestment problem of Myers (1977): in bad times, even senior creditors' claims may be somewhat risky, in which case some of the benefit from the bank's additional investment flows to the senior creditors. If the bank is senior, it internalizes this benefit and is willing to lend in bad times.

These theories of public and private debt are consistent with a number of stylized facts: bank loans tend to be secured and relatively short-term, public debt is more likely to be subordinated or relatively long-term, etc. Nevertheless, there has been relatively little empirical work on the detailed implications of these theories. As noted in Section II, James (1995, 1996) finds that, for firms in financial distress, banks generally do not make concessions unless public debt holders do, and banks typically make fewer concessions than public debt holders. This is consistent with the view that banks hold more senior claims and are tougher negotiators than public, more junior debt holders.

Other empirical work has focused on how the mix of public debt and bank debt varies with firm characteristics. As noted above, Houston and James (1996) find that firms that rely on a single bank use more public debt as growth opportunities are larger, which is consistent with the view that firms with lower tangible assets (and thus liquidation value) should use more public debt. Although Houston and James find that the opposite relationship holds for firms with multiple banks, they note that multiple banks are a step in the direction of public, diffusely-held debt. Johnson (1997) finds that the proportion of firm debt held by banks is greater as the firm has a lower market to book value ratio, which again is consistent with a positive link between public debt and growth opportunities. He also finds that smaller and younger firms use more bank debt, consistent with the notion that banks focus on firms with relatively greater information costs. In a study of initial public debt offerings, Datta, et. al. (2000) find that the negative average stock price response to these offerings is mitigated for firms with higher growth opportunities. Since such offerings reduce the fraction of financing provided by bank debt, this too is consistent with the notion that firms with fewer tangible assets should use more public debt. On the other hand, one could argue that this is simply a case where having well-known positive NPV projects mitigates the "lemons"-type announcement effect of issuing securities.

The upshot is that many of the complexities found in actual loan contracts – seniority, collateral, covenants – can be motivated as mechanisms for fine-tuning the bank's monitoring and control incentives as a function of firm characteristics. The same applies to the mix of (concentrated) bank debt and (diffuse) public debt.

C. Beyond Lending: Equity Stakes, Board Seats, and Monitoring

Thus far, we have assumed that banks only make loans, i.e., they do not hold equity. Although this is generally the case in the U.S., other countries have allowed banks to hold equity, Japan and Germany being well-known examples. Moreover, as James (1995) shows, U.S. banks have been allowed to take equity as a consequence of loan restructuring, and in many cases they hold these stakes for a considerable time after the restructuring. Banks may also gain power over firms by proxy voting of shares that the banks hold in trust.[21] Finally, even in the United States, bank officers may sit on the board of directors of firms to which they lend. In this subsection, we discuss research on how a bank's relationship with a borrower is affected by having the bank hold shares, vote proxies, or occupy board seats.

At first glance, allowing banks to hold equity has several potential advantages. In a discussion piece, Stiglitz (1985) argues that, although institutional shareholders might have goals more aligned with value-maximization, their shareholdings are usually too small to give them much direct control. By contrast, banks have a lever of control that an institution holding 1% of a firm's shares does not have – namely, the ability to refuse to renew loans. Since lenders get at most a fixed payment (interest plus principle), they care little about a firm's upside and much more about its downside. To the extent they exercise control over management, they will focus on avoiding bad outcomes; moreover, for large firms with extremely low chances of default, banks may simply do nothing. If banks hold significant equity stakes along with their loans, then they would care more about maximizing overall firm value.

John, John, and Saunders (1994) examine this issue in a simple model of firm risk-taking. If a bank's loan covenants give it effective veto power over the borrower's choice of project risk, then allowing bank holdings of equity does improve the efficiency of the borrower's risk choice; the intuition is precisely that of Stiglitz. The downside is that, because all else equal equity is riskier than debt, and because the firm chooses a higher (albeit more efficient) level of risk, holding equity increases the bank's overall portfolio risk. Thus, allowing banks to hold equity may exacerbate costs linked to bank failure.[22]

Mahrt-Smith (2000) shows that bank holdings of equity have another advantage: they can reduce the hold-up problem analyzed in Rajan (1992). In Mahrt-Smith's model, a firm that has already received funds from an informed inside bank needs financing for additional investment. As in Rajan, the Winner's Curse faced by outside banks gives the inside bank informational rents which in turn distort the firm's investment decisions. If the inside bank holds both debt and equity, then any debt that outside banks provide is senior to the inside bank's equity claim. The more the inside bank's claim consists of equity, the more senior and so the less risky are the outside banks' claims. Less risk means less sensitivity to information, diminishing the Winner's Curse problem faced by the outside banks. Thus, having the inside

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[21] Although voting shares held in trust is typically associated with German banks (see Gorton and Schmid, 2000), Haubrich and Santos (2002) show that modern-day U.S. bank trust departments also have significant voting powers.

[22] On the other hand, if the bank is a relatively passive investor, John, John, and Saunders show that letting the bank hold equity is more likely to *reduce* the risk of both the firm and the bank. The intuition follows Green (1984). If the bank holds only debt, the firm's controlling shareholders engage in some risk-shifting, so firm risk and thus the bank's loan risk are inefficiently high. Equity lets the bank share in the firm's upside potential, diminishing the controlling shareholders' gains from risk-shifting. Santos (1999) pursues the implications that this has for optimal regulation, and finds that regulation restricting bank equity holdings is either not binding or inefficient.

bank hold equity reduces the informational rent earned by that bank. The caveat is that, as in Jensen and Meckling (1976), greater use of external equity finance reduces the amount of effort that the firm's owner exerts, and so there is a cost to having the firm's inside bank hold equity. Because the ability to reduce the outside bank's risk is tied to the firm's need for additional funds, bank equity holdings are most attractive for financing firms with high growth potential.

Berlin, John, and Saunders (1996) focus on how a bank's shareholdings in a firm affect potential collusion between the bank and the firm against the interests of other nonequity stakeholders. Bank debt is assumed to be senior to the stakeholders' claims, and the firm and the bank observe an interim signal of the firm's situation, whereas the stakeholders do not. If the signal is good and the firm is really healthy, the firm and the bank may collude to convince stakeholders that the firm is distressed and concessions are required from creditors; these unnecessary concessions boost the firm's profits. The bank finds this attractive only if its equity share of the increase in profits offsets the concessions it must make on its debt. This puts a cap on the optimal amount of equity the bank can hold. On the other hand, if the firm is really distressed and concessions are required to prevent costly bankruptcy, the bank and the firm may collude to convince the stakeholders that the firm is healthy. This is a problem when deadweight bankruptcy costs are small, so that the bank prefers its senior claim on net bankruptcy proceeds to making concessions. In this case, having the bank hold some equity subordinates part of its claim to the stakeholders and rules out the bank's incentive to collude.

One caveat to Mahrt-Smith (2000) and Berlin, John, and Saunders (1996) is that subordinating the bank's loans accomplishes the same ends as having the bank hold equity. Indeed, in Mahrt-Smith's model, subordinated debt dominates equity because it does not cause under-exertion of effort by the firm's owner. Berlin, John, and Saunders suggest that the bank may not be able to credibly subordinate its debt claim because it could always take additional collateral when the firm's position begins to deteriorate. This would be most applicable to firms with many collateralizable assets. All else equal, such firms also tend to have lower bankruptcy costs, so this is consistent with their prediction that bank equity holdings are most useful for firms with small bankruptcy costs.

A more far-reaching objection to these models is that, even in countries where banks are permitted to hold equity, bank portfolios overwhelmingly favor loans over shareholdings. Santos (1998) finds that, as of year-end 1995, bank shares and equity participations were less than five percent of bank assets in a number of developed countries, including the G7. Germany, Japan, and Switzerland topped the list with shareholdings at 4.8%, 4.6%, and 4.9% of total bank assets, respectively. [23] Large banks in these

[23] Because these numbers include equity investments in financial firms, some of which may be unconsolidated affiliates, Santos' numbers may overstate the extent of bank shareholdings in unaffiliated firms.

countries had somewhat greater shareholdings, but even in Germany (the highest), shareholdings for large banks were only 6.3% of assets. Moreover, Mahrt-Smith and Berlin, John, and Saunders motivate bank shareholdings as a way to resolve frictions between a well-informed inside bank and uninformed outsiders, yet there is evidence that bank shareholdings tend to focus on the shares of large, publicly-traded firms, where such information asymmetries should be smallest. For example, Saunders and Walter (1994) report that, in 1989, German banks as a group held only .6% of all industrial firms' shares, but roughly 5% of the top 100 firms' shares. Thus, there must be some countervailing friction that weighs against bank shareholdings in general and bank shareholdings in smaller firms in particular.

Winton (2001) motivates these patterns as responses to banks' liquidity considerations. When a bank seeks funding to meet unexpected withdrawals, loan takedowns, and so forth, there is some chance that this funding must be explicitly or implicitly backed by the bank's claims on firms that it monitors. These are precisely the assets on which the bank has more information than its providers of funds have, giving rise to an adverse selection problem. In equilibrium, the bank prefers to let some liquidity needs go unmet, creating liquidity costs. Because, all else equal, equity is more risky, hence more exposed to inside information, than debt, the bank can minimize adverse selection costs by holding debt rather than equity. Of course, the bank can hold *some* equity without having a high chance that it will have to use these assets as backing for funding, but the bulk of its claims on firms that it monitors should be debt. Similarly, because the bank's information advantage is smallest for large, publicly-traded firms, holding equity in these firms leads to fewer adverse selection costs. Finally, to the extent that larger banks are better diversified against individual customer liquidity needs, they are less likely to face very severe liquidity needs, so they are able to hold more equity as a fraction of assets.

Thus far, our discussion has focused on the impact of bank shareholdings in terms of cash flow rights: Stiglitz, Mahrt-Smith, and Berlin, John, and Saunders emphasize shares' junior status and their claim to the firm's potential upside, and Winton focuses on the higher risk and thus information-sensitivity that these features create. Shares' voting rights provide banks with control rights over and above those associated with bank loans, and a bank with a significant equity stake in a firm may be pivotal in proxy or takeover contests. Such control rights can be amplified beyond the bank's actual shareholdings if it uses stock pyramids to concentrate its voting power, or if it can exercise the votes of shares that it holds in trust for investors. Moreover, whether through shareholdings or through their role as lenders, banks may use their influence to win seats on a firm's board of directors. We conclude this segment with a discussion of research on these issues.

There has been relatively little theoretical research on how the additional control rights possible through shares or board seats affect optimal contracting between a bank and its borrower. By contrast, such modeling is very common in work on venture capital, where, in contrast to bank loans, contracts typically provide far more control rights and far more upside via equity or conversion features. [24] Although there has been little work on the circumstances in which venture capital financing dominates traditional bank lending, von Thadden (1995) is a partial exception: he does not explicitly model debt versus equity lending contracts, but he does show that giving delegated monitors significant control rights and claims on a firm's cash flow "upside" is optimal in circumstances that resemble venture capital.

In von Thadden's model, an entrepreneur chooses between short- and long-term projects. Interim returns reveal information about the project's innate quality, and this is the *only* information about project quality that the entrepreneur and arm's-length investors receive. There are cases where long-term projects are ex ante optimal, yet the firm has a high chance of poor interim returns and should be liquidated if these occur. Short-term arm's-length finance implements such liquidation, but it may cause the entrepreneur to myopically prefer the short-term project, which has a higher chance of good interim returns. By monitoring at a cost, a "bank" can get clearer information on the firm's eventual chance of success, avoiding inefficient liquidation based on interim returns alone and achieving first-best results. The contract that implements the first-best outcome is a long-term contract that gives the "bank" total control over project continuation but requires that the bank compensate the entrepreneur whenever the interim return is poor, even if the project is then liquidated.

There are two critical ways in which this model differs from "standard" models of bank control such as Rajan (1992). First, the "bank" can learn information that even the entrepreneur does not have. Second, monitoring is optimal for projects that are very likely to be (optimally) liquidated, yet have a very small chance of producing very high returns. It follows that the "bank" gets most of its return in unlikely but very high return states. Both features resemble venture capital settings: the venture capitalist typically has more financial and general business expertise than the entrepreneur, and most target firms do poorly and are terminated but a few offset this by doing very well. Nevertheless, von Thadden does not model the "bank's" incentives to monitor, nor does he allow for intermediate levels of monitoring that would correspond to bank lenders being less informed than venture capitalists but better informed than arm's-length investors. The choice between bank loans and venture capital remains largely unmodeled.

Empirical work on bank control rights through shareholdings and board seats typically focuses on two competing hypotheses. On the one hand, it is possible that these additional control rights enhance bank's ability to control firm agency problems in a positive way. On the other hand, because a bank's

[24] For further discussion of venture capital contracting, see Sahlman (1990) and Kaplan and Strömberg (2001).

shareholdings are typically small relative to its loans to and other dealings with a firm, the bank may emphasize policies that help it at the expense of shareholders as a group.[25]

Findings depend critically on the economic and institutional environment in which banks operate. Examining German banks in 1975 and 1986, Gorton and Schmid (2000) find that banks use their shareholdings and board representation to improve firm performance. They find little evidence that banks use their voting powers for shares held in trust, whether for good or bad. Gorton and Schmid also find that banks' use of control is more beneficial than that of a nonblank blockholder. This suggests that bank blockholders are less likely to emphasize private benefits that harm shareholder value, perhaps because banks' "private benefits" take the form of loans, which do benefit from improved firm performance. Similar results are found by Kaplan and Minton (1994), who find that Japanese banks are more likely to get seats on a firm's board following poor performance by the firm, and that turnover of incumbent top executives increases in the year of the appointment. On the other hand, Weinstein and Yafeh (1998) and Morck, Nakamura, and Shivdasani (2000) find that Japanese firms with a main bank relationship tend to have lower growth and profitability and pay higher interest rates than firms without such relationships, and the effects tend to rise with the fraction of shares held by the main bank. Although the results on growth might be due to selection bias (banks prefer to hold more shares in more stable firms), the results on interest expense suggest that banks are not entirely innocent of pursuing private benefits of control.

By contrast with these results, Kroszner and Strahan (1999, 2001) find that U.S. banks are more likely to sit on the boards of firms that are large and stable, have high proportions of tangible assets, and rely little on short-term financing. Although these firms are more likely to borrow from a bank that has seats on their board than from other banks, this does not seem to alter loan terms: the terms do not differ significantly from those of loans that the same bank makes to similar firms whose board it does not sit on. Kroszner and Strahan interpret this as evidence that U.S. legal doctrines such as equitable subordination and lender liability discourage banks from sitting on boards of firms that have high expected costs of financial distress, and from sitting on boards of informationally-opaque firms where conflicts of interest might be easier to hide, hence more tempting.[26]

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[25] This is a variant of the corporate governance concern that shareholders with more voting power than cash flow rights tend to pursue private benefits of control rather than enhancement of shareholder value. See the discussion and references in "Corporate Governance and Control," by Becht, Bolton, and Roell (this volume).

[26] Under equitable subordination, a bank that is found to have exercised managerial control over and above what any arm's length lender might do may have all its claims subordinated to those of other creditors. Lender liability allows creditors to sue the bank if it has exercised such control. Berlin and Mester (2001) show that these features can be an optimal way of getting a large investor to both monitor and try to assure good outcomes for the firm as a whole – if a court finds that the investor misused its private information and control rights, it is subordinated and so penalized.

D. Banking Sector Structure and Lending

We now turn to research on how banking sector structure interacts with banks' role as delegated monitors of borrowing firms. This research largely falls into two broad and overlapping areas: the role of scale economies or diseconomies in monitoring, and the role of economies of scope in monitoring.

Much of the literature on scale economies in monitoring focuses on the role of diversification. In the early work on delegated monitoring discussed in Section II, a better-diversified bank is better able to resolve the agency concerns of its own investors, giving it a funding advantage. Since fixed costs of monitoring or evaluating borrowers are at the heart of these models, it follows that, rather than diversifying by making smaller loans to more borrowers, it is cheaper to diversify by keeping loan size fixed and lending to more borrowers. For this reason, larger banks should find it cheaper to diversify than small banks, giving them an efficiency advantage.

The early papers did not go much beyond this insight. In Diamond (1984), a single bank is examined in isolation; in Boyd and Prescott (1986) or Williamson (1986), infinite numbers of perfectly diversified banks compete perfectly. Also, all of these papers assumed that all loans are stochastically independent of one another, and that the marginal cost of monitoring additional loans is constant, so that infinitely-diversified banks offer depositors risk-free investments. In reality, there are only finite numbers of different borrowers, default risk across loans is partly systematic (defaults rise in recessions), and larger banks may face various diseconomies of scale. All of these issues have been the focus of later research into banking sector structure.

Yanelle (1989, 1997) and Winton (1995a, 1997) focus on how the finiteness of the economy affects equilibrium banking sector structure. As Yanelle (1989) notes, one immediate problem is that when finite numbers of banks compete for finite numbers of depositors and borrowers, the paradigm of perfect Bertrand (price) competition is not reasonable. To see why, suppose that two banks are competing; one offers a lower lending rate than the other, but the bank with the higher rate has offered a higher rate on its deposits and is expected to capture the deposit market. All else equal, a borrower that chooses the bank with lower lending rates might find itself at a bank without any funds to lend. If everyone expects this to be the case, the bank with higher rates may end up capturing the market.

A related feature of these models is the existence of multiple equilibria. This is due to "adoption externalities," where a depositor's or borrower's utility from a given bank's offered rates depends on how many other depositors and borrowers plan to use that bank. To see this, suppose that two banks compete and offer the same deposit and lending rates. If the market splits (the classic Bertrand outcome), both banks will have equal size and diversification. Now suppose instead that a number of depositors "switch" from the first bank to the second, and that several borrowers at the first bank anticipate this and also switch so as to get funding. If this occurs, the second bank is better diversified than the first, and to the extent that the second bank is now less likely to fail, its depositors are better off. Anticipating this, more depositors (and thus firms) may also want to switch to the second bank. Thus, if agents can coordinate, one bank should dominate. On the other hand, if they cannot coordinate, the market-splitting outcome is also possible.[27] These adoption externalities mean that agents' beliefs about how other agents will react to a given set of bank rates have dramatic effects on equilibrium outcomes, leading to multiple equilibria.

Winton (1995a) looks at bank structure when agents can freely become investors, banks, or firms, after which banks compete for deposits and loans simultaneously. There are usually multiple equilibria, so without coordination there is no guarantee that the most efficient outcome will emerge. If a single bank is most efficient and regulators charter one bank to attain this, the monopoly bank might exploit its power so greatly that direct lending without banks is preferable. This is least likely to be a problem when monitoring costs are high; intuitively, this is when direct lending is most likely to cause credit rationing (Williamson, 1986) or even autarky, so that the reduction in monitoring costs through delegation to the monopoly bank is most attractive.[28]

Both Yanelle (1997) and Winton (1997) address the problem of multiple equilibria in models where numbers of firms and investors are fixed exogenously. Yanelle (1997) assumes that fixed numbers of banks compete for each side of the market sequentially, and applies game-theoretic equilibrium refinements such as coalition-proofness and evolutionary stability. Outcomes depend on which side of the market "moves" first. When banks compete for loans first, multiple banks can coexist and earn positive profits in equilibrium. The coalition-proof equilibrium has the maximum feasible number of banks coexisting and earning zero profits, but this is not evolutionarily stable, so refinements do not yield clear predictions. If instead banks compete first for deposits, the coalition-proof outcome is evolutionarily stable. In it, heavy competition for deposits makes both deposit and lending rates Walrasian levels. At most one bank is active, capturing the market and earning zero profits. Since higher deposit rates increase banks' chance of default and associated costs, it is possible that direct lending is preferable to delegated monitoring, in which case banks compete themselves out of existence.[29]

Rather than use "standard" single-period equilibrium refinements, Winton (1997) examines which investor beliefs are most plausible at different stages of a banking system's development. Early on,

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[27] Since a single depositor's wealth cannot finance an entire firm, switching by a single depositor does not increase a bank's effective lending capacity, and market-splitting is a Nash Equilibrium.

[28] Yosha (1997) also examines tradeoffs between diversification and competition, but his focus is on Cournot competition among risk-sharing intermediaries that resemble mutual funds more than banks.

[29] The difference between the "loans-first" and "deposits-first" results is caused by Yanelle's assumption that deposits are in excess supply. Winton (1997) focuses on competition for deposits when loans are in excess supply, and gets results similar to Yanelle's "loans-first" case.

banks are not yet well established, and investors can only coordinate on banks via the rates that banks offer. Here, free entry tends to the maximal number of small, fragile banks. Although a larger, better-diversified bank that pays somewhat lower deposit rates would be best, the only way for banks to achieve this profitably is to lower their rate from the competitive equilibrium – a move that is unlikely to attract depositors to an untried bank. Over time, some banks fail, and investor beliefs begin to focus on the survivors in the sense that, all else equal, they expect the survivors will maintain their market shares. This creates an endogenous barrier to entry: expecting incumbent banks to be better diversified than new entrants, depositors are willing to accept lower deposit rates from incumbents. Barriers to entry and smaller numbers of surviving banks both promote collusive outcomes.[30] Evidence from this history of relatively unregulated banking regimes is consistent with these conclusions.

Up to this point, our discussion has assumed that a larger, better-diversified bank is always potentially more efficient than a smaller, less-diversified bank. There are several reasons why this may not be true. As noted in Section II, Krasa and Villamil (1992a,b) show that the combination of increasing costs for monitoring larger banks and nondiversifiable risk lead to an optimal bank size; Winton (1995a) shows that a banker's own limited capital can reduce expected costs of monitoring, which is most beneficial for smaller banks. Cerasi and Daltung (2000) focus on a third possibility, which is that the marginal cost for monitoring additional loans may be increasing. Again, the motivation stems from an individual banker's limited resources. Because any one banker has limited time and attention, his or her cost of monitoring additional loans increases with the number of loans already being monitored. Even if the bank creates a hierarchy of bankers monitoring other bankers, greater size should lead to more layers of monitoring and thus higher costs per loan. Since the diversification benefit from an additional loan diminishes as bank size grows, this cost structure leads to a finite optimal bank size. Although Cerasi and Daltung focus on the case where loans are stochastically independent, it is clear that any systematic loan risk will reinforce the effect of their scale diseconomy.

Another objection to these models is that, whereas they all assume that diversification is a passive function of bank size, in practice, diversification is to some extent a choice variable. For example, in 1982, Continental Illinois was one of the ten largest banks in the U.S., yet roughly 20% of its loan portfolio was in the energy sector – a fact that proved nearly fatal when oil prices dropped precipitously that year. To the extent that depositors cannot observe loan concentrations in timely fashion, banks may be tempted to choose a more concentrated and risky portfolio than depositors initially expected:

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[30] Deposit insurance reduces this barrier to entry, since depositors will no longer care as much (if at all) about a bank's chance of failure. Applying deposit insurance early on leads to even greater entry, fragmentation, and fragility, but fairly-priced insurance applied to a system that is already concentrated can be beneficial: by threatening incumbents with entry, deposit insurance can reduce their ability to sustain collusion.

shareholders gain from increased upside, while increased downside is shared with depositors because of limited liability. In a single-period setting where depositors cannot observe bank portfolio choice before risk is resolved, Hellwig (1998) shows that the bank will concentrate risk as much as possible. Even though depositors anticipate this and charge a higher rate as compensation, some diversification benefits are lost; indeed, if all funds can be concentrated on a single (large) borrower, delegated monitoring is completely undermined.

In a more dynamic setting, matters are less stark. As Marcus (1984) first showed, future rents or quasi-rents reduce a bank's incentive to take on more risk now, since higher risk means a greater chance of failure and loss of future value. Besanko and Thakor (1993) embed this in a model that combines active choice of diversification across two loan sectors with future relationship rents along the lines of Petersen and Rajan (1995). If bank competition increases, banks earn lower relationship rents and generally have more incentive to concentrate their portfolios.[31]

Winton (1999) suggests that risk-shifting via loan concentration per se may not be the biggest problem in banking in developed economies. If loans are relatively illiquid and it is difficult to change loan concentrations very quickly, investors are able to get *some* information about loan concentrations and adjust deposit rates accordingly before the loans mature and the outcome of risk shifting is realized. This gives banks some ability to commit to diversification strategies: loan concentrations will be detected before the bank can exploit depositors, so more "virtuous" strategies will be rewarded with lower deposit rates, and vice versa. By contrast, loan monitoring is more difficult to observe in a timely fashion, which may let a bank shift risk simply by not monitoring its loans.

This possibility does not arise in the previous papers on diversification because they model monitoring as ex post costly state verification that can be committed to up front. As we have seen, a more realistic view is that the bank must have incentives to monitor, and monitoring is useful because it lets the bank intervene before matters deteriorate too greatly – it is proactive. In other words, monitoring must be done ex ante and it is mostly of use when a borrower is in bad shape ex post. Similarly, banks' ex ante screening activities (e.g., Boyd and Prescott (1986)) seek to avoid making bad loans. In both cases, the emphasis is on avoiding or ameliorating bad outcomes. This is in contrast to most nonfinancial firms, where firms' actions may also seek to improve good outcomes. Loans have limited upside, and the emphasis is on avoiding downside.

It follows that a bank that does not monitor saves the cost of monitoring but makes bad outcomes worse or more likely. Since credit risk is correlated across loans in a given sector, the ex post gains from

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[31] Strictly speaking, Besanko and Thakor assume that bank deposits have flat-rate government insurance. Nevertheless, as Hellwig's (1998) analysis shows, even with risk-sensitive deposit rates or insurance premiums, banks would have incentive to engage in risk shifting if there were no future rents at stake.

monitoring are greatest when a loan sector is in a downturn. If the chance of troubled loans is very low when the sector is doing well (as for many commercial loans), not monitoring loans is a form of risk shifting. In good times, the bank saves monitoring costs and does not have many more defaults; in bad times, the bank is more likely to fail, leaving its debtholders with much of the worse performance. In this case, diversifying across sectors can improve monitoring incentives; diversification reduces the dispersion of the bank's loan returns (monitored or no), decreasing the gains to risk shifting. On the other hand, if the risk of troubled loans is so high in good times that monitoring pays for itself even then (as might be the case for credit card loans), monitoring incentives are strong even if the bank focuses on a single sector.[32] Winton argues that this may be one reason why Continental Illinois' focus on "Rust-Belt" and energy sector commercial loans was accompanied by lack of monitoring and eventual failure, whereas specialized credit card banks such as CapitalOne or MBNA had strong monitoring skills and cultures that withstood repeated sector downturns in the 1990s.

Since diversification is in part a matter of choice as well as a passive function of size, it follows that the decision to diversify rather than specialize will depend on the presence of scope economies as well as scale economies. The role of scope economies in monitoring and bank sector structure began with models of spatial differentiation, where transportation or other distance costs give local banks an advantage over more distant rivals. As Besanko and Thakor (1992) note, "local" advantage in the lending market need not be geographic; a bank with a lending focus on one industry or sector may be more effective in making loans to that sector than rivals whose focus is somewhat different.[33]

Both Besanko and Thakor (1992) and Gehrig (1995) use spatial models to examine the impact of increased entry on overall welfare and bank risk. In both papers, banks, firms, and depositors are located equidistantly around a "circular" economy of constant size. In Besanko and Thakor, an exogenous increase in the number of banks increases competition for both deposits and loans, making depositors and firms better off and bank shareholders worse off. The increase in deposit rates also increases the amount of deposits in the system and reduces bank capital ratios, increasing banks' chance of failure. Gehrig improves on this analysis in two ways. First, he endogenizes entry, and shows that entry can be either excessive or insufficient relative to the social optimum. Second, whereas Besanko and Thakor assume

[32] If there are deadweight costs to bank failure (such as ex post verification), diversification may still be attractive, but it is also possible that diversification can actually *increase* the bank's chance of failure for plausible levels of leverage. This occurs because loan returns are highly skewed to the left: there is a high chance loans pay off in full, and a low chance that they are troubled and produce losses. If losses in a sector downturn are high but the chance of a downturn is sufficiently low, a diversified bank may fail if any sector it is exposed to has a downturn, whereas a specialized (one-sector) bank only fails if its sector has a downturn.

[33] There is a great deal of evidence that the pricing of small loans and retail deposits does in fact vary regionally within the U.S.; see for example Petersen and Rajan (1995) and Neumark and Sharpe (1992).

that downturns affect all locations at once, Gehrig assumes that downturns hit an economic region of random size and location. Since larger banks are less likely to have their whole portfolio suffer a negative shock, they are less likely to fail. Increased entry tends to increase the risk of bank failure by shrinking bank size, and so increased incidence of regional shocks make entry less attractive, all else equal.

Matutes and Vives (1996) use a simpler spatial model to examine the impact of deposit insurance on bank competition and diversification. Two banks compete for deposits, which they then invest; depositors face distance costs, and larger banks are less likely to fail. As in Yanelle (1989, 1997) and Winton (1995a, 1997), there are multiple equilibria. Deposit insurance eliminates multiple equilibria and increases the supply of deposits, but increases the probability of bank failure and associated costs. The positive effects tend to dominate negative effects when uninsured banks would be local monopolies (some depositors don't use either bank); the opposite is true when uninsured banks would serve the entire market and compete directly.

Another approach to scope economies focuses on explicit information differentials between banks that are competing for the same borrowers. The first paper to address this is Broecker (1990). He shows that when banks get imperfectly-correlated binary signals about a borrower's quality, whichever bank gets the borrower's business knows that other banks were likely to have received more negative signals – a version of the "Winner's Curse." As there are more banks bidding for a given pool of borrowers, the equilibrium probability that *some* bank will accept a given borrower increases, and so the average quality of actual loans goes down. Riordan (1993) takes this a step further by examining continuous signals. He finds that, as the number of banks increases, banks apply more conservative acceptance standards, but the overall percentage of bad loans granted still increases.

We have already seen another implication of the Winner's Curse in the work of Sharpe (1990), Rajan (1992), and von Thadden (forthcoming): banks that are better informed about a given borrower have a comparative advantage over uninformed banks, enabling them to earn rents. Dell'Ariccia, Friedman, and Marquez (1999), Marquez (2001), and Dell'Ariccia (2000) explore how this affects banking sector structure. In Dell'Ariccia et al. (1999), two banks compete, first offering rates to all firms that they do not have relationships with, then offering rates to their existing customer bases. The Winner's Curse gives each bank an advantage over its existing customers that are in good shape. Because Dell'Ariccia et al. assume that banks cannot distinguish between naturally unattached firms and "lemons" that have left their existing bank, the bank with smaller customer base faces relatively more adverse selection when competing for new business. As a result, the smaller bank breaks even on new business, and the larger bank earns higher overall profits. Moreover, if a third bank with no market share tries to enter the market, it loses money in equilibrium; the Winner's Curse is a barrier to entry. Marquez (2001) shows that entry is easier as borrower turnover is higher (so that the pool of unattached firms has relatively fewer "lemons") or as entrants' ability to screen is higher. Dell'Ariccia (2000) endogenizes entry and market shares by incorporating a spatial setting in which firms face "distance" costs of borrowing. He shows that the equilibrium number of banks under free entry decreases as information asymmetries increase; intuitively, this worsens the Winner's Curse problem faced by entrants.

Since informational rents can lead to ex ante effort distortions as per Rajan (1992), it might be welfare improving if banks could commit to share their information. In fact, credit bureaus provide just this function and are becoming widespread. Pagano and Jappelli (1993) show that lenders' incentives to join such an information-sharing arrangement are greater as there is more borrower heterogeneity, as borrowers are more mobile, and as the lending market is larger – all of which tend to increase adverse selection problems. Padilla and Pagano (1997) show that such information sharing intensifies competition by reducing Winner's-Curse effects, reducing effort distortions as well. Nevertheless, the higher effort makes lenders better off, so it is possible that banks participate despite the loss of potential rents. In addition, when default information is shared, borrowers may further increase their efforts so as to avoid defaulting and being labeled a bad credit risk (Padilla and Pagano, 2000).[34]

In these papers, a bank's screening ability is innate and any signals that it receives are free. Some recent work has sought to endogenize banks' screening or monitoring ability. Thakor (1996) and Ruckes (1998) endogenize the probability with which banks engage in costly screening, and focus on how this interacts with macroeconomic conditions. We will return to their work in the next subsection. Gehrig (1998) examines the impact of integrating two previously separate monopoly banking markets when banks can choose their costly screening technologies' Type I and Type II error probabilities. Although integration may increase rate competition in a beneficial way, entry may be blocked as in Dell'Ariccia et al. (1999); if so, each bank focuses exclusively on its "home" market. Also, in some cases, integration reduces banks' investment in screening, reducing overall welfare.

Boot and Thakor (2000) focus on banks' decision to invest in expertise that differentiates them from their competitors. Firms can get "transaction" loans in which the bank simply lends and takes borrower quality (default chance) as given, or "relationship" loans in which the bank monitors at a cost and has some chance of improving the return of firms that would otherwise fail. Because relationship loans are assumed to be a differentiated product, increases in competition between banks undermine rents

[34] Gehrig and Stenbacka (2001) raise an important caveat to these results. Just as in switching-cost models in the industrial organization literature, the prospect of future information rents can make banks compete heavily ex ante for borrowers. By reducing future rents and thus current competition for unattached borrowers, information sharing may actually increase bank collusion and reduce social welfare.

on transaction loans relatively more than rents on relationship loans. As a result, banks invest less in relationship expertise, but more of their loans are relationship loans.[35]

In Boot and Thakor (2000), both interbank competition and relationship expertise are modeled in reduced form. Hauswald and Marquez (2000) endogenize these features and get a richer set of implications for bank strategy choice. In their model, banks are spatially differentiated and can make unscreened "transaction" loans or make screened "relationship" loans. Screening ability deteriorates as the "distance" between bank and borrower increases. Banks can improve their screening ability by investing in "sector" expertise that is location-specific or in "transferable" expertise that reduces the negative effects of distance. As in Boot and Thakor (2000), as costs of entry decline and more banks enter, transaction lending decreases and relationship lending increases; however, banks invest less in transferable expertise and more in sector-specific expertise. Thus, greater entry makes banks compete less heavily in peripheral lending markets, freeing up resources which are used to bolster their position in their core lending markets.[36]

Because all of these models of differential information focus exclusively on expected loan returns, they ignore how differential information affects bank risk. Winton (1999) addresses this issue. Just as effective monitoring or screening reduces the potential downside of loans, weaker or monitoring or screening skills exacerbate this downside. As a result, a bank diversifying into sectors where it lacks expertise faces greater downside risk from this sector, offsetting the potential benefits of risk diversification. Moreover, this increased downside risk can undermine the bank's incentive to monitor not only loans in the new sector but in the bank's core sector as well. Indeed, a number of well-known large banks that aggressively diversified during the 1980s found themselves with poor loan performance in many sectors, Citicorp being a case in point.

The general thrust of these theoretical papers on banking sector structure and monitoring is that the assumption that perfectly-diversified-and-perfectly-competitive banks form quickly and efficiently is overstated. Even if diversification offers scale economies, competitive forces may lead to high entry and fragmentation in the early stages of a banking system. Diseconomies of scale and informational economies of scope make slower diversification or even a strategy of specialization attractive. To the extent that a bank does want to expand, the results on Winners-Curse-type barriers to entry suggest two

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[35] Boot and Thakor also allow firms to access the capital market at a cost that decreases in borrower quality. A decrease in this cost has the opposite effect as an increase in interbank competition: bank lending rents and the total number of bank loans fall, reducing entry into banking; this makes relationship expertise *more* attractive.

[36] In a related vein, Almazan (2002) examines banks' specialization decisions in a spatial model, where monitoring is more expensive the further a borrower is from the bank. Because capital improves bank monitoring incentives, capital and "expertise" (distance from a borrower) are substitutes, and high capital banks have greater market share.

strategies. One is to focus on lending types or sectors where the entrant bank has the least disadvantage relative to incumbents; an example is Citicorp's successful expansion of credit card lending in East Asia in the 1990s, which exploited Citicorp's technological advantages vis-à-vis local banks in credit scoring and information systems.[37] An alternative strategy is to acquire banks that are already established in unfamiliar sectors, effectively buying lending expertise; drawbacks are that the acquiring bank may find itself buying *banks* that are "lemons," and the acquiring bank may find it harder to monitor its lenders in such unfamiliar sectors.

There are many empirical papers on these issues, mostly focusing on the impact of bank size and diversification on lending and loan portfolio risk. This in turn is somewhat subsumed in the even larger literature on bank efficiency. Rather than survey the efficiency literature in detail, we present highlights here, and refer the interested reader to the surveys by Berger and Mester (1997), and Berger, Demsetz, and Strahan (1999). Essentially, throughout the 1980s, studies tended to find few significant scale economies in banking past banks of moderate size; however, more recent studies (such as Berger and Mester, 1997) *have* found significant scale economies for banks of sizes as high as $25 billion. One possibility is that advances in technology have led to significant advantages for large banks; a case in point is credit card operations, which benefit from specialized expertise in credit scoring, account servicing, and customer information retrieval. A second possibility, which we explore below, is that larger banks are better diversified and can invest more of their assets in risky loans rather than safer but less profitable cash and government securities.

That larger U.S. banks *do* take on more risk is beyond doubt; see e.g. Boyd and Graham (1991), Chong (1991), Akhavein, Berger, and Humphrey (1997), Demsetz and Strahan (1997), and Hughes, Lang, Mester, and Moon (1999). Whether or not this is wholly due to greater risk-bearing capacity or to exploitation of deposit insurance and "too-big-to-fail" is less clear. Boyd and Graham (1991) present evidence that, in the 1970s and 1980s, a higher percentage of large banks failed than of small banks, suggesting that banks may have gone beyond the exploitation of scale economies of diversification. Examining publicly-traded U.S. banks during 1980-1993, Demsetz and Strahan (1997) find that larger banks' stock returns have less firm-specific risk, and that banks that are more diversified (both by loan sector and by geographic region) have lower firm-specific risk. Nevertheless, up through 1991, larger banks' total stock return variance was no less than that of smaller banks, suggesting that larger banks took on more risk to offset diversification advantages. Hughes et al. (1999) estimate a structural model of the decisions of risk-averse bank managers. They find that geographically-diversified banks gain both in efficiency and in reduced "insolvency risk" (standard deviation of return on equity normalized by

[37] Dell'Ariccia and Marquez (2001) provide a theoretical model of such behavior.

expected gross return on equity). Together with Demsetz and Strahan's results, this may indicate a reduction in large bank's risk-taking behavior in the 1990s. On the other hand, Winton (1999) notes that bank loan portfolio risk is highly-skewed to the left, with losses peaking during infrequent downturns. Thus, risk measures such as variance which work well for normal distributions may not perfectly capture bank failure risk, especially if the sample does not include a major downturn.

Another focus of the bank-size literature has been whether larger banks are less likely to lend to small firms. There are several overlapping motivations here. One focuses on diseconomies of monitoring more loans, as per Cerasi and Daltung (2000); if this is true, larger banks may prefer to focus their lending on large firms, since this requires fewer loans per dollar of assets. Since larger firms tend to be better diversified than smaller firms in the same industry, this need not reduce overall diversification very much, and saves on costs. An alternative argument is that large organizations favor the use of "hard" information; this may favor lending to large firms, since more information is publicly-available for them. Finally, large firms may prefer large banks simply because the level and complexity of their financial needs is beyond the capacities of a small bank or small group of small banks.

Again, a full discussion of the literature is beyond the scope of our paper, so we report highlights and refer the reader to Berger, Demsetz, and Strahan (1999) for references not otherwise given. The general finding is that large banks focus more on larger firms, and small banks on small firms. Thus, a number of U.S. studies find that small loans are a smaller fraction of total assets at large banks than at small banks. Berger and Udell (1996) find that small firm loans at large banks have significantly lower rates and collateral requirements than those at small banks. Since a number of studies suggest that higher collateral goes along with more risky borrowers, this is consistent with the idea that large banks focus more on relatively safe, "transparent" small firms, while small banks take on the riskier, "opaque" small firms which require greater monitoring. Most U.S. studies find that mergers among larger banks reduce small business lending; Sapienza (2000) finds similar results following mergers of Italian banks. Conversely, recent studies of *de novo* U.S. banks find that these small banks focus more on small loans than do established banks of similar size, which is consistent with entry aimed at filling the financial needs of small firms that have been abandoned by large-bank mergers.

We now turn to empirical evidence for scope economies linked to geographic or sector focus. Generally, in contrast to the findings for expansion within the U.S., there is evidence of geographic barriers to entry when banks expand internationally. This makes sense, since international cultural, legal, and informational differences are much greater than regional differences within the U.S. Berger, DeYoung, Genay, and Udell (2000) survey this literature, and provide a more comprehensive test by examining the efficiency of banks from a number of countries in five different "home" countries (France, Germany, Spain, U.K., U.S.). Home country banks are generally more efficient than foreign banks, but when the foreign bank is from the U.S., matters are usually reversed. Berger et al. interpret this as evidence that at least some U.S. banks are simply superior and able to more than overcome geographical barriers to entry. On the other hand, the sample may have been relatively favorable for foreign expansion: the "home" countries are relatively advanced economies, where informational barriers may be relatively less severe, and the sample period is from the mid-1990s, a relatively recession-free period.[38]

Acharya, Hasan, and Saunders (2001) examine the impact of commercial loan diversification on the profitability and risk of Italian banks. Consistent with models of specialization advantages, they find that diversification across industries reduces average returns and increases levels of doubtful or nonperforming loans. The effect of geographic diversification is mixed. Although such diversification generally hurts returns, for banks whose loans have moderate levels of risk, it actually improves returns slightly and reduces risk. This is consistent with the model of Winton (1999), which suggests that diversification is most likely to improve monitoring incentives when loans have moderate levels of risk.

Indirect evidence for economies of scope and specialization advantages is provided by DeLong (2001), who finds that stock market reaction (bidder plus acquirer) to mergers between U.S. banks is only positive for mergers between banks with similar sector focus or geographic scope. This is consistent with the bulk of research on nonfinancial mergers from the 1980s on, which find that focusing mergers add value whereas diversifying mergers tend to destroy value.

Finally, there is evidence that Winner's-Curse effects can be significant. Shaffer (1998) finds that, consistent with Broecker (1990) and Riordan (1993), loan loss rates are higher in local U.S. markets with more banks. He also finds that, during every year from three to nine years after founding, *de novo* banks have loan loss rates that are significantly worse than those of the average bank. Since *de novo* banks are required to have experienced bank management and are often started by an existing bank holding company, Shaffer argues that this is due to the Winner's Curse rather than lack of basic lending skills.

To summarize, research on the industrial organization of the bank lending sector suggests caveats to the initial models of delegated monitoring. Because of inherent adoption externalities, laissez-faire banking need not quickly lead to a competitive, well-diversified banking sector. Informational problems such as the Winner's Curse can compound this problem by creating endogenous barriers to entry; conversely, scope economies tied to specialized monitoring expertise may make "well-diversified" loan portfolios suboptimal.

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[38] At a more micro level, Berger, Klapper, and Udell (2001) examine lending in Argentina and find that smaller borrowers are less likely to borrow from foreign banks, especially those headquartered outside Latin America. Since smaller borrowers tend to be more "opaque," this is consistent with cultural and informational barriers to entry.

E. Credit Cycles and the Effect of Bank Funding on Lending

The papers we have discussed in this section typically focus on microeconomic concerns such as the nature of interactions between bank and borrower or the structure of the banking sector. We now briefly discuss work that focuses on how such microeconomic concerns can interact with macroeconomic business conditions. Given the vast literature on this subject, our approach is selective, aiming at key points and a few illustrative papers. This also leads us to a discussion of papers that examine the interaction between a bank's funding and lending activities, since some have argued that this is a critical source of business cycle effects.

In principle, effects can flow both from business conditions to bank lending decisions and vice versa. Worsening business conditions will clearly increase the risk of many potential borrowers, making banks more conservative ("broad lending channel"). To the extent that bank borrowers tend to be smaller and riskier than firms that access public debt markets, bank-dependent borrowers may be hit harder by higher interest rates or worsening business conditions, and bank lending may fall further than public debt borrowings. Conversely, if banks are an important source of funds for firms and consumers, bank-specific shocks that make banks more conservative will reduce borrowers' ability to invest or consume, and again this will hit bank-dependent borrowers hardest ("bank lending channel"). Thus, the evidence that the ratio of bank loans to public debt drops more when monetary policy is tight (see e.g. Kashyap, Stein, and Wilcox, 1993) is consistent with both models.

Since it seems likely that both channels occur in practice, and that there is feedback between them, we will ignore the perennial debate in the macroeconomic literature on which of these channels is more important than the other. Instead, we will discuss models that illustrate how these two effects come about and empirical evidence on these effects.

The simplest view of how worsening business conditions affect bank lending is that of Bernanke and Gertler (1989, 1990): worsening business conditions hurt borrowers' net worth, increasing agency costs that lenders such as banks face. Since loans are less attractive, fewer loans are made, and rates on any loans that are made are higher to compensate for higher costs of distress. Thus, the presence of agency costs exacerbates business cycles.

Although this focuses on the monitoring view of bank lending, Ruckes (1998) shows that similar results obtain when competing banks screen potential borrowers. Intuitively, screening does two things: it avoids making a bad loan, and (if the borrower is good) the screening bank has an information advantage over rivals that have not screened that borrower. When times are good, the chance of bad borrowers is low and any information rents are small, so banks do not screen intensively. As the proportion of bad borrowers grows, banks at first screen more intensively; eventually, however, there are so many bad borrowers that banks screen few borrowers and make few loans. These endogenous screening effects make lending contract and expand more than it would in the absence of differential information.

Whereas Bernanke and Gertler and Ruckes assume that banks are out to maximize loan value, Rajan (1994) motivates credit cycles through an agency problem between bank managers and their investors. Suppose bank managers vary in their lending ability: only poorly-run banks have bad loans in expansions, but all banks have bad loans in recessions. In expansions, poorly-skilled managers have incentives to renew bad loans so as to hide their incompetence; in recessions, they liquidate bad loans because good banks can also have bad loans, so liquidation does not send a signal of their ability. The upshot is that banks have overly loose lending standards during expansions. One caveat to this argument is that it assumes that the relative difference in loan quality between poorly-run banks and well-run banks is highest in expansions. It seems more likely that normal recessions create more difficulties for weaker borrowers, which should then hit poorly-run banks harder than well-run banks.

By focusing on problems within banks, Rajan's work is also a step in the direction of "bank lending channel" models, which focus on how problems at banks can then spill over to their borrowers and thus the entire economy. This literature has two major strands: papers that focus on how a bank's net worth (its level of equity capital) affects its lending behavior, and papers that focus on how adverse selection and other funding costs affect a bank's ability to make loans. Since capital constraints would not be an issue if banks could raise additional equity at no cost, and costs related to adverse selection are a significant part of the costs of raising additional equity, the two strands are interrelated. We begin with bank capital effects.

Thakor (1996) examines how changes in risk-based capital requirements affect bank lending decisions when it is costly to screen borrowers. Because equity capital is assumed to be more expensive than deposits, an increase in risk-based capital requirements makes loans less attractive on the margin relative to risk-free securities. As a result, higher capital requirements tend to reduce banks' willingness to screen and thus to lend. Conversely, banks that are more constrained by capital requirements are less likely to lend than are their less-constrained rivals.

Holmström and Tirole (1997) obtain similar results in a model of agency costs between borrowers and lenders. Firms are more likely to engage in risk-shifting as their net worth declines. Banks can prevent this via monitoring, but because banks borrow money from other investors, they too may engage in risk-shifting by not monitoring. As in Thakor (1996), banks with more capital monitor borrowers more intensively, allowing banks to credibly lend more. Thus, the link between capital shocks and lending depends critically on whether the net worth of nonfinancial firms or of banks is most affected.[39]

Whereas Thakor and Holmström and Tirole assume that bank managers are fully aligned with their shareholders' interests, Besanko and Kanatas (1996) distinguish between insider shareholders and external shareholders. Raising external equity capital dilutes bank insiders' incentives to monitor loans – another variant of the Jensen and Meckling (1976) agency problem between managers and outside shareholders. In some cases, the reduction in monitoring more than offsets the additional "cushion" against bank failure that the additional capital provides; thus, that higher bank capital requirements can sometimes increase the risk of bank failures. Although these results are striking, they seem most applicable to small banks, where issuing additional equity can substantially dilute top management's stake in the bank. In a large bank such as Citigroup, even a relatively small stock or option-based stake can leave management with significant risk in absolute terms, and it seems less likely that issuing equity will significantly affect top management's incentive to monitor loans effectively.

Diamond and Rajan (2000) also incorporate external equity capital, using their "bank fragility" model (see Section II) as a base. Recall that, in their model, short-term deposits limit the rents a bank manager can extract, but bank failure is costly because the bank manager's expertise is lost. Because it is junior to deposits, external equity cushions the bank against costly failure; however, shareholders have a weaker bargaining position than depositors and allow the bank manager to appropriate rents when the bank does not fail. It follows that, as the probability of good loan returns increases, the optimal level of bank capital falls. Also, because banks that are more capital-constrained face a greater risk of failure, their threat to liquidate borrowers is more credible, and they liquidate cash-constrained borrowers more often. By contrast, capital-constrained banks may find that their ability to extract cash now out of cash-rich borrowers is weakened, depending on the relationship between the firm's current cash flows, its liquidation value now, and its liquidation value in the future.

Diamond and Rajan's results are heavily influenced by their use of a Hart and Moore (1998) "incomplete contracts" setting, where everything is observable but only liquidation values are verifiable. Thus, "good loan returns" are linked to high firm liquidation values rather than high firm cash flows per se. As we have argued, banks may have private information that outside investors do not have. Also, in

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[39] In a related paper, Covitz and Heitfeld (1999) examine the link between bank market power and bank lending rates. When bank incentives to risk-shift are weak (i.e., banks are well-capitalized or have large future rents at stake) but firm incentives to risk-shift are strong, monopoly banks charge lower rates than competitive banks. The intuition is that lower rates reduce firm risk-taking incentives, but when bank competition increases, borrowers have more say in equilibrium rates, and they prefer high rates so that banks prefer to "go along for the ride" on risk-shifting rather than engage in costly monitoring and liquidation. Conversely, when risk-shifting incentives are reversed, monopoly rates are higher than competitive rates.

developed economies such as the U.S. or Japan, banks may be able to attach borrower cash flows. In this case, a capital-constrained bank may have incentive to squeeze cash out of small borrowers without much access to alternative funding sources; conversely, the bank may let a large, cash-constrained borrower with low liquidation value continue in the hope that its cash flows recover before outside investors realize the extent of the bank's (or the firm's) problems. Thus, Diamond and Rajan's results may be most applicable to economies where legal and institutional safeguards are less advanced.

Note that all four of these papers suggest that higher bank capital tends to increase lending, but whether this is good or bad depends on whether or not bank managers are aligned with bank shareholders. In Thakor (1996) and in Holmström and Tirole (1997), higher capital improves banks' monitoring incentives and thus the quantity of loans banks can credibly make. In Besanko and Kanatas (1996) and Diamond and Rajan (2000), higher capital loosens banks' lending standards, but this has either a bad (Besanko and Kanatas) or mixed (Diamond and Rajan) impact on credit quality.

A large empirical literature has examined the link between bank capital and lending. Much of this work stems from the debate over whether implementation of the 1988 Basel Accord's capital standards caused a "credit crunch" in the U.S.. Sharpe (1995) surveys this literature and finds that, overall, evidence suggests that bank profitability has a positive effect on loan growth, whereas loan losses have a significant negative effect on loan growth.[40] To the extent that higher profits increase capital and higher losses decrease it, this is consistent with banks cutting back lending when capital is low, but it is also consistent with banks cutting back lending when low profits or high losses suggest that loans will be less profitable going forward. In a more recent study, Beatty and Gron (2001) estimate a structural model of U.S. banks' simultaneous choice of asset growth and capital growth during the period from 1986 to 1995. They find that, for banks whose capital to assets ratio is in the bottom decile, increases in capital go with higher risk-weighted asset growth or higher initial levels of risk-weighted assets, and vice versa. (Risk-weighted assets weight loans most heavily.) For other banks, these relationships are less significant.

Several studies have examined firm-specific effects of bank capital levels. Thakor (1996) finds evidence that announcement of a bank loan commitment causes the borrower's stock price to increase significantly, which is consistent with bank screening activity. For the largest quartile of loan commitments as a fraction of bank capital, the increase is greater when the bank's capital is lower, which is consistent with such banks being more choosy about making large loans. Hubbard, Kuttner, and Palia (1999) find that banks with weaker capital levels charge borrowers higher rates, even controlling for borrower risk characteristics. The effect is significant only for borrowers that are small and unrated, or whose loans are priced over prime, all of which proxy for firms with high informational switching costs.

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[40] Empirical papers on the "credit crunch" are discussed in detail in a later section.

The picture painted by these findings is most consistent with Thakor (1996) and Holmström and Tirole (1997): as capital levels fall, banks become more conservative. The findings of Hubbard et al. (1999) suggest that informational frictions as in Rajan (1992) are also important. The caveat is that these findings all come from recent studies of U.S. banks. As noted above, in other countries, different institutional settings may favor models where bank moral hazard becomes more severe as capital falls. We return to the issue of bank moral hazard in Section IV below.

We now turn to papers that examine how adverse selection costs affect bank lending behavior. In these models, banks' private information about their loan portfolios leads them to face adverse selection costs when they seek funds by selling loans or by issuing uninsured liabilities or equity. Stein (1998) shows that, on the margin, these costs lead banks to prefer to fund loans by either selling off liquid securities that they hold or else issuing insured deposits. Tighter monetary policy reduces bank reserves and thus the amount of insured deposits banks can have. Since uninsured liabilities involve adverse selection costs, banks that have fewer liquid securities to draw on for cash cut back on lending. To the extent that smaller banks are less diversified across loans, their private information about loans matters more and they face greater adverse selection costs; thus, such banks should cut back lending more. Kashyap and Stein (2000) find evidence of such behavior: during monetary contractions, small banks with lower securities holdings do cut back on lending significantly more than their more liquid rivals. Ostergaard (2001) examines how lending at the U.S. state level and finds that loan supply in states with many small banks depends positively on banks' internal cash flows, whereas this is not true for states with few small banks.[41]

To sum up, there are a number of models that suggest that banks' monitoring or screening incentives can intensify credit cycles, both through changes in the external lending environment and through changes in banks' internal capital and funding situations. Empirical evidence from the U.S. suggests that negative shocks to bank capital have effects over and above any worsening of borrowers' conditions and that these effects are strongest for low-capital banks. Similarly, costs associated with non-core deposit funding also constrain bank lending, with the effects being strongest for small banks.

IV. Banking Panics and the Stability of Banking Systems

A key question about financial intermediaries is whether they are inherently unstable, that is, prone to banking panics? Some researchers believe that a theoretical model of the existence of financial

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[41] Bolton and Freixas (2000) and Gorton and Winton (2000) model another implication of adverse selection costs. In downturns, bank loans are more risky because borrowers' chance of default is higher. This increases adverse-selection costs associated with equity or uninsured liability funding, again making banks more conservative about making additional loans. We return to these issues in Section IV below.

intermediaries must simultaneously be a model of panics; banks and panics are inherently intertwined and models should reflect this. Whether this is the correct view or not clearly is at the root of public policies towards banks. In this section we first review the historical evidence on the experience of banking systems with respect to panics. This experience is quite heterogeneous, even though all these systems have banks offering the same asset and liability contracts. We also review the international experience with private bank coalitions. Private bank coalitions are a widespread feature of banking systems, though their roles vary greatly. In some systems they act as lenders-of-last-resort, while in others they are much less important. A great deal of research has been conducted on the economic history of various banking systems in different countries and different periods. Theories of banking panics should be seen in light of this research. We then review the theoretical models that have been proposed as explanations of banking panics. In the final subsection we briefly review the literature on bank regulation, including deposit insurance and capital requirements.

A. Definitions of Banking Panics and the Relation of Panics to the Business Cycle

A great deal of confusion surrounds the notion of a banking panic. One problem is the definition. There is a fairly broad range of phenomena that some researchers seem to have in mind. These are described by a number of terms, such as "financial crisis," "contagion," "banking crisis," "bank run," and "banking panic," that are somewhat unclear. Many of the events being referred to are situations in which banking systems are weakened due to shocks, but nothing happened corresponding to a banking panic, as defined below. It is not that such broader phenomena are uninteresting or unimportant. The issue is first of all what exactly happened in these "crises" and then secondly whether such events are inherently related to the structure of bank contracts and bank capital structures. Another problem is researchers' narrow focus on the U.S. experience and, in particular the Great Depression in the U.S. Many theorists cite Sprague (1910) as providing a description of the phenomenon they are interested in explaining and then proceed to develop a theory. Indeed, Sprague does describe U.S. panics, but those experiences appear to be a somewhat special, compared to the experiences of most other countries

With respect to a definition of a panic, it is difficult to be precise. It is tempting to define a panic in terms of an increase in the currency/deposit ratio, but because of bank suspensions of convertibility this is not accurate. Also, depending on the period over which the decline is defined, there can be large increases in this ratio without a panic having occurred. For these reasons precise definitions have not been used. Bernanke and James (1991), for example, express skepticism about this approach. Instead, definitions rely on a reading of the historical literature. Calomiris and Gorton (1991) define a banking panic as an event in which bank depositors at all or many banks in the banking system suddenly demand that banks convert their debt claims into cash, to such an extent that banks suspend convertibility. In other words, if the depositors of a *single* bank suddenly demand cash in exchange for their deposits, this is not system-wide event. It may be called a "run," but it is not a *banking panic*. In reality, however, panics in the U.S. tended to spread spatially and suspension happened in some cities before other cities, and sometimes not at all. Such considerations make precise definitions hard. A similar definition is given by Wicker (1996):

> … we define a banking panic to be an exogenous shock whose origins can be found in any sudden unanticipated revision of expectations of deposit loss accomplished by an attempt to substitute currency for checkable deposits, a situation usually described as a run on the banks. A general loss of depositor confidence distinguishes a banking panic from other episodes of bank failures. A transfer of deposits from weak to strong banks during a bank run without any change in the public's preference for currency does not qualify. (p. 17)

These definitions have in common the feature that a panic is a systemic event in which consumers want to hold currency in exchange for their demand deposits. The structure of the banking contract allows such withdrawals from banks by consumers, and these withdrawals, or attempted withdrawals, is the precipitating event.[42]

Applying the definition to Pre-Federal Reserve history in the U.S. is not easy. Calomiris and Gorton (1991) identify six panics in the United States prior to 1865, seven during the National Banking Era, and finally the Great Depression (discussed below). Table 3 shows the business cycle chronology and the dates of the panics in the United States during the National Banking Era. Prior to the National Banking Era, there were panics in 1814, 1819, 1837, 1839, 1857, and 1861 (see Calomiris and Gorton (1991)). After the National Banking Era ends, with the founding of the Federal Reserve System in 1914, there were the panics associated with the Great Depression. Sprague (1910) labels 1873, 1893, and 1907 as major panics. Kemmerer (1910) identifies six major panics and fifteen minor panics between 1890 and 1908. Kemmerer's major panics include 1873, 1893, and 1907, but he adds 1899, 1901, and 1903. Wicker (2000) agrees on 1873, 1893, and 1907, and calls 1884 and 1890 "incipient" panics. The point is that there is no consensus about the events that should be called "panics" in the U.S. prior to the founding of the Federal Reserve System. While there are common elements, corresponding to the definition, each episode has some unique features. There are important papers on some individual panic episodes, e.g., Wicker (1980), Donaldson (1993), Moen and Tallis (1992), Calomiris and Schweikart (1991), and White (1984). Wicker (2000) details each of the U.S. episodes.

Definitions of other crisis phenomena abound. An older literature links problems with the banking system to broader events and the business cycle, e.g. Fisher (1932), but is not specific about the

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[42] Many authors have discussed definitions of "banking crisis." See, for example, Grossman (1994) and Bernanke and James (1991).

details. Similarly, Bordo (1986) lists what he describes as "key elements of a financial crisis." One of the key elements listed is "bank runs precipitated by … threats to solvency" (p. 191). But, there are many other elements listed as well suggesting a link between panics and the macroeconomy. Grossman (1994) argues that historically "banking crises" included one of three elements: (1) a high proportion of banks failed; (2) an especially large or important bank failed; or finally, (3) that government intervention prevented the failures associated with (1) or (2). There are many other examples of attempts at definitions. For the most part, the same events are identified.

There are some notable features to Table 3. First, the table shows the proximity of the panic to the last business cycle peak. The timing of the panics in the U.S. prior to the National Banking Era is similar; see Calomiris and Gorton (1991). The percentage change in pig iron production is a measure of real economic activity. As might be expected, the currency deposit ratio rises sharply in a panic. Remarkably, the losses on deposits and the fraction of (national) banks failing during panics are very small. This is due to the activity of private bank clearinghouses, discussed below. It is, however, worth emphasizing that the actual historical experience of panics, small losses on deposits and few bank failures, seems at odds with the widely-held view of panics, mostly based on the experience of the U.S. Great Depression.

In the twenty-five year period following World War II banking crises all but disappeared. Bordo and Eichengreen (1999) find only one banking crisis between 1945 and 1971 in their sample of twenty-one industrial and emerging market countries. In the 1980s and 1990s, however, the International Monetary Fund counts fifty-four crises in member countries between 1975 and 1997, and the World Bank lists a larger number (see IMF (1998), and Caprio and Klingbiel (1996) for World Bank estimates). In the case of recent international banking "crises" it seems difficult, at least so far, to determine whether these events are panics or whether the banking systems suffered severe losses due to macroeconomic shocks. Five recent studies, for example, all offer different definitions of a "banking crisis." See Caprio and Klingbiel (1996), Demirgüç-Kunt and Detraiache (1998), Dziobek and Pazarbasioglu (1997), Kaminsky and Reinhart (1999), and Lindgren, Garcia, and Saal (1996). Caprio and Klingbiel (1996) is the root study for many of the lists of crises. Basically, their definition focuses on loan losses and the extent to which the net worth of the banking industry has eroded. If most or all of the capital in the banking system is gone, then there is a crisis.

It is clear that there are situations in which a banking system faces a common shock of sufficient magnitude to bring the soundness of the banking system into question. For example, the U.S. savings and loan debacle of the 1980's (see e.g., Brumbaugh (1988), Kane (1989), Barth (1991), and White (1991)), and the current situation of the Japanese banking system, were caused by deregulation (see Hoshi and Kashyap (1999)). These events may be called "crises," but there were no banking panics involved. A systemic shock to the banking system, whether it is part of a broader macroeconomic downturn or exchange rate shock, or a shock specific to the financial sector, do not obviously call into question the contractual design of financial intermediation. Nevertheless, these crises raise a number of issues about banks, which are discussed further below.

Despite the large number of "crises" it seems that bank panics and bank runs (on individual banks, but not systemic) have been relatively rare. But, this is due to a rather narrow definition of "panic." Recent history suggests that "panic" and bank crisis" are rather difficult to distinguish, and certainly more research is needed. Lindgren, Garcia, and Saal (1996) provide the most extensive study; they analyze all IMF member countries from 1980 to 1995. By their definition 133 member countries of the 180 members experienced "crises" or significant problems in the banking sector during the period.[43] Their analysis then focuses more specifically on 34 countries (19 developing economies, eight transition economies, and seven developed economies). They single out 36 cases of banking crises. In this sample there were seven cases of panic. The study highlights the difficulties in distinguishing "panics" from other phenomena. Indeed, unlike nineteenth century America, banking "crises" or "panics" may well be more complicated now by depositor beliefs about implicit or explicit deposit insurance. Thus, although it is tempting to say that the definition of a "banking panic" is ultimately an empirical matter, the phenomena of interest are very complicated and seem likely to vary for many reasons, not the least of which is data availability, making any definition problematic. Nevertheless, some important empirical regularity has been found. We turn next to this evidence.

It appears that there is an important business cycle component to the timing of panics. Gorton (1988), studying U.S. panics, provides evidence that panics come at or near business cycle peaks. See Table 3. Mishkin (1991) summarizing the findings of his study states that "with one exception in 1873, financial panics always occurred after the onset of a recession" (p. 96). Also, see Donaldson (1992). In the recent international context Demirgüç-Kunt and Detragiache (1998) study a large cross section of countries during the period 1981-1994 and also find that banking crises are more likely to occur with the onset of recession. Lindgren, Garcia, and Saal (1996) also find that banking crises of the modern era are related to the business cycle.

In terms of U.S. history, a seasonal factor in the timing of panics is noted by Andrew (1907), Kemmerer (1910), Miron (1986), Canova (1991) and Donaldson (1992), among others, though Calomiris and Gorton (1991), and Wicker (2000), among others, dispute the evidence. All these studies focus on

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[43] Lingren, Garcia, and Saal (1996) define a "crisis" as a situation where a large group of financial intermediaries have liabilities exceeding the market value of their assets, and the economy experiences bank runs or significant withdrawals, some financial firms collapse, and there is government intervention. If the banking system is unsound, but there is no crisis, it is termed a "significant problem."

the U.S. experience. While the timing of panics is, broadly speaking, clear, it is not clear that seasonal money demand shocks *caused* panics. At root the problem is that there are a small number of panic observations. Miron (1986) and Canova (1991) focus on interest rate movements and the inelastic supply of money in the period before the Federal Reserve System. Miron attributes the deceased occurrence of financial crises after 1914 to Federal Reserve activities, because the Fed essentially smoothed out seasonal interest rate movements. Canova argues that the decline in the seasonal pattern of interest rates to Fed activity has been overemphasized. Miron, Mankiw, and Weil (1987) and Barsky, Miron, Mankiw, and Weil (1988) also compare the pre-Fed period with the post-Fed period with respect to interest rate behavior.

B. Panics and the Industrial Organization of the Banking Industry

Another stylized fact about banking panics is summarized by Calomiris (1993a):

> International comparisons of the incidence and costs of banking panics and bank failures, and comparisons across regulatory regimes within the U.S., clearly document differences in banking instability associated with different regulatory regimes. The central lesson of these studies is that instability is associated with some historical examples of banking that had common institutional characteristics; it is not an intrinsic problem with banking per se…. the single most important factor in banking instability has been the organization of the banking industry (p. 21).

That the industrial organization of the banking industry is a critical determinant of the propensity for an economy to experience panics has been confirmed in a large literature on the historical and international experience of banking panics. Bordo (1985, 1986), Calomiris and Gorton (1991), and Calomiris (1993a) survey much of this literature and provide some new evidence on the causes of panics.

Calomiris (1993a) examined Scotland, England, Canada, Australia, and the U.S. Bordo (1986) studies the experiences of six countries (U.S., U.K., Canada, Sweden, Germany, and France) over the period 1870 to 1933. One of his conclusions is that most severe cyclical contractions in all the countries are associated with stock market crises, but not with banking panics, except for the United States. He notes that: "In contrast with the U.S. experience, the five other countries in the same period developed nationwide branch banking systems consolidating into a very few large banks" (p. 230). Bordo (1985) surveys banking and securities market panics in six countries from 1870 to 1933 and concludes that: "the United States experienced panics in a period when they were a historical curiosity in other countries" (p. 73). Grossman (1994) examines the experience of Britain, Canada, and ten other countries during the Great Depression to determine the causes of the "exceptional stability" exhibited by their banking systems. He considers three possible explanations: the structure of the banking system, macroeconomic policy and performance, and the behavior of the lender of last resort. He concludes that banking stability is the product of exchange-rate policy and banking structure.

Cross section variation in the United States is also interesting because some states allowed branch banking and some states did not. In the United States, states that allowed branching experienced lower failure rates in the 1920s and smaller banks were more prone to failure (see Bremer (1935) and White (1983, 1984)). Studying this cross section of state experience, Calomiris (1990) reaches the same conclusion about the importance of branching: "States that allowed branch banking saw much lower failure rates- reflecting the unusually high survivability of branching banks… From 1921 to 1929 only 37 branching banks failed in the United States, almost all of which operated only one or two branches. Branching failures were only 4 percent of branch-banking facilities, almost an order of magnitude less than the failure rate of unit banks for this period" (p. 291). Wheelock (1992a) compares the experiences of banks in different states during the 1920s in the U.S. and finds that states that allowed branch banking had fewer failures. Also, see Wheelock (1995). Calomiris (1993a) reviews more evidence.[44]

The importance of industrial organization of the banking system for the incidence of panics is illustrated by a comparison of the U.S. experience with the Canadian experience, which has been the focus of research by a number of scholars. The economies are similar and close in proximity, but Canada is a system that historically has consisted of a small number of highly branched banks, in contrast to the American system of many banks that are not branched across state lines, and sometimes not even within the state. Haubrich (1990), Bordo, Rockoff, and Redish (1994, 1995), and White (1984), among others, have studied the two systems. The contrast in experience is dramatic, as summarized by Bordo, Rockoff, and Redish (1994): "There is an immediate and important difference between the Canadian and United States banking systems. The Canadian experience has been one of considerable stability. There has been only one major bank failure sine World War I, and there were no failures during the Great Depression. In contrast, the American system has been characterized by a number of periods of instability. Rates of bank failures were high in the 1920s, and of course the entire system collapsed during the 1930s" (p. 325). Similarly, White (1984) writes: "In Canada, from 1920 to 1929, only one bank failed. The contraction of the banking industry was carried out by the remaining banks reducing the number of their offices by 13.2 percent. This was very near the 9.8 percent decline in the United States…In spite of the many similarities with the United States, there were no bank failures in Canada during the years 1929-1933. The number of bank offices fell by another 10.4 percent, reflecting the shocked state of the economy; yet this was far fewer than the 34.5 percent of all bank offices permanently closed in the United States" (p. 132).[45]

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[44] Carlson (no date) empirically examines U.S. banks during the 1920s and argues that branched banks were less likely to survive because they held riskier portfolios.

[45] An alternative point of view about the Canadian experience during the Great Depression is that of Kryzanowski and Roberts (1993) who argue that all of the major banks in Canada were insolvent during the Great Depression, but

C. Private Bank Coalitions

Bank coalitions, formal and informal, are an essential part of the industrial organization of the banking system. The existence or nonexistence of coalitions, the extent of their activity, and their interaction with the government are related to the likelihood of panic and to the resolution of panics if they do occur.

Banks are involved with each other because of the clearing of their liabilities. Banks mutually hold claims on each other because of their depositors writing checks and the banks need mechanisms for efficiently netting these claims. Historically, this led to the establishment of clearinghouses, joint associations of banks that had the purposes of organizing the netting of interbank claims. But these coalitions developed into institutions with many more functions. And, more generally, other types of coalitions, sometimes less formal, sometimes organized around a single large bank or even the government's central bank, seem to characterize the banking systems of many countries in many different historical periods. The extent to which these private bank coalitions exist, or existed historically, seems related to the industrial organization of the banking system and the incidence of bank panics.

The U.S. experience with banking panics appears to be an outlier in that it experienced fairly regular panics during the 19th century when few other economies did, as discussed above. Until the last few years, there have been a very large number of rather small, undiversified banks in the U.S. The research cited above suggests that these two facts are linked. U.S. banking history has also been intertwined with the development of the private clearinghouse system. Clearinghouses are private associations of banks that formed in major cities, spreading out across the country during the 19th century. On the U.S. clearinghouse system see Andrew (1908b), Cannon (1910), Gorton (1984, 1985), Gorton and Mullineaux (1987), Timberlake (1984), Sprague (1910), Moen and Tallman (2000), and Wicker (2000), among others.

The U.S. clearinghouse system developed over the course of the 19th century. In particular, the clearinghouses developed methods for coping with banking panics. At first the clearinghouse organized a method of pooling or equalizing reserves. Wicker (2000) argues that such action prevented panics in 1860 and 1861. By the end of the century they had invented a method of turning illiquid loan portfolios into private hand-to-hand money that could be handed out to depositors in exchange for their demand deposits during times of panic. This money, called "clearinghouse loan certificates," originated in the interbank clearing system as a way to economize on cash during a panic. During a banking panic member banks were allowed to apply to a clearinghouse committee, submitting assets as collateral in exchange for

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that there was no banking crisis because of implicit support from the government. This viewpoint is disputed by Carr, Mathewson, and Quigley (1995). Also, see Kryzanowski and Roberts' (1999) rejoinder.

certificates. If the committee approved the assets, then certificates would be issued only up to a percentage of the face value of the assets. The bank borrowing against its illiquid assets would have to pay interest on the certificates to the clearinghouse. The certificates could then be used to honor interbank obligations where they replaced cash, which instead could be used to pay out to depositors. The clearinghouse loan certificate process is the origin of the discount window (and is described in detail in the above cited sources), and serves the same function. Notably, the loan certificates were the joint obligations of the clearinghouse member banks; the risk of member banks defaulting was shared by allocating member liabilities in proportion to member bank capital. Thus, the certificates implemented a risk-sharing device, where the members jointly assumed the risk that individual member banks would fail. In this way, a depositor who was fearful that his particular bank might fail was able to insure against this event by trading his claim on the individual bank for a claim on the portfolio of banks in the clearinghouse. This was the origin of deposit insurance. In order for this to work, the clearinghouses in the U.S. developed bank examination and supervision methods, as well as reporting systems for bank information to be made public on a regular basis.

During the Panics of 1873, 1893, and 1907 the clearinghouse loan certificate process was extended, in increasingly sophisticated ways, in a radical innovation. In particular, the clearinghouse loan certificates were issued directly to the banks' depositors, in exchange for demand deposits, in denominations corresponding to currency. The amount of private money issued during times of panic was substantial. During the Panic of 1893 about \$100 million of clearinghouse hand-to-hand money was issued (2.5 percent of the money stock). During the Panic of 1907, about \$500 million was issued (4.5 percent of the money stock). See Gorton (1985). If the depositors would accept the certificates as money, then the banks' illiquid loan portfolios would be directly monetized.

The U.S. clearinghouse system was not the only private central bank-like institution. Before the U.S. Civil War, coincident with the beginnings of the clearinghouse system, the Suffolk Bank of Massachusetts was the focal point of a clearing system and acted as a lender-of-last-resort during the Panic of 1837. The Suffolk banking system operated in New England from 1825 to 1858 and was the first region-wide clearing system in the U.S. The Suffolk system was unique in using a net clearing system (see Rolnick, Smith, and Weber (1998a,b)). Rolnick, Smith, and Weber (1998b) argue that during the Panic of 1837 the Suffolk Bank it essentially acted as a lender-of-last-resort. Also, see Mullineaux (1987), Calomiris and Kahn (1996), Rolnick, Smith, and Weber (1998a, 1998b), and Bodenhorn (1998).

Bank coalitions are also not unique to the United States, though the extent of their activities varies enormously across countries. Most countries did not experience banking panics as frequently as the U.S., but there are many examples of bank coalitions forming on occasion in other countries as well. For example, the Clearing House of Montreal was maintained by the Canadian Bankers' Association and, according to Watts (1972), was officially recognized in 1901 'as an agency for the supervision and control of certain activities of the banks' (p. 18). According to Bordo and Redish (1987) "the Bank of Montreal (founded in 1817) emerged very early as the government's bank performing many central bank functions. However, the Bank of Montreal never evolved into a full-fledged central bank as did the Bank of England (or the government's bank in other countries) perhaps because of the rivalry of other large Canadian banks (for example the Royal Bank)." See Watts (1972), Haubrich (1990), and Breckenridge (1910).

The pattern of the Bank of Montreal (and earlier precursors like the Suffolk Bank) in which the bank coalition is centered on one large bank, is quite common. Another common feature is the cooperation of a (perhaps, informal) coalition of banks with the government to rescue a bank in trouble or stem a panic. For example, major Canadian banks joined with the Canadian government to attempt a rescue of the Canadian Commercial Bank in March 1985. See Jayanti, Whyte, and Do (1993). Similarly, in Germany the Bankhaus Herstatt was closed June 26, 1974. There was no statutory deposit insurance scheme in Germany, but the West German Federal Association of banks used \$7.8 million in insurance to cover the losses.

D. Are Banks Inherently Flawed Institutions?

Diamond and Dybvig (1983), reviewed above, is the most important paper on banking panics. Recall that this model combines preference shocks for early or late consumption with investment opportunities that are long-term. The model becomes one of banking panics with the additional assumption that depositors face a first-come-first-served rule, that is, a sequential service constraint. The assumption of this rule, combined with the irreversibility of long-term investment, means that if all agents decide to withdraw at the interim date, then those in front of the line will receive more than those at the end of the line. Consequently, a panic corresponds to an equilibrium in which agents believe, for whatever reasons, that other agents are intending to withdraw their deposits at the interim date. Such beliefs are self-fulfilling because the best response to the belief that other agents are intending to withdraw is to withdraw oneself. As Wallace (1988) points out, without the assumption of sequential service the model does not generate panics.

The theory of banking panics in Diamond and Dybvig intuitively corresponds to what many view as an irrational element of banking panics. The theory articulates the view that banks are inherently unstable arrangements. The theory is silent on the issue of what kinds of events would cause agents to have beliefs that other agents are going to withdraw their deposits; the events are "sunspots."[46] So, it is

[46] Postlewaite and Vives (1987) modify the Diamond and Dybvig model so that runs are an equilibrium phenomena, though see the comments of Jacklin (1989).

not testable; see Gorton (1988). Moreover, the “sunspots” have to concern all banks in a banking system, in order to generate a system-wide panic, rather than a run on a single bank. The theory is consistent with the cross-country variation in panic incidence only in the trivial sense that some countries have had system-wide sunspots, while other have not.

As an explanation of panics, the theory amounts to the assertion that the sequential service constraint is an inherent feature of reality. This is clearly unsatisfying in the sense that the underlying reality that would give rise to the sequential service constraint is not modeled. Recognizing this several researchers have tried to address this shortcoming.

Wallace (1988) presents a model that rationalizes the existence of the sequential service constraint. He assumes the basic Diamond and Dybvig set-up where consumers’ preferences are such that they need to have assets that can be “cashed” at optional times and where long-term investments are irreversible. They key new assumption is that consumers are isolated in the sense that they cannot coordinate their withdrawals or the amounts the bank will give each of them upon withdrawal. Consumers know where the bank is located and so they can go withdraw. But, their isolation means that at random times they will withdraw and there is no possibility for coordination. Sequential service is an outcome of the assumption that people are isolated from each other at the interim date, the date at which they learn their preferences for early or late consumption. As Wallace explains the assumption “…is consistent with the notion that people hold liquid assets because they may find themselves impatient to spend when they do not have access to asset markets, in which they can sell any asset at its usual price.” Wallace shows that the details of the model have implications for Diamond and Dybvig’s arguments about deposit insurance.

In Wallace’s formulation, following Diamond and Dybvig, bank liabilities do not circulate as a medium of exchange. Instead, when a consumer learns that he has preferences for early consumption, he withdraws from the bank to satisfy those needs. There is no purchase of consumption goods using bank liabilities as money. In the model, the bank is, in effect, also the store. But, in cash-in-advance type models or search-theoretic models, consumers buy goods with bank liabilities without any need to return to the bank to withdraw. This is the essence of a medium of exchange. And that is how bank notes and bank deposits work. While consumption smoothing, and the demand for consumption insurance, are likely important features of reality, it is not clear that consumption smoothing is really a meaningful sense in which bank liabilities are a medium of exchange.

Calomiris and Kahn (1991) rationalize sequential service as an optimal contractual response to depositors being uninformed about the value of their bank’s assets. This information can be produced, but at a cost. As discussed above, Calomiris and Kahn (1991) assume that information about the banker's decisions must be produced at a cost. Individual depositors who expend resources to produce the information will get into line to withdraw at the bank first. The sequential service constraint, i.e., a first-come-first-served rule, rewards those depositors in line first, so the information-producing depositors will recover more than other depositors. (As noted above, Jean-Baptiste (1999) is also relevant here.)

Green and Lin (1999, 2000) critique the Diamond and Dybvig model. They argue that the Diamond and Dybvig deposit contract is one of the feasible arrangements in the environment of their model. They argue that there are other arrangements that implement an efficient allocation without bank runs. In particular, agents are allowed to send messages of their type, i.e., their consumption timing preferences, to the bank. It turns out that truth-telling is a strictly dominant strategy. Green and Lin do not argue that their contracts are necessarily realistic, but that "Our results imply that environmental features from which Diamond and Dybvig's model abstracts are crucial to a full understanding of banking instability."

Reflecting its importance in the literature, there have been many extensions of the Diamond and Dybvig model. Goldstein and Pauzner (1999) is an important one. They address some of the more fundamental problems with the multiplicity of equilibria in Diamond and Dybvig's model. Agents, for example, do not consider the possibility of a run at the initial date when they deposit in the bank, so the subsequent date is not part of a rational expectations equilibrium. As a result, it is not clear that the deposit contract is optimal. Since there is no theory of selection from the multiplicity of equilibria, the theory is empirically vacuous. Goldstein and Pauzner modify the Diamond and Dybvig model by assuming that consumers do not have common knowledge about the fundamentals; rather they only obtain private signals. A private signal provides information about the final payoff on the bank's portfolio. But, the signal, though private, allows an agent to draw inferences about what signals other agents received. If an agent receives a high signal, the agent believes that other agents are likely to have obtained high signals as well. In this environment, there is a unique equilibrium and the probability of a bank panic is related to news about fundamentals and to the promised payoff on the demand deposit. Morris and Shin (2000)'s set-up is similar.

E. Information-Based Theories of Panics

Another view of panics sees them as rational events where depositors are essentially reacting to new information that is not bank-specific. The basic idea is that depositors learn some information that is relevant for assessing the risk of their bank, but is not specific to any particular bank; it is macroeconomic information. Nevertheless, the macroeconomic information is negative, i.e., a recession is looming, and risk averse depositors, revising their assessment of bank risk, may rationally decide to withdraw their deposits. In other words, there is consumption smoothing because the consumers realize that a recession is coming and consequently will need draw down their saving. They withdraw from their bank because they want to avoid losing their savings during the recession. Gorton (1987), Chari and Jagannathan (1988), Jacklin and Bhattacharya (1988), Allen and Gale (1998), and Gorton and Huang (2001) all have versions of this basic story.

In Gorton's (1987) model bank portfolio are subject to both idiosyncratic shocks and economy-wide shocks, but only the latter are observable by depositors.[47] Depositors update their beliefs about the state of bank portfolio based on the economy-wide shocks. Sometimes they seek to withdraw their deposits, a panic, because of fears that the banking system has a low quality portfolio, although they do not know whether their individual bank is in such a situation or not. Banks suspend convertibility to communicate information to depositors. In the model of Jacklin and Bhattacharya (1988) the bank cannot observe the true liquidity needs of depositors (i.e., depositor type) while depositors are do not observe the quality of bank assets. A unique (i.e., there are not multiple equilibria) bank run occurs when some of the depositors receive bad news about the realized state of the bank assets. In Chari and Jagannathan (1988) the proportion of depositors wanting to consumer early and the state of bank assets are also stochastic. Depositors can observe the initial size of the line of depositors at the bank and act conditional on this observation. The line may be especially long because some depositors received news that the bank's asset portfolio is in a bad state. But, this can be confused with a high proportion of early consumers. Thus, sometimes runs result in liquidating banks that do not have low quality asset portfolios.

Allen and Gale (1998) modify Diamond and Dybvig's model so that panics are related to the business cycle, rather than unexplainable events caused by "sunspots." The two important modifications are, first, that there is aggregate uncertainty about the value of the long-term assets held by banks. This assumption is introduced to link panics to business cycles, modeled as this aggregate risk. Second, the assumption of sequential service is dropped, as unrealistic. Consumers face consumption risk, as in Diamond and Dybvig. They can, however, observe a signal, a "leading indicator," that perfectly predicts the realization of the payoff on the long-term asset, but is not contractible. First best risk sharing can be achieved if contracts could be written on this signal. With noncontingent deposit contracts, but with the signal observable, panics can implement first best risk sharing when there is no cost to early withdrawal. Roughly speaking this is because when the long-term asset is worth zero, the bank's remaining investment is shared equally among the depositors because there is no sequential service. If there is a cost to early withdrawal, then the panic is inefficient and there is a role for the government.

[47] Gorton assumes that banks exist and he assumes the structure of the contracts.

An important difficulty with the information-based view of panics is that it views the problem as inherent in the banking system, like Diamond and Dybvig. Gorton and Huang (2001) present an information-based explanation, with same basic source of confusion between aggregate and idiosyncratic shocks as the above theories, but in the context of the industrial organization of the banking system. In addition to the asymmetric information setting, bankers may engage in moral hazard if their bank is in a low state. So, depositors must monitor banks. In their model, a panic is a manifestation of depositors monitoring their banks by withdrawing. But, this is not necessarily a panic, in the sense that only in systems of many small banks does it lead to banks being liquidated. Systems of large banks are monitored, and there may be withdrawals, but not panics. This is consistent with, for example, the comparison between the U.S. and Canadian experiences. Gorton and Huang's main result is to show how a coalition resembling a clearinghouse endogenously arises.

F. Other Panic Theories

There are a number of papers that study banking panics in the context of the entire banking system. These are models that focus on interdependencies between banks, either through interbank lending or through interbank clearing systems. The first of these was Bhattacharya and Gale (1987) who extend the Diamond and Dybvig model to examine the effects of preference shocks when there are many banks. Each individual bank faces uncertain liquidity demands, but there are many banks and there is no aggregate uncertainty. Bhattacharya and Gale show that when banks meet unanticipated demands for liquidity by borrowing in the interbank market, there is a free rider problem so that banks under invest in liquid assets. The basic result is that an unregulated interbank market for resources can be improved upon by a central bank that offers restricted opportunities to borrow and lend. Allen and Gale (2000) focus on the transmission of a shock in one location to other locations, suggesting that "contagion" is an important feature of financial crises. Other papers that examine crises and interbank links include Smith (1984, 1991), Donaldson (1992), Champ, Smith, and Williamson (1996), and Rochet and Tirole (1996), among others.

Williamson (1988) is a quite different model of panics. It is a multi-period extension of Boyd and Prescott (1986). His agents are risk neutral so there is no demand for consumption-smoothing insurance, but they do have random preferences and there are both a long-term and a short-term investment opportunity. With decentralized trade there is a possible lemons problem in that agents selling high quality capital cannot distinguish themselves from those selling low quality capital. Banks are large coalition of agents that overcome this information problem. However, the bank must allow for early withdrawals due to the random preferences of the depositors, so it issues demand deposits. The bank can achieve an allocation that is strictly preferred to the decentralized capital markets allocation by all agents in some states of the world. But, in other states of the world agents are indifferent between the two allocations. In states where agents are indifferent, the bank may dissolve. Williamson interprets this as a bank failure or collapse of the banking system.

G. Tests of Panic Theories

On the basis of the stylized facts about cross-country banking history, reviewed above, it would seem straightforward to observe that banks are not fundamentally flawed institutions. In fact, it does not seem to be an exaggeration to say that most of the theoretical work on panics has been motivated by the U.S. experience, which has then been incorrectly generalized. Panics simply are not a feature of most economies that have banks. The world is more complicated; industrial organization seems to be at the center of the incidence of panics. Not surprisingly, therefore, almost all the empirical work on panics has been on the U.S. experience. Until bank "crises" around the world in the last ten years, there simply has not been much else to study. Clearly, from the point of view of public policy and the design of bank regulation and central bank lender-of-last-resort activity it is important to distinguish between the two views of banking panics outlined above, if only because policies should be in place that are workable in economies where the banking system is susceptible to panics.

With regard to testing, a major difficulty is that Diamond and Dybvig (1983) is not a testable theory, since any observed a phenomenon is consistent with "sunspots." Instead, empirical investigations of panics have focused on the timing of panics in the U.S., checking for patterns that would be consistent with the information-based theories of panics. Importantly then, there are no formal tests that have been conducted that test one hypothesis against any particular alternative. Rather, there has been a variety of empirical work studying the times series behavior of the deposit-currency ratio, interest rates, and other variables, as well as studies of individual panic episodes. Empirical investigations include Gorton (1988), Donaldson (1992), Mishkin (1991), Park (1991), Calomiris and Gorton (1991), and Calomiris and Mason (1997). Wicker (1980, 1996, 2000), Donaldson (1993), Moen and Tallis (1992, 2000), Calomiris and Schweikart (1991), and White (1984) are also relevant.

Gorton (1988) argues that demand deposits are risky, like other securities, and that depositor behavior should correspond to consumption smoothing behavior based on the aggregate information available to them at the time. The basic idea is that when depositors receive information forecasting a recession they know that they will be dissaving, drawing down their bank accounts. But, their banks are more likely to fail during recessions, so they withdraw in advance to avoid such losses. Empirically Gorton analyzes the period 1863-1914 (and also the Great Depression) and shows that the post Civil War period behavior of the deposit-currency ratio displays the hypothesized timing. In fact, on every single occasion that a leading indicator of recession crosses a threshold, there is a recession. The basic conclusion is that there is nothing special about panic dates compared to nonpanic dates in terms of the behavior of the deposit-currency ratio. While the "sunspots" theory cannot be rejected, the conclusion is that if there are "sunspots" they must be consistent with estimated reduced for description of the deposit-currency ratio.

Donaldson (1992) revisits the issues raised by Gorton (1988) using weekly data, compared to Gorton who used data from the Call Reports, reported five times a year. Donaldson confirms that there are periods that predictably (from the point of view of an econometrician) correspond to instances when panics are more likely to occur, but that the exact starting dates during such periods are unpredictable. One interpretation of his results is that, although panics do tend to occur at business cycle peaks, there is some unknown triggering event that is not predictable, perhaps a "sunspot," but the data are not fine enough to say anything further.

Calomiris and Gorton (1991) first examine whether pre-panic periods were unusual. That is, do measures of seasonal flows of reserves and deposits show any evidence of tightness or shocks? There is no such evidence. The onset of panics is after the money flows associated with planting and harvesting. However, measures of real economic activity, in particular, the liabilities of failed businesses do decline. Also, stock prices declines did precede panics. Calomiris and Gorton write: "if one posits that the simultaneous violations of thresholds for percentages of real stock price decline and commercial failure increase are sufficient for panic, one can predict panics perfectly" (p. 144). Second, Calomiris and Gorton analyze bank liquidations and deposits losses during and after panics. Basically, there is no evidence of banks failing due to the panic. Rather, weak banks, by pre-panic measures, fail. Finally, Calomiris and Gorton look at sufficient condition for panics to end. The basic point here is that availability of liquidity to satisfy depositor demands does not seem to end panics, with the availability of the discount window during the Great Depression being the outstanding example. Rather, panics end when information becomes available, information typically produced by clearinghouses or the government about which banks are weak.

Mishkin (1991) also studies the National Banking Era in the U.S., as well as the Great Depression. He focuses on the timing of events and financial variables to distinguish between the monetarist and asymmetric information-based views of bank panics.[48] For example, an observation that interest rate spreads widen and stock market prices decline just prior to the panic, rather than a disruption in the financial markets following the panic, is viewed as evidence in favor of the information theory.

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[48] Some tests of theories of panics have focused, in part, on discriminating between the monetarist views of crises, associated with Friedman and Schwartz (1963) and the information-based theories, discussed above. Monetarists do not proposed a theory of panics, but note that panics reduce the money supply since withdrawals decrease the money multiplier. Thus, monetarists propose a central bank that acts as a lender-of-last-resort. However, if panics are due to asymmetric information, then monetary policy alone cannot eliminate panics or mitigate their effects.

Mishkin analyses each panic episode in U.S, history starting with the Panic of 1857 and concludes that "the asymmetric information approach to financial crises explains the timing of patterns in the data and many feature of these crises which are otherwise hard to explain" (p. 104). Mishkin's evidence is consistent with that of Gorton and Donaldson.

If asymmetric information is at the root of panics, then panics should end when depositors receive credible information about individual bank shocks. Park (1991) argues that empirically the evidence suggest that panics during in the U.S. did end when information about banks was provided to the public. He focuses on the actions of private bank clearinghouses and the government in providing credible information and concludes: "this empirical finding confirms the crucial link between bank-specific information and bank panics" (p. 285). Calomiris and Mason (1997) study the June 1932 bank panic in Chicago. They compare the attributes of banks that failed during that event to those that did not fail. They conclude that: "the failures during the panic reflected the relative weakness of failing banks in the face of a common asset value shock rather than contagion" (p. 881). "Private cooperation by the Chicago clearing house banks appears to have been instrumental in preventing the failure of at least one solvent bank during the panic" (p. 864). Other papers on the Great Depression are discussed below.

Demirgüç-Kunt and Detragiache (1998) study banking crises in a large sample of countries internationally during the period 1981-1994.[49] Their basic results "reveal strong evidence that the emergence of banking crises is associated with a deteriorated macroeconomic environment. Particularly, low GDP growth, high real interest rates, and high inflation significantly increase the likelihood of systemic problems in our sample; thus crises do not appear to be solely driven by self-fulfilling expectations as in Diamond and Dybvig (1983). This is consistent with the evidence presented in Gorton (1988) on determinants of bank runs in the U.S. during the eighteenth century" (p. 3-4). While this study is the only study of an international cross section of countries, and therefore is unique, it did not include any variables that might capture cross section variation in the industrial organization of the banking system, which the studies reviewed above suggest would be important. However, the study does include a dummy variable for the presence of explicit deposit insurance and an index of the quality of law enforcement. The presence of explicit deposit insurance significantly increases the likelihood of a banking crisis, while the "law and order" index shows that more "lawful" countries are less likely to have a crisis.

It should be emphasized that none of the above work constitutes a test in a statistical sense. While the evidence is suggestive, the basic finding that panics are associated with business cycle

[49] The sample ranges from sixty five to forty five countries in different regression, depending on data availability.

downturns does not rule out any theory of panics. In fact, in the Goldstein and Pauzner (1999) and Morris and Shin (2000) extensions of Diamond and Dybvig, the business cycle timing is completely consistent with the self-fulfilling nature of a panic. Morris and Shin write of their extension that: "The theory suggests that depositors will indeed withdraw their money when the perceived riskiness of deposits crosses a threshold value. But, nevertheless, the banking panic is self-fulfilling in the sense that individual investors only withdraw because they expect others to do so" (p. 14-15).

In fascinating recent research Kelley and Ó Gráda (2000) and Ó Gráda and White (2001) study the patterns of withdrawals from a single bank, the Emigrant Savings Industrial Bank, during bank runs in 1854 and 1857. Study at this level of detail can address questions concerning whether depositors respond to a signal that causes them to all crowd at once at the bank, or whether the run builds up slowly. Do rich or poor, less sophisticated or uninformed, line up first? And so on. Kelley and Ó Gráda (2000) find that in 1854 the bank panic followed ethnic patterns, particularly within the Irish community. Ó Gráda and White (2001) document time patterns in withdrawals (or account closings). There are responses to bad news, but there are elements of contagion as well. Moreover, the patterns are different in 1854 and 1857. In 1857, unlike `854, the run was led by business leaders and apparently sophisticated agents, followed by less informed depositors.

What is more important, however, is to keep in mind that, while to date it has not been possible to discriminate between panic theories with data, it is clear that the prima facie evidence is against theories that inherently intertwine banks and panics. The previous evidence about the industrial organization of the banking system strongly suggests that, at least historically, there is no necessary link between banks and panics.

H. The Banking Crises During the Great Depression

The Great Depression was a momentous event, resulting in vast institutional change in the U.S., and casting a shadow over the discipline of economics. In the case of U.S. banking, the Great Depression led to enormous change. Deposit insurance was enacted, and the Glass-Steagall Act, separating commercial banking from investment banking, was also passed in response to this event. Much has been written on the Great Depression (e.g., Kindleberger (1973), Temin (1989), Eichengreen (1992), Bordo, Goldin, and White (1998), and James (2001)) and we do not survey this vast literature here. Even the literature more narrowly focused on banking and financial factors during the Great Depression is large. Our focus is only on issues concerning the experience of banks, and banking systems, during the Great Depression, to the extent that these can be separated from other issues. Understanding the experience of banks during the Great Depression is important because much of bank regulatory policy emanates from this experience, rather than from the earlier panic experience. But, the Great Depression was a very different banking crisis than the earlier episodes in the U.S.

The panics during the Great Depression in the U.S. were certainly different from the previous episodes in terms of the extent of bank failures and losses on deposits. In the U.S. more than nine thousand banks failed during the Great Depression, between 1930 and 1933. That amounts to about one third of the total number of banks in existence at the end of 1929. In previous panics, the numbers of banks failing were miniscule, as shown in Table 3. Internationally, there was a variety of experience with regard to bank failure and system collapse. While the experience in much of Europe was similar to that in the U.S., in that banking systems did collapse (e.g., see Beyen (1949), James (1986), and Kindleberger (1973)), many countries experienced the Great Depression without banking crises (e.g., the United Kingdom, Canada, Czechoslovakia, Denmark, Lithuania, Holland, and Sweden). The international cross section variation with regard to banking crises during the Great Depression, and the magnitude of the failures in the U.S. are puzzles. The experience of Canada, discussed above, is an important example of an economy that had a dramatically different experience than the U.S. We begin with the international experience and then turn to the U.S.

Bernanke and James (1991) use annual data on twenty-four countries to study banking crises during the 1920s and 1930s. They construct a chronology of banking crises during the interwar period and focus on the links between the gold standard, banking crises, and real economic activity. The cite the industrial organization of the banking system as a significant factor in explaining which countries experienced banking panics during this period. In terms of the shock causing panics in those countries whose banking systems were prone to panics, they observe that there "were virtually no serious banking panics in any country after abandonment of the gold standard…" (p. 53), suggesting that deflation was the important shock. Another important point made by Bernanke and James (1991) concerns the real effects of severe banking problems. They argue that countries that experienced panics had deeper depressions than countries that did not experience panics. Bordo (1986), Calomiris (1993a), and Grossman (1994), all mentioned above, also focus on the cross-section variation of banking experiences internationally. Grossman (1994), like Bernanke and James, finds that a combination of macroeconomic policy and banking structure can explain much of the cross section experience in banking crisis. He rules out, as an explanation, lender-of-last-resort behavior of central banks.

Indeed, central banks were relatively new and inexperienced at dealing with bank crises, with the exception of the Bank of England. The Great Depression is a turning point in the history of central banking. According to Capie (1997), there were only eighteen central banks at the beginning of the 20th century. By 1950 there were 59 central banks and by 1990 there were 161. At the beginning of the 20th century, the U.S. Federal Reserve System was not yet established; this would occur in 1914. The Bank of

Canada came into being *after* the Great Depression, in 1934. Prior to the 20th century central banks were established as institutions with monopoly rights over money issuance. But, if a critical element of central banking is the function of lender-of-last-resort, then these institutions generally did not become central banks until later, typically during the 20th century—after the Great Depression.

Although the Federal Reserve System came into existence in 1914, and so there was a central bank with a discount window in existence during the Great Depression, there was no deposit insurance. Prior to the Federal Reserve being enacted there was the private system of clearinghouses that did provide a form of deposit insurance. And after 1934 there is explicit government-provided deposit insurance. However, during the period 1914-1934, there is no deposit insurance in the U.S., either private or public. Although during the Great Depression there were various points at which the government together with the clearinghouses attempted to act, nothing came of this.[50] Clearinghouses acquiesced to the Federal Reserve, but the Federal Reserve did not play the role that clearinghouses had played in earlier episodes. This accounts for much of how the panics of the Great Depression in the U.S. differed from earlier panics.

First of all, unlike earlier episodes in the U.S. where there was not a single panic near the business cycle peak. Gorton (1988) constructs a counterfactual, based on estimated structural equations and argues that if the private clearinghouse system in existence prior to 1914 had been in existence during the Great Depression (and there had been no Federal Reserve system), then there would have been a single panic in December 1929 (and also in June 1920).[51] Instead of one quarter to one third of the banks failing, Gorton estimates that less than one percent would have failed had the private clearinghouse system been in place. Instead, there was not a single panic during the Great Depression. In fact, it is a matter of dispute which episodes really constituted panics. The dates in question are periods in which there were numerous bank failures; November 1930 to January 1931, April to August 1931, September and October 1931, and February and March 1933. Friedman and Schwartz (1963) were the first to argue that these were four separate national banking panics during the Great Depression. This has been disputed, as we discuss below. The difficulty is not just the matter of the definition of what is a "panic," but also that these episodes were different that previous US. Panics in another way, emphasized by Wicker (1996), namely, that the center of the panic was not the money market in New York City. Rather, the initial banking problems were region specific. Wicker (1996): "There is no discernible pattern in the diffusion of the crisis from certain regional centers to the periphery. One reason for the absence of such a

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[50] In 1930 the Federal Reserve Bank of New York and the New York Clearinghouse Association attempted to arrange a rescue of the Bank of the United States, but the plan failed (see Wicker (1996)). Later, in 1933 there was a proposal to issue clearinghouse loan certificates to the public, but this also failed (see Wicker (1996)).

[51] The fact that there was no panic in 1920 was also significant because the 1920s saw significant numbers of banks fail in the U.S. See Alston, Grove, and Wheelock (1994).

pattern is the fact that the panic did not at any time engulf any of the largest banks of Philadelphia, Pittsburgh, and Chicago. Exactly how the loss of confidence spread across the twelve Federal Reserve Districts is still a matter requiring explanation" (p. 98).

The fact that the panics were more regional, at least they originated outside New York City, has led to disputes among researchers about which of the four events identified by Friedman and Schwartz really were national panics. It has also complicated efforts to test hypotheses about the causes of panics during the Great Depression. The debate over the origins of the panics in the Great Depression echoes the debates about whether panics are irrational contagion or information-based. The fact that rural areas play a role has led to consideration of the fall in agricultural income as an important factor. In a famous quotation, Friedman and Schwartz (1963) put it this way: "In November 1930 … a crop of bank failures, particularly in Missouri, Indiana, Illinois, Iowa, Arkansas, and North Carolina, led to widespread attempts to convert demand and time deposits into currency … a contagion of fear spread among depositors starting from agricultural areas, which had experienced the heaviest impact of bank failures in the twenties. But such contagion knows no geographical limits" (p. 308). In contrast to this view of contagion emanating from problems in agricultural, Temin (1976) argued that sharp declines in the value of bank asset portfolios caused bank failures. He constructed proxies for the quality of bank portfolios using traded bond prices and performed annual cross section regressions, attempting to explain the pattern of bank failures. Wicker (1980) presents a third point of view, arguing that the collapse in November 1930 of Caldwell and Company of Nashville, Tennessee was the shock setting off the panic, rather than declines in bank asset values or agricultural incomes.

A number of other authors have contributed to the subsequent debate, attempting to shed light on the three interpretations. The main innovation has been more detailed bank-level data. White (1984) U.S. national banks during four years, 1929-1932. For each of these years, the failed banks are matched with a stratified random sample of non-failing banks based on similar assets and geographical location. White then uses financial ratios to try to discriminate between failed and nonfailed banks, using logit regression. He argues that his results show that Temin and Friedman and Schwartz are not really in conflict. Bank failures are explained by a shocks causing agricultural distress, leaving banks with poorly performing loans. Thies and Gerlowski (1993) revisit White's analysis a bit differently and confirm his findings. Calomiris and Mason (2000) construct an even more detailed data set to analyze the causes of bank failure during the Great Depression. Their measures of fundamentals include attributes of individual banks, as well as proxies for local, regional, and national economic shocks. In the first three of the Friedman and Schwartz panics, they find no evidence of contagion-like effects. But, for the last episode this does not appear to be the case. Hamilton (1985) also examines the Panic of 1930 and the interpretations of Friedman and Schwartz, Temin, Wicker and White. Hamilton presents a fairly nuanced view, concluding that "The banking panic of 1930…had no single cause, and none of the various interpretations of the panic's causes—poor loans and investments made in the twenties, the Caldwell failure, or falling cotton prices—can fully account for the rise in the number of failures and for the shift in the states and regions afflicted with banking difficulties. The wave of failures can be explained by the combined effect of the overextended condition of the failed banks, the Caldwell shock, and the deteriorating agricultural conditions" (p. 607).

There is also controversy concerning the effects of the collapse of the banking system during the Great Depression. Friedman and Schwartz (1963) argue that the collapse of the banking system was only important because if meant a major decline in the supply of money, via the money multiplier when depositors withdrew currency. Temin (1976) sees the collapse of the banking system as a result of real shocks and that even without the banking crisis "the overall story of the Great Depression would not have been much different" (p. 9-10). Bernanke (1983) initiated a revision of the debate when he introduced another interpretation of the events. He argues that "the financial crises of 1930-33 affected the macroeconomy by reducing the quality of certain financial services, primarily credit intermediation" (p. 263). In other words, banks perform a real allocative role, which is important for the functioning of the economy. Without banks, due a collapse of the banking system, output will decline because banks can no longer allocate capital to firms. Bernanke works in the general econometric framework of unanticipated money causing changes in real output (the rate of growth of industrial production), introduced by Barro (1978). His first finding is that declines in money are not quantitatively large enough to explain the output declines of 1930-33. He then includes proxies for the effects of declines in intermediation services, for example, the real deposits of failing banks and the liabilities of failing businesses. These and other proxies improve the explanatory power of the output equation, strongly suggesting his interpretation.

Bernanke's paper has been very influential and generated a number of responses. Temin (1989) argued that firms which were more reliant on bank loans, namely smaller firms, should suffer the most when the banking system collapses. His analysis is based on dividing industries into bank-reliant ones and non-bank-reliant ones. He finds no pattern, arguing that Bernanke is wrong. Hunter (1982), however, provides more detailed analysis based on firm level characteristics and does find that small firms were affected differently. Also see the discussion in Calomiris (1993b). Another critique of Bernanke is that of Rockoff (1993) who argues that Bernanke's results are not robust to how money si defined. He constructs a measure of money that takes into account the fact that deposits in banks that have suspended convertibility are not "money" in the dame sense as deposits in other banks. When this measure of money is used, Rockoff finds that the nonmonetary proxy variables are not important in the specification. Essentially, Rockoff argues that any times series variable with a spike during 1929-1933 will have statistical significance. Calomiris and Mason (2001), in preliminary work, attempt to examine the issues at a much disaggregated level, asking whether indicators of local banks' conditions can explain cross section variation in state income.

Bernanke's original paper discusses the Canadian experience during the Great Depression, since it provides such a contrast to that of the U.S. suggesting that a more careful study of Canada would be valuable. Haubrich (1990) provides such a study. In Canada, there were no panics and no banking crises, though the number of branches declines from 4049 to 3640 between 1929 and 1933.[52] Essentially, Haubrich follows Bernanke's path, but studies Canada. He also looks at cross industry comparisons. He finds that measures of financial distress have no economic or statistical significance. His interpretation is that the real effects are due to crisis or panic. The banking system can contract because the demand for loans declines, but real effects only occur when the supply of loans contracts due to crisis. This interpretation is disputed by Calomiris (1993b).

I. Contagion

"Contagion" is the idea that some event can cause a chain reaction or domino effect among banks. For example, when one bank (or possibly a nonfinancial firm) fails, this, it is argued, can cause depositors at other banks to withdraw their deposits. Alternatively, when one bank becomes insolvent this can cause other banks to become insolvent because of a chain of illiquidity stretching through the interbank market. So, one view of "contagion" is that it refers to "interdependence" among banks, more so than nonfinancial firms. In Bhattacharya and Gale (1987) or Allen and Gale (2000), as well as the other papers mentioned above, banks are interdependent so shocks to one or a few banks may have an impact on other banks. This type of shock transmission mechanism is also prominent in discussions of the risks in the payments system. For example, Flannery (1996) develops a model in which banks become wary of lending to other banks, although most banks are in fact solvent. At root, the interbank loan market creates an interdependence that can propagate shocks through the banking system. Another view of "contagion" is informational. Banks are opaque institutions, so that information about a single institution might rationally or irrationally lead to a revision of beliefs about the value of other institutions.

There are a variety of ways of testing contagion hypotheses. Calomiris and Mason (1997) look for informational contagion effects. They adopt the empirical strategy of comparing the ex ante attributes of banks that failed during the Chicago panic of June 1932 with those that did not fail. If banks that failed were just as strong as those that survived, then this would be evidence in favor of confusion on the part of

[52] As noted above, Kryzanowski and Roberts (1993, 1999) claim that all of the large Canadian banks were insolvent during the 1930s and that the only reason that there was not a banking crisis was that there was implicitly complete deposit insurance provided by the government. This view is disputed by Carr, Matheson and Quigley (1995).

depositors. If banks that failed were weaker, then runs on individual banks were not purely random; weaker banks were run and then failed. They find that weaker banks did fail, and interpret their evidence as being inconsistent with contagion. Rather, there is evidence that while depositors were somewhat confused about the states of individual banks, only the weakest banks were forced into insolvency.[53] Though Calomiris and Mason also point to Chicago clearinghouse as the institution that facilitated this. Their study shows that weak banks failed in the panics while the strong survived. So, the panic did not cause ex ante stronger banks to fail. But, is it is not clear that this is a statement about the causes of the panic. The panic may have been caused by some version of "contagion," but in the end only weak banks failed.

Other studies of contagion have been event studies that examined the abnormal return on bank stocks when a bank fails, in the post WW II U.S. economy. For example, Aharony and Swary (1983) look at the stock reactions to three large bank failures in the 1970s. They found that other banks' stock prices did not respond. Similar studies include Aharony and Swary (1996), Swary (1986), and Wall and Peterson (1990). Basically, the empirical results support the idea that the stock market prices respond to new information, rather than to contagion caused by interbank linkages or irrationality. Kaufman (1994) reviews more of these studies.[54] Event studies test a number of joint hypotheses which makes them difficult to interpret. Chief among these problems is the fact that large U.S. banks are viewed as being "too-big-to-fail." This is the implicit government policy of rescuing large banks, possibly preventing their failure to the benefit of shareholders. O'Hara, Maureen and Wayne Shaw (1990) find positive announcement effects to encouraging government announcements concerning too-big-to-fail, suggesting that big bank shareholders benefit from this policy. Consequently, there may be detectable contagion effects to a large bank failure were it not for the too-big-to-fail doctrine.

Furfine (2001) analyzes the interbank market by analyzing all individual U.S. federal funds transactions during 1998, a year during which Russia defaulted on its sovereign debt and the hedge fund Long-Term Capital Management (LTCM) was rescued by the private sector. These transactions allow Furfine to trace any chain reaction or domino effect and allow him to identify whether banks, as a group, became fearful of transacting with other banks. Furfine (2001) finds that interest rates did not move from their level intended by the Fed, and that interest rate variability was not really affected by the crises with Russia and LTCM. Aggregate volume in the fed funds market rose in the second half of 1998, during the

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[53] Esbitt (1986) examined Chicago banks that failed in 1931 and shows that they were plagued by poor management.

[54] Saunders and Wilson (1996) study deposit flows in a sample of failed and healthy banks over the period 1929-1933 in the U.S. They find evidence of contagion for 1930-1932, but not in 1929 or 1933. However, during 1930-1932, failing-bank deposit outflows exceeded those at a matched control sample of nonfailing banks suggesting that there were informed depositors who distinguished among ex ante failing and nonfailing banks.

crises. Credit spreads in the interbank market did not increase, but were often narrower. Finally, individual banks borrowers at least as much during the crises as before. Furfine's results are the strongest results against contagion effects in the interbank market, but these results too are possibly a function of the too-big-to-fail policy of the U.S. government.

There are a large number of studies that examine banking crises in emerging markets in the 1980s and 1990s, arguing that some of these events seem to have elements of contagion. While definitions of "contagion" vary considerably, one view of "contagion" views it as the transmission of real shocks from country to country due to trade links, financial links, or "fear." Some studies of recent crises provide evidence that banks were an important transmission mechanism of shocks, possibly accounting for phenomena labeled "contagion." Peek and Rosengren (1997, 2000) see banks as a transmission mechanism, but do not think of it as contagion. Kaminsky and Reinhart (1998, 1999) identify three channels that may transmit shocks from one country to another: bank lending, liquidity, and trade. Their empirical work is based on forming clusters of countries based on measures of these three channels. They then show that these clusters are regional, a possible source of transmission of shocks. In the case of bank lending they distinguish a cluster of countries that borrows from Japanese banks and one which borrows from U.S. banks. Their main result is that the probability of crisis, conditional on crisis having happened in a certain banking cluster, tends to be higher than the unconditional probability of crisis. However, the clusters associated with each channel overlap so much that it is hard to argue that the common bank lender channel has really been isolated from the other channels. In a similar vein, Caramazza, Ricci, and Salgado (1999) use BIS data define a "common bank lender" for each crisis as the country that lent the most to the first country in crisis in each of the major crises, using a sample of 41 emerging markets. For example, in the Mexican crisis the common bank lender is the United States. Their main result is that countries that experienced crises were more reliant on a common lender than other countries. Van Rijckeghem and Weder (1999, 2000) also investigate the idea that international banks are a major channel for the transmission of shocks. Studies in this area are relatively new, but seem promising.

V. Bank Regulation, Deposit Insurance, Capital Requirements

Government provision of deposit insurance and government intervention into banking markets, including bank supervision and examination, limitations on bank activities, capital requirements, charter requirements and entry restrictions, closure rules, and other rules for banks, are now widespread around the globe. The rationale for deposit insurance and bank regulation is the argument that banks are inherently flawed institutions, being prone to harmful banking panics. Consequently, the government should provide deposit insurance and regulate bank risk taking. Moreover, once deposit insurance has been adopted, there is a further need for government intervention via bank regulation because of the incentive of banks to take additional risks once they have (underpriced) government deposit insurance (see Buser, Chen, and Kane (1981)).

Most of the vast literature on bank regulation is within this paradigm of panics, deposit insurance, and moral hazard. In general, the literature on bank regulation, and related issues, assumes the need for deposit insurance and government regulation and focuses on the implications of moral hazard problems for the design of bank regulation. There is an associated empirical literature that has attempted to uncover evidence that moral hazard is a problem in banking systems with insured deposits. The empirical literature, while covering a variety of topics, has not been particularly successful at finding evidence of moral hazard problems, despite its dominance as a theory of bank behavior and bank regulation. We start, however, with a discussion of the origins of bank regulation and deposit insurance. This is an important topic because the government provision of deposit insurance, and the associated bank regulation, is a quite recent phenomenon.

A. The Origins of Government Bank Regulation and Government Deposit Insurance

If banks are inherently unstable institutions, prone to panics, then government regulation is perhaps justified, in the form of government deposit insurance, capital requirements, and bank supervision and examination. However, as discussed above, most countries did not have banking panics, or, if they did, panics were infrequent. Why then are government deposit insurance schemes and bank regulation so widespread? Part of the answer is that they were not widespread until recently, reflecting policy advice based on the paradigm of panics, deposit insurance, and moral hazard.

Bank regulation and deposit insurance have their origins in the private arrangements among banks, as described above in the discussion of bank clearinghouses and other private bank coalitions, and theoretically by Gorton and Huang (2001). Governments took over these insurance schemes and regulations fairly recently, although in the U.S. there were various earlier deposit insurance arrangements sponsored by state governments (see White (1983), Calomiris (1990), and Wheelock (1992b)). The first formal nationwide government deposit insurance system in the world was established in the United States in 1934. Other countries did not follow the U.S. lead, even those that had experienced the depression of the 1930s. It was not until after World War II that countries around the globe began to adopt deposit insurance. For example, Canada did not adopt deposit insurance until 1967. Figure 2 shows the number of explicit national deposit insurance programs in countries around the world.[55] In 1980 only sixteen countries had explicit deposit insurance programs; by 1999, sixty-eight countries had such programs (see

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[55] Demirgüç-Kunt and Detragiache (no date) and Garcia (1999) detail the variation in the schemes adopted around the world.

Kyei (1995), Garcia (1999) and Demirigüç-Kunt and Sobaci (2000)). Two thirds of the deposit insurance programs in the world have been established in the last fifteen years. Widespread banking crises during the 1980s and 1990s were the proximate cause of the spread of government deposit insurance.

Not only is deposit insurance recent, it has been hard to explain why it was adopted in the first place. In the U.S., the federal deposit insurance legislation was originally supported by all but the largest banks, but was widely viewed by others as special interest legislation, a subsidy for banks. Even with the collapse of the banking system during the Great Depression, the Roosevelt administration, the bank regulatory agencies, and large banks opposed the legislation. See Flood (1992) and White (1998). In fact, looking at U.S. history, White (1998) concludes that: "There is no ready model to explain the growth and spread of federal insurance of intermediaries" (p. 87-89). This challenge may have been answered by Kane and Wilson (1998).

That deposit insurance and capital requirements are recent developments is consistent with the above observations that instability is not inherent in banking, that most banking systems do not have problems with banking panics; the U.S. experience is an outlier. Since 1934, when deposit insurance came into being, most of the U.S. banking experience has been quiescent. Figure 1 shows the number of bank failures in the U.S. since 1934. The figure strongly suggests that deposit insurance per se is not subject to moral hazard. For fifty years the banking industry in the U.S. was a rather quiet industry, with few failures and little academic attention. It appears that there was a regime switch in the mid-1980s. We return to this issue below.

B. Deposit Insurance and Moral Hazard

Moral hazard is the idea that bank shareholders have an incentive to take advantage of under-priced deposit insurance by engaging in riskier actions than they would otherwise. The idea that equity holders want to increase risk, at the expense of bondholders, applies to all situations where there is limited liability (and under the standard Black-Scholes assumptions). This is the observation that, viewing equity as a call option on the value of the firm, option values are increasing in volatility. In other words, the equity holders do not care if the payoffs are low because of limited liability, but they will benefit if the payoffs are high. This idea is commonly described as "gambling for resurrection" or "playing the lottery." Moral hazard has been viewed as being of particular relevance to banking because government deposit insurance premia are not (explicitly) based on the riskiness of the bank. Moreover, the argument is that banks are regulated, in part, to prevent them from engaging in moral hazard. The usual view, however, is that the equity holders will engage in risk-increasing strategies only when bank capital is low or nonexistent. This view implicitly reflects the idea that there are some institutional and contractual constraints on equity holders, but that these constraints lose their force when equity value is low. It has never been clear what these constraints actually are, or why they lose their force at low equity values.

A starting point for considering the moral hazard issue concerns whether deposit insurance premia are (implicitly) set to reflect the risk of individual banks. If insurance premia are fairly priced, then the incentives to engage in moral hazard are the same as in nonfinancial firms and, presumably it is prevented in the same way. Using stock price data and an option-based approach, Marcus and Shaked (1984) found that the vast majority of large banks are overcharged for deposit insurance. Pennacchi (1987), also using an option-based approach, finds that nearly all the banks in his sample were overcharged. These results suggest that the bank regulators or corporate governance mechanisms exert control over banks to limit their risk-taking so that they are effectively being overcharged even with flat rate premia. Also, see Ronn and Verma (1986). Federal Deposit Insurance Corporation (2000) discusses a variety if risk-based pricing methods.

Buser, Chen, and Kane (1981) and Marcus (1984) raise an important issue with the moral hazard argument, that is that in order to enter the banking industry, a charter from the government is required. The charter is the license to take deposits and make loans. The charter is not a transferable asset and it is lost if the bank fails. Charters are in limited supply because the government, in many countries, does not allow free entry into banking. This valuable charter alters the bank's risk-taking behavior, particularly as posited by those who argue that deposit insurance is under-priced and so bank equity holders have an incentive to engage in moral hazard. As Marcus (1984) put it "…the traditional view of bank finance in the presence of FDIC insurance is overly simplistic in that it ignores the effects of potential bankruptcy costs" (p. 565). Charter value causes the bank equity holders to decrease risk as default becomes more likely.

The pattern of bank failures shown in Figure 1 may be understandable based on the value of commercial bank charters. What changed? Essentially, the story is that prior to the 1980's banks were partially protected from competition. They often had local monopolies in deposit markets (see Hannan and Berger (1991) and Neumark and Sharpe (1992); there was no competition from money market mutual funds and there are interest rate ceilings. In other words, the charter values of banks were high. Keeley (1990) was the first to link Marcus' theoretical insight to the empirical world of banking in the mid-1980s. Keeley (1990) uses Tobin's q as a measure of market power or charters in banking. (Also, see Saunders and Wilson (2001).) For example, banks that have a local monopoly on deposits can issue deposits at below- market rates, and this will be reflected in the bank's stock price. He finds "that [Tobin's] q appears to be useful proxy for market power and that banks with greater market power hold more capital and pay lower rates on CD's" (p. 1186). Keeley's interpretation of banking in the 1980s is that increased competition in banking reduced charter values, causing banks to increase risk in response.

Demsetz, Saidenberg, and Strahan (1996) also conclude that banks with high charter values operate more safely than other banks. Keeley's argument is consistent with moral hazard being operative when commercial bank charter values are low. We return to Keeley's argument below.

The bulk of the empirical work aimed at testing the moral hazard hypothesis as applied to financial intermediaries analyzes the behavior of insolvent or poorly capitalized U.S. savings and loan institutions, "thrifts," during the 1980s. The S&L crisis would appear to be a good testing ground for the moral hazard hypothesis. A series of exogenous interest rate shocks in late 1979 and early 1980, and the deregulation of deposit rates, caused large numbers of thrifts to lose significant amounts of equity. Essentially, deregulation reduced the value of thrift charters while interest rate shocks almost simultaneously reduced their equity value. Between January 1980 and December 1988, nearly 1,200 thrifts failed, though not all were actually closed, later described as a policy of regulatory "forbearance," which makes for an even more interesting testing ground for moral hazard. Brumbaugh (1988), Kane (1989), Kormendi et. al. (1989), Barth (1991), and White (1991), among others, provide background on the thrift crisis.

The first type of tests for the presence of moral hazard in the thrift industry focused on comparing the behavior of insolvent thrifts with those of solvent counterparts. For example, Barth, Bartholomew, and Bradley (1990) find that failed thrifts had disproportionately high concentrations of commercial mortgages, real estate loans, and direct equity investments, compared to the average thrift. DeGennaro, Land, and Thomson (1993) study the investment strategies of the 300 largest thrifts to post capital deficiencies in 1979. The institutions of this group that subsequently failed followed "higher-growth investment strategies" than did those that returned to health. Benston (1985) analyzed a matched sample of solvent and insolvent thrifts. Between January 1, 1980 and August 31, 1985, 202 thrifts failed. Each of these thrifts was matched to two nonfailing thrifts, two just smaller and two just larger. Barth and Bradley (1989) also pursue this empirical strategy. Rudolph and Hamdan (1988) use financial ratios to try to discriminate between failed and solvent thrifts in the post-deregulation period (i.e., after the Depository Institutions Deregulation and Monetary Control Act of 1980 and the Garn-St. Germain Act of 1982). Brewer (1995) look at changes in thrifts' stock prices in response to changes in the mix of asset investments.

A related approach is to look at changes in thrift behavior following major legislation to see whether solvent and insolvent thrifts responded differently. The Depository Institutions Deregulation and monetary Control Act of 1980 and the Garn-St. Germain Depository Institutions Act of 1982 allowed thrifts to invest in previously forbidden assets. McKenzie, Cole, and Brown (1992) estimate the average returns on various types of thrift investments for the years ending June 30, 1987 and June 30, 1988. In particular, they estimate the returns on traditional thrift assets and on the new, nontraditional, investments.

Returns on nontraditional assets are estimated to be lower than on traditional assets, but in particular, the results are more pronounced at capital deficient thrifts. This can be interpreted as evidence that thrifts with low capital were engaging in moral hazard. However, as the authors note, there are a number of other explanations consistent with the finding. First, thrifts that were about to fail may have already sold the more liquid traditional assets, biasing the estimates of returns. Second, nontraditional assets may be easier to use to engage in fraud or "looting," a hypothesis distinct from moral hazard, as discussed below. Third, regulators were more inclined not to close insolvent thrifts with traditional portfolios.

These approaches to testing for moral hazard are fraught with difficulties. There is no question that failed thrifts are different than solvent thrifts; this is true by definition, since they failed and the others did not. And it is not surprising that the failed thrifts have many common characteristics; they engaged in similar types of investments and those investments did not do well. But, it is not clear that these observations have anything to do with moral hazard. For example, if a thrift is not successful investing in traditional asset categories, for whatever reasons, it may invest in new asset classes allowed by deregulation. If there is a negative exogenous shock to this new asset class, and the thrift subsequently is closed, it may have nothing to do with moral hazard. But, this outcome must be distinguished from the case where the thrift, seeing that its net worth is negative invests in the new asset class because the new assets are viewed ex ante as being very risky.

In addition to the problems mentioned above, another problem involves ensuring that the risk-taking behavior is caused by insolvency, rather than the other way around. This issue is related to the use of accounting data, which almost all of the studies rely on. Benston, Carhill, and Olasov (1991) discuss the accounting issues, and then go on to base their analysis on estimates of market values. These authors "conclude that insolvent thrifts did not expand more rapidly than did solvent thrifts and, in general, did not take greater risks" (p. 379). Brickley and James (1986) also avoid the accounting issues by looking at the response of stock prices to changes in Federal Savings and Loan Insurance Corporation closure policy. They find that the response is as if access to underpriced federal deposit insurance is a valuable option, but it is not clear that there is moral hazard. According to standard option theory, call options are more valuable if the maturity is extended, ceteris paribus.

Another interesting experiment concerns the U.S. Comptroller of the Currency's announcement, in 1984, that the eleven largest U.S. banking firms were "too big to fail" (TBTF), implying they would receive de facto 100 percent deposit insurance. Did this encourage risk-taking? O'Hara and Shaw (1990) investigate the effect on bank equity of the Comptroller of the Currency's announcement using event study methodology. They find positive wealth effects accruing to TBTF banks, with corresponding negative effects accruing to non-TBTF banks. Boyd and Gertler (1994b) study the poor performance of banks in the 1980s in a statistical study controlling for location, asset size remains a significant factor in poor performance of large banks. They find that the poor performance of the U.S. banking industry in the 1980s was due mainly to the risk-taking of the largest banks and interpret this as risk-taking that was encouraged by the U.S. government's too-big-to-fail policy. Also, see Black, Collins, Robinson and Schweitzer (1997). De Nicolo (2001) shows that the link between bank size and risk extends beyond the U.S. He examines banks in 21 industrialized countries during 1988-1998 and finds that larger banks have lower charter values (as measured by Tobin's q ratio) and higher risk of insolvency.

Some authors have attempted to address the shortcomings of studies based on the thrift crisis by examining historical situations where some institutions are covered by insurance, while other similar institutions are not. Wheelock (1992b), Wheelock and Kumbhakar (1995), and Wheelock and Wilson (1995) looked at individual banks in Kansas that participated in a state deposit insurance program in the 1920s, on a voluntary basis. Banks that chose insurance coverage took additional risks. Calomiris (1990) finds that deposit insurance in the early 1900s increased bank risk-taking, more so for states with mandatory insurance than for states with voluntary insurance. Grossman (1992), examining thrifts in the 1930s, found that thrifts entering the voluntary federal insurance program did take on more risks than uninsured thrifts after several years.

Demirgüç-Kunt and Detragiache (2000) analyze international evidence. They estimate the probability of a systemic banking crisis in a panel of 61 countries over the period 1980-1997. This is the period when most countries adopted deposit insurance; see Figure 2.[56] About 40 banking crises are identified in the panel and for about half the observations a deposit insurance system was present. The main result is that a dummy variable for the presence of deposit insurance is positive and significant. Refining this by distinguishing different types of deposit systems shows that explicit deposit insurance is associated with higher likelihood of crisis. As the authors point out, one possibility for the association between deposit insurance and bank crises is that economies with fragile banking systems tend to adopt deposit insurance. An instrumental variable approach to this issue shows deposit insurance to still be associated with crisis. The authors conclude that "explicit deposit insurance tends to be detrimental to bank stability" (p. 22).

The international evidence of Demirgüç-Kunt and Detragiache raises another issue. The moral hazard argument is the idea that equity holders are motivated to take on risk inefficiently in the hopes that there is a state of the world that could be realized in the future in which their equity would be positively valued. But, Akerlof and Romer (1993) point out that much of what is claimed to be evidence of moral hazard, in fact, appears to be behavior in which there is NO state of the world in which equity would be positively valued. Rather, it is "looting," that is, the equity holders are simply illegally stealing from the

[56] Years in which banking crises were occurring were excluded.

institution. Akerlof and Romer attempt to estimate the extent of looting during the U.S. S&L crisis and present a range of estimates that would account for a large fraction of the government clean-up costs. The argument is also applied to the banking systems of emerging markets. As Akerlof and Romer write: "..it is a safe bet that many developing countries that have far less sophisticated and honest regulatory mechanisms than those that exist in the United States will be victimized by financial market fraud as their financial markets develop" (p. 59). An important question concerns whether this type of fraud is increased when deposit insurance is adopted.

Returning to the U.S. S&L crisis, there is little dispute that if the government had closed thrifts faster, then the costs of resolving the insolvencies would have been lower. But, closure policies are somewhat complicated by the constraints the government may face. The government may optimally not want to close banks or thrifts and instead engage in a kind of moral hazard itself. See Gorton and Winton (2000). Acharya and Dreyfus (1989) and Mailith and Mester (1994) also analyze government closure policies for financial intermediaries. If there had been no deposit insurance for U.S. savings and loan institutions, then there would likely have been a generalized panic at some point, rather than forbearance by the government. This raises the question of the costs of deposit insurance. White (1998) attempts to address this issue with regard to U.S. commercial banks. While it is a difficult problem, and White admits the to tenuousness of his estimates, it certainly raises the point that the social value of deposit insurance is uncertain. White concludes that '…it is hard to escape the conclusion that deposit insurance did not substantially reduce aggregate losses from bank failures and may have raised them" (p. 119).

C. Corporate Governance in Banks and the Moral Hazard Argument

Despite the appealing simplicity of the moral hazard argument, it has been difficult to find compelling evidence of its existence. One issue concerns whether there are counterbalancing forces, arrangements that provide incentives for shareholders to not engage in risky strategies. Another issue concerns whether equity holders are even in a position to make decisions in large institutions anyway. As a practical matter, equity holders are not in a position to dictate policy in large banks, where management may be "entrenched." The idea that equity holders control the firm, the basis of the moral hazard argument, appears to contradict the standard corporate finance view of large firms, namely that managers are effectively in control, not equity holders. This is the essence of the agency view of corporate governance. This raises issues of corporate governance in banking. Are the corporate governance issues in banking similar to those in unregulated nonfinancial firms? Are there agency conflicts between bank owners and their managers? Is executive compensation for bankers different?

Not surprisingly there is evidence of agency conflicts between managers and shareholders in banking. James (1984) and Brickley and James (1987) demonstrate the importance of the market for corporate control in banking. James (1984) finds that salary expenses, occupancy expense, and total employment are higher for banks in states that prohibit acquisitions by other banks. James and Brickley (1987) find that banks in states that allow acquisitions have more outside directors on their boards. Schranz (1993) finds that banks in states that allow a more active takeover among banks are more profitable. Houston and James (1993) find that the frequency of management turnover among poorly run commercial banks is about the same as management turnover in poorly run nonbanks. They also find that the costs to managers, in terms of lost income and future job opportunities, of their departure are significant. Cannella, Fraser and Lee (1995) find that the bank managerial labor market discriminates between cases were the bank manager was arguably at fault for the bank failure and those cases where failure was due to exogenous events. Hubbard and Palia (1995) find that the pay-for-performance link in bank management compensation is stronger in states that permit interstate banking, suggesting that the market for corporate control is important. Also, see Barro and Barro (1990) and Crawford, Ezzell, and Miles (1995).

Corporate governance in banks may be similar to nonbanks in some ways, such as frequency of management turnover, but this may be due to regulatory intervention. Prowse (1995) studies corporate governance in U.S. commercial banking, and considers this issue. He borrows the method employed by Morck, Shleifer and Vishny (1989) to a sample of manufacturing firms and studies a sample of U.S. bank holding companies. The results are given in Table 4 (which is Table 1 of Prowse, p. 28). The frequency of control changes, in terms of percentage of the sample that experienced a change, is about the same for banks and nonbanks. But, the composition of the changes is very different. Clearly, regulatory intervention is important for banks, while hostile takeovers are not frequent. In Prowse's sample, management turnover is less important in banks than in nonbanks.

If there is a separation of ownership and control in larger banks, then moral hazard would be a problem only if the interests of equity holders and their managers were in alignment. Houston and James (1995) consider this question, that is, they ask whether executive compensation in banking is structured to promote risk-taking? They find that (on average) CEOs of banks are less likely to participate in a stock option plan; they hold fewer stock options, and they receive a smaller fraction of their total pay in the form of equity-linked remuneration compared to CEOs in other industries. They also find that the relation between equity-linked compensation and the value of the bank charter is positive and significant. Finally, they find that weakly capitalized banks (as identified by the regulators) are no more likely to use equity-linked compensation than other banks. Overall, it does not seem to be the case that equity-holders attempt to induce or entice managers to engage in moral hazard.

We are left with a conundrum. If there are corporate governance problems with large financial institutions, and these appear to be similar in magnitude to the problems in nonfinancial firms, how are bank and thrift managers being enticed to engage in moral hazard? Keeley's identification of the increase in commercial bank failures and the decline in bank capital ratios in the mid-1980s with increased competition seems compelling. But, it is not clear that the explanation is "moral hazard," that is, an increase in risk by equity holders seeking to maximize the value of their equity (given insured deposits). In the case of U.S. commercial banking, there was no exogenous shock that had the same detrimental effect on equity capital that occurred with thrifts. Competition increased in banking, and over a protracted period of time commercial banks failed. The question is: Who made the decision to engage risky investments, equity holders or bank managers?

Gorton and Rosen (1995) empirically analyze whether the risk-taking identified by Keeley is explained by shareholders making the decisions, i.e., moral hazard, or by managers. They look at the relationship between risk-taking and the ownership structure in banks. The banking environment of the late 1980s was not the usual environment. It was a competitive environment where opportunities were shrinking. In such an environment, managers may resist shrinking their banks through merger, acquisition, or directly by making fewer loans. But, equity value is not yet low. As charter values decline, shareholders prefer to exit the industry and redeploy their resources in investments with higher returns. But, to the extent that managers are entrenched, this could mean that their careers as bankers are over in many cases, as the industry is shrinking. In a shrinking industry, managers and equity holders have different incentives, and they are different than they would be in a growing industry.

Which group, managers or equity holders, make decisions depends sensitively on the relative sizes of the equity holdings of the managers versus the outside equity concentrations. At one extreme, the manager is the owner if he owns all the equity. At the other extreme, the manger may have no equity and face a large outside block holder who is in control. But, more likely combinations involve a manager with a small amount of equity in a bank where all the other shareholders are dispersed or there is a group of outside block holders. In these cases, a manager may not have enough equity to care as much about his pecuniary returns as he does about his private benefits of control, but his equity holding may be large enough for him to exert control. Because the other shareholders are dispersed, he is effectively entrenched and can attempt keep the size of his bank from decreasing in the shrinking industry. These issues mean that the sought after relationship is potentially nonlinear. This turns out to be very important empirically. Gorton and Rosen find that the managerial hypothesis is empirically more important than the moral hazard hypothesis, which can be rejected, in explaining risk-taking by banks.

The relations between managers' equity holdings and the ownership structure of the outside shareholders, i.e., the extent to which there are blocks, makes the relationship between control and risk taking potentially highly nonlinear. Gorton and Rosen use semiparametric methods to tests for the nonlinearities. Saunders, Strock, and Travlos (1990) estimate a linear relation between managerial stock holdings and the stock price volatility of their bank holding company over the period 1978-1985 and find a positive relation. Demsetz, Saidenberg, and Strahan (1997) use piecewise linear regression. They find that risk increases with the shareholdings of managers, but only for banks with relatively low charter value.The sample period is 1991-1995.

The structure of ownership and risk taking has also been investigated in the thrift industry. Cebenoyan, Cooperman, and Register (1995) analyze balance sheet measures of risk for samples of thrifts in 1988 and 1991. Independent variables include the holdings of insiders, and this variable squared, and a measure of the percentage of equity held by institutional investors. They find that "S&Ls with a high concentration of managerial stock ownership exhibit greater risk-taking behavior than other S&Ls in 1988, a period of regulatory leniency and forbearance on S&L closures, but lower risk-taking behavior in 1991, a period of regulatory stringency and nonforbearance" (p. 63). These results are confirmed in Cebenoyan, Cooperman, and Register (1999) over the period 1986 to 1995 with the same quadratic term included for insider holdings.

D. Bank Capital Requirements

Like deposit insurance, bank capital requirements, or at least, explicit capital requirements, are also a recent development. In the U.S., the Banking Act of 1933 required that bank regulators consider the "adequacy of the capital structure." In the 1950s, the Federal Reserve mandated capital levels on the basis of a formula based on amounts to be held against different asset categories. This was dropped in the 1970s. But it seems that no attempt was made to enforce explicit capital requirements until 1982 (see Morgan (1992), and Baer and McElravey (1992)). Risk-based capital requirements became effective in the U.S. in 1991 with the passage of Federal Deposit Insurance Corporation Improvement Act, which explicitly required regulators to enforce capital requirements. The Basle Accord, reached on July 12, 1988, was a regulatory agreement among the G-10 countries, together with Switzerland and Luxembourg, which specified risk-based capital requirements.

Intuitively, bank capital reduces the likelihood of bank failure. So, if banks are riskier than socially desirable, why not require that they hold more capital? What is the cost of such a policy? For nonfinancial firms equity finance is costly because of asymmetric information, the explanation developed by Myers and Majluf (1984). Wansley and Dhillon (1989) and Polonchek, Slovin, and Sushka (1989) find that the announcement of common stock issuances by commercial banks in the U.S. results in a significant negative stock price reaction, though the reaction is smaller, on average, than for industrial firms. This is somewhat surprising because banks are generally viewed as more opaque institutions than nonfinancial firms. Cornett and Tehranian (1994) may provide some of the answer. They document that the stock price reaction to a voluntary equity issuance is significantly more negative than those associated with an involuntary issuance taken to satisfy capital requirements.[57] But, these results do not address other issues concerning bank capital, to which we now turn.

The recent attention to bank capital requirements seems ironic, as Benveniste, Boyd, and Greenbaum (1991) point out. They observe that in the U.S. there has been a century-long secular decline in bank capital ratios, until about forty years ago. Prior to 1850 about 50% of bank assets were financed with capital. By the turn of the century the fraction financed by capital had shrunk to less than 20 percent. It was about 14 percent in 1929 and just over six percent at the end of World War II. Since then bank capital rose a small amount from the mid-1940s through the mid-1960s, then declined through the mid-1970s, and rose thereafter. In 1986, total capital was 6.8 percent, the same as it was in 1950. When first implemented, the Basle Accord called for a minimum capital of 7.25 percent of total assets by the end of 1990 (of which at lest half was to be "core capital") and at least 8.0 percent of assets by the end of 1992 (against with at least half in core capital).[58] During the late 1980 and through the 1990s U.S. bank holding companies increased their capital ratios to the highest levels in 50 years. See Saunders and Wilson (1999) and Flannery and Rangan (2001). However, the nation's largest banks lost about one fourth of their market capitalization in the third quarter of 1998, coinciding with the Russian crisis and the Long Term Capital Management debacle. Hovakimian and Kane (2000) argue empirically that neither the market nor regulators prevented large banks from shifting risk to the government deposit insurance safety net.

These trends raise a number of questions. Why was there such a long downward trend? Why has it been reversed? Why did regulators (and academics) start focusing on capital requirements? What are the trends in other countries? Most of these questions have not been studied. Benveniste, Boyd, and Greenbaum (1991) interpret bank charter value (monopoly rents) as a hidden source of capital that began to dissipate in the late 1970s and 1980s, as discussed above. Flannery and Rangan (2001) argue that the increase in capital ratios in the last fifteen years is due to market forces disciplining banks. This argument contrasts with earlier views that banks always held the minimum amount of required capital, and that increases in capital ratios imposed costs on banks, and possibly on borrowers through a "credit crunch."

If there are significant costs to raising bank capital, government-imposed capital requirements can have real effects. Banks may choose to exit the industry rather than satisfy the requirements. Such "exit"

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[57] Wagster (1996) studies the wealth effects to shareholders of stocks of banks in Canada, Germany, Japan, the Netherlands, Switzerland, the United Kingdom, and the United States due to announcements of eighteen important events leading up the Basle Accord, starting on September 11, 1985 and ending on March 28, 1990. The main result is that only shareholders of Japanese banks experienced significant wealth effects for all eighteen events. Moreover, the cumulative gain was a positive 31.63 percent.

[58] "Core capital" includes common equity and minority interests in consolidated subsidiaries, but excludes loan loss reserves.

may occur through a reduction in bank loans rather than a reduction in bank assets per se. In such an event, otherwise worthy borrowers would not obtain bank loans. There would be a "credit crunch" due to capital requirements. Shortly after the Basle Accord in 1988, U.S. banks reduced their investments in commercial loans and increased the investments in government securities. More specifically, the share of total bank assets composed of commercial and industrial loans fell from about 22.5 percent in 1989 to less than 16 percent in 1994. At the same time, the share of assets invested in government securities increased from just over 15 percent to almost 15 percent. See Keeton (1994) and Furfine (2001). This period has been identified as a "credit crunch," which refers to the possibility that banks were reluctant to lend to worthy loan applicants because of capital requirements.

In fact, the credit crunch, broadly outlined above, could be due to a number of nonmutually exclusive factors. Banks may have voluntarily and autonomously reduced their risk appetites. Regulators may have become tougher, causing the loan contraction. The Basle Accord, because of its risk-sensitive measures of capital, may have encouraged banks to reallocate their assets towards government securities. Finally, aside from the risk-sensitive nature of the capital requirements, the level of the required capital (to assets ratio) may have caused the reallocation. These factors are all supply-related. But, since there was a recession during the early 1990s, the decline in lending may have been demand-related. As noted above in Section III, a large empirical literature has searched for evidence of a supply-related credit crunch. The basic approach is to regress bank loan growth on measures of bank capital and control variables. Versions of this regression have been studied by Bernanke and Lown (1991), Hall (1993), Berger and Udell (1994), Haubrich and Wachtel (1993), Hancock and Wilcox (1994), Brinkman and Horvitz (1995), Peek and Rosengren (1995), and Beatty and Gron (2001). With different sample periods, slightly different econometric specifications, different definitions of capital adequacy, and so on, it is not surprising that the results are mixed. Other researchers have tested whether bank supervisors or regulators become tougher during recessions, causing or contributing to a credit crunch. See, for example, Bizer (1993), Wagster (1999), Furfine (2001), and Berger, Kyle, and Scalise (2001). Although there is some evidence that bank capital does affect bank lending, the studies have a difficult time distinguishing loan demand shifts from loan supply shifts, leaving the question of the relative importance of different effects unanswered.

While we discussed bank capital models generally above, there are other papers focusing on the effects of increasing regulatory capital on bank risk taking. Flannery (1989), Furlong and Keeley (1989, 1990), and Kim and Santomero (1988) are examples of partial equilibrium models that examine the relationship between bank leverage and risk-taking. Because these papers are partial equilibrium, the issue of whether there is anything peculiar about banks raising capital is not addressed. Gennotte and Pyle (1991) is more general equilibrium. Gorton and Winton (2000) present a general equilibrium of bank capital in which there is a social cost to increasing bank capital requirements, as well as a benefit. The benefits are clear; nontransferable charter value, which is also socially beneficial, is protected more with higher capital ratios. But, there is a unique cost to forcing banks to raise capital, namely, they can supply fewer deposits in general equilibrium. Deposits are in demand for the reasons put forth by Gorton and Pennacchi (1990); they provide a way for uniformed agents to transact. In this context, the government never imposes binding capital requirements because it is not socially optimal for bank equity holders to exit the industry, resulting in a smaller banking industry.

E. Other Issues

There are many other regulatory issues that have been studied. In this subsection, we mention a few of the more important or more interesting issues.

The Glass-Steagall Act, passed in the United States in the aftermath of the Great Depression, separated commercial banking from investment banking, ostensibly because of conflicts-of-interest in undertaking lending activity and underwriting activity. While this is no longer the case under current U.S. law (due to changes that culminated in the passage of the Financial Services Modernization Act of 1999), the question whether such separation is socially desirable remains of interest. If banks produce private information in their lending activity, might they have an incentive to only underwrite their poor-quality borrowers? Such questions have been addressed by Ang and Richardson (1994), Gande Puri, Saunders and Walter (1997), Krozner and Rajan (1994), Puri (1994, 1996), Gande, Puri, and Saunders (1999), Yasuda (1999), and Schenone (2001), among others. An open issue is the way in which these joint activities affect bank relationships with borrowers and borrower corporate governance.

Market discipline of banks refers to the extent to which market participants can determine when and which banks are riskier, and impound this information into asset prices. To the extent that market participants are better able to perform this role, there is less need for government oversight. A large literature has investigated this question. For example, Flannery and Sorescu (1996) consider the extent to which bank subordinated debt prices reflect the riskiness of banks. Berger, Davies, and Flannery (2000) compare the information in market security prices to the information produced by bank supervisors. See Flannery (2001) for a discussion.

Another interesting regulatory issue concerns the behavior of the regulators. Kane (1990) focuses on the incentives of regulators during the resolution of insolvent thrifts in the U.S. According to Kane, the Resolution Trust Corporation, the government agency charged with liquidating insolvent thrifts, was inefficient due to the agency problem of the government wanting to avoid recognizing losses that would be borne by the government insurance fund. Dell'Aricia and Marquez (2001) analyze competition among regulators when there are externalities across national markets. Competition can result in lower regulatory standards.

VI. Conclusion

We have surveyed the major themes and major developments in research in financial intermediation over the last two decades, or so. There are many related topics that we have not covered. For example, the roles of banks in economic growth, and the role of banks in the transmission of monetary policy, are large subjects that we have not touched on at all. Other topics have been only briefly examined. Nevertheless we hope the reader is convinced of the progress made in understanding financial intermediation. Despite this progress there are still major questions. Some of these are:

1. Why do banking crises and banking panics persist? Most theories of banking panics seem inconsistent with the facts put forth by economic historians. The view that banks are inherently unstable seems based on a misreading of U.S. financial history. Overall, it seems that the question of whether banking is inherently unstable or not remains unresolved.
2. Recent experience in emerging markets again raises the issue stability of banking systems. Why are emerging markets experiencing banking panics and crises? Are these crises fundamentally different than earlier historic episodes? Is the basic problem corruption, bad regulations, moral hazard, or some combination?
3. What features of the industrial organization of banking systems make the banks in the system more prone to panics? Are these features consistent with the usual model of competition? In other words, if a few large banks are not panic prone, are they prone to being monopolists?
4. On a related note, how does the industrial organization of the bank lending sector interact with banks' funding and capital structures? Empirically, how does bank funding structure affect the structure of the bank's loans and loan portfolio?
5. The basic paradigm of bank regulation, namely, moral hazard emanating from mispriced deposit insurance, may have outlived its usefulness, if it was ever relevant. It is clear that in the U.S. this has not been a problem since the inception of deposit insurance, nor has clear-cut evidence been produced for the existence of this problem. Corporate governance issues in intermediaries and the intersection of governance and alleged incentives for moral hazard have yet to be fully explored. What is the rationale for government intervention into banking markets?
6. Is corporate governance in banks fundamentally different than nonbanks?
7. Why are deposit insurance and capital requirements such recent developments, especially if their efficacy is as claimed?

8. The differences between loans and bonds seem clear, but questions remain. The existence of loan sales complicates the distinctions that have been made theoretically. The existence of vulture investors, who act like state-contingent banks, buying up blocks of bonds in distressed firms and then actively participating in restructuring, also complicates the distinction. Finally, despite the large literature on potential conflicts of interest, there has been little work on how bank lending and bank underwriting activities jointly affect the corporate governance of bank borrowers.
9. Our survey has focused on the traditional "bank-like" model of monitored finance. There are other forms of monitored finance, such as venture capital. What determines the choice between these different structures? Are these differences driven by the type of firm that seeks financing, or by financing structure of the intermediary?
10. Most models of banking assume that banks and borrowers are perfectly rational. How can insights from the growing field of behavioral finance change our understanding of banks? This question is only just starting to receive attention.[59]
11. Why are bank liabilities used as media of exchange, but not the liabilities of nonbanks? Why can't demand deposits be traded without being cleared through the banking system? These questions remain largely unexplored.
12. How have loan sales, credit derivatives, commercial paper conduits, collateralized loan obligations, and other recent financial innovations, affected banking?
13. Are banks and stock markets substitutes? Is there a meaningful distinction between of "bank-based" systems and "stock market-based" systems? What are the welfare implications of "bank-based" systems versus "stock market-based" systems?

[59] Manove and Padilla (1999) examine how the presence of overly-optimistic entrepreneurs complicates bank lending decisions; under competition, banks may be insufficiently conservative, reducing investment efficiency. Coval and Thakor (2001) show how rational agents may endogenously choose to become intermediaries between overly-optimistic agents, who become entrepreneurs, and overly-pessimistic agents, who become depositors.

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Table 1

Net Financing of Nonfinancial Enterprises, 1970-1985 (%)

	Canada	Finland	France	Germany	Italy	Japan	U.K.	U.S.
Retentions	76.4	64.4	61.4	70.9	51.9	57.9	102.4	85.9
Capital transfers	0.0	0.2	2.0	8.6	7.7	0.0	4.1	0.0
Short-term Securities	-0.8	3.7	-0.1	-0.1	-1.3	N.A.	1,7	0.4
Loans	15.2	28.1	37.3	12.1	27.7	50.4	7.6	24.4
Trade Credit	-4.4	-1.4	-0.6	-2.1	0.0	-11.2	-1.1	-1.4
Bonds	8.5	2.8	1.6	-1.0	1.6	2.1	-1.1	11.6
Shares	2.5	-0.1	6.3	0.6	8.2	4.6	-3.3	1.1
Other	1.3	7.4	-1.4	10.9	1.0	-3.8	3.2	-16.9
Statistical Adjustment	1.2	-5.0	-6.4	0.0	3.2	N.A.	-13.4	-5.1
Total	99.9	100.1	100.1	99.9	100.0	100.0	100.1	100.0

Source: Mayer (1990) based on OECD Financial Statistics. See Mayer (1990) for details.

Table 2

Stock Price Response to Announcements of Corporate Security Offerings

Type of Security Offering	Two Day Abnormal Return[+]
Common Stock	-3.14% (155)
Preferred Stock	-0.19% (28)
Convertible Preferred Stock	-1.44% * (53)
Straight Bonds	-0.26% (248)
Convertible Bonds	-2.07% * (73)
Private Placement of Debt	-91.0% (37)
Bank Loans	1.93% * (80)

+ Sample size in parentheses.

* Indicates significantly different from zero.

Source: Smith (1986) and James (1987).

Table 3

Banking Panics During the U.S. National Banking Era

NBER Cycle **Peak-Trough**	**Panic Date**	**% Change in the Currency-to-Deposits Ratio+**	**% Change in Pig Iron Production++**	**Loss Per Deposit $**	**% and # Nat'l Bank Failures**
Oct. 1873 - Mar. 1879	**Sept. 1873**	**14.53**	**-51.0**	**0.021**	**2.8 (56)**
Mar. 1882 - May 1885	**Jun. 1884**	**8.8**	**-14.0**	**0.008**	**0.9 (19)**
Mar. 1887 – Apr. 1888	**No Panic**	**3.0**	**-9.0**	**0.005**	**0.4 (12)**
Jul. 1890 – May 1891	**Nov. 1890**	**9.0**	**-34.0**	**0.001**	**0.4 (14)**
Jan. 1893 – Jun. 1894	**May 1893**	**16.0**	**-29.0**	**0.017**	**1.9 (74)**
Dec. 1895 – Jun. 1897	**Oct. 1896**	**14.3**	**-4.0**	**0.012**	**1.6 (60)**
Jun. 1899 – Dec. 1900	**No Panic**	**2.78**	**-6.7**	**0.001**	**0.3 (12)**
Se. 1902 – Aug. 1904	**No Panic**	**-4.13**	**-8.7**	**0.001**	**0.6 (28)**
May 1907 – Jun. 1908	**Oct. 1907**	**11.45**	**-46.5**	**0.001**	**0.3 (20)**
Jan. 1910 – Jan. 1912	**No Panic**	**-2.64**	**-21.7**	**0.0002**	**0.1 (10)**
Jan. 1913 – Dec. 1914	**Aug. 1914**	**10.39**	**-47.1**	**0.001**	**0.4 (28)**

+ Percentage change in the ratio at the panic date from the previous year's average.

++ Measured from peak to trough.

Source: Gorton (1988).

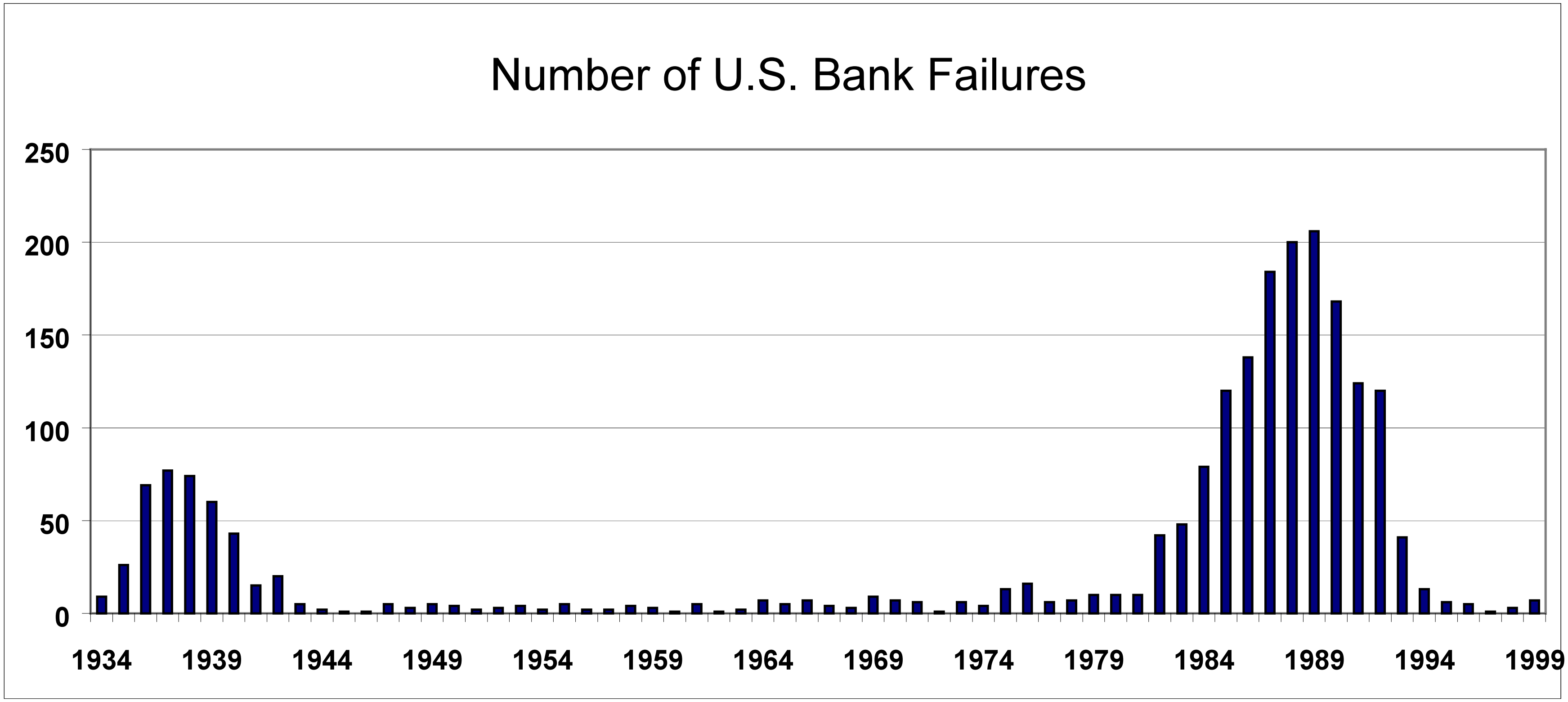
Table 4

Corporate Control Changes in Banks and Nonbanks
(Percent of total sample)

	Morck, Shleifer and Vishny Sample of 454 Manufacturing Firms	Prowse Sample of 234 Bank Holding Companies
Hostile Takeover	8.8	1.7
Management Turnover	20.5	10.2
Friendly Merger	7.5	10.7
Market-Based Control Changes	36.8	22.6
Regulatory Intervention	0	14.1
Total Control Changes	36.8	36.7

Source: Prowse (1995).

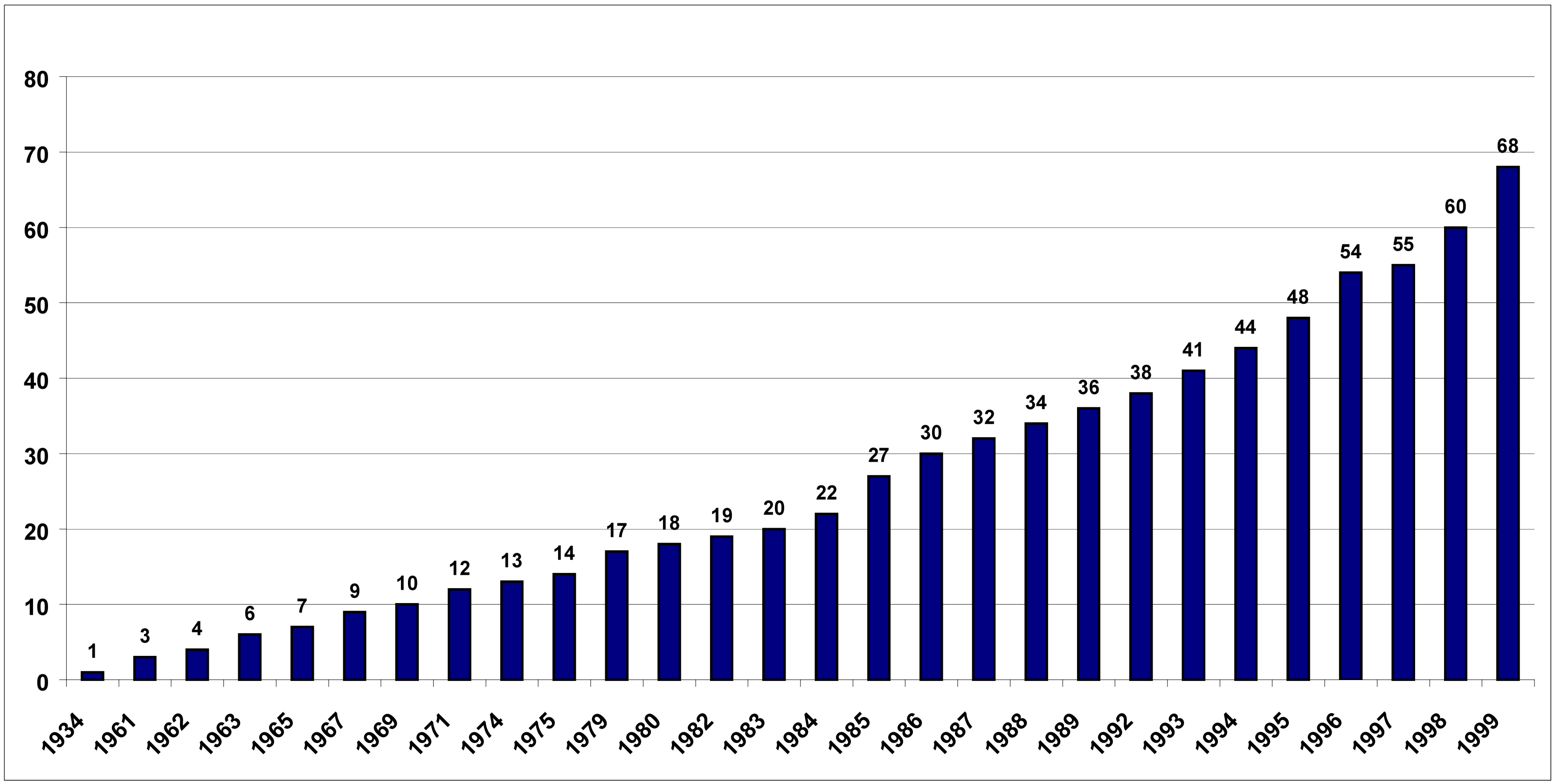
Figure 1



Source: FDIC.

Figure 2

Number of Explicit Deposit Insurance Schemes in the World



Source: Demirgüc-Kunt and Sobaci (2000).

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SOME EVIDENCE ON THE UNIQUENESS OF BANK LOANS*

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This paper presents evidence that banks provide some special service with their lending activity that is not available from other lenders. I find evidence that bank borrowers, not CD holders, bear the cost of reserve requirements on CDs. In addition, I find a positive stock price response to the announcement of new bank credit agreements that is larger than the stock price response associated with announcements of private placements or public straight debt offerings. Finally, I find significantly negative returns for announcements of private placements and straight debt issues used to repay bank loans.

1. Introduction

Although the economic rationale for commercial banks and other financial intermediaries is not well understood, recent theories of financial intermediation have focused on the role of banks in information production and transmittal [see, for example, Leland and Pyle (1977), Campbell and Kracaw (1980), and Diamond (1984)]. Banks and other intermediaries, the argument goes, have a cost advantage over other outsiders in producing and transferring information, either because of something intrinsic in the intermediation process, as Leland and Pyle and Diamond suggest, or because information production and the provision of transaction and other intermediary services are complementary activities. An implication of this view is that bank loans are different from publicly placed debt because banks know more about a company's prospects than other investors do.

The emphasis on information transmission contrasts sharply with an alternate hypothesis about the role of banks in the economy. The alternative holds that their special function is to provide transaction services through the issuance of demand deposits. On the asset side, banks are assumed to be simply passive portfolio managers [see Fama (1980)].

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This paper provides evidence on whether commercial banks provide any special service with their lending activity that is not available from other lenders (i.e., on whether bank loans are unique). This evidence comes first from an examination of the incidence of the reserve requirement tax, and second from an analysis of the stock price response to announcements of bank loans, private placements of debt, and public straight debt issues.

My first examination extends research by Fama (1985), who studies the incidence of reserve requirements on bank certificates of deposit (CDs). He argues that because close substitutes for bank CDs, such as commercial paper or bankers' acceptances, exist and because CDs provide no special transaction services, reserve requirements on CDs must be borne by bank borrowers. In support of this conjecture, Fama finds no significant differences between the average yields on CDs and on high-grade commercial paper or bankers' acceptances. Fama concludes that because bank borrowers bear the cost of reserve requirements there must be something special about bank loans that distinguishes them from other types of privately placed and publicly placed debt.

A problem with Fama's conclusion is that the reserve requirement tax could be at least partially offset by a subsidy from the Federal Deposit Insurance Corporation (FDIC) in the form of deposit insurance supplied at less than actuarially fair prices. A more powerful test of the incidence of the reserve tax, provided here, examines the behavior of CD rates around changes in reserve requirements, when no offsetting changes in deposit insurance prices occur. My results support Fama's conclusion that the reserve tax is borne by bank borrowers.

A second source of evidence on the uniqueness of bank loans comes from a comparison of stock price responses to the announcements of bank loan agreements and other types of debt offerings. In analyzing the function of commercial banks, Kane and Malkiel (1965) and more recently Fama (1985) and Bernanke (1984), argue that bank loans are a form of inside debt, because banks have information about the borrower that is not available to other securities holders. As inside debt, bank loans are a way of avoiding the underinvestment problem associated with information asymmetries. Specifically, in the context of the Myers and Majluf model (1984), loans by banks (as inside debt) are similar to financial slack (internally generated funds). One testable implication of the bank-debt-as-inside-debt hypothesis is that because bank loans avoid the information asymmetries associated with public debt offerings, a non-negative stock price response will be associated with their announcement. For similar reasons, if private placements acquired by insurance companies are also inside debt, a non-negative stock price response is expected.

I examine the stock price response to publicly announced bank credit agreements, private placements, and publicly placed straight debt issues.

Abnormal performance is positive and statistically significant for bank loan announcements and nonpositive for publicly placed straight debt issues. These results are similar to those reported by Mikkelson and Partch (1986). Surprisingly, a negative and statistically significant stock price response is observed for debt placed privately with insurance companies. Most notably, I find a negative stock price response for private placements and straight debt issues used to repay bank loans. These results suggest that bank loans are unique, but they are not fully consistent with the inside-debt argument, as I discuss below.

The remainder of the paper is organized into five sections. In section 2, I analyze the incidence of the reserve requirement tax. In section 3, I describe my sample of bank credit agreements and debt offerings. The stock price effects associated with these borrowing arrangements are examined in section 4. In section 5, several explanations for the observed stock price behavior are explored. A brief conclusion is provided in section 6.

2. Incidence of the reserve requirement

The current reserve requirement on short-term CDs with original maturity of less than 180 days is 3%. In the absence of any special service provided to bank borrowers *or* any special service to CD holders, a reserve requirement tax would result in the elimination of CD financing. In a competitive deposit market other depositors (non-CD holders) will not bear the tax, because if a bank attempted to shift the tax to them, other banks not issuing CDs would bid them away. Bank stockholders cannot be expected to pay the tax because non-bank lenders (who are not subject to the reserve tax) would have a higher risk-adjusted return.

Fama (1985) argues that CD holders do not bear the reserve requirement tax and that therefore bank loans are special. This conclusion is based on his finding no significant difference between the yield on CDs and the yields on commercial paper and bankers' acceptances. Fama's evidence is not fully convincing, for two reasons. First, the reserve tax could be borne not by borrowers but by the FDIC through the provision of deposit insurance at less than actuarially fair prices. Second, CDs are insured only to $100,000, whereas the typical denomination is $1 million, so their rates may contain a default premium. If the default risk on CDs is greater than for commercial paper, observed yields on the two securities may be identical even though CD owners pay the reserve tax.

An alternative method of examining the incidence of the reserve tax is to examine the behavior of CD yields in relation to the yields on other money market instruments around changes in reserve requirements. Without any contemporaneous change in insurance costs, an increase in reserve require-

Table 1

Average annual yields to maturity on high-grade certificates of deposit, commercial paper, and Treasury bills and yield spreads (January 1977 to December 1984, sample size = 471).[a]

Panel A: Average annual yields (weekly data)

Instrument	3% reserve requirement period Jan. 1977–Nov. 1978 July 1980–Dec. 1984	5% reserve requirement period Nov. 1978–July 1980
90-day CDs	10.67	11.89
30-day CDs	10.52	11.59
90-day commercial paper	10.59	11.83
30-day commercial paper	10.40	11.51
90-day Treasury bills	9.74	10.66
30-day Treasury bills	9.11	10.01

Panel B: Average annual yield spread (in percent) between CDs and other money market instruments (standard errors in parentheses)

Spread[b]	3% reserve requirement period Jan. 1977–Nov. 1978 July 1980–Dec. 1984	5% reserve requirement period Nov. 1978–July 1980	Entire sample period
$SPCDTB_{90}$	0.931	1.211	0.992
	(0.04)	(0.07)	(0.03)
$SPCDTB_{30}$	1.412	1.581	1.455
	(0.05)	(0.09)	(0.04)
$SPCDCP_{90}$	0.073	0.038	0.065
	(0.01)	(0.02)	(0.01)
$SPCDCP_{30}$	0.117	0.078	0.110
	(0.01)	(0.02)	(0.01)

[a] Yields are based on weekly (Friday close) price quotes from the traders at Bank of America for high-grade CDs and for dealer-placed commercial paper rated A1–P1. All data were obtained from Data Resources Inc. DRI-FACS file.

[b] $SPCDTB_{90}$ = average annual yield spread between 90-day CDs and 90-day Treasury bills,
$SPCDTB_{30}$ = average annual yield spread between 30-day CDs and 30-day Treasury bills,
$SPCDCP_{90}$ = average annual yield spread between 90-day CDs and 90-day commercial paper,
$SPCDCP_{30}$ = average annual yield spread between 30-day CDs and 30-day commercial paper.

ments should reduce the yield on CDs in relation to other yields if depositors pay the reserve tax.

Changes in the reserve requirements applied to CDs during the 1978–1980 period provide an opportunity to examine the incidence of the reserve tax. Effective November 2, 1978, and continuing through July 24, 1980, the Federal Reserve imposed a supplemental reserve requirement of 2% on all CDs in excess of \$100,000. In addition, during this period, marginal reserve requirements of from 5% to 10% were imposed on CDs in excess of a base amount.[1]

[1] See table A7 of the *Federal Reserve Bulletin* for a list of reserve requirements.

The effect of these changes was to raise the reserve requirement on all large CDs from 3% to 5% and as high as 15% for CDs issued in excess of the base amount.

To examine the effect of these changes and the incidence of the reserve tax, I obtained weekly secondary market price quotes and computed yields for thirty- and ninety-day high-grade CDs, commercial paper, and Treasury bills. These data were obtained from Data Resources, Inc. (DRI), for the period January 1, 1977 to January 1, 1985.

Table 1 presents the average annual yield on CDs, commercial paper, and Treasury bills during the period in which a 3% reserve requirement was effective and the period in which a minimum 5% reserve requirement was imposed. Table 1 also contains the average spreads between CDs and other money market instruments for the 1977–1984 period. I find no statistically significant difference in the average spread between CDs and commercial paper or Treasury bills during the two periods. Assuming a competitive banking industry, the evidence presented in table 1 supports Fama's conclusion that bank borrowers and not CD holders bear the reserve tax.

3. Description of the sample and methodology

3.1. Random sample of firms

I am not aware of any source that provides information by company on new bank loan agreements. To obtain a sample of these financing events, I selected 300 companies at random from the population of firms contained in the 1983 Center for Research on Security Prices (CRSP) daily return file that were listed on the first trading day in 1974. I included companies in the sample if they were listed in the *Moody's Industrial, Transportation*, or *Utilities* manuals. (Excluded from the sample were financial companies.) I then searched the *Wall Street Journal Index* for information on each firm over the ten-year period 1974–1983 to identify all public straight debt offerings for cash, private placements of debt, and bank borrowing agreements that did not coincide with other financing, dividend, or earnings announcements.

The bank loan agreements in the sample consist of new credit agreements and the expansion of existing agreements. They include both extensions of lines of credit (commitments to lend) and term loans. The typical agreement, however, involves a line of credit where, at the firm's option, borrowing can be converted into a term loan.

Privately placed debt agreements consist of debt sold for cash to a restricted number of institutional investors. Most (approximately 70%) of the agreements involve an insurance company as the lender.

The total sample consists of 207 financing announcements. There are eighty announcements of bank loan agreements, thirty-seven announcements of

Table 2

Distribution by year of announcements of bank credit agreements, privately placed debt, and publicly placed straight debt for a random sample of 300 NYSE- and AMEX-traded non-financial firms (1974–1983).

Year of announcement	Bank loan agreements	Privately placed debt	Public straight debt
1974	9	4	5
1975	11	7	13
1976	7	7	8
1977	8	7	4
1978	1	8	6
1979	8	1	9
1980	11	1	10
1981	9	1	9
1982	10	1	16
1983	6	0	10
Total	80	37	90

private placements, and ninety announcements of public straight debt offerings. Table 2 presents the distribution of announcements by type of event by year for the period 1974–1983. Although there is no discernible time pattern for the number of bank loan or straight debt announcements, the number of private placement announcements decreases substantially after 1978.[2]

3.2. *Descriptive statistics*

Table 3 contains summary statistics for the debt offerings in my sample. Row 1 contains the amount of each type of offering. As table 3 indicates, public debt offerings are larger on average than private offerings. For bank loan agreements and private placements, the loan amounts reported may overstate the amount actually borrowed by the firm. In many cases these are commitments to lend, and the entries in row 1 of table 3 are based on the amount of the commitment.[3]

[2] The number and dollar volume of privately placed debt is reported in the *Investment Dealer's Digest*. The dollar value (in millions) and number of privately placed bond issues during the period are:

	1974	1975	1976	1977	1978
Dollar value	$8,214	11,856	17,811	21,797	18,511
Number of issues	696	685	717	1,017	900

	1979	1980	1981	1982	1983
Dollar value	15,270	10,750	10,860	10,397	10,360
Number of issues	786	640	556	531	525

[3] Private placements have many of the same features as bank loan agreements. The borrower is typically given an option to borrow up to some prespecified amount over a period of one to five years. See Zinbarg (1975).

Table 3

Descriptive statistics for commercial bank loans, privately placed debt, and publicly placed straight debt for a random sample of 300 NYSE- and AMEX-traded non-financial firms (1974–1983).[a]

	Type of borrowing					
	Commercial bank loans (sample size = 80)		Privately placed debt (sample size = 37)		Public straight debt (sample size = 90)	
Descriptive measure	Mean	Median (Range)	Mean	Median (Range)	Mean	Median (Range)
Debt amount (millions of dollars)	72.0	35.0	32.3	25.0	106.2	75.0
	(4–800)		(5–120)		(10–1,000)	
Firm size (millions of dollars)[b]	675	212	630	147	2,506	1,310
	(28.6–10,311)		(20.2–6,365)		(47–59,540)	
Debt amount/market value of common stock	0.72	0.46	0.52	0.25	0.26	0.15
	(0.04–2.6)		(0.04–2.6)		(0.02–1.5)	
Maturity of debt (years)[c]	5.6	6.0	15.34	15.0	17.96	20.0
	(0.6–12)		(3–25)		(1–40)	
Number of firms	52		34		43	
Number of firms with publicly traded debt outstanding[d]	25		16		30	

[a] Statistics given in the first row are the mean followed by the median. The range is provided in the second row.

[b] Firm size is for December 31 of the year immediately preceding the security offering or borrowing. Firm size equals the book value of all liabilities and preferred stock plus the market value of common stock outstanding. The market value of common stock is the product of the number of shares outstanding and the closing price per share at year-end preceding the announcement. Closing prices are from the *Security Owners Stock Guide*. The book value of liabilities and the number of shares outstanding are from *Moody's* manuals.

[c] Maturity of the loan or debt offering is from the *Wall Street Journal* article. No information on maturity was provided for twenty-four bank loans, two private placements, and nine straight debt offerings. For bank loans that are convertible to term loans, the maturity of the term loan is used.

[d] Firms are classified as having publicly traded debt if the *Moody's* manual report the firm had rated debt outstanding at year-end preceding the financing announcement.

Firms using private placements and bank loans are on average smaller than firms using public offerings of straight debt. The average firm size in both the bank loan sample and the private placement sample is about 25% of the average firm size in the straight debt sample. This finding is consistent with Brealey and Myers's (1985) view that private placements and bank loans typically involve small and medium-sized companies.

Row 4 of table 3 presents the average maturity of each type of borrowing. Bank loans are of considerably shorter maturity than either privately placed debt or straight debt. Indeed, the longest-term bank loan is twelve years, less than the median maturity of either privately placed or publicly placed debt.

3.3. Methodology

The market model is used to obtain estimates of abnormal stock returns around the announcement of the financing events. The announcement is defined as the date of the first report of the borrowing agreement or debt offering in the *Wall Street Journal*. The market model was estimated on daily returns for the period that begins 120 trading days before and ends 120 trading days following the announcement (event) date, excluding 41 trading days centered around the event date. The abnormal stock return or prediction error for firm j over day t is defined as

$$PE_{jt} = R_{jt} - \left(\hat{\alpha}_j + \hat{\beta}_j R_{mt}\right),$$

where R_{jt} is the rate of return of security j over period t, R_{mt} is the rate of return on the CRSP equal-weighted market index over period t, and $\hat{\alpha}_j$ and $\hat{\beta}_j$, are ordinary least squares estimates of firm j's market model parameters.

The daily prediction errors are averaged over all firms within a particular group to produce a daily portfolio average prediction error:

$$APE_t = 1/N \sum_{j=1}^{N} PE_{jt},$$

where N is the number of firms in the sample. I calculate a two-day announcement period abnormal return by summing the prediction errors for day -1 and day 0. This procedure incorporates the possibility that the announcement may have been made during trading hours the previous day and reported with a one-day lag.

Tests of statistical significance of the average prediction errors are based on standardized prediction errors. The two-day standardized prediction error for firm j is defined as

$$SPE_j = \sum_{t=-1}^{0} PE_{jt}/S_j,$$

where

$$S_j = \left[2V_j^2\left[1 + \frac{1}{M} + \frac{(R_{mt} - R_m)^2}{\sum_{i=1}^{M}(R_{mi} - R_m)^2}\right]\right]^{1/2},$$

and V_j^2 is the residual variance of the market model regression for firm j, M is the number of days in the estimation period (199), and R_m is the mean market return over the estimation period.

Table 4

Average two-day percentage prediction errors (APE) on the announcement of commercial bank loans, privately placed debt, and publicly placed straight debt offerings for a random sample of 300 NYSE- and AMEX-traded non-financial firms (1974–1983).

Type of event	APE	Z-value[a]	Proportion negative[b] (sample size)
Bank loan agreement	1.93%	3.96	0.34[d] (80)
Private placement	−0.91%	−1.87	0.56 (37)
Public straight debt	−0.11%	−0.40	0.56 (90)
Bank loan agreement borrowing indicated[c]	1.71%	3.20	0.35[d] (71)
Bank loan agreement no borrowing indicated[d]	3.68%	1.71	0.23[e] (9)

[a] The null hypothesis is that the average standardized prediction error equals zero. $Z = \sqrt{N}(ASPE_t)$, where $ASPE_t$ is the average standardized prediction error and N is the number of firms in the sample.
[b] The null hypothesis is that the proportion of negative prediction errors equals 0.5. The test statistic is a Wilcoxon signed ranks statistic.
[c] Loan agreements in which the *Wall Street Journal* article describing the agreement indicates borrowing has occurred or is expected to occur under the loan agreement.
[d] Sign test statistic is significant at 0.05 level.
[e] Sign test statistic is significant at 0.01 level.

The average standardized prediction error is

$$ASPE_t = \frac{1}{N} \sum_{j=1}^{N} SPE_{jt}.$$

Assuming the individual prediction errors are cross-sectionally independent, the following Z-statistic can be computed:

$$Z = \sqrt{N}(ASPE_t),$$

which is asymptotically distributed unit normal under the hypothesis that the average standardized prediction error equals zero.

4. Stock price response to borrowing arrangements

Table 4 reports the average stock price response to the announcement of bank loan agreements, private placements, and public straight debt offerings. The average prediction error for bank loan agreements is positive and statistically significant at the 0.01 level. In addition, 66% of the prediction errors are positive.[4] There is no statistically significant difference between announcements of bank loan agreements in which immediate borrowing is indicated and announcements in which no immediate borrowing is indicated.

The positive stock price response to bank loan agreements contrasts with the non-positive response to public offerings of securities reported by other researchers.[5] As table 4 indicates, I also find a non-positive stock price response associated with the announcement of a public offering of straight debt. The average two-day prediction error associated with straight debt offerings is -0.11 percent, not statistically different from zero at the 0.10 level.

If the positive response to bank loan agreements is the result of some benefit from the intermediation process, but a benefit not unique to commercial banks, one would expect to observe a similar response to debt placed privately with insurance companies. As table 4 indicates, however, the average two-day prediction error associated with the announcement of privately placed debt is -0.91 percent, which is significantly different from zero at the 10% level (p-value of 0.063). Moreover, the difference between the average prediction error of bank loan agreements and of privately placed debt agreements is statistically significant at the 0.01 level.

5. Interpretation of the average stock price response

The difference in abnormal performance among announcements of bank loans, private placements, and straight debt offerings may arise because these debt offerings (or the borrowers using them) differ systematically in some important feature, such as the maturity of the issue or the purpose of the borrowing, that is unrelated to the identity of the lender. Alternatively, bank loans may differ from other types of borrowing because banks provide some special service with their lending activity. A testable implication of the second explanation is that the share price response to the announcement of bank loans will differ from the share price response to announcements of private placements or public debt offerings with characteristics similar to commercial bank loans.

In this section I examine the share price response associated with announcements of bank loans, private placements, and straight debt offerings grouped by stated purpose of the borrowing, the maturity of the offering, the default risk of the borrower, and the size of the borrower.

[4] Mikkelson and Partch (1986) also report a positive and statistically significant response to the announcement of bank credit agreements. They, however, focus on public securities offerings and do not explore differences in the stock price response associated with bank loan agreements and private placements.

[5] See Dann and Mikkelson (1984), Mikkelson and Partch (1986), Eckbo (1986), Asquith and Mullins (1986), and Masulis and Korwar (1986).

Table 5

Average two-day prediction errors (*APE*) on the announcement of commercial bank loans, privately placed debt, and publicly placed straight debt offerings grouped by stated purpose of the borrowing for a random sample of 300 NYSE- and AMEX-traded non-financial firms (1974–1983).

	Type of borrowing								
	Bank loan agreements[a] (sample size = 80)			Private placements (sample size = 37)			Public straight debt (sample size = 90)		
	APE (*Z*-value)[b]	Sample size	Average maturity[c]	*APE* (*Z*-value)	Sample size	Average maturity	*APE* (*Z*-value)	Sample size	Average maturity
Repay debt	1.14% (1.64)	17	6.5	0.51% (0.69)	5	14.2	−0.35% (−0.43)	32	17.4
Capital expenditure	1.20% (1.05)	24	5.9	−0.23% (0.02)	5	16.6	0.55% (1.63)	34	18.9
General corporate purposes	4.67% (2.54)	8	4.6	0.26% (0.31)	9	17.1	0.07% (0.24)	9	17.1
Repay bank loans	3.10% (2.35)	11	5.8	−2.07%[d] (−3.18)	18	14.4	−1.63%[e] (−1.74)	12	18.4
No purpose given	1.74% (1.79)	20	4.7	—	—	—	0.69% (0.73)	3	14.0

[a]Stated purpose is the primary purpose given in the *Wall Street Journal* article describing the borrowing. In cases in which multiple purposes are given, the first purpose listed is used to classify the event.

[b]The null hypothesis is that the average standardized prediction error equals zero. $Z = \sqrt{N}(ASPE_i)$, where $ASPE_i$ is the average standardized prediction error and N is the number of firms in the sample.

[c]Maturity of the loan or debt offering is from the *Wall Street Journal* article describing the offering. Maturity is in years.

[d]The return is significantly different, at the 0.01 significance level, from the average prediction error for the sample of other private placements for which the stated purpose is other than repaying bank loans.

[e]This return is significantly different, at the 0.05 level, from the average prediction error for the sample of other straight debt issues for which the stated purpose is other than repaying bank loans.

5.1. Analysis of borrowing agreements by stated purpose

One explanation for the positive abnormal performance associated with bank loan agreements is based on the asymmetric information model of Myers and Majluf (1984). Bank loans may serve as a form of inside debt if banks have inside information about the value of the firm's growth prospects and bank loan rates reflect this information. Myers's and Majluf's model pertains to new financing, however, and offers no prediction about borrowing for other purposes. Examining the stock price response to bank loans grouped by stated purpose provides one test of the inside-debt hypothesis.

All borrowing announcements are placed into one of five purpose categories: (1) refinance debt, (2) capital expenditures, (3) general corporate purposes, (4) repayment of bank loans, and (5) no purpose given. The classification by purpose is based on information contained in the *Wall Street Journal* article describing the announcement. Where several purposes are stated, borrowing is classified by the first purpose listed or, where indicated, the primary purpose of the borrowing.

The average two-day prediction errors for bank loans, private placements, and straight debt offerings grouped by purpose are presented in table 5. Table 5 also includes the average maturity of each type of borrowing. The average prediction errors for bank loans are positive for all stated purposes, although general corporate purposes and the repayment or refinancing of bank debt are the only two categories in which the average prediction errors are statistically different from zero at the 0.01 level. There are, however, no significant differences (at the 0.10 level) between the mean returns for bank loans classified by purpose.

In only one category, the repayment of bank loans, is the average prediction error for private placements significantly different from zero. The average prediction error for this category is negative and appears to be the major component of the negative average prediction error associated with private placements reported in table 4. Moreover, the average prediction error for private placements used to repay bank loans is statistically different (at the 0.01 significance level) from that of private placements used for other purposes.

In the sample of straight debt offerings, only the repayment of bank loans category has an average prediction error significantly different from zero at the 0.10 level. The average two-day prediction error is -1.63 percent (p-value = 0.08).

Two findings in this section are of particular interest. First, there is no significant difference between the share price response to bank loans used to refinance debt (either existing bank loans or other debt offerings) and bank loans used for capital expenditures. The same conclusion is reached if the capital expenditures and general corporate purpose categories are combined. Therefore, the positive average abnormal returns associated with the announcement of new bank loans cannot be attributed solely to avoidance of information asymmetries associated with *new* investments. The second finding is the statistically significant decrease in share price for privately placed debt and straight debt used to refinance bank loans. This result is curious; why do managers use private placements to refinance bank loans, given the adverse share price reaction? One possible explanation is the difference in maturity between bank loans, private placements, and public debt offerings. This issue is explored in the next section.

5.2. Analysis of borrowing arrangements by maturity of the offers

The difference in average abnormal performance among borrowing arrangements may be attributed to differences in the average maturity of the issue. As table 3 indicates, bank loans have a shorter average maturity than do private placements and straight debt offerings in the sample.

Maturity of the debt issue may be important in explaining the differences in abnormal performance for several reasons. First, as suggested by Merton (1974) and Ho and Singer (1982), short-term debt may be less risky than long-term debt. In particular, Ho and Singer demonstrate that holding the market value of debt constant, an increase in the time to maturity of the debt will increase the elasticity of the value of the bond with respect to the value of the firm.[6] Myers and Majluf (1984) predict that the stock price response to the announcement of a new security issue depends on the sensitivity of the value of new securities to changes in firm value. This implies that the absolute value of the stock price response to the announcement of a debt offering should increase with the time to maturity of the offering.

Flannery (1986) provides a second reason for the importance of maturity. He argues that a firm's choice of maturity can provide a signal about management's assessment of earnings prospects. Flannery shows that, with transactions costs associated with new debt issues, managers who believe their firm is undervalued by outsiders can signal the true value of the firm by issuing short-term debt (i.e., debt repayable before cash flows are realized). When the undervalued firm's true prospects are revealed, refunding occurs at a lower default risk premium. Overvalued firms, on the other hand, find a short-term debt strategy more expensive because any initial cost savings from issuing short-term debt are more than offset by higher transaction costs of refinancing and higher subsequent refinancing costs (in terms of a higher default risk premium).

[6] With a discount bond, to maintain a constant market value of debt as its maturity increases the promised terminal payment to debt holders must also increase. In addition, note that the elasticity of risky debt equals the weighted average of the elasticity of equity for the unlevered firm and the elasticity of riskless debt (which is zero). An increase in the maturity of debt makes the expected payoff characteristics of debt more similar to those of equity (by raising the terminal payment) and therefore increases the elasticity of debt.

Easterbrook (1984) and Fama (1985) provide a third reason why maturity might matter. Both authors focus on the agency costs of monitoring managers. Easterbrook argues that the costs of monitoring are lower if the firm is frequently in the market for new capital.[7] The issuance of new securities triggers a review of the firm's earnings prospects by intermediaries (investment bankers and commercial banks). These intermediaries send reliable signals to existing as well as new claimants on the firm about the firm's ability to meet fixed-pay-off contracts. The intermediaries send reliable signals by bonding performance, directly through their own investment or indirectly through the value of their reputation. Fama (1985, p. 36) argues that bank loans avoid duplication of information costs:

> Bank loans usually stand last or close to last in the line of priority among contracts that promise fixed pay-offs. Bank loans are short-term and the renewal process triggers periodic evaluation of the organization's ability to meet low-priority fixed pay-off contracts. Positive renewal signals from bank loans mean that other agents with higher fixed pay-off claims need not undertake similar costly evaluations of their claims.

A firm's decision to commit to periodic evaluations can therefore provide a positive signal of management's assessment of the firm's earnings prospects.

The hypothesis that the positive share price response associated with bank loan announcements is due *solely* to the shorter maturity of bank loans I call the *maturity hypothesis*. If the difference in abnormal performance is due solely to the shorter maturity of bank loans, one would expect to observe a positive share price response for public straight debt offerings and private placements with maturities similar to those of bank loans.

The maturity hypothesis is not necessarily inconsistent with the hypothesis that banks provide some special service to borrowers. For example, Black (1975), Fama (1985), and Kane and Malkiel (1965) argue that banks have a cost advantage in making loans to depositors. The inside information provided by a continuing deposit history is particularly valuable, they argue, in making and monitoring repeating short-term loans. This argument explains why banks may have lower costs to originate short-term repeating loans but does not explain why firms use private placements or publicly placed long-term debt to refinance bank loans. If a continuing relationship between the bank and its loan customers results in lower costs of refinancing, banks also should have a comparative advantage in making long-term loans to these customers. There-

[7] Rozeff (1982) presents a similar argument in his analysis of the determinants of dividend payout ratios. He argues that dividend payments are a device that reduces the agency cost of equity by requiring the firm to acquire external funds more frequently. The suppliers of new funds require the firm to supply new information about the firm's earnings prospects. The agency cost savings from higher dividend payments are offset by higher transactions costs associated with new financing. These two opposing influences produce an optimum dividend payout ratio.

fore, although a change in a firm's earnings prospects may result in a shift in its maturity preference, it is not clear why this action also results in a change in the intermediary used (e.g., from banks to insurance companies). One explanation is that banks are constrained from making long-term loans.[8] This constraint could arise from regulatory pressure or a preference by banks for matching the maturity of their assets with the maturity of their liabilities.[9]

To test the maturity hypothesis, I divided the straight debt and private placement announcements into two groups, one consisting of offerings with a maturity of less than ten years and a second consisting of offerings with a maturity of ten years or more. I then analyzed the stock price response to borrowing announcements in the two groups.

My results are reported in table 6. Although the average prediction errors are larger for short-term offerings than for longer-term borrowing, the difference in average returns is not statistically significant. As an additional test of the maturity hypothesis I estimated the relation between the two-day prediction error and the maturity of the offering for each type of borrowing arrangement, using weighted least squares. The weights used in the regression analysis are the reciprocal of the standard error of each firm's abnormal returns. My results reveal no statistically significant relation between the share price response to the announcement of the offering and the maturity of the offering. These results, together with those reported in table 6, are inconsistent with the maturity hypothesis.

5.3. Other explanations

The other potential explanations for the differences in abnormal performance among borrowing arrangements are: differences in the risk of the debt issued, differences in the size of borrowing firms, and differences in the size of debt offering in relation to the size of borrowing firm. Smith and Warner (1977) argue that private placements contain more detailed restrictive covenants and are more likely to be used by riskier firms than is publicly placed debt. Differences in default risk may explain the differences in abnormal returns that I find. Alternatively, abnormal performance may be related to firm size. The announced ability to borrow may be good news for small firms (which borrow primarily from banks), but not much news at all for large firms (which

[8]The presence of a supply constraint is suggested by the lack of activity in the long-term commercial loan market. In my sample, only one bank loan has a maturity of more than ten years. The Federal Reserve Board's *Survey of the Terms of Bank Lending* indicates banks specialize in short-term loans. The survey for August 1985 indicates only 12% of commercial loans made have maturities of more than one year. These loans have an average maturity of four years.

[9]Although no federal regulations limit the maturity of commercial loans, a factor used in bank examinations to determine asset quality and capital requirements is the maturity mismatch of a bank's assets and liabilities. See Spong (1985).

Table 6

Average two-day percentage prediction errors (APE) on the announcement of private placements and straight debt offerings classified by maturity for a random sample of 300 NYSE- and AMEX-traded non-financial firms (1974–1983).

Type of event	APE	Z-value[a]	Sample size	Average maturity[b]
Straight debt, maturity less than 10 years	0.766%	1.625[c]	25	5.4 years
Straight debt, maturity greater than 10 years	−0.441%	−0.537	57	21 years
Private placements, maturity less than 10 years	−0.232%	−0.193	5	5.6 years
Private placements, maturity greater than 10 years	−1.011%	−2.002	32	17 years

[a]The null hypothesis is that the average standardized prediction error equals zero. $Z = \sqrt{N}(ASPE_t)$, where $ASPE_t$ is the average standardized prediction error and N is the number of firms in the sample.

[b]Maturity of the loan or debt offering is from the *Wall Street Journal* article describing the offering.

[c]Significantly different (at the 0.10 level) from the APE for straight debt issues with maturity greater than ten years at the 0.10 level.

use publicly placed debt) that have other ways of disseminating information. Bank borrowing may therefore be simply a proxy for firm size. Finally, the relative size of the offering may be an important determinant of the stock price response if it serves as a proxy for changes in leverage.

As a proxy for the default risk of the borrower, I obtained for each firm the rating of its most recently issued debt prior to each announcement in my sample. Debt ratings are from the *Moody's* manual. Panel A in table 7 provides the proportion of firms with debt outstanding in three rating categories: AA or better, A, and BAA and below. The proportion of firms in each rating category, as well as the proportion of firms with rated debt is similar for the private placement and bank loan samples. A higher proportion of the straight debt offerings is in the AA or better and A rated categories. If the rating of outstanding debt provides a proxy for default risk, firms announcing new bank loans and private placements have a higher default risk than those announcing straight debt offerings.

Myers and Majluf (1984) predict that abnormal performance is related to the sensitivity of the value of the securities issued to changes in the firm value. Default risk can affect the sensitivity. Panel B of table 7 provides two-day average prediction errors for each type of borrowing grouped by rating. For each type of borrowing arrangement, the abnormal returns are larger the higher the debt rating. This result is consistent with the prediction of Myers's and Majluf's model. The results in table 7 are *not* consistent, however, with the hypothesis that differences in default risk explain the difference in stock price

Table 7

Debt ratings for a random sample of 300 NYSE- and AMEX-traded non-financial firms announcing bank loan agreements, private placements, and straight debt offerings (1974–1983), and average two-day percentage prediction errors for firms grouped by rating of outstanding debt.

Panel A: Debt rating[a]

Type of event	Proportion of firms rated AA or better[b]	Proportion of firms rated A	Proportion of firms rated BAA or below	Proportion of firms with rated debt
Bank loan agreements	0.12 (5)	0.10 (4)	0.78 (25)	0.48 (34)
Private placements	0.12 (2)	0.20 (3)	0.68 (11)	0.47 (16)
Public straight debt offerings	0.31 (20)	0.41 (27)	0.28 (18)	0.69 (65)

Panel B: Average two-day prediction errors by debt rating[c]

	Rated A or better	Rated BAA or below	Not rated
Bank loan agreements	3.89% (2.82)	1.77% (1.92)	1.76% (2.184)
Private placements	1.18% (1.68)	0.30% (0.211)	−2.03% (−2.90)
Public straight debt offerings	0.40% (1.72)	−0.32% (−1.42)	−1.08% (−1.45)

[a] Rating refers to the bond rating of the most recently issued debt prior to announcement. Ratings were obtained from *Moody's* manuals.

[b] Sample size is in parentheses.

[c] Z-value in parentheses; the null hypothesis is that the average standardized prediction error equals zero. $Z = \sqrt{N}\,(ASPE_t)$, where $ASPE_t$ is the average standardized prediction error and N is the number of firms in the sample.

response to different types of borrowing agreements. The proportion of firms in each rating category is similar for bank loans and private placements, but the abnormal return associated with bank loans is positive (on average and in each rating category), whereas the abnormal return for private placements is negative.

As table 3 indicates, firms in the bank loan sample are smaller than firms in the straight debt sample. To determine whether differences in firm size can explain differences in abnormal performance I estimate the following cross-sectional equation:

$$STRET_i = \alpha_1 + \alpha_2 STMVCS_i + \alpha_3 Issue\ I + \alpha_4 Issue\ II + \varepsilon_i, \qquad (1)$$

where $STRET_i$ is the two-day standardized prediction error for firm i;

$STMVCS_i$ is the market value of common stock divided by the standard error of the two-day prediction errors for firm i; *Issue I* equals 1 if issue is a private placement, zero otherwise; *Issue II* equals 1 if issue is a straight debt offering, zero otherwise; and ε_i is the error term.

The results are presented below (t-statistics in parentheses):

$$STRET_i = \underset{(1.75)}{0.305} + \underset{(1.61)}{1.17E^{-9}} STMVCS_i - \underset{(-1.97)}{0.554}\, Issue\ I - \underset{(-1.83)}{0.306}\, Issue\ II,$$

$$R^2 = 0.05.$$

The results indicate no statistically significant relation between the stock price response to the borrowing announcement and the size of the firm after controlling for issue type. These results indicate that differences in abnormal returns among borrowing agreements are not the result of differences in firm size.

I obtain similar results when firm size is measured as the sum of the market value of common stock and the book value of all other liabilities. In addition, I find no statistically significant relation between abnormal returns and firm size within each type of borrowing arrangement. Finally, I obtain similar results when the relative size of the offer, defined as the ratio of the amount of the offering to the market value of the firm's outstanding common stock, is substituted for the size variable in eq. (1).

6. Summary and conclusions

Significant positive abnormal returns accrue to stockholders of firms announcing new bank loan agreements, whereas negative abnormal returns accrue to stockholders of firms announcing private placements. In addition, negative and statistically significant abnormal returns are associated with the announcement of private placements and straight debt issues used to retire bank debt.

One possible explanation for the difference in abnormal performance is that bank loans differ in some important feature such as maturity. Alternatively, bank loans may differ from other types of borrowing because of some special service provided by banks with their lending activity. An analysis of differences in the maturity, borrower default risk, borrower size, and purpose of the borrowing indicates that differences in abnormal performance are not due *solely* to differences in characteristics of the loan or characteristics of the borrowers. This result, together with the evidence concerning the incidence of reserve requirements, suggests that banks provide some special service not available from other lenders. Further research is needed to identify that unique service or unique attribute of bank loans, and to explain its relation to the market value of the firm.

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Banks as Liquidity Providers: An Explanation for the Coexistence of Lending and Deposit-Taking

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ABSTRACT

What ties together the traditional commercial banking activities of deposit-taking and lending? We argue that since banks often lend via commitments, their lending and deposit-taking may be two manifestations of one primitive function: the provision of liquidity on demand. There will be synergies between the two activities to the extent that both require banks to hold large balances of liquid assets: If deposit withdrawals and commitment takedowns are imperfectly correlated, the two activities can share the costs of the liquid-asset stockpile. We develop this idea with a simple model, and use a variety of data to test the model empirically.

WHAT ARE THE DEFINING CHARACTERISTICS of a bank? Both the legal definition in the United States and the standard answer from economists is that commercial banks are institutions that engage in two distinct types of activities, one on each side of the balance sheet—deposit-taking and lending. More precisely, deposit-taking involves issuing claims that are riskless and demandable, that is, claims that can be redeemed for a fixed value at any time. Lending involves acquiring costly information about opaque borrowers, and extending credit based on this information.

A great deal of theoretical and empirical analysis has been devoted to understanding the circumstances under which each of these two activities might require the services of an intermediary, as opposed to being implemented in arm's-length securities markets. While much has been learned from this work, with few exceptions it has not addressed a fundamental question: why is it important that *one institution carry out both functions*

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under the same roof?[1] For example, Diamond (1984) provides a convincing argument that some types of loans should be made by intermediaries, but it is hard to see in his model why the intermediary cannot be a nonbank finance company funded with short term debt, rather than a commercial bank funded with demand deposits. Similarly, Gorton and Pennacchi (1990) show that intermediation can be valuable in creating adverse-selection-free demand deposits, but it is again not obvious why this cannot be accomplished by mutual funds that invest only in liquid securities (e.g., high-grade commercial paper and T-bills) and that do not make any loans involving monitoring.

The question of whether or not there is a real synergy between deposit-taking and lending has far-reaching implications. On the one hand, if one takes the view that there is no synergy, the fact that banks engage in both activities might be interpreted as resulting from either past or current distortions in the regulatory environment. For example, it might be argued that deposit insurance has encouraged an artificial gluing together of the two activities, as banks attempt to maximize the value of the insurance put option by engaging in risky lending. Under this view, one would naturally tend to be sympathetic to "narrow banking" proposals, which effectively call for the breaking up of banks into separate lending and deposit-taking operations that would resemble finance companies and mutual funds, respectively.[2] On the other hand, if there is a real synergy, a forced switch to narrow banking could lead to large inefficiencies.

In a similar vein, models of the monetary transmission mechanism—particularly those that stress the so-called "bank lending channel"—often hinge crucially on the assumption that banks engage in both deposit-taking and lending.[3] In particular, central-bank open-market operations that affect the level of reserves in the economy can only have a direct effect on bank loan supply if banks are financed by reservable demand deposits. To the extent that there is an active lending channel, if the issuing of reservable deposits were to be decoupled from the function of extending credit to individuals and businesses, the conduct of monetary policy could be noticeably altered.

In this paper, we argue that there may indeed be significant synergies between deposit-taking and lending. We focus on a product that, in our view, is important in distinguishing banks from other lenders such as insurers and finance companies: loan commitments or credit lines (we use the two terms interchangeably in what follows). We take the central feature of a commitment to be that a borrower has the option to take the loan down *on*

[1] These exceptions include Calomiris and Kahn (1991), Flannery (1994), Qi (1998), and Diamond and Rajan (2001). We discuss some of these papers in more detail below.

[2] For narrow-banking arguments along these lines, see Simons (1948), Bryan (1988), Litan (1988), and Gorton and Pennacchi (1992).

[3] See, for example, Bernanke and Blinder (1988) and Stein (1998) for the theory behind the lending channel; Bernanke and Blinder (1992), Kashyap, Stein, and Wilcox (1993), Kishan and Opiela (1998), Ludvigson (1998), Morgan (1998), and Kashyap and Stein (2000) for supporting evidence; and Kashyap and Stein (1994) for a survey.

demand over some specified period of time.[4] Simply put, once the decision to extend a commitment has been made, it behaves *just like a demand deposit*: The customer can show up any time and withdraw funds, and these withdrawals will be somewhat random from the bank's perspective. Or said differently, both demand deposits and loan commitments offer to bank customers a very similar service: the provision of liquidity on demand to accommodate unpredictable needs.[5]

The next step in the argument is the observation that an institution that offers liquidity on demand must invest in certain costly "overhead" in order to carry out its job effectively. In particular, the overhead in our model consists of the large volume of cash and securities that a bank holds as a buffer stock on the asset side of its balance sheet.[6] Such a buffer stock is required to the extent that capital markets are imperfect, so that a bank cannot accommodate liquidity shocks simply by raising new external finance on a moment's notice. Moreover, this form of overhead is burdensome for a number of reasons. First, on the cash component, there is obviously the foregone interest. Second, even securities that bear a market rate of interest impose a cost on bank shareholders, because of the double taxation of the interest income in the corporate form. Finally, as is frequently argued in the corporate finance literature, a large balance of highly liquid assets gives managers a great deal of discretion, and is likely to increase agency costs (see Flannery (1994) and Myers and Rajan (1998)).

Once it is recognized that both deposits and loan commitments require overhead in the form of liquid-asset holdings, and that this overhead is costly, the potential for synergy between the two activities becomes clear. There will be a synergy to the extent that the two activities can "share" some of the costly overhead, so that a bank that offers both deposits and loan commitments can get by with a smaller total volume of liquid assets on its balance sheet than would two separate institutions that each specializes in only one of the functions. The synergy exists as long as deposit withdrawals and commitment takedowns are not too highly correlated. Intuitively, a deposit-taking bank holds a buffer stock of cash and securities as a hedge against a state of the world where there are large deposit outflows. But in many other states, there are no deposit outflows, and the buffer stock just sits idle. If the buffer stock can instead be used to accommodate commitment takedowns in these states, efficiency will be enhanced.

[4] Holmstrom and Tirole (1998) also stress that a key function of an intermediary is to provide liquidity in the form of loan commitments. However, they do not link the commitment function to the intermediary's liabilities.

[5] Diamond and Dybvig (1983) point to the intermediary's role in smoothing aggregate liquidity shocks through diversification, but do not emphasize that this can be done across both sides of the bank balance sheet.

[6] Over the period 1992 to 1996, a typical "small" bank with assets on the order of $36 million held roughly 5 percent of these assets in cash and another 35 percent in securities. For a "large" bank with assets on the order of $9.5 billion, the corresponding figures were 6 percent and 25 percent. See Table II below.

A simple example helps to illustrate the logic of our model. Imagine two intermediaries, F (for finance company) and B (for bank) who compete for the same pool of borrowers. The difference is that while F is financed entirely with long-term bonds, B has a "deposit franchise"—that is, it has a monopoly position that allows it to pay below-market rates on $100 of demand deposits. The only hitch with these deposits is that there is some probability that $20 of them will be withdrawn unpredictably. Assuming that B cannot raise external finance on short notice, it will have to keep $20 in cash on hand in order to exploit the rents from its deposit franchise. Now think about F and B competing to attract $20 worth of loan commitment business from a firm X. If we further assume for simplicity that commitment takedowns are perfectly negatively correlated with deposit withdrawals, it is clear that B will be a lower-cost producer of commitments, because it does not have to add to its cash balance to offer this service.[7]

Thus in this example, the bank B wins firm X's commitment business. Moreover, once it has sunk the cost of investigating X to ensure that it is a good credit for the commitment, B will also have an advantage in competing with F for other business from X where liquidity provision plays no role—for example, it might be in a better position to offer X a term loan in addition to the commitment.

The example suggests two broad empirical implications of our theory. First, across types of financial institutions, we should see banks doing: (1) more commitment-based lending than other intermediaries such as finance companies or insurance companies as well as (2) more long-term lending to those particular borrowers who are also relatively heavy users of commitments. Second, within the commercial banking sector, those banks with the most pronounced advantage in offering demandable deposits (as measured, e.g., by the ratio of transactions deposits to total deposits) should: (1) hold more in cash and securities; and (2) do a greater fraction of their lending on a commitment basis.[8]

In the remainder of the paper, we develop this theory more fully, and test some of its principal implications. We start in Section I with a brief history of the commercial banking industry which suggests that our basic story is well motivated. In Section II, we sketch a simple model that formalizes the intuition from the example above. In Sections III and IV, we conduct our empirical tests. To preview, we find strong evidence for two basic propositions. First, banks do more commitment-based lending—especially via unsecured lines of credit—than any other type of lending intermediary. Second, within the banking sector, those banks with high ratios of transactions deposits to total deposits also have high ratios of loan commitments to loans—

[7] In our formal model, we relax these assumptions, so that: (1) external finance is costly but not impossible to raise; and (2) deposit withdrawals and commitment takedowns need not be negatively correlated, only less than perfectly positively correlated.

[8] Our focus on explicit loan commitments may arguably be too narrow. A broader interpretation of the model would encompass "implicit" commitments upheld by reputational considerations, whereby long-standing customers might come to rely on a bank to meet their unexpected liquidity demands even absent a formal contract. Unfortunately, the problem from an empirical perspective is that such implicit commitments cannot be measured.

that is, banks specializing in demandable deposits also seem to specialize in commitment-based lending, consistent with our theory. Conclusions follow in Section V.

I. Historical Overview

The following sketch is somewhat selectively culled from existing histories and is intended to provide broad motivation for our theory, not systematic evidence.

A. Deposits

The consensus among historians (see De Roover (1948), Lane and Mueller (1985), and Usher (1943) for example) is that deposit banking in Continental Europe evolved from the activity of money changing. The early Middle Ages saw an increasing use of coins rather than barter in trade. There was, however, a problem with the available coins. Coinage was imperfect, so coins could contain very different quantities of metal even when newly produced by the same mint. There were many mints in even a small area, each of which had its own method of production and standard of honesty. Moreover, even after production, the coins could be deliberately clipped or sweated (by shaking them in a bag with other coins so as to remove metal), or the edges could be filed (milling of the edges was introduced only in the 16th century). Further, the coins were subject to normal wear and tear. Sometimes, a mint reduced the precious metal content in coins, bringing its prior coinage into disrepute. Given that coins were of differing quality, traders offered the worst acceptable coins in their possession for trade, further reducing the quality of coins in circulation. So while money eliminated the problem of double coincidence of wants inherent in barter, a new problem arose—uncertainty about the value of the money.

Money changers helped to mitigate this uncertainty. The money changer specialized in coins, so he knew both foreign and local coins, could distinguish the counterfeit from the genuine, knew bullion and exchange rates, as well as the extent to which different coins were depreciating. He could therefore make an assessment as to whether a debased coin would be acceptable at face value or be valued only for its metal content. He used this knowledge to perform two functions.

First, he valued the foreign or debased coins that a customer brought in and exchanged them for local coins that could circulate easily. Of course, for the money changer to play a useful role, not only did he have to have expertise in coins, but he also had to have a reputation for honesty in his dealings—or else the public would fear rather than welcome his expertise.

Second, the money changer separated the coins into those he would send back to the mint for recoinage and those he could reintroduce into circulation. He chose to whom to give which coins. For instance, debased coins were less valuable in large payments where coins were weighed but they could still fetch their face value in small payments. Thus the money changer also served what might be termed a placement function today.

It was a small step from changing money to opening deposit accounts. When a trader brought in coins, the money changer could open an account for the trader rather than giving him new coins. If the trader wanted to pay a supplier money, the money changer would simply make an accounting entry, debiting the trader's account. If the supplier had an account with the money changer, the money changer would credit the account, thus reducing the entire payment transaction to pen strokes. It was not much harder to make the payment if the supplier had an account with another money changer. Over a period—say a day—the money changers would cumulate all the payments and receipts for their respective clients and make only the net payment to each other in cash, after which the necessary accounting entries would be made. Because payments were pooled then netted, deposit banking reduced the overall volume of payments made in coins. Furthermore, it allowed merchants to leave the business of dealing in uncertain coinage entirely to the network of money changers, letting merchants focus on what they knew best: production and trade. Thus, deposit banking and banking networks were born to facilitate payments.

B. Overdrafts

The money changer had to maintain a reserve of coins so as to make net payments to other bankers and to meet withdrawals by depositors. But not all the cash that was initially deposited had to be maintained as reserve since only a fraction of depositors would need their money at any time. Fractional reserve theories of banking suggest that banks channeled idle cash into loans to entrepreneurs.

However, the nature of the loans made, as well as the identity of the recipients, was determined by the deposit business. Banks typically did not make long-term loans (though these were no more risky than the unsecured loans they did make). Instead, the early private banks allowed depositors to borrow by overdrawing their account (e.g., Usher (1943)). These overdrafts were thus loans obtained virtually on demand by depositors. From the perspective of the money changer, the overdraft facility (or its modern equivalent, the line of credit) was essentially the same as a deposit. Both products required the money changer to come up with cash on demand, that is, they were products through which the money changer provided liquidity. With the overdraft facility, the money changer was not legally required to make the loan (he could refuse to allow the overdraft). In practice, the difference was probably moot; once customers came to rely on the money changer's overdraft facility, it would hurt his reputation almost as much if he refused to allow it without good reason as it would if he refused to pay out on deposits.

Given that deposits and overdrafts were essentially the same product, the money changer could spread his fixed costs over a larger volume of business if he offered both. Once the money changer had invested in the physical infrastructure—building, strongbox, guards—to keep the cash reserves he needed to meet unexpected deposit withdrawals, and once he had established a network with other money changers (so that he could call on their liquidity if his own reserves proved inadequate), he could use the same security arrangements and relationships to meet unexpected overdrafts.

Moreover, in the small trading economies of that period, he probably did not have to keep much more additional cash as reserve to service the overdrafts, and any reserve could be worked much harder. There typically must have been a balance between deposit inflows and overdraft outflows in a closed trading economy. As a somewhat simplistic example, at harvest time, the farmer would sell grain and be flush with cash so he would be a net depositor while the grain merchant would carry an overdraft. During the rest of the year, the grain merchant would pay down the overdraft as he sold the grain while the farmer's deposit balances would lapse into overdraft before the next harvest. The lending and borrowing by the farmer and the grain merchant would covary naturally in such a way as to minimize the demands on the bank's reserve. Only a dramatic failure of the harvest, or disproportionate growth of a particular sector, would upset the natural harmony and destabilize the bank. Thus, the liquidity demands of customers could be diversified in natural ways if the money changer offered both deposits and overdrafts.

Early bankers thought this natural diversification of liquid reserves across demands to be the primary advantage of banks. Hammond (1957, pp. 55–58) cites Senator Robert Morris of Pennsylvania, who made the following statement to the Philadelphia Assembly in 1785.

> By becoming stockholders in a bank, the merchants had pooled their cash to make it go further. But there were very few of them, Mr. Morris said "who do not stand in need of the whole of their money in the course of business, and when in need they borrow occasionally perhaps the whole amount or more." Further, "it is upon these principles the merchants generally remain stockholders—when one does not want his money, it is earning his share of the dividend from another; and by thus clubbing a capital together, as it were, the occasional wants of all are supplied." Why, he asked in substance, should not the merchants do collectively and conveniently what they had used to severally and inconveniently?

It is clear that the term "stockholder" is used in the same sense as we have used "depositor" above. What is interesting is that Morris makes little attempt to distinguish between merchants withdrawing the money they had previously deposited and their borrowing anew. Thus deposits and lines of credit were thought of then, much as we advocate in this paper, as similar products drawing on common resources. In what follows, we formalize this historical rationale for a bank.

II. The Model

A. Framework

The model is designed to capture in a minimalist fashion the following characteristics of a bank: (1) the bank's role is to provide funds to its customers on demand; but (2) it finds it costly to raise external finance unexpectedly; so (3) it maintains a buffer stock of liquid assets; and (4) holding the buffer stock is also costly. Note that (2) and (4) imply that the model will have to incorporate two distinct capital market frictions: There needs to be an ex post *flow* cost of raising new external finance, as well as an ex ante *stock* cost of holding liquid assets.[9] As we discuss further below, the former can be motivated based on an adverse-selection argument in the spirit of Myers (1984) and Myers and Majluf (1984), while the latter can be motivated based on a variety of factors, including taxes and agency costs.

There are three dates: 0, 1, and 2. The short-term interest rate on securities is exogenously fixed in this partial-equilibrium framework, and is i, both between date 0 and date 1, as well as between date 1 and date 2. For notational simplicity, we assume that all interest—as well as all other fees and charges—is paid out at date 2. This avoids compounding, and means that someone investing a dollar in securities at date 0 will accumulate total interest of $2i$ at date 2.

A.1. Assets

The bank makes term loans L at date 0 which mature and are paid off at date 2. The two-period rate on these loans is $r(L)$. We assume that the bank has some market power in lending (see Hannan (1991) and Cosimano and McDonald (1998)) which implies that $r_L < 0$. The assumption of market power is only to limit the scale of lending activities, and an assumption about increasing costs of making loans would achieve the same end. The details of what drive loan demand are unimportant for our purposes, so this simple reduced-form approach is sufficient.

In addition to term loans, the bank can also hold an amount S_0 of liquid assets—for example, cash, central bank reserves or Treasury bills—on its balance sheet between dates 0 and 1. These assets earn the security-market interest rate of i, but we assume this is partially offset by a proportional deadweight cost of τ per dollar held. Thus the net return on liquid assets from date 0 to date 1 is $(i - \tau)S_0$. As suggested above, one can attach a number of interpretations to the parameter τ. Perhaps the simplest case is to think of S_0 as invested in cash or non-interest-bearing reserves, so that $\tau = i$.[10] Alternatively, τ might be taken to reflect the (unmodeled) tax or agency costs associated with holding financial slack. Flannery (1994) and Myers and Rajan (1998) argue that for financial institutions, the agency problems associated with holding liquid assets may be particularly severe,

[9] Froot and Stein (1998) develop a model of a bank with exactly this structure.

[10] Somewhat more subtly, one might make a similar argument for banks' holdings of short-term T-bills, to the extent that the prices of these T-bills reflect a general equilibrium liquidity premium above and beyond what would obtain in a standard perfect-markets model. In other words, because they can be used in an almost money-like fashion in a variety of transactions (repurchase agreements, etc.) short-term T-bills may, like money, have an implicit "convenience yield" and thus offer a lower rate of return relative to other assets than can be explained solely by differences in risk. For a related discussion of the equilibrium premium for asset liquidity, see Holmstrom and Tirole (2001).

as there is much scope for asset substitution. Thus the ex ante expected return on liquid assets, net of financing costs, may be negative.[11]

At date 1, some of the liquid assets may be drawn down, leaving a remaining balance of S_1 to be held until date 2. This remaining balance continues to earn the rate i between date 1 and date 2, but for simplicity we assume that there is no longer any deadweight cost τ. Under the interpretation where the liquid assets had to be held in cash between date 0 and date 1 to meet unexpected liquidity demands, this would correspond to assuming that the cash can now be rolled over into interest-bearing securities, thereby eliminating the opportunity cost. Alternatively, under the interpretation where there are tax or agency costs of holding securities, one can imagine that the quantity S_1 is actually deployed more efficiently by paying down some of the bank's existing market-rate debt (see below). In this case, S_1 is not literally held on the asset side of the balance sheet, but rather represents a "contra" account against the liability side, an account which is implicitly earning an economic return of i.

A.2. Liabilities

The total assets to be financed at date 0 are $L + S_0$. They are financed partly by demandable deposits. Demand deposits pay no interest at any time, so the bank will take all it can get at date 0. We assume that this amount, D_0, is exogenously determined, for example, by the kind of customers living in the immediate neighborhood of the bank.[12] Thus D_0 can be thought of as a measure of the value of the bank's deposit-taking franchise. The disadvantage of deposits is that a random fraction ω of those who deposit at date 0 may withdraw at date 1, where ω is 0 or 1 with equal probability.[13]

In addition to deposits, the bank can also issue claims in the public market at either date 0 or date 1, denoted by e_0 and e_1, respectively. These claims mature at date 2, and can be thought of as either bonds or equity. We assume that there are no information asymmetries between the bank and

[11] Given the costs, banks naturally have an incentive to economize on their holdings of cash and securities. Risk management can be a partial substitute for such holdings, and thus can be somewhat helpful in this regard (Stulz (1996) and Froot and Stein (1998)). Nevertheless, as long as it is impossible to fully hedge against liquidity shocks, some liquid assets will have to be held in equilibrium, which is all we really need for our story to go through.

[12] All that really is needed is that the deposit rate be less than i, so the bank earns rents on its deposit franchise and will be willing to invest in securities to support it.

[13] We are ruling out the possibility that the bank tries to stem deposit outflows by raising deposit rates. However, our conclusions continue to apply even with endogenously determined deposit rates, so long as depositors' liquidity demands are somewhat inelastic. It is also not important for our results that all deposits be at risk for withdrawal—all we require is that some non-zero fraction be at risk. Even with a very large number of depositors, this is likely to be the case as long as there is some systematic component to liquidity demand. One can imagine many factors that might give rise to such a systematic component. (A bank run is an extreme example.)

investors at date 0, so that the cumulative rate paid on any (two-period) claims issued at this time is $2i$.

However, at date 1, there is the potential for adverse selection in the capital market, perhaps because the bank has gained some inside information as to the quality of its loan portfolio, and can use this information to exploit new investors. We could model this adverse-selection problem explicitly; however, for the sake of transparency, we adopt a very simple quadratic formulation where the total cost of incremental funds e_1 raised at date 1 is given by $ie_1 + \alpha e_1^2/2$. Here α measures the degree of capital market imperfection—the larger it is, the more costly is external financing relative to the frictionless case.[14]

A.3. Commitments

Finally, the bank may issue loan commitments at date 0, which obligate it to provide funds to borrowers on demand at date 1. We do not explicitly model why firms or consumers might wish to enter commitment arrangements. One important motivation may be that commitments provide insurance against a future inability to borrow. As Holmstrom and Tirole (1998) argue, upon the realization of an adverse shock, a firm may have insufficient collateral to raise external finance, and may be liquidated, even though it has significant nonpledgeable value as an ongoing concern. To protect against such inefficient liquidation, the firm may wish to buy a commitment which is effectively an insurance policy against the adverse state.[15]

In any case, we do not formalize these effects, but instead just assume an exogenous demand for commitments, and again endow the bank with some market power. Specifically, if the bank sells C dollars of commitments at date 0, it receives total revenue of fC, where we assume that $d(fC)/dC > 0$ and $d^2(fC)/dC^2 \leq 0$.[16] At date 1, a random fraction z of the commitments are taken down, where z is 0 or 1 with equal probability. Those borrowers who do take down the commitments pay an interest rate of i on the balance

[14] Although this quadratic formulation may appear ad hoc, Stein (1998) derives almost exactly the same reduced form in a more formal model where there is adverse selection with respect to a bank's uninsured nondeposit liabilities. Our α parameter can be mapped directly into the parameter A in that paper, which is a measure of the information asymmetry between bank managers and investors.

[15] In reality, loan commitments often have "material adverse change" clauses which allow a bank get out of its obligation under certain circumstances. Thus, while commitments may, in the spirit of Holmstrom and Tirole (1998), provide insurance to borrowers against *some* types of negative shocks (e.g., moderate declines in credit quality), this insurance is incomplete: it does not cover certain extreme negative outcomes, such as managerial fraud and so forth. Presumably, reputational concerns help deter banks from invoking the clause in the former sorts of cases.

[16] The second derivative of commitment revenue with respect to commitment volume, $d^2(fC)/dC^2$, can be written as $2f_C + Cf_{CC}$. Thus a sufficient condition for the second derivative to be negative is that the demand for commitments be sufficiently price elastic—that is, that f_C be sufficiently negative.

outstanding between date 1 and date 2.[17] We assume that the probability that deposits are withdrawn ($\omega = 1$) conditional on commitments being drawn down ($z = 1$) is ρ. So if $\rho = \frac{1}{2}$, the withdrawal of demand deposits and the takedown of loan commitments are independent events; if $\rho = 1$, they are perfectly positively correlated; and if $\rho = 0$, they are perfectly negatively correlated.[18]

B. Solving the Model

With all the assumptions in place, we are now ready to solve for the bank's optimal choice of L (term loans), C (commitments), and S_0 (liquid assets). The bank seeks to maximize its expected net income, denominated in date-2 dollars:

$$\text{Max}\, E\{rL + fC + izC + (i - \tau)S_0 + iS_1 - 2ie_0 - ie_1 - \alpha e_1^2/2\}. \tag{1}$$

In so doing, it faces the following constraints:

$$L + S_0 = D_0 + e_0 \tag{2}$$

$$L + S_1 + zC = D_0(1 - \omega) + e_0 + e_1 \tag{3}$$

$$S_1 \geq 0. \tag{4}$$

Constraints (2) and (3) are simply balance sheet identities for date 0 and date 1, respectively. Since it is costly to raise money from the public at date 1, the bank will, if need be, liquidate its entire portfolio of liquid assets at date 1 to meet the demands of depositors or borrowers. However, if this is not sufficient, any new funds will have to be obtained through a costly public issue and not through short sales. This is reflected in (4), which indicates that date-1 liquid-asset holdings cannot become negative.

The first order conditions are given by:

$$L: \quad r + Lr_L = 2i \tag{5}$$

$$C: \quad f + Cf_C = \alpha/2\, dE(e_1^2)/dC \tag{6}$$

$$S_0: \quad \tau = -\alpha/2\, dE(e_1^2)/dS_0. \tag{7}$$

[17] Setting the interest rate on the outstanding balance to i in this way is an innocent normalization.

[18] The withdrawal of demand deposits and the takedown of loan commitments can be less than perfectly correlated even if there are large numbers of depositors and borrowers. Depositors and borrowers may come from different segments of the population and so may have different liquidity demands. Alternatively, the two groups may have different incentives. For example, in a bank run, depositors have an incentive to withdraw their money, while borrowers have little incentive to take down commitments. Indeed, Saidenberg and Strahan (1999) document a pronounced *negative* correlation between deposit flows and commitment takedowns at large banks during the period of bond-market turmoil in the fall of 1998.

The intuition is straightforward. At the margin, loans are financed by issuing two-period claims at date 0; hence (5). An additional dollar in commitments sold will increase the bank's fee income but will also increase the expected costs of external finance at date 1; hence (6). In contrast, the bank will incur the cost τ by holding more liquid assets at date 0, but will save on expected issue costs at date 1; hence (7).

Substituting (2) into (3) and applying (4), we have the following expression for the date-1 external financing need:

$$e_1 = \text{Max}[zC + \omega D_0 - S_0, 0]. \tag{8}$$

As can be seen from (8), the value of e_1—and hence the nature of the solution to the model—depends on the magnitude of the optimal value of liquid assets, S_0^*, relative to the initial deposits, D_0, and the optimal level of commitments, C^*. In particular, we can identify four different regions:

Region 1: $S_0^* \le \min(C^*, D_0)$.

Region 2: $C^* \le S_0^* \le D_0$.

Region 3: $D_0 \le S_0^* \le C^*$.

Region 4: $S_0^* \ge \max(C^*, D_0)$.

It turns out that our key results are driven by what happens in Region 1. So for the purposes of exposition, our focus in the text is primarily on understanding the comparative statics properties of an equilibrium that lies in this region. (In the Appendix, we provide a fuller analysis of the other regions.) In Region 1, the bank is forced to raise external finance in three out of the four possible states of the world—if outflows take place on either commitments or deposits, or on both. Using (8), this implies that:

$$E(e_1^2) = \rho/2[(C + D_0 - S_0)^2] + (1 - \rho)/2[(D_0 - S_0)^2 + (C - S_0)^2]. \tag{9}$$

Substituting (9) into (7), and differentiating, we obtain:

$$\tau = \alpha/2[C^* + D_0 - S_0^*(2 - \rho)]. \tag{10}$$

Therefore,

$$S_0^* = [C^* + D_0 - 2(\tau/\alpha)]/[2 - \rho]. \tag{11}$$

Similarly, substituting (9) into (6) and differentiating, we have:

$$f + C^* f_C = (\alpha/2)[\rho D_0 + C^* - S_0^*]. \tag{12}$$

Substituting S_0^* from (11) in the right-hand side of (12) and simplifying, we get:

$$f + C^* f_C = \frac{\alpha[(2\rho - \rho^2 - 1)D_0 + (1-\rho)C^* + 2(\tau/\alpha)]}{(4-2\rho)}. \tag{13}$$

Implicitly differentiating leads to the following comparative statics result:

$$\frac{dC^*}{dD_0} = \frac{-\dfrac{\alpha(1-\rho)^2}{(4-2\rho)}}{\dfrac{d^2(fC)}{dC^2} - \dfrac{\alpha(1-\rho)}{(4-2\rho)}}. \tag{14}$$

The denominator on the right-hand side is negative, and the numerator is negative so long as commitment takedowns and deposit withdrawals are not perfectly positively correlated ($\rho < 1$). So C^* increases with an increase in D_0. Thus we have established the following proposition.

PROPOSITION 1: *For parameters such that the equilibrium is in Region 1 where $S_0^* \leq \min(C^*, D_0)$, both the holdings of liquid assets S_0^* and the quantity C^* of commitments that the bank issues at date 0 are increasing in the amount of demand deposits D_0.*

Why is there a synergy between demand deposits and commitments in Region 1? Given that they compete for the same scarce resource at date 1—the store of liquid assets—why do they not tend to crowd each other out? The answer lies in recognizing that the stock of liquid assets is not fixed, but rather is optimally adjusted with changes in deposits. In this region, an increase in deposits leads the bank to bump up liquid-asset holdings to cover the increased withdrawal risk. These extra liquid assets are also available to help if a commitment takedown occurs instead. As long as the commitment and deposit outflows are not perfectly correlated, this explains our synergy.

Another way to understand the source of the synergy is to see when it breaks down. If liquid-asset holdings exceed either the maximum possible deposit withdrawal or the maximum commitment drawdown, so that we are no longer in Region 1, commitments are locally independent of deposits. In particular, we show in the Appendix that the analogs to equation (13) for these other regions are given by:

In Region 2: $$f + C^* f_C = \alpha\rho(1-\rho)C^*/2 + \rho\tau. \tag{15}$$

In Regions 3 and 4: $$f + C^* f_C = \tau. \tag{16}$$

Consider as a specific example Region 3, where liquid assets exceed the maximum possible deposit outflow. In this case, a deposit withdrawal that occurs by itself does not stress the bank's liquidity position. There is only a problem (and hence a need for external finance) when both deposit and commitment outflows occur simultaneously. Thus if there is an increase in deposits in this region, the bank will raise its holdings of liquid assets, but just enough to cover the extra risk that both outflows happen at the same time. Consequently, the extra liquid assets which are added provide no scope for the bank to increase its commitments. Indeed, this can be seen from (16), which tells us that the optimal level of commitments in this region is already pinned down, by balancing the (constant) marginal cost of holding liquidity with the marginal revenue from offering the commitments.

Having said something about the local nature of equilibrium within each of the four regions, the next step is to pose the global question: As the level of deposits D_0 increases from zero to infinity, what happens to liquid-asset holdings and commitments? In Appendix A, we prove the following.

PROPOSITION 2: *(i) As D_0 moves from zero to infinity, both S_0^* and C^* are weakly increasing, continuous functions. (ii) Define C^τ as that value of C such that $f + Cf_C = \tau$. If τ is sufficiently large, such that $C^\tau < 2\tau/\alpha\rho$, then Region 4 does not exist. Rather, as D_0 increases, the equilibrium moves from Region 3 (where S_0^* is rising and C^* is flat), to Region 1 (where both S_0^* and C^* are rising), and then to Region 2 (where S_0^* is rising and C^* is flat).*

Figure 1 provides a concrete illustration of the proposition, for a case where $f(C) = 1 - 0.025C$; $\rho = 0.5$; $\alpha = 0.1$; and $\tau = 0.45$. The proposition and the figure suggest a variety of related empirical implications of our theory. First, comparing across types of financial institutions, nonbank lenders (e.g., finance companies), who are presumably in Region 3 with no demand deposits, should on average hold fewer liquid assets and do less in the way of commitment-based lending than deposit-taking banks, to the extent that at least some banks have sufficient deposits to wind up in Regions 1 or 2. Similarly, within the banking sector, those banks that have more in the way of demandable deposits should hold more liquid assets and do more commitment-based lending.

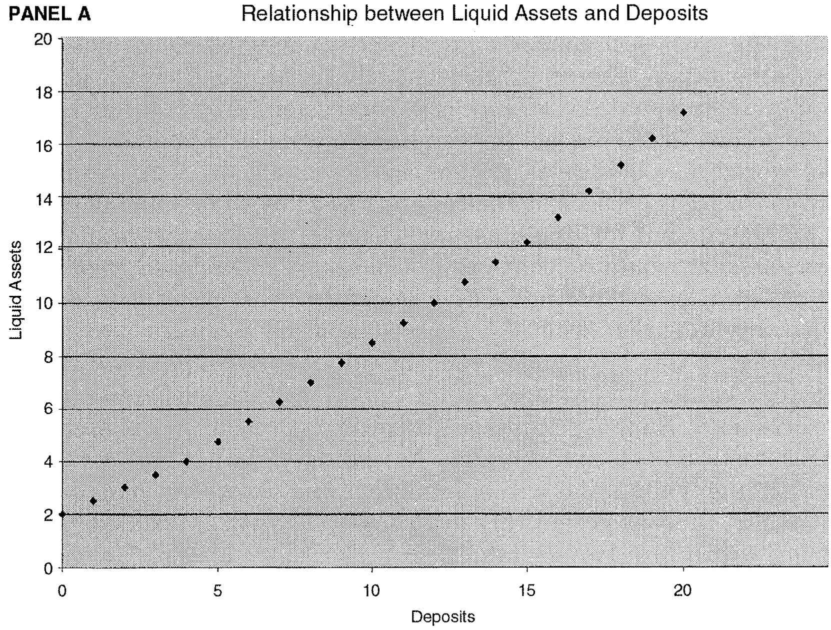
More specifically, in our empirical work below, we test the following three predictions of the model. The first has to do with comparing banks to nonbank lenders, while the latter two involve within-banking-sector comparisons.

Prediction 1: Deposit-taking banks will offer relatively more commitments than other lending intermediaries.

Prediction 2: Across a sample of banks, an increase in demand deposits should lead to an increase in liquid-asset holdings.

Prediction 3: Across a sample of banks, an increase in demand deposits should lead to an increase in loan commitments.[19]

[19] As can be seen from Figure 1B, we do not require all (or even any) banks to be in Region 1 for Prediction 3 to hold in the cross section. The prediction only fails if all banks are in Region 3 or if all are in Region 2. Of course, if we could identify into which region a given bank falls, we could construct sharper tests of the theory. However, this would require precise estimation of the underlying structural parameters of the model, a very difficult task.



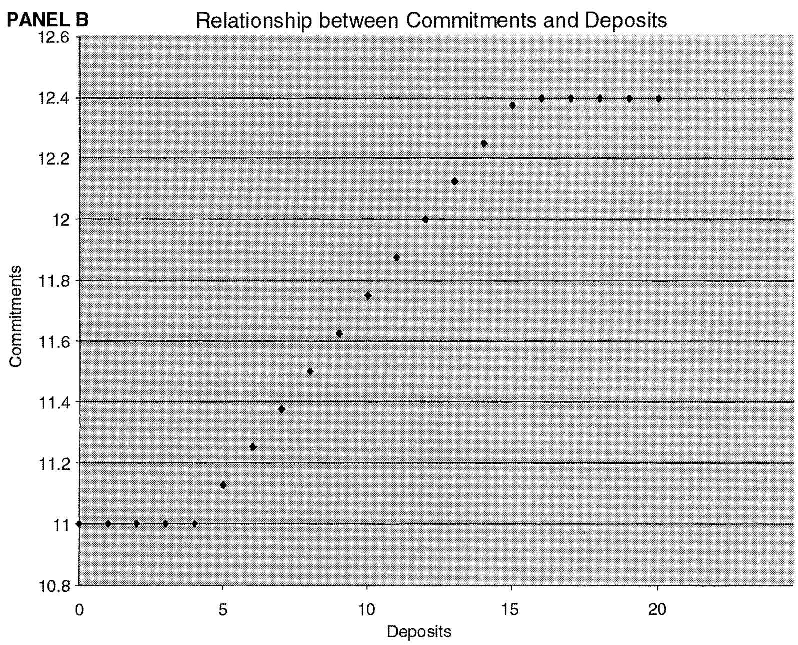


Figure 1. Liquid assets and commitments versus deposits. The figure plots the solution to the model for the following parameter values: $f(C) = 1 - 0.025C$; $\rho = 0.5$; $\alpha = 0.1$; and $\tau = 0.45$. The function $f(C)$ represents the fee on commitments; C is the volume of commitments issued; ρ is the correlation between commitment outflows and deposit outflows; α is a measure of the flow costs of external finance; and τ is a measure of the deadweight costs of holding financial slack. Panel A shows the relationship between liquid assets and deposits. Panel B shows the relationship between commitments and deposits.

Predictions 2 and 3 are conceptually straightforward, and we test them with separate cross-sectional ordinary-least-squares (OLS) regressions. However, an alternative way to think about these two predictions jointly is in terms of an instrumental variables (IV) regression. If both Predictions 2 and 3 are borne out in the data, this implies—purely as a matter of algebra—that we would also obtain a positive coefficient in an IV regression where commitments are regressed against liquid assets, with demand deposits serving as an instrument for liquid assets.[20] The intuitive interpretation of such an IV regression would be that commitments are correlated *with that component of liquid-asset holdings which is driven by demand deposits*. This is a concise way of articulating the main idea of our model.

By contrast to this IV thought experiment, our model *does not* necessarily predict that commitments and liquid assets will be unconditionally positively correlated. Suppose banks differ in terms of the parameter α, which measures costs of external finance. According to equations (11) and (13), banks with high values of α will hold more liquid assets but may make fewer commitments, thereby potentially inducing a negative correlation in an OLS regression with these two variables.

C. An Extension: Implications for Term Lending

As the model is currently set up, there is no synergy between a bank's deposit-taking activities and its term lending. The amount of term lending is given by (5), and is a function solely of loan demand and the security-market interest rate i. However, it is easy to extend the model so as to generate an additional synergy that links the term lending in with commitments, and thus by extension with deposits. Suppose that when a bank offers a line of credit, it must spend some resources to investigate the potential borrower, so as to ensure that he is creditworthy. Once this cost is sunk, the bank will clearly be at an advantage in making a term loan to the same borrower.

Thus it would be inappropriate to interpret our model as saying that banks should be expected to do *only* commitment-based lending. Quite to the contrary: to the extent that having a deposit franchise encourages a bank to get into the commitment business, being in the commitment business in turn might naturally spill over into doing some non-commitment-based term lending. A potentially more precise implication of this line of reasoning is that one might predict that banks' term lending would be disproportionately tilted towards those types of customers that make relatively heavy use of commitments. For example, if a particular small firm has very volatile working capital needs and is hence a heavy user of bank credit lines, it might be

[20] In this IV interpretation, the OLS regression of liquid assets on demand deposits (corresponding to Prediction 2) would serve as the first-stage IV regression which generates a fitted value of liquid assets to be used in the second stage. The second stage of the IV procedure would then involve running commitments against this fitted value of liquid assets. If the fitted value is just an increasing linear function of demand deposits, the second stage regression is equivalent to checking whether commitments are positively related to demand deposits, which in turn corresponds to a test of Prediction 3.

more likely than the average firm to raise its longer-term funding for plant and equipment from banks too, as opposed to from finance companies.

D. Related Theories

We are not the first to draw a link between a bank's lending and deposit-taking activities. Calomiris and Kahn (1991) describe demand deposits with sequential service as a way to provide incentives for the most efficient outside investors to monitor a borrower. Depositors who are the first to withdraw get paid in full, giving them an endogenous incentive to monitor for value-decreasing actions by the borrower. Furthermore, their rush to withdraw in turn alerts passive outside investors that the borrower may be acting against their interest. But industrial firms do not issue demandable claims, at least not as much as banks (see Flannery (1994)). So the distinguishing feature of a bank in their model has to be that it suffers from more severe agency problems than an industrial firm. Flannery suggests that this is indeed the case. Bank loans give off regular cash repayments, and these can be redeployed quickly into new loans. It is hard to restrict such redeployment because making new loans is central to a bank's business. Thus bank assets can be more easily transformed than industrial-firm assets, which may explain why bank investors need tighter control through demandable claims.[21] Diamond and Rajan (2001) take a somewhat different tack by arguing that demandable claims allow banks to promise more than the market value of their assets, thus allowing banks to "create" liquidity.

Our paper differs from these in that its primary focus is not on why banks' term loans and demand deposits go together, but rather on why *lines of credit* and demand deposits go together. We argue that both are claims on liquidity. Therefore offering both may help a bank to diversify across claimants with different takedown patterns, thus enabling it to hold the minimum necessary reserve. Others have recognized diversification possibilities across depositors (for example, see Diamond and Dybvig (1983)) or across borrowers (Holmstrom and Tirole (1998)) or even across banks (Bhattacharya and Gale (1987)). Our contribution is to point out the potential for diversification across both sides of a bank's balance sheet. Our model does have subsidiary implications for term loans, as noted earlier, but they are strictly a byproduct of the synergy between deposits and commitments.

III. Evidence on Banks versus Other Lending Institutions

A. Data Description

To investigate Prediction 1, we use the 1993 National Survey of Small Business Finances (NSSBF). This survey, conducted in 1994 through 1995

[21] While Myers and Rajan (1998) are in agreement with Flannery (1994) that banks have assets subject to transformation risk, they disagree about what those assets are. In Myers and Rajan, the liquid assets held by the bank as reserve to meet demandable claims are the ones subject to transformation risk.

for the Board of Governors of the Federal Reserve and the U.S. Small Business Administration, covers a nationally representative sample of small businesses. The target population is all for-profit, nonfinancial, nonfarm business enterprises that had fewer than 500 employees and were in operation as of year-end 1992. The data set contains 4,637 firms, and describes all the loans each firm has as of year-end 1992, as well as the institutions these loans came from.

We want to obtain a picture of the kinds of loans each institution makes. For each firm, we assign each loan to a bin based on both its type (e.g., line of credit, mortgage, etc.) and the type of financial institution it comes from (e.g., bank, finance company, etc.). We then add up the loans in each bin across all firms. If we divide the total loans in a bin by the total loans made by that type of institution, we obtain the fraction of the particular loan type in the institution's portfolio. Our theory suggests that an overdraft (a negative balance) on a demand deposit is identical to a takedown on a line of credit. Therefore, we treat a negative balance on a demand deposit as a takedown of an unsecured line of credit.

B. Results

In Table I, we describe the kinds of loans that each type of institution makes to small firms. Approximately 70 percent of banks' lending is through lines of credit, with 31 percent coming from unsecured lines of credit. By comparison, only 51 percent of finance company lending is through lines of credit, and hardly any of these—just 5 percent—are unsecured lines. Interestingly, insurance companies also offer unsecured lines of credit, perhaps because some of them maintain substantial amounts of liquid assets. No other type of institution offers significant amounts of unsecured credit lines.

An unsecured line may be the closest analog to the concept in our model, since it does not require the borrower to arrange for collateral to cover the loan, and hence may be more unpredictable in its drawdown behavior than a secured line. However, this conjecture is hard to validate directly. Fortunately, the database also contains responses to the following questions, which are highly relevant to our unpredictable-drawdown idea: "Has your firm ever required financing for seasonal or unexpected short term credit needs? If so, to what source does the firm first look for financing these needs?" Over 70 percent of respondents mentioned a bank as the primary source for this type of credit. Barely 1 percent mentioned a finance company, while a fraction of a percent mentioned an insurance company, even though these institutions account for 11 percent and 2 percent of *overall* lines of credit to small firms. The most important sources other than banks were family and friends. Thus, even relative to their overall market share in lines of credit, banks are the most important source that small firms use to fund *unexpected* credit needs.

IV. Within-Banking-Sector Tests

Next, we look across a sample of banks to see if Predictions 2 and 3 are supported. To get started, we must identify the empirical counterparts to

Table I

Banks versus Other Lending Institutions: Fraction of Each Institution's Lending Accounted for by Loan Type (by Dollar Volume)

The data in this table come from the 1993 National Survey of Small Business Finances, and cover a sample of 4,637 for-profit, nonfinancial, nonfarm enterprises that had fewer than 500 employees as of year-end 1992. Each loan is sorted into bins based on its type (line of credit, mortgage, etc.) and the type of financial institution it comes from. The loans in each bin are added up across all firms. The fraction of a particular loan type in an institution's portfolio is obtained by dividing the total loans in a bin by the total loans made by that type of institution.

	Unsecured Lines of Credit	Secured Lines of Credit	Total Lines of Credit	Leases	Mortgages	Auto Loans	Equipment Loans	Other
Commercial banks/S&Ls	0.31	0.39	0.70	0.02	0.13	0.01	0.06	0.07
Finance/leasing company	0.05	0.45	0.51	0.15	0.08	0.10	0.11	0.01
Insurance company	0.11	0.05	0.16	0.00	0.51	0.00	0.00	0.31
Brokerage firm	0.01	0.12	0.13	0.00	0.65	0.00	0.00	0.22
Mortgage bank	0.00	0.00	0.00	0.00	0.98	0.00	0.00	0.02
Venture capitalist	0.00	0.03	0.03	0.00	0.01	0.00	0.00	0.95
Other	0.01	0.02	0.04	0.04	0.34	0.01	0.09	0.49

our model's key variables. We must also determine the time horizon over which to measure these variables and the set of banks to be used in our analysis. We begin by discussing these choices and describing the basic characteristics of the data. Appendix B provides a more detailed description of exactly how each of our variables is constructed.

A. Measuring Deposits, Liquid Assets, and Commitments

Our data come from the "Call Reports," the regulatory filings that all commercial banks having insured deposits submit each quarter. The Call Reports include detailed information on the composition of bank balance sheets and some additional data on off-balance-sheet items. These data are reported at the level of the individual bank. Since many banks are part of multibank holding companies, we aggregate up the individual-bank data to form holding-company-level balance sheets; henceforth, any time we refer to the empirical properties of our sample of "banks," the entities we have in mind are these holding companies.[22] However, it should be noted that our results are quite similar if we do not bother to do the aggregation, and instead work directly with the individual-bank data.[23]

The Call Reports identify several items that could serve as proxies for our liquid-assets variable S_0. The most obvious of these is cash, since not only is it held for liquidity purposes, it also pays no interest and therefore is costly for banks to hold. However, as discussed above, interest-bearing securities also fit with the spirit of the model, as one can appeal to tax or agency considerations to rationalize a cost of holding them. To measure securities, we begin with the basic Call Report definition of securities holdings, and add to it Federal Funds sold.[24] Thus our baseline proxy for S_0, which we denote by LIQRAT, includes the sum of cash plus securities plus Fed Funds sold, all normalized by assets.[25] We do not include in the numerator of LIQRAT assets held in trading accounts—which are tracked separately in the Call Reports—since these assets may not represent a passive and readily available store of liquidity.

One point to note about the LIQRAT measure is that by including cash, it includes required reserves, which only offer a bank short-horizon liquidity protection when a commitment takedown occurs. More precisely, a bank can accommodate a commitment takedown out of required reserves, but absent

[22] To be a bit more precise: the aggregated balance sheets we create represent all the banks in a given holding company, but do not capture any of the holding company's nonbank assets or liabilities.

[23] Even though multibank holding companies are the norm among larger institutions—accounting for 88 of the 100 biggest entities in our sample—stand-alone banks still dominate the overall sample: of the total of 9,262 entities in our full sample, 87.6 percent are stand-alones.

[24] After March 1994, the Call Reports break securities into two classes, those which are expected to be held to maturity and those which are available for sale. We continue to focus on the sum of the two.

[25] Alternatively, one might include unused loan commitments in the denominator. Normalizing by either total assets or total assets plus loan commitments gives virtually identical results.

an offsetting inflow, would have to find some way (e.g., selling off securities) to replace these reserves by the end of its next reporting period. While buying a week or two of time in this way may be an extremely important function, this suggests that the type of buffer-stocking role played by cash may be distinct from that played by securities. Thus we also experiment with a second liquid-assets measure, SECRAT, which removes the cash and is just the ratio of securities plus Fed Funds sold to assets.

With regard to measuring loan commitments, ideally we would like to isolate the credit that has been extended by the bank which can be drawn down upon demand by borrowers. However, the model also presumes that these withdrawals should be somewhat unpredictable so that they generate a liquidity-management problem for the bank. The Call Reports identify three types of obligations which potentially fit this description. A feature that is common to all three is that the Call Reports only measure the level of *unused* commitments. As we discuss below, this method of measuring commitments could potentially cause problems for our tests and will require us to proceed with care.

The first set of obligations that could be included are standard loan commitments. The borrowers for these commitments range from consumers (through home equity lines of credit), to construction firms (through real estate commitments and construction and development commitments), to other businesses (through commercial letters of credit, securities underwriting commitments, and "other commitments" which are mainly obligations to supply loans to commercial and industrial firms). These conventional commitments clearly fit the notion of liquidity provision embodied in the model.[26]

The second set of obligations to be considered are credit-card commitments. The aggregate lines associated with credit cards are large, equal to roughly the amount of all the other commitments in the first category.[27] However, we have a couple of concerns about lumping credit cards together with the aforementioned types of commitments. First, we worry that a significant fraction of credit-card lines are unlikely to ever be drawn upon, since many credit-card customers—often those with the highest limits—pay their balances in full each month. This implies that the amount of real liquidity services offered through a dollar's worth of credit-card commitments may be much less than the comparable figure for conventional commitments. A further issue is that the credit-card business is dominated by a small number of banks: as of the second quarter of 1995, 78 percent of all balances outstanding reflected cards issued by the top 25 banks. On the one hand, this suggests that the results of our equal-weighted regressions should hardly change if we do lump together credit card commitments and conventional commitments; we have verified that this is in fact true. On the other hand, we doubt that our model captures many of the factors governing card

[26] See Shockley and Thakor (1997) for a detailed analysis of the contractual structure of loan commitments.

[27] For instance, as of the end of 1995, the ratio of credit card commitments to the sum of credit card commitments and all other types of commitments was 0.516.

issuance at the leading credit-card banks. Consequently, we opt to exclude credit cards from our baseline definition of commitments.[28]

Similarly, our baseline proxy for commitments also excludes a third type of commitment-like obligation: standby-letters-of-credit (SLOCs). The regulatory guidelines indicate that SLOCs are distinguished from other letters of credit and loan commitments because of "the fact that the funding is triggered by some failure to repay or perform some obligation." This wording suggests that—counter to the spirit of our model—a bank is likely to have some warning that it may be called upon to provide funding with an SLOC, if, for example, it can predict when a client is approaching financial distress. As a practical matter, these subtleties make little difference because the aggregate volume of SLOCs is quite small relative to other forms of commitments.[29] Indeed, we have verified that all our results are virtually identical if we include SLOCs in our measure of commitments.

Having settled on a measure of commitments, we again need a way to purge it of pure size effects. In doing so, we also want to avoid comingling the lending decision with the liquid-assets-holding decision. This desire to abstract from capital-structure considerations means that we cannot use assets as our denominator. Instead, we look at the magnitude of commitments relative to loans. To do this, and to minimize the impact of any outliers, we use the ratio of conventional commitments over the sum of commitments plus loans as our proxy, and call this variable COMRAT.

In addition, in a robustness test that we describe below, we seek to isolate those commitments associated with a single specific type of lending activity, C&I (commercial and industrial) lending. To do this, we take those commitments labeled "other commitments" in the Call Reports—which are predominantly, though not exclusively, commitments to make C&I loans—and divide them by the sum of C&I loans plus other commitments. We call this variable CICOMRAT.

The construction of our deposit proxy raises many of the same considerations as the commitment proxy. Specifically, we need to decide which of the various types of deposits identified in the Call Reports are most similar to the variable D_0 in the model. We also need to find a scaling procedure that eliminates size effects in a sensible way. Historically, one might have been able to use what the Call Reports label "demand deposits" (defined as non-interest-bearing deposits which are payable on demand) as a clean measure of D_0. Clearly these deposits (which as of 1995 still accounted for about 21.5 percent of all deposits) fit with the concept described in the model. However, over the last 20 years, a number of other accounts have emerged

[28] As a robustness check, we have also rerun all our regressions with a sample that excludes the most credit-card-intensive banks—those in the top 10 percent of the sample as ranked by the ratio of credit-card commitments to total commitments. The results are very close to those we report below.

[29] At the end of 1995 for all banks, the ratio of net performance SLOCs plus net financial SLOCs to total commitments (including credit cards) plus all net SLOCs is about 7.1 percent. Also, SLOCs seem to be much more prevalent among large banks.

which provide transactions services while paying some interest to depositors. In this case, the regulations embedded in the Call Reports offer a convenient classification scheme since all accounts that can be used for transactions purposes are aggregated into a single category called "transactions deposits." We use transaction deposits in the numerator of our deposit proxy.

In focusing on transactions deposits, we exclude certain types of deposits which may be accessible on demand but subject to certain limitations. For instance, a money market deposit account restricts the holder to writing no more than three checks per month but typically offers a return close to the Treasury-bill rate. We suspect that this type of account is closer to a savings account than to the deposits described in our model.[30] However, we find that using a broader measure that includes both money market deposit accounts and transactions accounts makes no difference to our main results.

To normalize our deposit proxy, we could, in principle, scale by a variety of measures of bank liabilities. We opt to use total deposits as our baseline denominator. Thus our empirical deposit variable, which we call DEPRAT, is the ratio of transactions deposits to total deposits. We have also experimented with narrower measures—such as the sum of transactions deposits and time and savings accounts—in the denominator of this ratio, and find that this also has little effect on our results.

B. Sample Formation

We try to minimize the number of banks that are excluded from our sample, in an effort to avoid creating any sample-selection biases. Therefore, we do not condition on whether banks are continuously in our sample or whether they engaged in mergers. (Fortunately, it turns out that screening on these criteria does not change any of our principal findings.) The only condition for inclusion is that a bank has at least eight quarters' worth of data during the period between 1992 and 1996.

We collect data over this five-year window because we believe that having some time-series data helps us to address a potential econometric problem. This problem arises because the commitment data from the Call Reports capture *the actual volume of unused* commitments. At high frequencies, this may differ from the concept in our model, which is, roughly speaking, the bank's *target level of unused* commitments. Consider the following example of how things might go awry econometrically. Suppose that a small bank has as one of its major customers a local builder, who is both a depositor and a commitment borrower. Now imagine that this builder experiences a liquidity shock. In an effort to cope, he drains his checking account—thereby reducing transactions deposits—and also draws down his line of credit. Given the way things are measured, this will show up as a reduction in commitments,

[30] We also exclude items such as wholesale CDs. In addition to the fact that they are not demandable, another rationale for excluding them is that they pay roughly security-market rates of interest. In the context of our model, it is crucial that deposits pay below-security-market rates, so that the bank earns rents from issuing them.

and we may spuriously estimate a positive correlation between transactions deposits and commitments that is not due to the liquidity synergy that we hypothesize, but rather to high-frequency liquidity-demand shocks.

Having several years' worth of data helps us to address this concern in a number of ways. Our first, most basic approach is to time-average the bank-level data. By doing so, we remove any high-frequency variation in liquidity demand that might be generating the sort of mechanical correlation just described. Intuitively, over a period of several years, a bank's average observed level of unused commitments should closely approximate its target level of unused commitments. So our baseline sample uses the average values of all of our proxies over the last five years for which complete data is available. As an aside, the particular five year interval we use (1992 through 1996) also has the advantages of excluding any business cycle turning points and having had the Basle risk-based capital standards fully in place.[31]

In addition to the time averaging, we have in unreported robustness tests investigated two other alternatives that draw on the panel structure of the data to assess the importance of high-frequency shifts in liquidity demand. One set of tests involves running panel regressions to see if any correlations increase when we just pool all the data without doing the time averaging. It turns out that the correlations in the raw, unaveraged data are, if anything, slightly weaker than those we report below, suggesting that spurious hard-wiring due to high-frequency liquidity shocks is not very important.

As another alternative to time averaging, we have also conducted instrumental variables estimation in which the lagged (four or eight quarters) value of DEPRAT is used to instrument for the current value. The results are very similar to those shown below. This also suggests that the results are driven by the permanent across-bank variation in the data, and not by high-frequency within-bank variation in liquidity demand. To conserve space, we only report results for the time-averaged data.

C. Descriptive Statistics

Table II shows information on our principal variables, COMRAT, DEPRAT, LIQRAT, and SECRAT, for both the entire sample of banks and for three subcategories of banks based on the size of average assets. The data reveal several noteworthy patterns. First, large banks generally do more commitment-intensive lending—the median value of COMRAT for the 100 largest banks is 0.262, as opposed to 0.075 for the smallest banks. On the other hand, as is well known, small banks hold substantially more in the way of liquid assets (median LIQRAT = 0.404) than their larger counterparts (median

[31] For banks with less than five years of data, we use all the available observations to form the averages. However, the results from analyzing a sample where only banks with five full years of data are available and the banks have not undergone any significant mergers (defined as acquiring another bank with more than 10 percent of the acquiring bank's assets) are very similar to those shown below.

Table II

Basic Descriptive Statistics for Deposits, Liquid Assets, and Commitments: Full Sample

The sample begins with all federally insured banks between 1992 and 1996. All banks within the same holding company are aggregated together to form a single holding-company-level observation, and observations for which there are less than eight quarters of data are then dropped. Size categories are based on the average level of real total assets: Large banks are the 100 banks with the highest values of average real assets; medium-sized banks are the next 500 banks; and small banks are the remaining banks. LIQRAT is the ratio of cash plus securities to assets. SECRAT is the ratio of securities to assets. DEPRAT is the ratio of transactions deposits to total deposits. COMRAT is the ratio of loan commitments to loan commitments plus loans. Q1 indicates the first quartile, Med. refers to the median, and Q3 denotes the third quartile.

1992–1996 Time-averaged Data	All Banks (N = 9,262)			Large Banks (N = 100)			Medium-sized Banks (N = 500)			Small Banks (N = 8,662)		
	Q1	Med.	Q3	Q1	Med.	Q3	Q1	Med.	Q3	Q1	Med.	Q3
LIQRAT	0.319	0.401	0.511	0.264	0.313	0.369	0.293	0.369	0.453	0.322	0.404	0.515
SECRAT	0.262	0.344	0.454	0.198	0.249	0.302	0.244	0.318	0.399	0.264	0.347	0.458
DEPRAT	0.223	0.281	0.345	0.241	0.293	0.327	0.167	0.263	0.327	0.225	0.282	0.346
COMRAT	0.041	0.078	0.127	0.186	0.260	0.333	0.086	0.134	0.180	0.039	0.075	0.120

LIQRAT = 0.313). Lastly, the table shows that there is considerable variation in DEPRAT within each subsample, but no clear correlation for this measure with bank size.

D. Regression Results

Having established the basic properties of the data, we now present some evidence regarding our two within-banking-sector predictions. Given the overwhelming importance of bank size documented in Table II, we take two steps to control for size. First, we conduct the analysis for both the full sample and separately for each of the size-based subsamples. Secondly, we also control for size within each sample by including the log of real bank assets in all of our regressions. In unreported robustness checks, we have also tried including two further size terms, corresponding to the square and the cube of the log of bank assets. These additional terms have no effect whatsoever on our results.

Finally, the regression results shown in the subsequent tables also include a set of regional dummy variables (for each Federal Reserve District), and information on the composition of each bank's loan portfolio, specifically: the ratio of commercial and industrial loans to total loans; the ratio of real estate loans to total loans; and the ratio of loans to individuals to total loans. We view the loan composition and regional dummies as further attempts to soak up variation in customer liquidity demand—in this case, across-bank variation—that might be problematic. More specifically, these proxies should help control for any propensity of different types of borrowers to have simultaneously greater demand for both transactions deposits and commitments. This helps counter an objection of the sort: "Bank *X* has high levels of both transactions deposits and commitments not because of any liquidity synergy, but rather because it caters to a particular type of client base that likes both of these products."

An extreme version of this concern is the possibility that, in the cross section, a correlation between transactions deposits and loan commitments might be induced mechanically by compensating balance arrangements, whereby commitment users are required to hold some money in a checking account with the bank providing the commitment. While we cannot get at this possibility directly with the Call Report data, we can provide some comfort from two other sources. First, Berger and Udell (1995) show that loan commitments only rarely (in seven percent of the contracts they examine) involve compensating balance agreements. Second, from the NSSBF, we obtained data on both the total unused lines of credit each firm has, as well as its total deposits. A cross-sectional regression of the former against the latter produces a coefficient that is statistically and economically indistinguishable from zero.

D.1. Prediction 2: Liquid Assets versus Transactions Deposits

In Table III, we report the results of OLS regressions in which we run both LIQRAT (in Panel A) and SECRAT (in Panel B) against DEPRAT. For both measures of liquid assets, we obtain positive coefficients, consistent

Table III

Liquid Assets versus Transactions Deposits

Dependent variable in Panel A is LIQRAT, the ratio of cash plus securities to assets. In Panel B, the dependent variable is SECRAT, the ratio of securities to assets. Each cell displays the point estimate, *t*-statistic, and "explanatory power" for the OLS coefficient on DEPRAT, the ratio of transactions deposits to total deposits. Explanatory power is defined as the coefficient on DEPRAT, times the standard deviation of DEPRAT, divided by the standard deviation of the dependent variable. The other independent variables whose coefficients are not reported include the log of real bank assets, the ratio of commercial and industrial loans to total loans, the ratio of real estate loans to total loans, the ratio of loans to individuals to total loans, and Federal Reserve district dummies. The sample begins with all federally insured banks between 1992 and 1996. All banks within the same holding company are aggregated together to form a single holding-company-level observation, and observations for which there are less than eight quarters of data are then dropped. Size categories are based on the average level of real total assets: Large banks are the 100 banks with the highest values of average real assets; medium-sized banks are the next 500 banks; and small banks are the remaining banks.

	Sample			
	All Banks	Large Banks	Medium-sized Banks	Small Banks
Number of observations	9,262	100	500	8,662
Panel A: Dependent Variable = LIQRAT: (cash + securities)/assets				
Coefficient on DEPRAT	0.227	0.313	0.105	0.235
(t-statistic)	(16.62)	(2.94)	(1.82)	(16.67)
Explanatory power of DEPRAT	0.172	0.309	0.084	0.177
Panel B: Dependent Variable = SECRAT: securities/assets				
Coefficient on DEPRAT	0.153	0.255	0.056	0.158
(*t*-statistic)	(10.83)	(2.64)	(0.95)	(10.84)
Explanatory power of DEPRAT	0.114	0.280	0.045	0.118

with Prediction 2.[32] When we look at either the full sample or the subsample of small banks, the *t*-statistics in both panels are huge, ranging from 10.83 to 16.67.[33] When we look at the large- and medium-sized banks, where the samples sizes are greatly reduced (as we have defined our size classes, we have 100 large banks, 500 medium-sized banks, and 8,662 small banks), the

[32] We also obtain very similar results if we use the ratio of cash to assets as an alternative liquid-assets measure.

[33] To ensure that our full-sample *t*-statistics are not inflated due to some unobserved cross-correlation structure, we performed the following check: We split the full sample into 10 randomly drawn subsamples, and reran all of our regressions separately for each of the subsamples. We could then look to see if the coefficients from the subsample regressions cluster as closely together as implied by the full-sample standard errors. As it turns out, they do. We thank Gene Fama for suggesting this idea.

point estimates are very similar in magnitude, though the t-statistics are naturally much lower, ranging from 0.95 to 2.94.

In an effort to help gauge the economic (as opposed to merely statistical) significance of our results, we also report the "explanatory power" of DEPRAT in each of the regressions, where explanatory power is defined as the coefficient estimate on the DEPRAT variable, times the standard deviation of DEPRAT, divided by the standard deviation of the dependent variable. This can be thought of as measuring what fraction of the variation in the dependent variable is explained by just DEPRAT alone. As can be seen from the table, the explanatory power of DEPRAT for both LIQRAT and SECRAT is generally quite high, taking on values in the range of 0.10 to 0.30 in most of the regressions.

One caveat about these results (suggested to us by the referee) is that our liquidity measures include pledged securities, some of which are pledged against state and municipal deposits. This pledging can induce a relatively mechanical relationship between DEPRAT and either LIQRAT and SECRAT. To ensure that this is not driving our results, we have rerun the regressions in Table III with two modifications. First, we have subtracted pledged securities from the numerator of our left-hand side variables (either LIQRAT or SECRAT). And second, we have subtracted state and municipal transactions deposits from the numerator of DEPRAT. It should be noted that this approach most likely creates a downward bias in the estimated coefficient on DEPRAT. This is because whatever the Call Reports classifies as state and municipal transactions deposits may not correspond exactly to those deposits which require the pledging of securities; consequently, we may be introducing some measurement error into DEPRAT. Nevertheless, even this conservative adjustment has only a modest impact on the results, and does not change the qualitative conclusions reported above, particularly when one focuses on the full sample. For example, in the LIQRAT regression with all banks, the coefficient on DEPRAT is 0.227 (t-statistic = 16.62) in Table III, and it is 0.150 (t-statistic = 10.45) when we adopt these alternative definitions of LIQRAT and DEPRAT.

D.2. Prediction 3: Commitments versus Transactions Deposits

Table IV displays the results of regressing COMRAT on DEPRAT. These regressions test the most basic prediction of our theory, namely that commitment intensity and transactions-deposit intensity should be positively correlated. The table shows that there is indeed a very strong positive correlation. The pattern holds within each size category of banks and is always strongly significant—the t-statistic is 20.21 for the full sample and even attains a value of 3.35 for the 100-observation sample of large banks. Moreover, the explanatory power of the DEPRAT variable is again quite high in these regressions, ranging from 0.181 to 0.242, suggesting that our results reflect a substantial economic effect.

As discussed above, the results of Tables III and IV can be jointly interpreted in terms of an instrumental variables (IV) specification: Taken to-

Table IV

Commitments versus Transactions Deposits

Dependent variable is COMRAT, the ratio of loan commitments to loan commitments plus loans. Each cell displays the point estimate, *t*-statistic, and "explanatory power" for the OLS coefficient on DEPRAT, the ratio of transactions deposits to total deposits. Explanatory power is defined as the coefficient on DEPRAT, times the standard deviation of DEPRAT, divided by the standard deviation of the dependent variable. The other independent variables whose coefficients are not reported include the log of real bank assets, the ratio of commercial and industrial loans to total loans, the ratio of real estate loans to total loans, the ratio of loans to individuals to total loans, and Federal Reserve district dummies. The sample begins with all federally insured banks between 1992 and 1996. All banks within the same holding company are aggregated together to form a single holding-company-level observation, and observations for which there are less than eight quarters of data are then dropped. Size categories are based on the average level of real total assets: Large banks are the 100 banks with the highest values of average real assets; medium-sized banks are the next 500 banks; and small banks are the remaining banks.

	Sample			
	All Banks	Large Banks	Medium-sized Banks	Small Banks
Number of observations	9,262	100	500	8,662
Coefficient on DEPRAT	0.116	0.232	0.160	0.113
(*t*-statistic)	(20.21)	(3.35)	(5.80)	(19.35)
Explanatory power of DEPRAT	0.181	0.207	0.242	0.188

gether, these results imply that if one runs an IV regression of COMRAT on LIQRAT (or SECRAT), with DEPRAT serving as an instrument for LIQRAT (or SECRAT), the estimated coefficient will be positive. Again, the intuition behind such an IV regression—which nicely summarizes the workings of our model—is that commitments are related specifically to those liquid assets which are held to back transactions deposits. By contrast, note that our model does not predict that there will be an unconditional positive correlation between COMRAT and LIQRAT (or SECRAT). For example, this correlation could be negative if there is substantial heterogeneity across banks in costs of external finance. And indeed, this is what we see in the data: A simple OLS regression of COMRAT on LIQRAT for our full sample of banks uncovers a significant *negative* correlation.

D.3. Robustness to Endogeneity Concerns: A Look at C&I Commitments

One final and potentially serious econometric concern that we have not yet addressed is that there may be an endogeneity bias that gives rise to a spurious positive correlation between COMRAT and DEPRAT. There are a number of specific mechanisms that could lead to such a bias, but one natural story (suggested to us by the referee) goes as follows. Suppose there are two banks, 1 and 2, that are initially identical. Now imagine that Bank 1 has a surge in loan demand, which it finances at the margin by issuing nontransactions deposits. This can be thought of as Bank 1 following a pecking-order-type of financial policy, where nontransactions deposits rank high in the pecking order. As we have scaled our variables, this leads mechanically to a decrease in both COMRAT and DEPRAT for Bank 1, and hence might generate an artificial positive correlation between the two in a cross section.

Notice that the problem we face here is not just about scaling per se, but rather is a specific version of the generic problem that plagues the entire literature on investment and financial constraints: We are running an "output" variable (COMRAT) on a capital-structure variable (DEPRAT), and the worry is that the latter is not exogenous, but rather is endogenously linked to the former. To take a concrete example from the financial-constraints literature, consider Lang, Ofek, and Stulz (1996). There the real variable is firm investment, and the capital-structure variable is the firm's leverage ratio, but the fundamental endogeneity problem is the same.

To address the problem, we draw on an insight—due originally to Lamont (1997)—that has been helpful in the financial-constraints literature, and that has been subsequently used by Lang et al. (1996), Houston, James, and Marcus (1997), and several others. Lamont's idea is that it can be informative to look at how the *investment of certain divisions with firms* responds to firm-wide variations in cash flow or capital structure. In the specific Lang et al. context, the endogeneity problem is resolved by looking at the investment of *small divisions* within a firm. The implicit assumption is that even if a firm's overall capital structure is endogenously linked to its overall investment prospects, it is unlikely to be driven by the investment prospects of one of its smaller divisions.

The analogy in our setting is that we can look at the commitment ratio for one small "division" of a bank, namely its C&I lending business. As noted above, we have already constructed an alternative commitment variable, CICOMRAT, which is the ratio of "other" commitments (mostly C&I commitments) to C&I loans plus "other" commitments. We now restrict our attention to a subsample (the "C&I sample") of our universe of banks, those for whom the ratio of C&I loans to total loans is between 10 percent and 50 percent. We use the lower cutoff so as to exclude banks whose involvement in C&I lending is negligible, and the upper cutoff to remove those for whom the C&I business might be a dominating influence on their balance sheets. Fortunately, our conclusions are not sensitive to the use of these particular cutoffs; we have experimented with looser and tighter screens, with very similar results.

Table V displays summary statistics for our C&I sample. As can be seen, 4,257 of our original 9,262 banks—a little less than half—meet the criteria for inclusion in the C&I sample. We lose 20 of our 100 largest banks, and 235 of our 500 medium-sized banks. However, those that remain have similar median values of LIQRAT, SECRAT, and DEPRAT. The medians of our new variable, CICOMRAT, are 0.526 for the largest banks, 0.364 for the medium-sized banks, and 0.241 for the small banks.

In Table VI, we present regressions that are identical to those in Table IV, except that in this case it is CICOMRAT (instead of COMRAT) that is run

Table V

Basic Descriptive Statistics for Deposits, Liquid Assets, and C&I Commitments: C&I Sample

The sample begins with all federally insured banks between 1992 and 1996. All banks within the same holding company are aggregated together to form a single holding-company-level observation, and observations for which there are less than eight quarters of data are then dropped. Size categories are based on the average level of real total assets: Large banks are the 100 banks with the highest values of average real assets; medium-sized banks are the next 500 banks; and small banks are the remaining banks. The sample is then further screened to remove any banks whose ratio of C&I loans to total loans is less than 10 percent or greater than 50 percent. LIQRAT is the ratio of cash plus securities to assets. SECRAT is the ratio of securities to assets. DEPRAT is the ratio of transactions deposits to total deposits. CICOMRAT is the ratio of C&I commitments to C&I commitments plus C&I loans. Q1 indicates the first quartile, Med. refers to the median, and Q3 denotes the third quartile.

1992–1996	All Banks (N = 4,257)			Large Banks (N = 80)			Medium-sized Banks (N = 265)			Small Banks (N = 3,912)		
Time-averaged Data	Q1	Med.	Q3	Q1	Med.	Q3	Q1	Med.	Q3	Q1	Med.	Q3
LIQRAT	0.322	0.397	0.498	0.273	0.313	0.376	0.310	0.387	0.452	0.325	0.399	0.503
SECRAT	0.263	0.338	0.441	0.208	0.251	0.301	0.258	0.330	0.394	0.265	0.341	0.446
DEPRAT	0.248	0.301	0.361	0.260	0.302	0.335	0.252	0.300	0.358	0.247	0.301	0.362
CICOMRAT	0.149	0.251	0.350	0.458	0.526	0.575	0.270	0.364	0.439	0.140	0.241	0.334

Table VI

C&I Commitments versus Transactions Deposits

Dependent variable is CICOMRAT, the ratio of C&I commitments to C&I commitments plus C&I loans. Each cell displays the point estimate, t-statistic, and "explanatory power" for the OLS coefficient on DEPRAT, the ratio of transactions deposits to total deposits. Explanatory power is defined as the coefficient on DEPRAT, times the standard deviation of DEPRAT, divided by the standard deviation of the dependent variable. The other independent variables whose coefficients are not reported include the log of real bank assets, the ratio of commercial and industrial loans to total loans, the ratio of real estate loans to total loans, the ratio of loans to individuals to total loans, and Federal Reserve district dummies. The sample begins with all federally insured banks between 1992 and 1996. All banks within the same holding company are aggregated together to form a single holding-company-level observation, and observations for which there are less than eight quarters of data are then dropped. Size categories are based on the average level of real total assets: Large banks are the 100 banks with the highest values of average real assets; medium-sized banks are the next 500 banks; and small banks are the remaining banks. The sample is then further screened to remove any banks whose ratio of C&I loans to total loans is less than 10 percent or greater than 50 percent.

	Sample			
	All Banks	Large Banks	Medium-sized Banks	Small Banks
Number of observations	4,257	80	265	3,912
Coefficient on DEPRAT	0.209	0.389	0.406	0.198
(t-statistic)	(9.64)	(2.62)	(4.39)	(8.80)
Explanatory power of DEPRAT	0.127	0.283	0.246	0.128

against DEPRAT.[34] Just to restate, our key identifying assumption in this table is that even if DEPRAT is influenced by total bank lending, it is much less likely to be as strongly influenced by a bank's C&I lending, especially if C&I lending is not the bank's dominant line of business. As it turns out, the point estimates in Table VI imply explanatory power very similar to that seen in Table IV. And even with more than half the observations gone, the t-statistics also continue to indicate strong significance, ranging from 9.64 for the whole C&I sample to 2.62 for the remaining large banks. Overall, these results give us a good deal of comfort that our earlier findings are not the product of an endogeneity bias of the sort described above.

[34] We continue to include in the regression all the same controls as before. In particular, it is important that we keep in the ratio of C&I loans to total loans. This is because the numerator of CICOMRAT is "other commitments," which in addition to C&I commitments also encompasses some other commitments. This measurement problem in CICOMRAT is clearly correlated with the extent of a bank's C&I lending. For example, if a bank's ratio of C&I loans to total loans is zero, but it has a lot of "other commitments" (and hence a high value of CICOMRAT) these are very unlikely to be C&I-related commitments. Thus including the ratio of C&I loans to total loans in the regression helps to sop up this measurement error.

V. Conclusions

Recent research on financial intermediation has remained largely silent on the question of what ties together the traditional commercial banking functions of deposit-taking and lending. Our main point is that in a sense, they are just two different manifestations of the same function—the provision of liquidity on demand. This is especially true to the extent that banks are heavily involved in commitment-based lending. After all, once the decision to extend a line of credit has been made, it is really nothing more than a checking account with overdraft privileges, or a demand deposit account with a negative balance.

Once it is recognized that loan commitments and demand deposits represent very similar products, it is an easy step to argue that there may be synergies to offering both. In this paper, we have focused on developing a theoretical and empirical case for one particular such synergy, namely the sharing of the burden of holding liquid assets on the balance sheet. However, it should be noted that there may be other synergies which operate in a broadly similar manner, with commitments and demand deposits sharing the cost of a common resource that helps in the provision of liquidity.

Consider an institution facing the choice of whether it should acquire a commercial banking charter or instead set itself up as a nonbank intermediary. On the one hand, there are clearly a variety of costs associated with being a commercial bank—one has to submit to additional regulation and supervision, capital requirements, reserve requirements, and so forth. On the other hand, one gains access to such valuable government-provided services as the Federal Reserve's discount window, as well as the payments system, with the associated large daylight overdraft privileges. If an institution is going to bear the costs, it will be better off to the extent that these costs can be spread over not just a deposit-taking franchise, but other activities that can also take advantage of the discount window and access to the payments system. Again, lending on a commitment basis would seem to fit this description perfectly.

From a policy perspective, our work suggests that the resilience of the institutional form of the commercial bank may be attributable to real considerations of economic efficiency, rather than simply to historical accident or the distortions inherent in policies such as deposit insurance. Therefore, calls for narrow banking—which are typically premised on the idea that deposit-taking and lending are two totally different and unrelated activities—may be leaving out an important consideration.

A narrow banking advocate might argue that, absent deposit insurance, money market mutual funds would be more efficient at performing the deposit-taking function than banks. One key advantage that money market funds have as deposit-takers is that their deadweight cost of holding securities, as given by τ, is much smaller. To the extent that τ reflects tax factors, the mutual fund form does not suffer from the same double taxation as a banking corporation. Moreover, to the extent that τ reflects agency problems, these too are likely to be greatly mitigated in a money market fund, whose charter—by restricting it to holding highly liquid, investment-grade securities, and requiring it to mark its assets to market on a daily basis—gives its managers much less discretion to engage in the sort of risk-shifting activities that drive bank agency problems.[35]

Of course, the flip side of this sort of narrowly defined charter is that a money market mutual fund simply cannot be in the business of making loan commitments and term loans. In other words, it cannot both have its cake (a deposit franchise without any tax or agency costs) and eat it too (the discretion to engage in traditional, opaque lending-type activities). This is why it may be hard to design a narrow banking structure that delivers the same *overall* economic performance as a bank, even if a money market fund dominates a bank on the pure deposit-taking dimension.

To be more specific, imagine a situation where a traditional commercial bank converts itself into a holding company with two legally distinct subsidiaries: a finance company and a money market mutual fund. Let us grant the narrow banking advocate's point: that having the mutual fund structure allows the deposit franchise to be more efficiently exploited. Is the holding company better off overall? Not necessarily, because an important synergy is lost with the holding company structure. The finance company sub can no longer raise funds internally by tapping the liquid assets of the money market mutual fund sub. In other words, if the finance company sub decides to get into the commitment business and it experiences a liquidity shock, it will now have to resort to a costly new issue in the external capital market, since the mutual fund sub is not allowed to invest in loan commitments. By contrast, in an integrated bank, managers have the discretion to sell off liquid assets and rebalance the overall asset portfolio towards illiquid loans if they so choose. This discretion may give rise to agency costs, but, as our model illustrates, it also can have important benefits.[36]

Beyond the particular issue of narrow banking, this paper points more generally to the merits, as well as the potential pitfalls, of the functional approach to financial regulation advocated by Merton (1995). On the positive side, few economists would quarrel with the idea that regulators should look at the underlying function that a financial product provides, rather than its nomenclature. The danger arises if one defines the functions too narrowly, and therefore fails to see the complementarities between closely related activities. For example, since there are some institutions (like money market funds) that specialize in an activity much like deposit-taking, and others (like finance companies) that specialize in lending, an overly simplis-

[35] A related advantage of money market funds—at least in a world without deposit insurance—is that by precommitting not to engage in risky lending, they ought to be able to offer lower returns to their depositors.

[36] This is just a specific version of the general argument that integration can create value by giving managers the authority to make value-enhancing transfers across lines of business. See, for example, Stein (1997) for a recent treatment.

tic application of the functional logic might lead one to claim that what commercial banks do is spanned by other types of intermediaries. This in turn might be used to argue that there is no need for regulation to be tailored in any way to the particulars of the commercial banking industry; for example, the lending side of a bank might be thought of and treated as functionally indistinguishable from that of a finance company.

In our view, this kind of reasoning misses the key point that bank lending is fundamentally different in nature, and is inextricably tied up with banks' deposit-taking activities. If one insists on assigning activities to functional buckets, it may make more sense to stick both commitment-based lending and deposit-taking into a single bucket, and label the function "liquidity provision." According to this definition, banks are not so obviously spanned by other types of intermediaries, and may legitimately deserve to be thought of as a special type of financial institution.

Appendix

A. Proof of Proposition 2

First, let us derive the optimal commitments and liquid-asset holdings in the various regions. We showed in the text that in Region 1 where $S_0^* < \text{Min}[C^*, D_0]$, we have

$$S_0^* = [C^* + D_0 - 2(\tau/\alpha)]/[2 - \rho] \tag{A1}$$

and C^* solves

$$f + Cf_C = \alpha/(4 - 2\rho)[(2\rho - \rho^2 - 1)D_0 + (1 - \rho)C + 2(\tau/\alpha)]. \tag{A2}$$

The same basic method of solution can be applied to the other regions, with e_1 evaluated differently in each case, according to equation (8) in the text. In Region 2 where $C^* \leq S_0^* < D_0$, this yields

$$S_0^* = D_0 + \rho C^* - 2\tau/\alpha \tag{A3}$$

and C^* solves

$$f + Cf_C = \alpha\rho(1 - \rho)C/2 + \rho\tau. \tag{A4}$$

In Region 3 where $D_0 \leq S_0^* < C^*$, we obtain

$$S_0^* = \rho D_0 + C^* - 2\tau/\alpha \tag{A5}$$

and C^* solves

$$f + Cf_C = \tau. \tag{A6}$$

In Region 4 where $S_0^* \geq \text{Max}[C^*, D_0]$, we have

$$S_0^* = D_0 + C^* - 2\tau/\alpha\rho \tag{A7}$$

and C^* solves

$$f + Cf_C = \tau. \tag{A8}$$

We now trace how C^* and S_0^* move with D_0. Start with $D_0 = 0$. Since $S_0^* \geq 0$, we must be in Region 3 or Region 4. However, we cannot be in Region 4 because (A7) would imply that $S_0^* < C^*$ when $D_0 = 0$, which is incompatible with being in Region 4. Therefore, we start in Region 3. Let us assume continuity of S_0^* and C^* in D_0 in what follows. We will verify this assumption later.

Let C^τ be the value of C that solves (A6). Then $C^* = C^\tau$ in the region. As a result, $dS_0^*/dD_0 = \rho < 1$ in Region 3. This implies that either D_0 will eventually hit S_0^* (and we will move to Region 1) or S_0^* will hit C^τ (and we will move to Region 4). Substituting S_0^* for D_0 in (A5), solving for S_0^*, and recognizing that $S_0^* < C^\tau$ in Region 3, we get the necessary condition to move into Region 1 as $C^\tau < 2\tau/\alpha$. By contrast, if $C^\tau > 2\tau/\alpha$, it is easily shown that S_0^* will eventually hit C^τ and we move to Region 4. So we have two cases to examine.

Case 1: $C^\tau > 2\tau/\alpha$.

Let us quickly describe what happens in Region 4. C^* does not vary with D_0, and has constant value C^τ. Therefore, $dS_0^*/dD_0 = 1$. This implies that we will not leave Region 4 since liquid assets are greater than deposits and commitments to begin with, and while commitments do not change with D_0, liquid assets grow one for one with it. Thus liquid assets will always be greater than deposits and commitments and we will not leave Region 4 however high the level of deposits. So if $C^\tau > 2\tau/\alpha$, we move from Region 3 to Region 4. Commitments are invariant with deposits in both regions.

Case 2: $C^\tau < 2\tau/\alpha$.

In this case, we move from Region 3 to Region 1. Totally differentiating (A1), we get

$$\frac{dS_0^*}{dD_0} = \frac{1}{2-\rho}\left(1 + \frac{dC^*}{dD_0}\right). \tag{A9}$$

In differentiating (A2), we can show that dC^*/dD_0 is less than $(1 - \rho)$. Substituting in (A9), $dS_0^*/dD_0 < 1$. So we do not move to a region where $S_0^* > D_0$. We can only move to Region 2. In Region 2, $dC^*/dD_0 = 0$. Therefore, $dS_0^*/dD_0 = 1$. So S_0^* will continue to be below D_0 as D_0 increases, while S_0^* will continue to be above C^* as D_0 increases. So we will never leave the region.

Having determined the regions we move between as D_0 increases, we now have to show that commitments and holdings of liquid assets are (weakly) increasing in D_0. We know S_0^* and C^* are weakly increasing in D_0 in each region. To show that they (weakly) increase throughout, we have to show that they are continuous in D_0. Clearly, they are continuous within a region. We now show that they are continuous as they transit between regions.

Let us consider the transition between Region 3 and Region 1; the other transitions are similar. Consider Region 3. Let the value of D_0 at which $S_0^* = D_0$ be D^τ. Substituting for S_0^* in (A5) and solving, we get

$$D^\tau = C^\tau/(1 - \rho) - 2\tau/[\alpha(1 - \rho)], \tag{A10}$$

and this is also the value of S_0^*. We know the value of $C^* = C^\tau$. These are the left-hand limits of the functions S_0^* and C^* as D_0 increases to the boundary between the regions. To show the functions S_0^* and C^* are continuous, we have to show the right-hand limits are the same.

In Region 1, S_0^* is described by (A1). Substituting D^τ as described in (A10) for D_0 and simplifying, we get

$$S_0^* = \frac{C^*(1 - \rho) + C^\tau}{(2 - \rho)(1 - \rho)} - \frac{2\tau}{\alpha(1 - \rho)}. \tag{A11}$$

Substituting D^τ as described in (A10) for D_0 and S_0^* as described by (A11) into (A2), C^* is obtained by solving

$$f + C^* f_C = \frac{\alpha}{2}\left[\frac{(1 - \rho)^2(C^* - C^\tau)}{(1 - \rho)(2 - \rho)}\right] + \tau. \tag{A12}$$

Clearly C^τ solves this. As a result, the right-hand limit of $C^* = C^\tau$. Substituting in (A11), we get that the right-hand limit of S_0^* is $C^\tau/(1 - \rho) - 2\tau/[\alpha(1 - \rho)]$. Therefore, the right-hand limits equal the left-hand limits and C^* and S_0^* are continuous in D_0 at the boundary between regions. It is a tedious but straightforward task to show continuity across the other borders also. Thus S_0^* and C^* are weakly increasing in D_0 throughout. Q.E.D.

B. Data Appendix

The underlying source for our bank-level data are the regulatory filings (known as the Call Reports) that all commercial banks having insured deposits submit each quarter. We build up “holding-company” balance sheet data by summing the variables for all the banks in the same holding company, defined as the highest holding company to which a bank belongs (item RSSD9348).

We opt to build up from the underlying individual-bank-level data in the Call Reports rather than try to break out the bank data from filings that are submitted by the actual holding companies themselves. We do so for two reasons. First, thousands of banks are not part of any holding company, and thus data for these single banks must be taken from the Call Reports. Second, and more importantly, there is no easy way to reliably recover the banking activities of a holding company that also has nonbank subsidiaries from the reports that are filed at the holding company level—the accounts between the different parts of the holding company are deeply comingled and are effectively impossible to mechanically separate.[37] The only cost of forming the holding company data in this way is that it is impossible to net out interholding company transfers.

For many of the variables, we can directly use items reported by the banks, but in a few cases, we need to construct our variables. There is also one series where definition changes force us to splice together several series. The remainder of this Appendix identifies the variables that we use and highlights any significant choices we make.

Liquid Assets Proxies

Constructing our proxy for the ratio of securities to assets, SECRAT, is a bit complicated because banks report their holdings of different securities in different items, and the classification system distinguishing the items changes during our sample. Up until March 1994, banks were asked to report all their securities holdings in a single variable, RCFD0390. After that time, there are two series that identify those securities expected to be held to maturity and those that would be available for sale, RCFD1754 and RCFD1773, respectively. We believe that the reporting change did not much affect the estimated total level of securities, which, for our purposes, is what really matters. Following the convention in the reports, we do not count assets that are held in trading accounts—which are ostensibly tied in to trading operations—as securities. However, we do consider Federal Funds that have been sold (RCFD1350) as a liquid asset. Putting all this together means that prior to March 1994, SECRAT is defined as the sum of RCFD1350 plus RCFD0390, divided by RCFD2170. Starting in March 1994, SECRAT is defined as the sum of RCFD1350, RCFD1754, and RCFD1773, all divided by RCFD2170. To get LIQRAT, which is the ratio of cash plus securities to assets, we add cash

[37] There are further problems that arise because the reporting frequency of the holding company reports vary by size, with smaller holding companies only reporting twice per year, and because multiple banking holding companies can exist under one large holding company, generating many duplicate filings. For example, the reporting tree breaking out the subsidiaries of current Citigroup holding companies runs 40 pages.

(RCFD0010)to the numerator of SECRAT. In one of our sensitivity tests, we also work with pledged securities, which correspond to RCFD0416.

Loan Commitment Proxies

As mentioned in the text, banks report data on a number of commitment-like items. The six items that we sum in the numerator of COMRAT are RCFD3814, RCFD3816, RCFD3817, RCFD3818, RCFD6650, and RCFD3411. These items cover home equity lines of credit, real estate commitments, securities underwriting commitments, "other" commitments, construction and development commitments, and commercial letters of credit, respectively. (This means that we ignore credit-card commitments (RCFD3815) and stand-by letters of credit (RCFD3820 and RCFD3822); though as we discuss in the text, we have investigated the impact of these other items in various sensitivity checks.) To create COMRAT, we then divide this numerator by the sum of commitments plus total gross loans (RCFD1400). In our tests using CICOMRAT, we divide "other" commitments (RCFD3818) by commercial and industrial loans (RCFD1766) plus "other" commitments.

In our regressions, we also include as control variables the ratios of (1) C&I loans to total loans, (2) loans to individuals to total loans, and (3) real estate loans to total loans. For each of these three ratios, the denominator is RCFD1400. The numerators are RCFD1766, RCFD1975, and RCFD1410, respectively.

Deposit Proxies

The deposit variable, DEPRAT, is the simplest of indicators to construct because both transactions deposits (RCON2215) and total deposits (RCFD2200) are directly reported. As noted in the text, we also experimented using just demand deposits (RCON2210) in the numerator of DEPRAT and found that this makes little difference. The one piece of judgment we apply is to include both domestic and foreign deposits in the definition of our denominator, total deposits. There is no detailed information available for the maturity (or intended purpose) of foreign deposits, so we cannot get data on foreign deposits for the numerator of our ratio. For the vast majority of banks there are no foreign deposits, so this choice makes absolutely no difference. For the very largest banks, this means we will be understating DEPRAT. However, this seems preferable to completely ignoring the presence of foreign deposits. Finally, in one of our sensitivity checks, we also make use of RCON2203, transactions deposits of states and political subdivisions in the United States.

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Asymmetric Information Effects on Loan Spreads

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Abstract

This paper estimates the cost arising from information asymmetry between the lead bank and members of the lending syndicate. In a lending syndicate, the lead bank retains only a fraction of the loan, but it acts as the intermediary between the borrower and the syndicate participants. Theory predicts that private information, in the hands of the lead bank, will cause syndicate participants to demand a premium and that a large loan ownership by the lead bank should reduce asymmetric information and the related premium. Nevertheless, the estimated OLS relation between the loan spread and the lead bank's share is positive. This result, however, ignores that we only observe equilibrium outcomes and that, in equilibrium, the asymmetric information premium demanded by participants is offset by the diversification premium demanded by the lead bank. Using exogenous shifts in credit risk of the lead bank loan portfolio as an instrument, I measure the asymmetric information effect of the lead's share on the loan spread.

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Asymmetric Information Effects on Loan Spreads

Abstract

This paper estimates the cost arising from information asymmetry between the lead bank and members of the lending syndicate. In a lending syndicate, the lead bank retains only a fraction of the loan, but it acts as the intermediary between the borrower and the syndicate participants. Theory predicts that private information, in the hands of the lead bank, will cause syndicate participants to demand a premium and that a large loan ownership by the lead bank should reduce asymmetric information and the related premium. Nevertheless, the estimated OLS relation between the loan spread and the lead bank's share is positive. This result, however, ignores that we only observe equilibrium outcomes and that, in equilibrium, the asymmetric information premium demanded by participants is offset by the diversification premium demanded by the lead bank. Using exogenous shifts in credit risk of the lead bank loan portfolio as an instrument, I measure the asymmetric information effect of the lead's share on the loan spread.

1. Introduction

Theory suggests that ownership should be an important mechanism for mitigating the effects of asymmetric information. According to the Leland and Pyle (1977) model, an increase in the ownership of the informed party would signal a higher quality of the underlying project thereby reducing the cost of asymmetric information. However, there is little, if any, direct evidence supporting this prediction. The effect of the ownership on the asymmetric information is difficult to show, because ownership is endogenous. The syndicated loan market offers a special case of asymmetric information between the lead bank and participants in the lending syndicate. Consistent with theoretical predictions, the lead bank's ownership of the loan should reduce asymmetric information between the lead and participants, which should reduce the overall loan spread. The advantage of looking at the syndicated loan market is that the lead bank's loan portfolio is observable. This enables me to identify shifts in the lead's ownership that are driven by the lead bank's loan portfolio diversification and that are exogenous to the asymmetric information in the lending syndicate. Using the diversification shifts as an instrument, I am able to isolate the asymmetric information effect of the lead's loan ownership on the spread.

Syndicated loan market is a very important form of corporate financing. In the United States alone, syndicated loan issuance grew from approximately $150 billion in 1987 to $1.7 trillion in 2006. In contrast to a traditional bank loan, which involves a relationship between a borrower and a single lender, a syndicated loan is originated by a "lead bank" which sells pieces of the loan to other (participant) banks. Although it retains only part of the loan, the lead bank acts as the manager for the loan with primary responsibility for ex-ante due diligence on, and ex-post monitoring of the borrower. Participant banks consequently depend on the information collected by the lead bank. However, there is an adverse selection problem because the lead bank has incentives to syndicate bad or risky loans.[1] In addition, there is a moral hazard problem because after the lead bank sells parts of the loan to syndicate participants its incentive to continue monitoring is reduced. Thus, whereas in a traditional bank loan spread is determined by borrower characteristics, in a syndication loan the private content of the information collected by the lead bank induces an additional premium, driven by the degree of information asymmetry between the lead and participant banks.

An increase in the lead bank share of the loan would reduce asymmetric information between the lead and participants and, therefore, *decreasing* the premium demanded by the participant banks. This prediction is the same for the adverse selection and moral hazard effects. However, an increase in the lead bank share of the loan would also increase the lead's credit risk exposure, resulting in an *increase* in the premium demanded by the participant banks. Indeed, Pavel and Phillis (1987), Pennacchi (1988), Gorton and Pennacchi (1995), and Demsetz (1999), showed that credit risk diversification is among the main reasons for loan sales by the lead bank. Thus, there are two opposing effects, asymmetric information and diversification, that *simultaneously* influence the loan spread. Therefore, the loan spreads and syndicate structure observed in the data represent a set of equilibrium points

[1] Lead banks have an incentive to originate high risk loans due to private benefits from building a relationship with the borrower and/or underwriting fees charged by the lead directly to the borrower at the origination of the loan. Cases of wrongdoing by lead banks include the collapse of Penn Square Bank, which, at the time it defaulted, was servicing in excess of $2 billion in participations as well as the more recent instance of Chase Manhattan's $245 million loan to AroChem (Bank Brussels Lambert and Skopbank v. Chase Manhattan Bank, 1996 US Dist. LEXIS 15631). After Chase charged a direct underwriting fee of $4.95 million, the borrower was unable to meet the minimum financial covenants specified in the loan agreement. To keep the participant lenders from abandoning the loan at closing, Chase attributed the missed covenants to market conditions, thus, misrepresenting the real cause of the technical default. In general, litigation between syndicate members is rare because syndicate loans are not considered a security and a loan agreement typically limits the lead bank's liability.

and the adverse selection/moral hazard effect can not be identified without an exogenous instrument.

The instrument proposed here builds on the intuition of Leland and Pyle (1977). The lead bank typically retains a very large share of the loan, and consequently, it is uniquely exposed to idiosyncratic credit risk. Thus, controlling for overall credit risk, a *unique* contribution to the lead bank's portfolio credit risk would shift the diversification premium demanded by the lead bank without affecting the premium demanded by the participant banks. To construct the instrument, for each loan I build the lead bank's loan portfolio and use annual information on industry level default correlations to construct variance of the probability of default of the lead's loan portfolio, a measure that positively correlates with the credit risk premium demanded by the lead bank.

After instrumenting the lead bank's share, I find the asymmetry of information with the syndicate participants to have a large economic cost reflected in the spread charged to the borrower: a 9% change in lead share (from 10% to 19%) translates to approximately a 29 basis points change in loan spread. This estimate implies that information asymmetry within the lending syndicate accounts for approximately 4% of the total credit cost. This result is net of the reputation of the lead bank, and other important mechanisms used to moderate information asymmetry.

Several previous papers have looked at the determinants of the lending syndicate, including Simons (1993), Preece and Mullineaux (1996), Dennis and Mullineaux (2000), Jones, Lang, and Nigro (2000), Lee and Mullineaux (2004), Panyagometh and Roberts (2002), Esty and Megginson (2003), and Sufi (2007). Their common finding is that syndicate structure is determined by the availability of public information about the borrower as much as by loan contract characteristics and borrower credit risk. As there is more public information available about a borrower, a larger fraction of a loan is likely to be syndicated. This relation was previously interpreted as evidence of an information asymmetry problem between the lead bank and participants in a lending syndicate. However, as discussed earlier, the lead share observed in the data is a set of equilibriums resulting from interactions between the lead and participant banks. In the absence of instruments, interpretation of the observed data is problematic to interpret.

To the best of my knowledge, Gorton and Pennacchi (1995) is the only other paper that examines the effect of the lead bank share on the loan spread. In the context of secondary market loan sale, they find a negative relation between selling bank share and premium demanded by buying banks.[2] However, the economic effect is insignificant. Overall, the novelty of my paper is that I instrument the asymmetric information and diversification effects.

The remainder of the paper is structured in four sections: empirical framework and data, results, robustness checks, and conclusions.

2. Empirical framework and data

2.1 Empirical framework

Loan syndication is a process whereby a lead bank initiates a loan and then sells a share of the loan to other financial institutions. Before and after the syndication, the lead bank acts as an agent for the lending syndicate in collecting and processing information about the borrower. Prior to syndication, the lead bank conducts due diligence on the borrower and

[2] Participations sold on the secondary loan market represent claims against the selling banks. In that sense, the premium charged by the buying banks is not part of the interest rate charged by the borrower, and it is, more or less, directly observable.

presents a confidential memorandum to potential buyers summarizing its assessment of the borrower's quality. In addition, after syndication, the lead bank is in charge of monitoring the borrower. Thus, before the loan is syndicated, there is an adverse selection problem, because the lead bank has an incentive to syndicate loans of lower quality.[3] After the loan is syndicated, there is a moral hazard problem, because the lead bank only retains part of the loan and, therefore, its incentives to monitor are reduced. Both adverse selection and moral hazard imply that syndicate participants are exposed to the risk of wrong doing by the lead bank and, as a result, they will demand a higher loan spread.

The adverse selection problem in the lending syndicate can be reduced if the lead bank retains a fraction of the loan. The lead bank knows the true underlying quality of the loan. Therefore, a larger lead bank's share would signal a better loan quality and would reduce the spread demanded by the syndicate participants. If the lead's share is an effective mechanism in reducing the adverse selection problem in the lending syndicate, we would expect to find in the data a negative relation between loan spread and lead bank's share. Similarly, for the moral hazard problem, the larger the lead bank's share, the better the incentives alignment between the lead and syndicate participants, and the lower the loan spread.

Both adverse selection and moral hazard effects suggest a negative relation between loan spread and the lead bank's share. However, there is an additional opposing effect that *simultaneously* affects the observed relation between the two variables. A larger lead bank share increases the lead's credit risk exposure. Hence, the spread demanded by the lead bank is a function of diversification and should be positively related to the share that it retains.

[3] Due diligence associated with the loan issuance is not regulated by the Security Act. In addition, the lead bank has no fiduciary responsibility to the loan syndicate members. Disclaimers of the lead bank's responsibility are extensively covered in a typical loan agreement.

[FIGURE 1]

In the absence of instruments, the *observed* relation between loan spreads and lead bank shares corresponds to a set of equilibrium points resulting from the interaction of the two opposing effects: adverse selection/moral hazard (participants) and diversification (lead bank). The appendix presents a moral hazard version of the theoretical framework that captures identification of the adverse selection/moral hazard effect. Figure 1 summarizes the basic elements of the identification. On the figure, the horizontal axis is the lead share and the vertical axis is the loan spread. The curve with the negative slope corresponds to the participants demand and captures the adverse selection/moral hazard effect. The curve with the positive slope corresponds to the lead bank demand and captures the diversification effect. The demands are not observable directly. For each loan we only observe the equilibrium lead share and loan spread, this corresponds to an intersection of the two pricing schedules. Thus, regressing the loan spread against the lead bank share is similar to regressing price against quantity in the context of a supply and demand analysis, which is meaningless.

To identify the premium demanded by the participant banks, we need to identify a variable (instrument) that would affect lead's diversification without directly affecting the degree of adverse selection or moral hazard in the lending syndicate. In Figure 1, this corresponds to shifting the lead's demand while keeping the participants' demand fixed. The instrument that I use to isolate the adverse selection/moral hazard effect measures each loan's contribution to the credit risk of the lead bank's loan portfolio. The rationale behind this method is that the lead bank's portfolio is not perfectly diversified, and it is uniquely exposed to idiosyncratic risk. In other words, there is a risk component that will be priced by the lead bank but not by the participant banks.

The central risk faced by the banks is the credit risk of their loan portfolio. For each loan, I calculate change in credit risk resulting from the addition of the loan to the lead bank's loan portfolio. To measure credit risk, I use *variance* of the loan portfolio default probability. This measure is an essential element of credit risk management and it directly affects loan spread demanded by the lead bank.[4] It also has an advantage of being computationally similar to the variance of returns of an equity portfolio. Accordingly, for a given bank:

$$\text{Default probability variance} = w'\Omega w, \text{ where} \tag{1}$$

w : loan portfolio weights (bank specific);

Ω : probability of default covariance matrix (economy specific).

Loan portfolio weights and the covariance matrix are computed at the 2-digit SIC level. Typically, banks would use their historical default data to estimate expected default probability and its variance. I use probability of default covariance matrices (Ω) calculated for the U.S. market by Standard & Poor's CreditPro database at the 2-digit SIC level (83 by 83 matrix).[5] The matrices are computed annually (in total, there are 12 matrices corresponding to 1993-2004) using default data over the past three years. A diagonal element

[4] The following quote from a J.P. Morgan Chase 2000 10-K report highlights assumptions used in the construction of the default probability variance: "*Credit risk management begins with an assessment of the risk of loss resulting from the default by a borrower or counterparty. <…> Using statistical techniques, estimates are made of both expected losses (on average, over a cycle) and unexpected losses for each segment of the portfolio. Unexpected losses represent the potential volatility of actual losses relative to the expected level of loss. These estimates drive the credit cost and capital allocations to each business unit.*"

[5] S&P CreditPro database uses economy-wide default data. For example, if at the beginning of 2004 there are 10 companies identified with SIC code 21, and 2 of them default within a year, then the probability of default for SIC code 21 in 2004 is 0.2. Variance matrix (Ω) is estimated using binomial distribution. Ω can also be calculated using the option pricing approach first proposed by Merton (1974). For a comparative analysis of the two methods of assessing probability of default correlations, see De Servigny and Renault (2004).

of the matrix is the variance of the probability of default of a given industry, each off-diagonal element is the probability of default covariance between the two corresponding industries.

Portfolio weights (*w*) are calculated using all completed loans (including non-syndicated loans) issued to U.S. borrowers and reported in Reuters DealScan database. For a given loan, weights are computed using all outstanding loans originated during the previous three years. For example, if a given loan was issued on July 1, 2004, the relevant loan portfolio includes all loans issued after July 1, 2001 and outstanding as of July 1, 2004.[6]

The instrument, the loan's contribution to the credit risk of the lead bank's loan portfolio, is the difference between the default probability variance measured *after* and *before* the loan was added to the portfolio. Only the fraction of the loan retained by the lead is relevant for its portfolio. However, the actual lead's share is determined in equilibrium and, for this reason, it can not be used in the construction of the instrument. Therefore, I use the median lead bank share for each loan size quartile as the new (after) loan weight.

The final sample includes 120 lead banks with an average loan portfolio size of 3,049 deals. For example, the loan portfolio for Bank of America, constructed using DealScan, is approximately 75% of its total domestic commercial loans (50% of its total loan portfolio) as reported in the bank's annual reports. These numbers suggest that a significant fraction of the loan portfolio is incorporated in the analysis. The implied expected default probability for the lead bank's domestic commercial loans portfolio is approximately 0.3%.[7] This is consistent

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[6] Loan portfolios are constructed at the parent level and account for bank mergers. Because loan participants often sell their share in the secondary market, I exclude those loans in which the loan share is smaller than 4%. I calculate exposure on revolver lines to be 50% of the total commitment; this is consistent with a study conducted by JP Morgan Chase (see Araten and Jacobs, 2001).

[7] Average default probability variance of a loan portfolio is estimated to be 0.0037. Using naïve binomial approach, this corresponds to the expected default probability of 0.3% (0.0037=0.003*(1-0.003)).

with Carey and Treacy (1998), who find that probability of default of the banking industry aggregate commercial loan portfolio in 1997 was 0.2%.

Using change in default volatility of the lead's loan portfolio as the instrument, the adverse selection/moral hazard effect is estimated recursively in two stages. Equations (2) and (3) correspond to the first and second stages, respectively. A fitted value of the lead share, computed using the first stage estimates, is used to replace the observable lead share in the second stage.

$$\textit{Lead share} = \alpha_1 \textit{ Controls} + \alpha_2 \textit{ Instruments} + \varepsilon \qquad (2)$$

$$\textit{Required loan spread} = \beta_1 \textit{ Lead bank share}_F + \beta_2 \textit{ Controls} + \upsilon \qquad (3)$$

I control for factors that might affect the level of adverse selection or moral hazard within the lending syndicate and the borrower's credit risk. I specifically control for the lead bank's reputation, presence of collateral, and covenants, because these mechanisms could moderate adverse selection and moral hazard in the lending syndicate. The general set of controls includes non-price loan characteristics, lender and borrower characteristics, and market conditions. While loan spread and syndicate structure are determined simultaneously in the process of syndication, the non-pricing terms of the loan, including amount, maturity, collateral, and covenants, are typically set before the syndication process. This justifies use of loan characteristics as the control variables.

The full structural model is a system consisting of three equations: a participant's demand, a lead bank demand, and an equilibrium condition. Because I use 2SLS estimation, estimating adverse selection/moral hazard effect independently from diversification effect is equivalent to estimating the two effects simultaneously in a system of equations. I will address the credit risk premium (the lead bank's demand) in the robustness section.

2.2 Data and variables overview

Each observation in the analysis corresponds to a separate loan agreement, for which data were collected from the Reuters DealScan database.[8] The starting sample includes information on 23,087 completed dollar-denominated loans, issued between 1993 and 2004 and involving 9,931 different U.S. borrowers, while excluding regulated and financial industries identified as SIC 40 through 45 and 60 through 64. The central explanatory variable in the analysis - loan share retained by the lead bank - is available for approximately 30% of the cases. Some other variables considered in the analysis, including loan spread, borrower's sales at time of loan origination, and maturity also have limited availability. Each regression indicates the actual number of observations used in the analysis. Overall, the resulting sample is biased towards larger and public companies; this, however, should bias my results against finding adverse selection/moral hazard effect.

Syndicated loans can be structured in several tranches, also called facilities. For U.S. companies, a syndicated loan, on average, consists of 1.4 facilities per loan with a median of 1. Identity of participants, syndicate structure, and general contract terms are typically determined at the deal level. Consequently, for deals with multiple facilities, I look at the loan characteristics of the largest tranche that start at the loan initiation. This classification does not significantly affect the distribution of loan type in the final sample.

There are multiple roles that can be assigned to the members of the lending syndicate. To identify the lead bank, I follow the S&P (2006) definitions. If identified, the administrative agent is defined to be the lead bank. If the syndicate doesn't have an administrative agent, then

[8] DealScan is generally accurate in registering loans at the origination. Because league tables are a powerful marketing tool in the syndicated loan market, lenders have incentives to report this data. For more information on DealScan data, see Carey, Post, and Sharpe (1998).

lenders that act as book runner, lead arranger, lead bank, lead manager, agent, or arranger are defined as the lead bank. Cases in which more than one of these roles appears in the lending syndicate are very rare. Following this criteria, 4.7% of deals have more than one lead arranger. In these cases, I calculate the share retained by the lead arranger to be equal to the sum of the shares retained by the multiple arrangers.

I measure the spread using All-in Drawn Spread *net* of upfront fees. All-in Drawn Spread is measured in basis points and it is defined by the DealScan as the total annual cost, including a set of fees and fixed spread, paid over LIBOR for each dollar used under the loan commitment. The largest fraction of an upfront fee typically goes to the lead arranger as the compensation for structuring the loan. Because my focus is on the participant banks demand, I consider spread net of upfront fees.

[TABLE 1]

Other data sources used in the analysis include S&P CreditPro and Compustat. Table 1 presents summary statistics for the variable in the analysis. Construction of the variables, descriptive statistics, and data sources are explained in the appendix.

3. Results

3.1 Instrumental variables

The fundamental of my instrument is that the lead bank is not fully diversified and it has unique exposure to the idiosyncratic credit risk. Indeed, in the process of syndication, lead bank retains, by far, the largest fraction of the loan. Lead bank's average share is 27% or $44 million, whereas the largest non-syndicated loans typically do not exceed $5 million.

Average participant share is 4%; in addition, participants are likely to sell or securitize their risk.[9]

[TABLE 2]

The change in variance of the loan portfolio default probability is calculated using portfolio weights specific to the lead bank. In Table 2, I verify that the instrument is unique to the portfolio of the lead bank. Specifically, I compute the change in variance of default probability using portfolio weights of several other banks, and look at the correlation between the instrument and these alternative measures.[10] The first row in Table 2 corresponds to the instrument. The rest of the rows correspond to alternative benchmarks: a participant with the largest loan share (row 2), a random participant with a commitment in excess of 4% (row 3), a comparable participant based on the market share and portfolio size (rows 4 and 5), and a random competitor outside of the lending syndicate, based on the average loans size and client size (rows 6 and 7).[11] The correlation between the measure calculated for the lead bank and the measures calculated for the participant banks is very small and statistically insignificant, thus confirming that the instrument measures a unique feature of the lead bank loan portfolio.

If there is measurement error in the calculation of the default volatility, it should make my instrument weak, and therefore make it difficult to measure adverse selection/moral hazard effect. To account for potential measurement problems, I also include as an

[9] Ivashina and Sun (2007) show that, in two years following loan origination, approximately half of the participants in the lending syndicate sell their share on the secondary loan market, while the lead banks tend to remain as part of the syndicate.
[10] For compactness I call the instrument "variance", however I report standard deviation of the probability of default of the lead's loan portfolio.
[11] Participant banks are likely to have smaller in-sample portfolios because it appears that banks that enter syndicated loans as participants are unlikely to be syndicated loan underwriters (lead banks). This fact partially explains the increase in variance of the default volatility (rows 2 through 5). If we pick a random, comparable competitor from the pool of lead underwriters (rows 6 and 7), the default probability variance is comparable to that of the lead bank.

instrument the lead bank's lending limit. The lending limit is a simple additional proxy for the lead's loan portfolio diversification. Since banking is a regulated industry, there are regulatory lending restrictions aimed at reducing banks' portfolio credit risk. In particular, loans to a single lender cannot exceed 15% of a bank's capital for uncollateralized loans, and 25% for collateralized loans. But in addition to regulatory lending limits, banks have internal lending limits, often associated with their internal structure. These limits can be binding. Industry studies indicate that many banks with assets in excess of $1 billion have loan-size limits in the $2-$10 million range.[12] Because I do not directly observe the lending limit, I use the DealScan sample and measure the lending limit as a 75th percentile of the dollar size of the lead bank share, calculated over the year prior to the date of analysis. The results are robust to alternative cutting points. As expected, the distribution of the lead share reveals the average lending limit to be only $35 million, much smaller than the regulatory limit.

[TABLE 3]

Table 3 presents results for the first-stage regression. The focus of the table is on the two instruments: change in default probability variance and lending limit. Both instruments are jointly statistically significant in explaining the share retained by the lead bank. In addition, the signs on these coefficients are consistent with the instruments' economic interpretation. Specifically, an increase in default probability variance reflects a higher credit risk and, therefore, if the loan share is held constant, the lead bank will demand a larger spread. This predicts a negative partial correlation between the lead bank share and change in default probability variance. Similarly, lower lending limit is associated with a higher credit risk. This predicts a positive partial correlation between the lead bank share and lending limit.

[12] See, for example, Bromiley and Stansifer (1994).

3.2 Identification

The general rule for identification of a structural model is that both rank and order conditions are satisfied. Consistent with the rank condition, equations in my system are linearly independent. The order condition requires that the number of instruments not be smaller than the number of endogenous variables in any equation. It is satisfied in my model in that the premiums demanded by both participants and lead are overidentified (i.e., there are more instruments than endogenous variables).

Having two instruments enables me to test the overidentifying restrictions. Accordingly, overidentifying restriction is not rejected with p-value equal to 0.30. This confirms the joint validity of my instruments and is further evidence of the efficacy of my economic model.

To ensure that identifying instruments are jointly significant, I estimate the reduced form for lead bank loan share reported in Table 3 before estimating the equation by 2SLS. The critical value for the F test of joint significance being quite large, we can proceed with the second stage of the 2SLS estimation of the loan spread equation.

3.3 Spread required by the participant banks: Information asymmetry effects

[TABLE 4]

The main result of this paper is presented in Table 4. In each regression, the dependent variable is the loan spread, and the focus is on the coefficient on the lead share. There is a dramatic difference between the OLS (using unconditional lead share) and 2SLS (using fitted lead share) estimates. This illustrates the bias present in the estimates, if the joint determinants of the loan spread and lead share are not properly accounted for. The negative coefficient on the fitted lead bank share measures the relation between lead share and the loan spread demanded by the syndicated participants due to adverse selection/moral hazard problem.

The economic significance of this coefficient is large: a 1% (10% to 11%) increase in lead bank share corresponds to a 3.26 basis points reduction in the average participant's premium. Thus, one standard deviation decrease in the fitted value of the lead bank share implies a 41 basis point or 28% increase in the loan spread. However, the first stage regression indicates that logarithm of facility amount is one of the central determinants of the lead bank share. One standard deviation change in logarithm of facility amount implies a 9% change in the lead share. Thus, conditional on economically sound variation in loan size, 9% change in the lead share translates into an approximately 29 basis point change in loan spread. At an average LIBOR rate of 559 basis points and upfront fees of 40 basis points, information asymmetry within the lending syndicate accounts for 4% of the total credit cost.[13] Although, 9% is still an economically large change in lead share, because it is equivalent to a $24 million increase in lead bank exposure.[14]

All regressions include year, loan purpose, and bank fixed effects. In addition, I control for lead bank's reputation and several loan characteristics (including performance pricing, covenants, and collateral) that affect the level of information asymmetry within a syndicate. Performance pricing ties loan spread to the firm's financial indicators, allowing for the

[13] LIBOR of 559 corresponds to the 1993-2004 average of a 3-month interbank rate (source: Datastream).

[14] Standard errors used to compute the significance of the second stage estimates account for the use of fitted value from the first stage as an instrument. Given that the first and second stages are linear and all exogenous variables are included in the first stage, this adjustment represents a special case of the Murphy-Topel two-step adjustment. In general, using clustered errors in two-step estimation is questionable. Following the analysis by Petersen (2007), clustering of standard errors should be evaluated as a reference, rather than the ultimate result. I considered clustering of errors at the bank, firm and industry levels. The changes in standard errors are relatively small, thus suggesting that auto-correlation in the residuals is not significant. The results are available upon request.

spread to change automatically with the changes in the leverage and/or interest coverage ratio. Asquith, Beatty, and Weber (2004), find that the inclusion of performance pricing in bank debt contracts is more likely when the borrower is less transparent. Consistent with my finding, the presence of performance pricing should reduce the costs of asymmetric information within the lending syndicate and, therefore, reduce the premium demanded by the participant banks. The same intuition applies to the inclusion of collateral and financial covenants, although I find a positive sign for these two features.[15]

The availability of public information about borrowers directly affects the informational asymmetry between the lead bank and syndicate participants. The less transparent the borrower, the more syndicate members will have to rely on the information collected and reported by the lead bank. Throughout the paper, I measure information transparency by introducing explicit controls for credit ratings and borrower's size. In addition, for the sample matched to Compustat, I control for asset size, leverage, and profitability. The results continue to hold, and their diminished statistical and economic significance is consistent with the reduced importance of bank information collection in a sample of publicly transparent companies. To assure that reduction in statistical significance is not attributed to omitted variables, regression (2) and (3) present results before and after inclusion of accounting measures. If measurement of credit risk would be a problem, the coefficient on the lead share without proper controls would be downward biased (steeper negative slope in the participants demand). Thus, introduction controls for size, leverage and profitability should bring the

[15] All non-price characteristics of a loan contract are set prior to determining spread and syndicate structure. However, to account for potential endogeneity of loan characteristics, I also estimate Heckman (1978) treatment effects. The results are qualitatively similar and available upon request. In addition, I consider alternative definitions of the financial covenants, including that of Bradley and Roberts (2004). These changes do not affect the results.

coefficient on the lead share up. However, the change is insignificant, suggesting that imprecision in controls for credit risk is an unlikely source of bias.

4. Robustness of the results

4.1 Spread required by the lead bank: Diversification effect

The identification of the adverse selection/moral hazard effect depends on the fact that the lead bank is not fully diversified. In Table 5, I directly test the relation between the lead's share and the spread that it demands. The diversification effect indicates that, as the lead bank share increases, the lead bank becomes more exposed to the credit risk and, therefore, it will demand a higher spread. Similarly to the adverse selection/moral hazard effect, the diversification effect is not directly observable, and can not be identified without proper instruments. To identify diversification effect, I need an instrument that exogenously shifts the level of asymmetric information within the lending syndicate without directly affecting the lead bank credit risk exposure. The lead bank reputation directly affects level of asymmetric information within the syndicate, but it is an unlikely element of a credit risk model. Thus, I use syndicate-specific reputation, measured in terms of the previous connections between syndicate members, to instrument the diversification effect.

My main reputation measure is the maximum number of deals arranged by the same lead bank with the same participants, measured over a three-year horizon and expressed as a percent of the total deals underwritten during this period. To illustrate, assume that for a given syndicate loan, A is the lead bank and banks B and C are the participants. If bank B and bank C participated in 10% and 20%, respectively, of the deals underwritten by bank A over the past three years, the reputation measure for this loan would be 20%. In my sample, the median and mean of this reputation measure is 11% and 12.5%, respectively. In addition, to account for reciprocal relationships, I use a dummy variable that indicates a past relationship in which the participant and lead banks switched roles. Correlation between the reputation variables is low, confirming that they measure different aspects.

Higher reputation measures reflect lower levels of asymmetric information within the syndicate. Alternatively, for a given spread, when reputation is high, the lead bank would syndicate a larger fraction of the loan. Consequently, I expect a negative sign between the lead bank share and reputation measures. The predictions are consistent with the first stages results in Table 3.

[TABLE 5]

Table 5 reports results of the second-stage regression corresponding to the lead bank's required spread. Measures of syndicate-specific reputation are the identifying instruments, and, therefore, are not included in the second stage regression. As in Table 4, the key coefficient corresponds to the lead bank loan share. The point estimate is, again, significantly different from the OLS analysis. The positive relation between the share retained by the lead bank and the required spread is consistent with the diversification effect. As expected, the risk factors' impact on the spread demanded by both lead and participant banks is similar. It is important to notice that identification of asymmetric information effect and diversification effect are tested *independently* from each other, thus reinforcing the overall validity of the findings.

4.2 Alternative credit risk management techniques

Variance of the default probability of the lead's loan portfolio is, most likely, measured with an error. However, because it is used as an instrument, precision in the measurement is of the secondary order. The central point is that my instrument correlates with the portfolio specific credit risk. Additionally, for the adverse selection/moral hazard identification to be conceptually invalid, the lead bank needs to be able to eliminate its idiosyncratic exposure at zero or fixed costs. Using active risk management is costly and, in that sense, it would directly affect the cost of credit. Nevertheless, a bank's actual credit risk exposure might be difficult to measure because banks use unobservable risk management techniques including credit derivatives (CDS), securitization through collateralized loan obligations (CLO), and loan sales on the secondary market.

While these mechanisms are becoming more and more popular they were not very important between 1993 and 2004. In fact, CDS on loans started trading in 2004, and standard documentation for the U.S. market was published by the International Swaps and Derivatives Association in June 2006. The first CLO completed by a U.S. bank occurred in late 1997. Total CLO volume for 1997-2001 (U.S. market) is estimated around $100 billion, less than 2% of the total amount of syndicated loans.

Fractions of syndicated loans can also be resold on the secondary loan market. However, less than 5% of the loans originated between 2000 and 2004 are quoted in the secondary loan market. The numbers are even smaller for the previous years. Most of the quoted loans are packaged specifically for institutional investors and therefore are unlikely to have an important information asymmetry problem within the syndicate. Thus, I excluded all the quoted loans from my sample. More broadly, while loan contracts do not explicitly prohibit the lead bank to sell its share, they do require borrower approval for the sale to go though. In that sense, it is unlikely that selling loans on the secondary market is an important way for the lead bank to reduce its credit risk due to "sensitive client relationship issues arising from loan transfer notification requirements, loan assignment provision, and loan participation restrictions" (OCC, Capital Interpretations, 1999). Analysis of the secondary market data indicate that trading of syndicated loans typically occurs at the participant level, and that most traded loans are loans syndicated to institutional investors. Additional supporting evidence can be found in work on loan sales by Dahiya, Puri, and Saunders (2003) and Drucker and Puri (2006), Ivashina and Sun (2007).

4.3 Upfront fees

[TABLE 6]

Lead bank's compensation consists of an upfront fee not shared with the rest syndicate and spread. One might wonder if the upfront fee, rather than the spread could be used to compensate lead bank for the credit risk exposure. Evidence suggests that there is not much variability in the upfront fees, making it an unlikely channel to settle a diversification premium. I provide additional evidence in Table 6, where I analyze the key result of the paper in the sample where upfront fees are available, approximately 20% of my sample. Thus, Table 6 uses the same specification for two different dependent variables: all-in-drawn spread net of upfront fee, and upfront fee. If upfront fee would be used to settle a diversification premium, then the variance of the default probability of the loan portfolio, constructed to measure the lead's idiosyncratic risk exposure, should be important in explaining upfront fee and not net spread. The estimation of a reduced form for spread (spread as a function of all the exogenous variables) confirms that default probability variance is important in explaining spread but not upfront fee. When upfront fee is used as the dependent variable, there is a significant drop not only in statistical but also in economic explanatory power of variance of default probability.

Conceptually, it is not clear if asymmetric information cost is due to the moral hazard or adverse selection problem between lead banks and syndicate participants. If this is an adverse selection problem, consistent with Leland and Pyle (1977), asymmetric information can not be resolved through a fixed payment (upfront fee).

4.4 Monitoring synergies

There is a concern that concentration of the lead's loan portfolio could be explained by the monitoring expertise of the lead bank. Consistent with the diversification effects, loan portfolio concentration in a particular industry should be associated with higher credit risk and, therefore, the lead bank should demand a higher spread. However, if industry concentration of the loan portfolio is associated with synergies in information collection and monitoring, the spread demanded by the lead bank should be lower. In terms of Figure 1, higher credit risk would shift the lead bank demand to the right and industry monitoring expertise would shift the lead bank demand to the left. This generates opposite predictions for the coefficient on the variance of the probability of default in the first stage regression. Table 3 indicates that an increase in variance off the default probability is associated with the lower lead bank share. This result is consistent with the diversification effect.

[TABLE 7]

Table 7, provides additional evidence by reexamining the central result of the Table 4 for the sample where the loans are issued to industries where lead bank's share of the loan portfolio is less than the sample median (3%). This sample corresponds to the cases in which the lead bank does not have monitoring expertise. If concentration of the loan portfolio is affected by the monitoring expertise of the lead bank, then the results for this sub-sample should not hold. However, the results remain qualitatively the same.

4.5 Adjustment for recovery rates

In the second section, I discussed the construction of change in default probability variance, my main instrument for identifying adverse selection/moral hazard effects. Table 8 examines the robustness of the relation between the spread and the lead share presented in Tables 4 and 5 to alternative specifications of the change in variance of default probability.

[TABLE 8]

Overall, the results in Table 8 confirm the economic and statistical significance of the adverse selection /moral hazard and diversification effect. Perhaps most interesting is the part that corresponds to adjustments for recovery rates (lines 8 through 11). Loss in the event of default is an important component of expected loss, and was not considered in the calculation of the original instrument. I use four alternative proxies for the recovery rates: credit ratings; industry asset tangibility; presence of collateral; and leverage. I scale down the default probabilities for companies likely to have high recovery rates. The results are not sensitive to the scaling factor. Overall, the adjusted measures are highly correlated with the original measure, and the central results remain economically strong and robust.

5. Conclusions

In this paper, I examine how the lead bank's ownership share of the loan affects the information asymmetry in the lending syndicate, and the loan spread charged to the borrower. The observable relation between the lead share and loan spread is endogenous. I instrument the true effect of ownership on the asymmetric information premium, using shifts in the lead bank's credit risk exposure. Thus, I find the information asymmetry problem within a syndicate to have an important economic impact on loan spread. In particular, I find that a 9% increase in the share retained by the lead bank reduces by approximately 29 basis points the spread required by participants (4% of the total cost).

I conclude that in this market information asymmetry and, thus, the cost of borrowing, can be effectively reduced by controlling the share of the loan retained by the lead arranger. Overall, this paper provides a framework for understanding the syndicated loan market structure as well as banks' merger activity.

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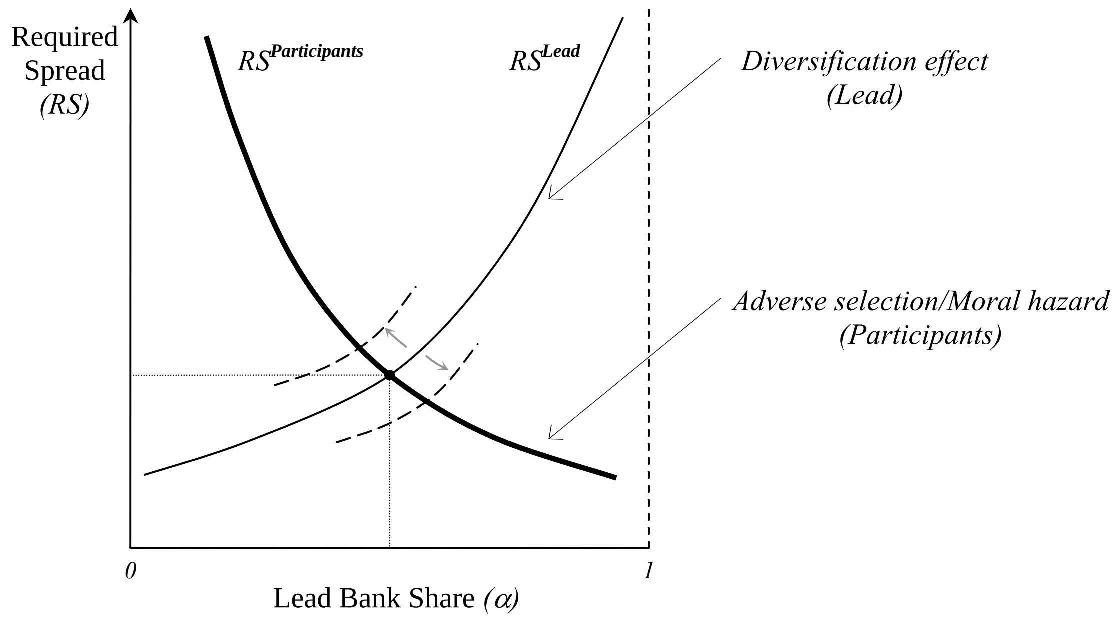
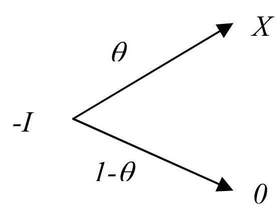
FIGURE 1
SIMULTANEOUS NATURE OF LOAN SPREAD AND LEAD BANK SHARE



Appendix 1

Lead bank's credit risk exposure is an increasing function of its loan share. However, credit risk exposure of the syndicate participants (per dollar of the loan held) is unaffected by the lead's share. Thus, I argue that, for each loan, credit risk component specific to the portfolio of the lead bank exogenously affects the lead's share of the loan; i.e., it only affects interest rate through the lead share. This is the nature of the instrument used to identify the asymmetric information effect. The following simple setup formalizes this idea in a moral hazard framework

Borrower's investment opportunity is a risky project that requires an investment of I dollars and the resulting returns are either high X or low 0. The probability of the high outcome is θ, and it is a function of monitoring by the lead bank. Only the lead bank knows its effort (θ):



The project is financed using a syndicated loan. Conditional on success, a borrower pays back to the lenders the principal plus the interest rate R, and a fixed fee F. Syndicate participants behave competitively and realize zero profit:

$$I=\theta R \quad \text{or} \quad R=(I/\theta)$$

For a given lead bank share, optimal monitoring solves:

$$\max_{\theta}\ \alpha\theta R - \tfrac{1}{2}\beta\theta^2$$
$$\alpha R - \hat{\theta}\beta = \alpha\tfrac{I}{\hat{\theta}} - \hat{\theta}\beta = 0$$

$$\hat{\theta} = \sqrt{\tfrac{\alpha I}{\beta}}$$

As the lead's share of the loan increases, it faces a higher idiosyncratic credit risk cost (αC) due to lack of diversification. Monitoring cost is independent of the lead's credit risk exposure. Thus, optimal loan share solves:

$$\max_{\alpha}\ (\alpha\theta R - \tfrac{1}{2}\beta\theta^2 - \alpha C + F) - \alpha I$$
$$\text{s.t. } \theta(X - R) - F \geq 0$$

$$\tfrac{d}{d\alpha}(\theta X - \tfrac{1}{2}\beta\theta^2 - \alpha C) = 0$$
$$\tfrac{d\theta}{d\alpha}X - \tfrac{d\theta}{d\alpha}\beta\theta - C = 0$$

$$\tfrac{d\bar{\theta}}{d\alpha} = \tfrac{1}{2}\sqrt{\tfrac{I}{\alpha\beta}}$$
$$\tfrac{1}{2}\sqrt{\tfrac{I}{\alpha\beta}}X - \tfrac{1}{2}I - C = 0$$
$$\hat{\alpha} = \tfrac{X^2}{\beta(2C+I)^2}$$

$$\downarrow C \Longrightarrow \uparrow \alpha \Longrightarrow \downarrow R$$

That is, credit risk unique to the lead's portfolio (*C*) affects the interest rate only through the lead's loan share. This allows me to measure the asymmetric information effect on the interest rate using instrumental variable approach.

Appendix 2
Variable description

Variable	Definition	Source
	Endogenous variables:	
All-in Spread Drawn	All-in Spread Drawn is defined as total (fees and interest) annual spread paid over LIBOR for each dollar drawn down from the loan net of upfront fees	Dealscan
Lead share	Share of the loan that is retained by lead arranger at loan origination	Dealscan
	Instruments:	
Δ Default probability variance	Change in default probability variance of the lead bank calculated at the loan level using loan portfolio weights constructed from Dealscan and CreditPro default correlation matrices	Dealscan/ S&P CreditPro
Lending limit	Bank specific variable defined as 75^{th} size percentile of the loans issued over the past three years	Dealscan
	Explanatory variables:	
Industry default probability	2-digit SIC industry expected loss probability	S&P Creditpro
Senior debt rating	S&P senior debt ratings	Dealscan/ S&P CreditPro
Not rated	Dummy variable equal to 1 if the borrower is not rated	Dealscan/ S&P CreditPro
Commercial paper rating	Dummy variable equal to 1 if the borrower has a commercial paper rating	Dealscan/ S&P CreditPro
Public	Dummy variable equal to 1 if the borrower is a publicly traded company	Dealscan
Sales at close	Sales at close in millions	Dealscan
Assets	DATA6	Compustat
Leverage	Industry adjusted ratio of book value of debt to total assets: [DATA181+DATA10 (or DATA56 or DATA130 depending on availability and in that order)]/DATA6	Compustat
ROA	Industry adjusted ratio of operating income before depreciation to total assets: DATA13/DATA6.	Compustat
Log (Facility amount)	Logarithm of total facility amount in millions of dollars	Dealscan
Maturity	Maturity of the facility in months	Dealscan
Number of facilities	Number of facilities in the loan package	Dealscan
Collateral	Dummy variable equal to 1 if the loan is secured	Dealscan
Financial covenants	Dummy variable equal to 1 if the loan has financial covenants	Dealscan
Prime base rate	Dummy variable equal to 1 if the base rate is Prime	Dealscan
Performance pricing	Dummy variable equal to 1 if the loan has performance pricing	Dealscan
Ranking	Lead arranger's ranking calculated using lead's market share based on the number of deals	Dealscan
Syndicate reputation: Lead to participant	Maximum number of links between the lead bank and a member of the syndicate, scaled by the total number of deals arranged by the lead bank; this is a syndicate specific measure calculated over a three-year horizon	Dealscan
Syndicate reputation: Reciprocal (dummy)	Dummy variable equal to 1 if over the past three years lead bank was a participant in a syndicate led by on of the current participants (i.e., lead banks and participant bank switched their roles); this is a syndicate specific measure	Dealscan

TABLE 1
SUMMARY STATISTICS

This table presents descriptive statistics for completed dollar denominated loans, originated between 1993 and 2004, to U.S. companies excluding regulated and financial industries identified with 2-digit SIC 40 through 45 and 60 through 64. Borrowers' and lenders' characteristics are computed as of the earliest date prior to the origination of the loan. For definitions of other dependent variables, please see the appendix.

	Full sample Observations = 5,017			Compustat sample Observations = 3,617		
	Median	Mean	StdDev	Median	Mean	StdDev
All-in Spread Drawn (basis points)	120.00	140.30	102.01	110.00	132.96	100.39
Lead share (%)	22.45	27.17	17.17	21.50	26.55	17.14
Fitted lead share (%)	27.45	27.17	12.35	26.62	26.55	12.87
Industry default probability (%)	1.24	2.16	2.41	1.51	2.33	2.44
Not rated (dummy)	0.00	0.49	0.50	0.00	0.46	0.50
Commercial paper rating (dummy)	0.00	0.18	0.38	0.00	0.21	0.41
Public (dummy)	1.00	0.75	0.44	1.00	0.92	0.27
Previous lending relationship (dummy)	1.00	0.60	0.49	1.00	0.63	0.48
Sales at close ($MM)	520.00	2,383.68	7,473.69	696.66	2,854.79	8,338.42
Log (Sales at close)	6.25	6.35	1.67	6.55	6.60	1.64
Assets ($MM)	--	--	--	649.47	3,294.25	8,657.48
Log (Assets)	--	--	--	6.48	6.67	1.66
Leverage (Ind. Adjusted) (%)	--	--	--	0.02	0.06	0.29
ROA (Ind. Adjusted) (%)	--	--	--	0.03	0.05	0.11
Facility amount ($MM)	125.00	270.69	527.33	135.00	299.73	595.12
Log (Facility amount)	4.83	4.81	1.28	4.91	4.88	1.29
Maturity (months)	36.00	39.00	22.00	36.00	39.00	22.00
Number of facilities	1.00	1.35	0.68	1.00	1.34	0.63
Collateral (dummy)	0.00	0.00	0.00	0.00	0.00	0.00
Financial covenants (dummy)	0.00	0.12	0.32	0.00	0.13	0.33
Prime base rate (dummy)	0.00	0.03	0.16	0.00	0.02	0.15
Performance pricing (dummy)	1.00	0.66	0.47	1.00	0.69	0.46
Ranking	6.00	12.49	16.98	6.00	11.83	16.55
Syndicate reputation: Lead to participant	11.02	12.51	8.02	11.32	12.93	8.15
Syndicate reputation: Reciprocal (dummy)	1.00	0.97	0.18	1.00	0.97	0.17
Credit risk: Δ Default probability variance (%)	0.00	0.00	0.22	0.00	0.00	0.20
Credit risk: Lending limit ($MM)	55.00	63.07	58.03	55.00	64.11	54.55

TABLE 2
DESCRIPTION OF CHANGE IN DEFAULT PROBABILITY VARIANCE

This table presents descriptive statistics for the change in default probability variance used as an instrument to identify the spread required by the participant banks. Change in default probability variance is calculated at the loan level and measures the contribution of the particular loan to the variance of the probability of default of the lead bank loan portfolio. Default probability variance is constructed using 2-digit SIC default covariance matrices from the CreditPro database and bank specific 2-digit SIC portfolio weights computed using Dealscan. The first row corresponds to the measure used in the regression analysis. Other rows are presented for comparison. Largest participant is the participant that retains the largest fraction of the loan. Comparable participant is the participant bank that is closest to the lead bank in terms of size. Competitor is a non-participant bank randomly selected among banks reported in Dealscan that are comparable to the lead bank in terms of loan and client size. The last column reports the correlation between change in default probability variance of the lead bank and the comparison group. ***, **, and * indicate *p* values of 1%, 5%, and 10%, respectively.

	Default probability variance (%)	**Change in Default probability variance (%)**				
	Mean	5th %	Median	95th %	Mean	Corr.
1 *Lead bank*	6.1 ***	-0.025	0.0018	0.047	0.001	--
2 *Largest participant (Loan share)*	12.9 ***	-0.151	0.0053	0.144	-0.010	0.012
3 *Random participant*	7.5 ***	-0.041	0.0037	0.126	0.025 **	0.013
4 *Comparable participant (Market share)*	6.9 ***	-0.022	0.0030	0.034	0.002	0.002
5 *Comparable participant (Portfolio size)*	7.0 ***	-0.019	0.0031	0.037	0.013 **	0.022
6 *Random competitor (Loan size)*	6.6 ***	-0.006	0.0034	0.037	0.008 ***	0.035 **
7 *Random competitor (Loan and client size)*	7.9 ***	-0.009	0.0064	0.109	0.019 ***	0.082 ***

TABLE 3
FIRST STAGE REGRESSION: SYNDICATE STRUCTURE

This table presents results of the first-stage regression. The dependent variable is shares retained by the lead arranger. The sample contains completed dollar denominated loans, originated between 1993 and 2004, to U.S. companies excluding regulated and financial industries identified with 2-digit SIC 40 through 45 and 60 through 64. Model (1) corresponds to the sample where loan data were available. Models (2) and (3) re-examine the result for the subsample of loans matched to Compustat. Borrowers' and lenders' characteristics are computed as of the earliest date prior to the origination of the loan. Syndicate reputation variables are used as identifying instruments for diversification effect (Table 5). For definitions of the explanatory variables, please see the appendix. ***, **, and * indicate *p* values of 1%, 5%, and 10%, respectively.

	(1)			*(2)*			*(3)*		
	Coeff.	t-stat		Coeff.	t-stat		Coeff.	t-stat	
Borrower characteristics:									
Industry default probability (%)	0.24	3.0	***	0.06	0.7		0.03	0.3	
Not rated	5.29	7.3	***	6.49	7.5	***	5.66	6.5	***
Senior debt rating									
AAA	7.41	1.2		12.93	1.6		12.91	1.6	
AA +	4.06	0.9		8.51	1.3		8.67	1.3	
AA	6.92	2.3	**	4.33	1.3		4.68	1.4	
AA -	5.01	2.4	**	3.58	1.5		3.86	1.6	*
A +	5.54	3.5	***	5.73	3.3	***	5.59	3.2	***
A -	4.16	3.5	***	4.47	3.5	***	4.37	3.4	***
A -	2.71	2.4	**	3.27	2.5	**	3.19	2.5	***
BBB +	1.99	2.0	**	1.84	1.6	*	1.95	1.7	*
BBB	1.10	1.2		1.20	1.2		1.20	1.2	
BB +	1.04	0.9		2.73	2.0	**	2.69	2.0	**
BB	-0.49	-0.4		-0.32	-0.3		-0.32	-0.3	
BB -	1.13	1.1		1.59	1.3		1.60	1.4	
B +	4.49	4.5	***	4.82	4.1	***	4.62	3.9	***
B	4.48	3.6	***	5.03	3.4	***	4.83	3.3	***
B -	2.69	1.7	*	0.77	0.4		0.84	0.4	
CCC +	5.61	2.6	***	6.76	2.9	***	6.31	2.8	***
CCC	4.51	1.1		4.24	1.0		4.46	1.0	
CCC-	7.71	1.7	*	7.52	1.5		7.00	1.4	
Commercial paper rating	0.73	1.1		0.94	1.2		1.26	1.6	*
Public	0.21	0.5		0.63	0.8		0.54	0.7	
Previous lending relationship	-1.11	-3.0	***	-1.13	-2.6	***	-1.03	-2.4	**
Log (Sales at close)	-0.52	-3.4	***	-0.44	-2.2	**			
Log (Assets)							-1.35	-5.5	***
Leverage (Ind. Adjusted)							-1.19	-1.6	***
ROA (Ind. Adjusted)							-4.01	-2.1	**
Contract characteristics:									
Log (Facility amount)	-6.69	-30.7	***	-6.49	-24.8	***	-5.88	-20.7	***
Maturity (Months)	-0.03	-3.7	***	-0.03	-3.0	***	-0.03	-3.3	***
Number of facilities	-5.80	-19.2	***	-5.31	-14.3	***	-4.95	-13.3	***
Collateral	0.49	1.2		0.81	1.6	*	0.50	1.0	
Financial covenants	-0.20	-0.4		-0.21	-0.3		-0.33	-0.5	
Prime base rate	1.14	1.0		0.85	0.6		0.95	0.7	
Performance pricing	-1.80	-4.3	***	-1.85	-3.8	***	-2.06	-4.2	***

TABLE 3 – *continued*

Lead bank characteristics:										
Ranking		0.10	3.8	***	0.11	3.8	***	0.11	3.8	***
Credit risk: Δ Default prob. variance (%)	z_1	-2.58	-3.2	***	-1.09	-2.2	**	-1.01	-2.2	**
Credit risk: Lending limit ($MM)	z_2	0.01	2.5	***	0.01	2.2	**	0.01	2.3	**
Syndicate characteristics:										
Syndicate reputation: Lead to participant	z_3	-0.48	-14.3	***	-0.48	-12.1	***	-0.47	-11.8	***
Syndicate reputation: Reciprocal	z_4	-5.00	-5.1	***	-3.67	-3.1	***	-3.68	-3.1	***
Instruments:										
F-test: ($z_1 = z_2 = z_3 = z_4 = 0$)			6.9	***		6.8	***		6.2	***
F-test: ($z_1 = z_2 = 0$)			3.0	**		2.8	**		2.8	**
F-test: ($z_3 = z_4 = 0$)			10.3	***		12.0	***		9.8	***
Fixed Effects:		Yes			Yes			Yes		
Bank		Yes			Yes			Yes		
Year		Yes			Yes			Yes		
Loan purpose		5,017			3,617			3,617		
Observations		0.53			0.55			0.55		
Adjusted R^2		Yes			Yes			Yes		

TABLE 4
DETERMINANTS OF LOAN SPREADS: ASYMMETRIC INFORMATION EFFECT

This table reports results of the second stage regression corresponding to the spread required by the participant banks (asymmetric information effects). Participants' pricing behavior is identified using C*hange in Default probability variance* and *Lending Limit* measurements that exogenously shift the spread demanded by the lead bank. The dependent variable, *All-in Drawn Spread*, includes fixed fees (excluding upfront fee) and variable spread that the borrower pays for each dollar drawn down under loan commitment. Each observation in the regression corresponds to a different deal. The first set of results reports coefficients estimated by OLS. Models (1), (2), and (3) report point estimates for the second stage regression using predicted values for share retained by the lead arranger from Table 3. The sample contains completed dollar denominated loans, originated between 1993 and 2004, to U.S. companies excluding regulated and financial industries identified with 2-digit SIC 40 through 45 and 60 through 64. Model (1) corresponds to the sample where loan data were available. Models (2) and (3) re-examine the result for the subsample of loans matched to Compustat. Borrowers' and lenders' characteristics are computed as of the earliest date prior to the origination of the loan. For definitions of the explanatory variables, please see the appendix. ***, **, and * indicate p values of 1%, 5%, and 10%, respectively.

	OLS			**2SLS**								
				(1)			***(2)***			***(3)***		
	Coeff.	t-stat		Coeff.	t-stat		Coeff.	t-stat		Coeff.	t-stat	
Syndicate structure:												
Lead share (%)	0.26	3.3	***	-3.26	-2.0	**	-2.18	-1.6	*	-2.13	-1.6	*
Borrower characteristics:												
Industry default probability (%)	0.79	1.7	*	1.68	2.4	**	0.25	0.4		0.16	0.3	
Not rated	6.49	1.6		25.24	2.5	**	21.63	1.3		23.25	1.6	
Senior debt rating												
AAA	-23.89	-0.7		2.02	0.1		30.93	0.5		21.28	0.4	
AA +	-77.97	-3.1	***	-63.37	-2.1	**	-43.04	-0.9		-35.98	-0.8	
AA	-27.48	-1.6		-3.53	-0.2		-20.30	-0.9		-5.89	-0.3	
AA -	-52.85	-4.6	***	-33.62	-2.0	**	-38.20	-2.1	**	-27.99	-1.6	
A +	-53.41	-6.0	***	-33.57	-2.4	**	-36.61	-2.0	**	-31.43	-1.8	*
A -	-51.40	-7.7	***	-36.60	-3.4	***	-39.90	-2.9	***	-34.53	-2.7	***
A -	-39.19	-6.1	***	-29.57	-3.3	***	-26.61	-2.3	**	-23.25	-2.2	**
BBB +	-28.97	-5.1	***	-21.82	-2.9	***	-24.12	-2.9	***	-19.25	-2.3	**
BBB	-23.12	-4.7	***	-19.12	-3.1	***	-20.14	-2.9	***	-17.25	-2.6	***
BB +	11.43	1.7	*	15.20	1.9	**	22.80	2.1	**	23.10	2.2	**
BB	20.87	3.4	***	19.45	2.7	***	21.65	2.9	***	23.32	3.2	***
BB -	27.39	4.9	***	31.48	4.5	***	31.27	3.8	***	32.84	4.1	***
B +	44.58	8.0	***	60.85	5.9	***	54.64	3.8	***	52.93	4.0	***
B	59.01	8.5	***	75.36	6.6	***	64.82	4.2	***	60.08	4.1	***

TABLE 4 – *continued*

B -	60.71	6.8	***	70.23	6.1	***	69.16	5.6	***	62.39	5.1	***
CCC +	107.53	9.0	***	127.23	7.5	***	127.25	5.8	***	119.35	5.9	***
CCC	193.74	8.4	***	209.99	7.4	***	205.83	7.2	***	198.12	7.1	***
CCC-	164.41	6.5	***	191.96	5.8	***	158.11	4.5	***	126.61	3.8	***
Commercial paper rating	-10.51	-2.8	***	-7.90	-1.7	*	-7.40	-1.4		-5.97	-1.1	
Public	-11.44	-5.0	***	-10.66	-3.9	***	-7.52	-1.6		-1.97	-0.4	
Previous lending relationship	0.77	0.4		-3.02	-1.0		0.03	0.0		0.21	0.1	
Log (Sales at close)	-5.06	-5.9	***	-6.91	-5.1	***	-5.36	-3.3	***			
Log (Assets)										-9.70	-2.7	***
Leverage (Ind. Adjusted)										33.51	6.5	***
ROA (Ind. Adjusted)										-103.60	-7.1	***
Contract characteristics:												
Log (Facility amount)	-12.13	-9.2	***	-35.68	-3.1	***	-26.80	-1.6	*	-23.68	-1.7	*
Maturity (Months)	-0.05	-1.1		-0.17	-2.1	**	-0.21	-2.1	**	-0.19	-1.9	*
Number of facilities	6.79	3.9	***	-13.61	-1.4		-9.77	-0.7		-8.48	-0.7	
Collateral	47.04	20.2	***	48.82	16.9	***	54.97	15.0	***	49.06	15.2	***
Financial covenants	13.30	4.3	***	12.54	3.4	***	15.08	3.9	***	15.55	4.1	***
Prime base rate	161.82	25.3	***	165.95	21.2	***	169.76	19.9	***	160.94	19.1	***
Performance pricing	-19.76	-8.5	***	-26.16	-6.3	***	-19.58	-3.5	***	-19.25	-3.3	***
Lead bank characteristics:												
Ranking	0.40	2.7	***	0.74	3.1	***	0.58	1.7	*	0.55	1.8	*
Syndicate characteristics:												
Syndicate reputation: Lead to participant	-0.73	-3.8	***	-2.40	-2.9	***	-2.13	-1.7	*	-1.95	-1.7	*
Syndicate reputation: Reciprocal	7.24	1.3		-10.13	-1.0		-4.29	-0.4		-4.54	-0.4	
Fixed Effects:												
Bank		Yes			Yes			Yes			Yes	
Year		Yes			Yes			Yes			Yes	
Loan purpose		Yes			Yes			Yes			Yes	
Observations		5,017			5,017			3,617			3,617	
Adjusted R^2		0.59			0.50			0.55			0.61	

TABLE 5
DETERMINANTS OF LOAN SPREADS: DIVERSIFICATION EFFECT

This table reports results of the second stage regression corresponding to the spread required by the lead bank (diversification effects). For compactness, credit ratings are not reported. The spread demanded by the lead bank is identified using syndicate specific *Reputation* measurements that exogenously shift the spread required by the participant banks. The dependent variable, *All-in Drawn Spread,* includes fixed fees (excluding upfront fee) and variable spread that the borrower pays for each dollar drawn down under the loan commitment. Each observation in the regression corresponds to a different deal. Models (1), (2), and (3) report point estimates for the second stage regression using predicted values for share retained by the lead arranger from Table 3. As in Table 4, Model (1) corresponds to the sample where loan data were available and Models (2) and (3) re-examine the result for the subsample of loans matched to Compustat. Borrowers' and lenders' characteristics are computed as of the earliest date prior to the origination of the loan. For definitions of the explanatory variables, please see the appendix. ***, **, and * indicate p values of 1%, 5%, and 10%, respectively.

	(1)			*(2)*			*(3)*		
	Coeff.	t-stat		Coeff.	t-stat		Coeff.	t-stat	
Syndicate structure:									
Lead share (%)	1.36	3.7	***	1.98	4.4	***	1.80	4.1	***
Borrower characteristics:									
Industry default probability (%)	0.52	1.1		-0.01	0.0		0.04	0.1	
Not rated	0.71	0.2		-5.33	-0.9		0.27	0.1	
Commercial paper rating	-11.38	-2.9	***	-11.70	-2.7	***	-11.08	-2.6	***
Public	-11.65	-5.0	***	-10.45	-2.4	**	-4.03	-1.0	
Previous lending relationship	2.13	1.0		5.00	2.0	**	3.91	1.6	*
Log (Sales at close)	-4.61	-5.1	***	-3.64	-3.2	***			
Log (Assets)							-5.28	-3.6	***
Leverage (Ind. Adjusted)							37.45	9.3	***
ROA (Ind. Adjusted)							-92.34	-8.9	***
Contract characteristics:									
Log (Facility amount)	-4.99	-1.7	*	0.12	0.0		0.06	0.0	
Maturity (Months)	-0.02	-0.3		-0.08	-1.3		-0.04	-0.6	
Number of facilities	12.89	4.4	***	12.35	3.6	***	12.20	3.8	***
Collateral	46.68	19.6	***	51.57	18.0	***	47.63	17.3	***
Financial covenants	13.49	4.3	***	15.88	4.4	***	16.86	4.9	***
Prime base rate	160.31	24.6	***	165.89	21.5	***	160.04	21.7	***
Performance pricing	-17.65	-7.1	***	-11.72	-4.0	***	-10.97	-3.9	***
Lead bank characteristics:									
Ranking	0.26	1.7	*	0.07	0.4		0.04	0.2	
Credit risk: Δ Default prob. variance (%)	9.91	2.2	**	11.33	2.0	**	14.19	2.5	**
Credit risk: Lending limit ($MM)	-0.07	-2.5	**	-0.02	-1.0		-0.02	-0.8	
Fixed Effects:									
Senior debt credit rating	Yes			Yes			Yes		
Bank	Yes			Yes			Yes		
Year	Yes			Yes			Yes		
Loan purpose	Yes			Yes			Yes		
Observations	5,017			3,617			3,617		
Adjusted R2	0.58			0.58			0.61		

TABLE 6
ROBUSTNESS CHECK: UPFRONT FEE

This table verifies that the diversification premium demanded by the lead bank is part of the *All-in Drawn Spread* and not the *Upfront Fee.* Results of the Table 4 are reexamined for the subsample where Upfront Fee is available. *All-in Drawn Spread* includes fixed fees and variable spread that the borrower pays for each dollar drawn down under the loan commitment, net of upfront fee. Panel A highlights results from the first-stage regression where the dependent variable is *All-in Drawn Spread*. Full specification of the first stage is the same as in Table 3 Model (1). Panel B reports results of the second stage regression corresponding to the spread required by the participant banks (asymmetric information effects). For compactness, credit ratings are not reported. For definitions of the explanatory variables, please see the appendix. ***, **, and * indicate *p* values of 1%, 5%, and 10%, respectively.

Dependent variable:	All-in Drawn Spread			Upfront Fee		
	Coeff.	t-stat		Coeff.	t-stat	
Panel A: First stage regression (Spread)						
Credit risk: Δ Default prob. variance (%)	31.19	2.9	***	8.62		
Credit risk: Lending limit ($MM)	-0.02	0.44		0.01		
Adjusted R^2	0.54			0.25		
Panel B: Second stage regression (Participants' pricing)						
Syndicate structure:						
Lead share (%)	-3.86	-1.7	*	-1.41	-1.2	
Borrower characteristics:						
Industry default probability (%)	0.34	0.3		0.83	1.4	
Not rated	33.23	1.9	*	-4.63	-0.6	***
Commercial paper rating	11.30	0.7		-1.81	-0.2	***
Public	-5.54	-0.8		-5.57	-1.7	***
Previous lending relationship	-0.67	-0.1		-6.02	-2.3	
Log (Sales at close)	-4.72	-1.8	*	-2.80	-2.2	***
Contract characteristics:						
Log (Facility amount)	-37.81	-2.3	**	-8.71	-1.1	***
Maturity (Months)	-0.40	-2.5	**	0.00	0.0	
Number of facilities	-17.47	-1.3		-3.36	-0.5	*
Collateral	51.66	7.6	***	17.85	5.6	***
Financial covenants	-3.31	-0.4		-0.21	-0.1	**
Prime base rate	133.28	9.5	***	26.51	4.0	***
Performance pricing	-18.75	-2.9	***	-13.68	-4.5	***
Lead bank characteristics:						
Ranking	0.81	2.0	**	0.12	0.6	
Syndicate characteristics:						
Syndicate reputation: Lead to participant	-2.18	-1.8	*	-0.57	-1.0	**
Syndicate reputation: Reciprocal	-12.65	-0.5		-17.58	-1.6	***
Fixed Effects:						
Senior debt credit rating		Yes			Yes	
Bank		Yes			Yes	
Year		Yes			Yes	
Loan purpose		Yes			Yes	
Observations		1,067			1,067	
Adjusted R^2		0.39			0.21	

TABLE 7
ROBUSTNESS CHECK: INFORMATION COLLECTION EXPERTISE

This table re-examines the results for the subsample of loans extended to companies in industries where the lead bank does not have monitoring (or information collection) expertise. A bank is said not to have monitoring expertise if its loan portfolio in a given 2-digit SIC industry is below the median level of 3%. Results are comparable to Model (1) in Tables 3, 4 and 5. The dependent variable for the second stage is *All-in Drawn Spread*; it includes fixed fees (excluding upfront fee) and variable spread that the borrower pays for each dollar drawn down under the loan commitment. Each observation in the regression corresponds to a different deal. For compactness, credit ratings are not reported. For definitions of the explanatory variables, please see the appendix. ***, **, and * indicate *p* values of 1%, 5%, and 10%, respectively.

	First stage			Second stage					
	Lead share			Participants' pricing			Lead's pricing		
	Coeff.	t-stat		Coeff.	t-stat		Coeff.	t-stat	
Syndicate structure:									
Lead share (%)				-2.82	-1.6	*	0.71	1.4	
Borrower characteristics:									
Industry default probability (%)	0.14	1.3		0.60	0.8		0.05	0.1	
Not rated	4.24	3.8	***	13.43	1.2		-1.76	-0.3	
Commercial paper rating	0.40	0.4		-9.43	-1.3		-10.99	-1.7	*
Public	0.59	1.0		-11.88	-2.8	***	-13.63	-3.7	***
Previous lending relationship	-1.67	-3.0	***	-1.85	-0.4		3.86	1.1	
Log (Sales at close)	-0.55	-2.2	**	-6.50	-3.3	***	-4.61	-3.0	***
Contract characteristics:									
Log (Facility amount)	-6.70	-19.4	***	-35.46	-2.6	***	-11.65	-2.6	***
Maturity (Months)	-0.03	-2.5	**	-0.15	-1.4		-0.03	-0.4	
Number of facilities	-6.08	-13.1	***	-12.79	-1.0		8.68	1.9	**
Collateral	0.39	0.6		52.93	12.6	***	51.80	14.3	***
Financial covenants	0.01	0.0		13.97	2.5	***	13.96	2.9	***
Prime base rate	-0.14	-0.1		176.52	15.8	***	177.03	18.0	***
Performance pricing	-1.77	-2.8	***	-36.60	-6.8	***	-30.09	-7.9	***
Lead bank characteristics:									
Ranking	0.11	3.2	***	0.50	1.7	*	0.08	0.4	
Credit risk: Δ Default prob. variance (%)	-4.41	-3.2	***				11.39	1.5	
Credit risk: Lending limit ($MM)	0.01	1.0					-0.09	-2.5	***
Syndicate characteristics:									
Syndicate reputation: Lead to participant	-0.51	-10.5	***	-1.84	-1.9	*			
Syndicate reputation: Reciprocal	-4.09	-3.0	***	-4.50	-0.4				
Fixed Effects:									
Senior debt credit rating		Yes			Yes			Yes	
Bank		Yes			Yes			Yes	
Year		Yes			Yes			Yes	
Loan purpose		Yes			Yes			Yes	
Observations		2,397			2,397			2,397	
Adjusted R^2		0.51			0.53			0.60	

TABLE 8
ROBUSTNESS CHECK: ALTERNATIVE DEFINITIONS OF DEFAULT PROBABILITY VARIANCE

This table evaluates the robustness of the relationship between spread and lead bank share reported in Tables 4 and 5 to alternative definitions of *Default probability variance*. The first line repeats the central result of the paper reported in Tables 4 and 5 using the original measure of *Default probability variance* calculated using lagged cross-industry matrices of default correlations. Revolver lines were scaled by 50% and maturity was assumed to be less than three years. The rest of the lines report point estimates of the *Lead Share* for alternative definitions of *Default probability variance*. The first column reports correlation with the original measure, the last column the F-stat of the joint significance of the four instruments used in the reduced form of the *Lead Share*. Lines 2 through 5 consider alternative specifications for the default correlations matrices. Lines 6 and 7 consider alternative assumptions for the outstanding portfolio. Lines 8 through 11 consider several methods of incorporating recovery rates in the analysis. ***, **, and * indicate *p* values of 1%, 5%, and 10%, respectively.

		Corr.	Participant banks (Table 4)			Lead bank (Table 5)			Instruments
			Coeff.	t-stat		Coeff.	t-stat		F-stat
1	***Original measure (Tables 4 & 5)***	--	-3.26	-2.0	**	1.36	3.7	***	6.9
2	*Loan share: median share by loan size*	0.98	-2.86	-1.8	*	1.36	3.8	***	6.8
3	*Default matrix: 1 year default horizon*	0.79	-4.06	-2.0	**	1.44	3.9	***	7.2
4	*Default matrix: not lagged, 1 year horizon*	0.71	-2.30	-1.7	*	1.20	3.2	***	5.1
5	*Default matrix: not lagged, 3 year horizon*	0.73	-2.01	-1.7	*	1.20	3.2	***	4.9
6	*Loans drawn: until maturity*	0.97	-3.43	-1.9	**	1.36	3.7	***	6.9
7	*Loans drawn: 100% revolver loans*	0.95	-2.46	-1.7	*	1.35	3.7	***	6.6
8	*Recovery rates: credit rating*	0.96	-3.00	-1.9	*	1.34	3.7	***	6.8
9	*Recovery rates: asset tangibility*	0.96	-3.92	-2.2	**	1.34	3.7	***	7.3
10	*Recovery rates: collateral*	0.96	-2.35	-1.7	*	1.34	3.7	***	6.6
11	*Recovery rates: loan size/sales*	0.95	-3.90	-2.1	**	1.31	3.6	***	7.3

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FURTHER EVIDENCE ON THE BANK LENDING PROCESS AND THE CAPITAL-MARKET RESPONSE TO BANK LOAN AGREEMENTS*

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This paper investigates the hypothesis that bank loans convey information to the capital market regarding the value of the borrowing firm. Unlike previous researchers, we distinguish between new bank loans and loan renewals. For new loans, the excess stock return for borrowers around the loan announcement is not significantly different from zero. For favorable loan revisions, the excess return is significantly positive; for unfavorable revisions, it is significantly negative. We interpret these results to imply that banks play an important role as transmitters of information in capital markets, but new bank loans per se do not communicate information.

1. Introduction

A rapidly evolving view among financial economists is that banks play an important, and perhaps unique, role as transmitters of information in capital markets. This view holds that banks either produce or are given access to information not available to other capital-market participants. Banks make lending decisions on the basis of this information and the banks' decisions, which become publicly available, provide signals about borrowers' creditworthiness.

James (1987) provides evidence that supports this view. In an event study of the common stocks of firms announcing bank credit agreements, he reports an excess return of +1.93% over the two-day period surrounding the announcements that is significantly different from zero. This evidence is consistent with the hypothesis that banks play a unique role as transmitters of information in

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capital markets, because the average excess return in response to the announcement of other types of corporate financings is either significantly negative or not significantly different from zero.[1] Comfirmatory evidence is provided by Mikkelson and Partch (1986). In a longitudinal study of 360 firms, they analyze stock returns around announcements of various classes of security offerings over an 11-year period and report results similar to those found by other authors, including a significant excess return of +0.89% around the announcement of bank credit agreements.

To some extent, though, James and Mikkelson and Partch investigate only part of the phenomenon. Neither study distinguishes between new credit agreements and extensions or renewals of existing agreements. A fuller appreciation of the bank lending process and the way in which banks transmit information in capital markets can be gained by making this distinction. Doing so can indicate, for example, whether banks have an information advantage over other capital-market participants at the outset of a loan agreement or whether this advantage comes about as the result of a continuing working relationship with the borrower.

This paper expands upon the work of James and Mikkelson and Partch by differentiating between new bank credit agreements and revisions to already existing agreements. Like James and Mikkelson and Partch, we find a positive and significant two-day announcement-period excess return for the entire sample of bank loan announcements. However, when the observations are divided into announcements of new credit agreements and announcements of revisions to existing agreements, we find that the positive announcement-period return is due almost solely to the latter group.

When the sample of announcements on existing agreements is divided into those in which the credit agreement is expanded or in some other way improved for the borrower and those in which the agreement is cancelled or made more restrictive, we find a significantly positive announcement-period return for the former group and a significantly negative return for the latter group. We interpret these results as evidence that banks play an important role as transmitters of information in capital markets.

2. Asymmetric information and the bank lending process

There are at least two perspectives on the way in which banks gain access to information not available to other capital-market participants. According to

[1]See Asquith and Mullins (1986), Dann and Mikkelson (1984), Eckbo (1986), Linn and Pinegar (1988), Loderer and Van Drunen (1986), and Masulis and Korwar (1986). Smith (1986) summarizes this literature. Two exceptions to this general observation are Kim and Stulz (1988), who report a positive and significant excess return around the announcement of Eurobond issues, and Wruck (1989), who documents a positive and significant excess return around the announcement of private equity offerings.

the first, banks invest in information-gathering technology that gives them a competitive advantage in evaluating risky lending opportunities. When a potential borrower applies for a loan, the bank evaluates the borrower, and the bank's loan decision signals the prospective borrower's creditworthiness to other capital-market participants. Benston and Smith (1976), Diamond (1984), and Campbell and Kracaw (1980), among others, develop this idea more fully. If it is assumed that a firm will enter into a new bank loan agreement only if it currently has no bank financing in place or the terms of the new credit agreement are more favorable than its current agreement, this line of reasoning predicts a positive stock-price response when new bank loans are announced.

An alternative view is that banks gain access to private information about their customers over time as a result of an intimate, continuing business relationship with them. This idea can be traced to Black (1975) and Kane and Malkiel (1965). Fama (1985) expands on this theme to argue that banks play a unique role in providing funds to businesses. Fama's argument is composed of two parts. First, bank debt, along with other types of privately placed fixed-payoff securities, is classified as inside debt. Banks have access to information not available to holders of the firm's publicly traded securities or those who hold other outside claims, such as employees and trade creditors. Second, because bank loans typically have a low priority among fixed-payoff claims, signals from the credit renewal process are credible and consequently reduce the monitoring costs incurred by the firm's other claimants.

Fama's argument for the uniqueness of bank loans places considerable weight on the loan renewal process as a mechanism for transmitting information. Loan renewals are important because of the periodic review to which firms that enter into short-term bank credit agreements submit themselves. Within this framework, there is no requirement that banks have a competitive information advantage over other suppliers of funds at the initiation of the loan. Rather, banks learn about their customers through time as a natural outgrowth of their business interactions. This line of reasoning suggests that if there is to be a stock-price response to announcements of bank credit agreements, the effect should be observed around announcements of revisions to, not initiations of, such agreements.[2] Of course, announcements regarding loan revisions or renewals can signal either positive or negative information. For example, a revision in which the interest rate on the loan is reduced or restrictive convenants are relaxed is likely to provide positive information about the state of the firm. Alternatively, an announcement in which the credit

[2]A variation on this theme is that a firm's willingness to submit to periodic credit evaluations may provide market participants with a positive signal concerning management's assessment of the firm's prospects. If so, announcements of new credit agreements should be associated with a positive stock-price reaction even if banks have no inside information at the initiation of the credit agreement. In order for this scenario to lead to a separating equilibrium, firms must face a penalty for false signaling.

limit is reduced or the interest rate is increased is likely to convey negative information.

The two perspectives on how banks transmit information are not mutually exclusive. It is entirely possible that banks have a competitive advantage over other capital-market participants in evaluating new borrowers and that they also gain access to private information through a close working relationship with borrowers. Consequently, announcements of both new credit agreements and revisions to existing agreements can convey information to the capital market. By distinguishing between new and revisions to existing credit agreements, and between positive and negative revisions to existing agreements, this study sheds additional light on the bank lending process and the manner in which banks transmit information in capital markets.

3. Sample selection procedure

To construct a sample, we searched the *Wall Street Journal Index* (*WSJI*) for the period 1976–1986 for announcements concerning credit agreements between U.S. corporations and U.S. or foreign banks. Only firms with stock prices on the Center for Research in Security Prices (CRSP) daily file of New York Stock Exchange (NYSE)- and American Stock Exchange (AMEX)-listed companies are included in the sample. The search resulted in a sample of 1,145 announcements of bank credit agreements.

Observations are deleted from the sample if other major corporate announcements are contained in the same article or appear in another *WSJ* article on the same day, the prior day, or the following day. Examples of these 'contaminating' announcements include announcements of dividends, earnings, stock issues, other debt issues, management changes, acquisitions, exchange offers, divestitures, bankruptcy fillings, joint ventures, stock repurchases, credit rating changes, and asset sales. In all, 288 observations are deleted for this reason. An additional eight observations are removed because we cannot determine whether the *WSJ* article corresponds to the original announcement date of the credit agreement. Finally, 121 announcements are deleted because the CRSP file does not include enough daily returns data for the empirical analysis that follows. Thus, the final sample contains 728 clean announcements of bank credit agreements.

On the basis of information contained in the *WSJ*, we initially classify announcements as concerning new or existing credit agreements. Specifically, all credit agreements are initially categorized as new if the *WSJ* either indicates that the agreement is new or does not indicate that it is a revision, renewal, extension, replacement, or renegotiation of an existing credit agreement. For those agreements classified as new, we searched each borrower's annual report for the year-end before and after the announcement to determine whether the announcement actually involves a revision of an existing credit agreement. If so, we reclassify the announcement accordingly. Thus, any credit agreement that is identified by either the *WSJ* or the firm's annual report as being a revision to an existing agreement is placed in the category of revisions to existing credit agreements. On this basis, of the 728 clean announcements, 371 are of new credit agreements and 357 concern existing agreements. Of the new credit agreements, 334 are by industrial firms, and 341 of the revised credit agreements are by industrial firms. The remaining 37 new credit agreements and 16 revised agreements are by commercial banks and utilities.

After this search, some ambiguity remains as to whether all of the announcements classified as new credit agreements actually refer to new credit agreements with new banks or whether some refer to new credit agreements with the same bank or banks. For 214 of the 371 observations classified as new agreements, the annual report states that the agreement is 'new', but does not specifically indicate that it involves a new bank or banks. Unfortunately, the typical annual report contains a discussion of the firm's bank credit agreements, including a discussion of the terms of the agreement, but does not identify the names of the lender banks. However, for 78 announcements, the annual report indicates that the credit agreement is new and also indicates that it involves a new set of banks. Thus, depending on the definition employed, the sample of new loans contains either 371, 214, or 78 observations. Table 1 provides a frequency distribution of the announcements according to the year in which they occur.

Table 1

Frequency distribution by year for a sample of 371 new bank credit agreements and 357 revised bank credit agreements for NYSE- and AMEX-listed companies, 1976–1986.

Year	All credit agreements	All new credit agreements	Credit agreements denoted as new in annual report	Credit agreements with new banks identified in annual report	Revised credit agreements
1976	86	37	23	8	49
1977	103	44	25	8	59
1978	94	52	33	15	42
1979	105	62	36	11	43
1980	83	49	23	7	34
1981	42	26	9	5	16
1982	66	36	23	8	30
1983	47	17	11	5	30
1984	47	21	15	5	26
1985	33	18	9	4	15
1986	22	9	7	2	13
Total	728	371	214	78	357

Examples typical of announcements of new credit agreements include those by AVC Corp.:

> AVC Corp. said it arranged a $17 million financing agreement with a group of four banks.
>
> The accord provides for a revolving credit until March 31, 1978, at an interest rate 0.75 percentage-point over the prime, or minimum, lending rate. After that date, the credit will convert into a five-year term loan payable in 20 equal installments. The interest rate for the term loan hasn't been determined.
>
> The company, which is engaged in three principal lines of business – fasteners and formed metal parts, textiles, and television broadcasting – said the agreement will consolidate its short- and medium-term obligations. It also will be used partially to fund its $3.5 million 1976 capital-spending plans.
>
> The banks in the lending group are First Pennsylvania Bank, Citibank, Cleveland Trust Co., and U.S. Trust Co. (*WSJ*, July 2, 1976, p. 19)

and by EG&G Inc.:

> EG&G Inc. said it negotiated a $150 million multicurrency credit agreement with a banking group headed by Morgan Guaranty Trust Co.
>
> EG&G said the eight-year agreement consists of a five-year revolving credit arrangement followed by a three-year term loan.
>
> The company said proceeds are to to be used for general corporate purposes. Initially, EG&G said about $70 million will be used to replace short-term borrowings used last year to purchase four million EG&G shares.
>
> EG&G manages projects for the government, including the Nevada nuclear test site and Cape Canaveral, and makes scientific parts and instruments. (*WSJ*, April 12, 1985, p. 45)

Announcements representative of revised credit agreements include those by Skil Corp.:

> Skil Corp. said it negotiated a $25 million loan with Continental Illinois National Bank & Trust Co. of Chicago, First National Bank of Chicago, and Algemene Bank Nederland N.Y.
>
> The seven-year agreement replaces a three-year credit with the same banks. The old agreement, which was due to expire next year, had a current balance of $17 million, the maker of power tools said. (*WSJ*, June 16, 1977, p. 31)

Table 2

Descriptive statistics for a sample of 371 new bank credit agreements and 357 revised bank credit agreements for NYSE- and AMEX-listed companies, 1976–1986.

	New agreements			Revised agreements		
Variable	Range	Mean	Median	Range	Mean	Median
Amount of credit agreement (millions of dollars)	2.0–3000	113.8	40.0	2.0–4800	120.8	45.0
Market value of equity[a] (millions of dollars)	2.1–6578	416.4	95.6	1.0–4846	223.7	66.0
Amount of credit agreement/ market value of equity	0.004–7.1	0.66	0.36	0.003–77.8	2.17	0.65
Maturity of credit agreement (years)	0.5–15.0	6.2	7.0	0.1–15.0	4.8	5.0

[a]Number of shares of common stock outstanding multiplied by the market price per share five days before the announcement of the credit agreement.

and by Genisco Technology Corp.:

> Genisco Technology Corp. said it was granted a new $10 million unsecured revolving line of credit by Bank of America.
>
> The computer graphics and peripheral and electronics company said it can borrow as much as $10 million at or below the bank's prime, or base, rate under the agreement, which expires April 30, 1989.
>
> The agreement supersedes a secured line of credit the bank issued in 1981. Under that agreement, Genisco could borrow as much as $6 million, depending on several factors at the bank's prime rate over five years. (*WSJ*, June 1, 1983, p. 28)

When the information is available, the dollar amount of the loan and the term-to-expiration of the credit agreement are recorded. Table 2 displays summary statistics for these data.

4. Methodology

We are interested in the relation between changes in the market value of common stock and announcements of bank credit agreements. The method of analysis is an event-time study of stock returns over the two-day period encompassing the day on which information concerning the credit appears in the *WSJ* (day 0) and the previous day (day -1).

We use the same empirical procedure employed by James (1987) and Mikkelson and Partch (1986). For each firm, we calculate excess returns using a market-model benchmark with market-model parameters estimated over a period beginning 170 days before and ending 21 days before the announcement date. To determine the statistical significance of announcement-period returns, we compute standardized excess returns by dividing the announcement-period excess return by the respective standard deviation of the prediction error obtained from the market model. We then sum the standardized excess returns and divide the sum by the square root of the number of observations to compute a z-statistic. In addition, we calculate the proportion of announcements with positive announcement-period excess returns, and conduct a binomial test to determine whether that proportion is significantly different from the proportion of positive residuals over the period beginning 170 days before and ending 21 days before the announcement.

5. Stock prices and announcement of bank loan agreements

5.1. *Full-sample results*

Table 3 presents two-day announcement-period excess returns for the full sample of bank credit agreements and for various subsamples. For the full sample, the excess return is +0.61%, which, with a z-statistic of +2.69, is significantly different from zero. This result is consistent with the findings of James and Mikkelson and Partch and supports the notion that bank credit decisions convey information to the capital market. However, when the sample is divided into announcements of new loans and announcements of revisions to existing credit agreements, it is evident that the two-day excess return for the full sample is attributable, almost exclusively, to the latter group. For the sample of new credit agreements, the average announcement-period excess return of −0.01% is not significantly different from zero (z-statistic = −0.47). Similarly, for the sample of agreements specifically identified as new in the annual report and for the sample in which the annual report indicates that the new loans involve new banks, the announcement-period excess returns of +0.07% and +0.23% are not significantly different from zero. However, for the sample of announcements concerning already existing loans, the average excess return of +1.24% is significantly positive (z-statistic = +4.33). In addition, the average excess return for the sample of loan revisions is statistically different from the average excess return for the full sample of new loans and for the sample of those indicated as new in the annual reports at the 0.05 level of significance. The results are unchanged when only industrial firms are included in the samples. When the small samples of banks and utilities are analyzed separately, however, none of the announcement-period excess returns are significantly different from zero.

Table 3

Average announcement-period excess returns, significance tests, and proportion of positive excess returns for a sample of 371 new bank credit agreements and 357 revised bank credit agreements for NYSE- and AMEX-listed companies, 1976–1986.

Type of announcement	Number of observations	Announcement-period excess return (%)	z-statistic	Announcement-period proportion of positive excess returns
	(A) *Full sample of credit agreements*			
All credit agreements	728	0.61[d]	2.69	0.485
New credit agreements	371	−0.01	−0.47	0.439
Credit agreements denoted as new in annual reports	214	0.07	0.41	0.458
Credit agreements with new banks identified in annual reports	78	0.23	0.47	0.500
Revised credit agreements	357	1.24[d]	4.33	0.532[e]
	(B) *Revised credit agreements*			
Favorable revisions	259	0.87[d]	3.76	0.556[e]
Unfavorable revisions	22	−3.86[d]	−3.28	0.318
Mixed revisions[a]	76	3.98[d]	4.20	0.513
	(C) *Credit agreements with mixed revisions*			
No prior negative news[b]	26	2.35	1.51	0.538
Prior negative news[c]	50	4.82[d]	4.08	0.500
	(D) *Credit agreements with unfavorable revisions*			
Cancelled or reduced by borrower	10	0.16	0.27	0.500
Revised unfavorably by lender	12	−7.22[d]	−4.68	0.167[f]

[a]For the observations in this subsample, some terms of the new credit agreement are more favorable than those in the old agreement and some terms are less favorable.

[b]No negative news concerning the credit agreement was published in the *WSJ* in the twelve months prior to the revision.

[c]Negative news concerning the credit agreement was published in the *WSJ* within twelve months prior to the revision.

[d]Announcement-period excess return is significantly different from zero at the 0.01 level.

[e]Proportion of positive announcement-period excess returns is significantly different from the proportion of positive residuals during the market-model estimation period at the 0.01 level.

[f]Proportion of positive announcement-period excess returns is significantly different from the proportion of positive residuals during the market-model estimation period at the 0.05 level.

5.2. Revisions to existing credit agreements

Announcements concerning existing credit agreements can contain either positive or negative information. To determine whether the market distinguishes between announcements on this basis, we divide the sample into three categories according to whether (1) the terms of the agreement are revised favorably, (2) the terms are revised unfavorably, or (3) some terms are revised favorably, while others are revised unfavorably.

There are four dimensions of a credit agreement by which the terms of a loan can be revised: its maturity, interest rate, dollar value, and protective covenants. The protective covenants include such items as a minimum current ratio, a maximum leverage ratio, and the security pledged against the loan. Observations are placed in the favorably-revised category if the *WSJ* article indicates that the maturity of the agreement is lengthened, the interest rate is reduced, the dollar value of the loan is increased, or the protective covenants are made less restrictive. In 43 cases the *WSJ* article reports that the loan 'replaced' an existing credit agreement, but gives no specific information about the terms of the previous loan. In those cases, we assume that the only provision that changes is the maturity date, so those observations are placed into the favorably-revised category. This category contains 259 observations. The Skill Corp. and Genisco Technology Corp. announcements quoted earlier are examples of favorable revisions.

The second category contains observations in which the agreement is revised unfavorably. Either the amount of the loan is reduced, the maturity is shortened, the interest rate is increased, or the protective convenants are made more severe. This group contains 22 observations. One way to simultaneously reduce the amount of the loan and decrease its maturity is to cancel the credit agreement. This occurs in eight cases. The following announcement concerning Storage Technology Corp. is an example of an unfavorable revision to a credit agreement:

> Storage Technology Corp.'s loss of a loan commitment from Chemical Bank leaves the maker of data storage systems short of cash and hurts its effort to continue operations.
>
> The Louisville, Colorado-based company said Friday that the agreement between it and Chemical Bank, a unit of Chemical New York Corp., which would have provided Storage Technology with a $150 million credit line, had been terminated. Storage Technology needs the funds to continue operations while it reorganizes under Chapter 11 of the federal Bankruptcy Code.
>
> However, Storage Technology said it is negotiating with other financial institutions for new financing, and a company source said the 'probabilities are very high' that the company could find a new cash infusion in a week or two. Any new loan will have to be approved by the bankruptcy court.
>
> Neither Storage Technology nor Chemical Bank would comment on why the credit commitment fell through. Touche Ross & Co., the eighth-biggest accounting firm in the U.S., which claimed credit for

arranging the agreement, couldn't be reached for comment. (*WSJ*, November 19, 1984, p. 4)

The third category contains 76 observations in which some terms of the credit agreement are revised favorably and others unfavorably. Often, the announcements describe these revisions as a 'restructuring' of the loan. The following announcement regarding International Systems and Controls Corp. is an example of a 'mixed' revision:

> International Systems & Controls Corp. said it signed an agreement with its banking group for temporary additional financing and modifications of its collateral in connection with its revolving credit agreement expiring July 1.
>
> Earlier this month, the engineering, manufacturing, and financial concern said it arranged additional financing, coupled with an increase in collateral and deferral of certain interest payments to cover differences between working capital requirements and proceeds expected from dispositions and collections.
>
> The new agreement doesn't have a specific maturity date, doesn't include a formal waiver of existing default items, and doesn't specifically extend the maturity date of the existing agreement, ISC said. But it is planned to be retired in the near future, the company added.
>
> ISC said it is negotiating with its banks for sizable periodic debt reduction and retirement of borrowings outstanding under the revolving agreement.
>
> ISC didn't give any details but said it believes the temporary financing will enable it to deal with its working capital requirements until it recovers capital from its dispositions and divestitures and collects major project receivables currently in negotiation. (*WSJ*, May 31, 1978, p. 40)

The announcement-period excess return for each loan category is presented in panel B of table 3. The excess return of +0.87% for the sample in which the terms of the credit agreements are revised favorably is significantly greater than zero at the 0.01 level (z-statistic = +3.76), while the excess return of −3.86% for the sample in which the terms are revised unfavorably is significantly less than zero (z-statistic = −3.28). These results indicate that the loan revision and renewal process is an important mechanism for transmitting information and that capital-market participants respond in a predictable way to unambiguous announcements concerning the creditworthiness of the bank's borrowers. Our results are consistent in one aspect to the findings of Holtausen and Leftwich (1986), who investigate the information content of bond rating changes. Similar to our findings, they report a significant negative excess return around the announcement of downgradings by Moody's and Standard and Poors. Surprisingly, they report an insignificant excess return around announcements of rating upgrades.

For the sample of mixed revisions, the excess return of +3.98% is also significantly greater than zero and is much larger than the excess return for the sample of favorably-revised agreements. This result is puzzling in that, a priori, we anticipated that this class of announcements would convey a less positive signal about the state of the firm than announcements of purely favorable revisions.

5.3. *A closer look at mixed revisions*

We can think of one possible explanation for the highly positive returns around mixed-revision announcements. Consider why it is in the best interest of both the lender and the borrower to simultaneously improve some terms of an agreement and make some terms less favorable. If the borrower cannot meet certain covenants of the loan agreement, those terms must be relaxed if default is to be avoided. Other terms are then made more restrictive to insure that the lender(s) does not lose value. Indeed, many of the mixed announcements indicate that the motive for restructuring the loan is that the borrower has either violated a covenant of the loan agreement or missed an interest payment, or that the borrower will miss a future interest payment if the loan is not restructured. If the borrower's difficulties are not already known by outsiders, a mixed revision contains both positive and negative information. The negative information is that the firm is having financial problems; the positive information is that the bank has decided to restructure the credit agreement so that the firm can continue to operate. However, if the market is already aware of the borrower's problems, the primary new information released by the announcement is that the bank – which presumably has inside information – has decided to continue the loan agreement, albeit with modified terms.

To explore this issue further, we investigate whether the market reacts differently to announcements of mixed revisions depending on whether the potential for default is or is not already publicly known. For each of the 76 mixed-revision announcements, we searched the *WSJI* for the prior year to locate earlier announcements concerning the credit agreement. In 50 of the 76 observations, the *WSJ* previously had published an article indicating that the borrower was in jeopardy of violating one or more of the terms of the agreement. In 26 cases, no prior negative information about the loan is reported by the *WSJ*. Excess returns for these two samples are reported in panel C of table 3.

To a limited extent, the results are consistent with the idea that more positive information is revealed when the bank signals its willingness to continue to work with a firm when it has been previously reported that there is a problem with the loan. For this sample, the announcement-period excess return is +4.82%, which, with a z-statistic of +4.08, is significantly positive. For the other 26 observations, the average two-day excess return of +2.35% is not significantly different from zero. These results suggest that the market reacts more strongly when the bank signals its intent to continue to work with a client known to be in distress. This type of information signal could be important in helping a struggling firm to continue operations because of its effect on other parties doing business with the firm. However, the average excess returns for the two groups are not significantly different from each other. Of course, in conducting this test, we are relying heavily on information provided by the *WSJ*. In some cases, the security market may have information that a credit agreement is in distress despite the lack of such a report in the *WSJ*. To the extent we have misclassified these announcements, the announcement-period excess return for this sample is biased upward and the power of our test reduced.

5.4. *A closer loot at unfavorable revisions*

When credit agreements are revised unfavorably, the action can be initiated by the borrower or by the lender. Announcements in which the borrower cancels the agreement are likely to contain less negative information (or even positive information) than those in which the credit agreement is revised unfavorably by the bank. The sample of 22 unfavorable revisions is divided further into a group of 10 cancellations or reductions initiated by the borrowing firm and a group of 12 unfavorable revisions initiated by the lender. The results for these two samples are reported in panel D of table 3. The excess returns for the two samples are significantly different from each other. For the set in which the loan cancellation is initiated by the borrower, the two-day excess return is an insignificant +0.16; the excess return for the remaining announcements is −7.22% with a z-statistic of −4.68.

5.5. *New credit agreements*

Except for five cases, all of the firms in our sample that announce new credit agreements had some prior bank financing in place, albeit with a different bank. Thus, just as with loan revisions, the new bank loan can be made on terms that are more or less favorable than those of the old credit agreement. To classify the terms of each new credit agreement as more or less favorable, we searched the company's annual reports to identify the terms of both the old and the new agreement. We are able to identify both sets of terms for 198 of the 371 new-loan announcements. Among this group, 180 new loans have more favorable terms than the old agreement and 18 have some terms that are more favorable and some that are less favorable. We are able to identify no cases in which all the terms are less favorable than the old agreement. Of the 180 new loans on more favorable terms, 135 are from the set identified as a new loan in the annual report and 58 are from the set for which the annual

Table 4

Average announcement-period excess returns, significance tests, and proportion of positive excess returns for a sample of 198 new bank credit agreements for which the terms of the new and old agreements could be determined for NYSE- and AMEX-listed companies, 1976–1986.

Type of announcement	Number of observations	Announcement-period excess return (%)[d]	z-statistic	Announcement-period proportion of positive excess returns[e]
(A) *New credit agreements made on more favorable terms than prior agreement*				
All new credit agreements	180	0.17	0.95	0.467
Credit agreements denoted as new in annual reports	135	−0.13	0.14	0.459
Credit agreements with new banks identified in annual reports	58	0.12	0.29	0.466
(B) *New credit agreements with a mixture of more and less favorable terms relative to prior credit agreement*[a]				
All new credit agreements	18	−0.44	0.40	0.389
Credit agreements denoted as new in annual report	12	−0.59	−0.18	0.417
Credit agreements with new banks identified in annual reports	5	0.04	−0.02	0.600
(C) *New credit agreements with a mixture of more and less favorable terms relative to prior credit agreement*				
No prior negative news[b]	16	−0.56	0.46	0.375
Prior negative news[c]	2	0.50	0.10	0.500

[a] For observations in this subsample, some terms of the new credit agreement are more favorable than those of the old agreement and some terms are less favorable than those of the old agreement.

[b] No negative news concerning the old credit agreement was published in the *WSJ* in the twelve months prior to the revision.

[c] Negative news concerning the old credit agreement was published in the *WSJ* in the twelve months prior to the revision.

[d] No announcement-period excess return is significantly different from zero at the 0.05 level.

[e] No proportion of positive announcement-period excess returns is significantly different from the proportion of positive residuals during the market-model estimation period at the 0.05 level.

report indicates that the new agreement involves a new bank. A similar breakdown of the new loans with mixed terms is 12 and 5, respectively. To parallel loan revisions with mixed terms, new loans with mixed terms are classified according to whether the *WSJ* previously has reported that the borrower was in danger of violating one or more of the covenants of the old credit agreement.

Excess returns for the various categories of new credit agreements are presented in table 4. They are easily summarized: in no case is the announcement-period excess return significantly different from zero. Additionally, for each of the three categories of more favorable new loans (panel A), the excess return is less than the excess return for the sample of favorably revised loans. It is significantly less (at the 0.05 level) for the two largest samples. For each of the three categories of mixed-term new loans (panel B), the excess return is less than the excess return for the sample of mixed revisions. It is significantly less for the two largest samples.

5.6. *The bank lending process*

The evidence indicates that the bank lending process works in the following way: When a bank enters into a new credit agreement, it does so with no consequential information advantage over other outside claimholders and, on average, announcements of new loan agreements reveal no information, even if the new loan is on more favorable terms than the firm's old loan. Over time, the bank becomes privy to information not available to outside claimholders, and, based on this information, periodically revises the terms of the credit agreement. If the information available to the bank reflects positively on the firm, the loan can be renewed or revised on terms more favorable to the borrower. This decision sends a positive signal to the market. Alternatively, if the firm is having financial difficulties, the bank can cancel the loan, increase the interest rate, or tighten various protective covenants. This decision signals negative information to the market.

There is a third course of action the bank can take. If the firm is having trouble meeting a particular loan covenant, the bank can restructure the loan to permit the firm to continue operations. The strength of the signal provided by this decision depends on what information was previously available to the market. If the market is already aware of the problem, the stock-price reaction is more positive than if the problem is first revealed publicly by the loan restructuring. In short, the data indicate that the bank loan review and revision process provides useful information to capital-market participants.

The results are not totally satisfying, however. If new loan announcements reveal no information and if information is revealed only as credit agreements are revised, the average announcement-period excess return across all types of loan revisions should be zero. That is, on average, excess returns around announcements in which credit agreements are revised on more favorable terms should just offset those in which loans are cancelled or revised unfavorably. Contrarily, across all credit agreement revisions, the average announcement-period excess return is positive and statistically significant. One possible explanation for this phenomenon is that there is a reporting bias on the part of the firms or banks. They may be less inclined to announce that performance has been unsatisfactory and that credit agreements have been terminated. An alternative explanation is that in many cases a credit agreement may simply be allowed to expire. Such expirations can represent a negative decision by the bank, but as with dividend omissions, an announcement is not required and our data collection procedure cannot identify such occurrences. The sheer difference in the sizes of our samples lends some support to this conjecture. The sample contains 259 favorably-revised agreements and only 22 that are revised unfavorably.

Bias could also creep into the sample through our screening process. By including only clean announcements, we may have screened out a greater proportion of negative than positive revisions. To investigate the possible impact of such a bias, we generate the announcement-period excess return for the entire sample of 456 clean and contaminated announcements of credit agreement revisions for which return data are available. For this sample, the average announcement-period excess return is +0.81%, which, with a z-statistic of +2.88, is significantly different from zero. Thus, the announcement-period return is smaller when clean and contaminated announcements are used, but it is still significantly positive.

5.7. *Other explanatory factors*

Our analysis emphasizes the different market reactions to announcements of new and existing credit agreements. However, as the descriptive statistics of table 2 indicate, there are some fundamental differences between new and revised agreements that might also explain the different market reactions. For example, for the new credit agreements, the average amount of the loan divided by the market value of the equity of the borrower is 0.66. For the revised agreements, this ratio is 2.17. Similarly, the average equity values of the firms in the former sample are greater and the maturities of the loans much smaller than those in the latter. As we have discussed, several of the companies with revised credit agreements were confronting substantial financial problems. These firms' equity values are likely to have declined substantially, which will exaggerate the apparent differences between the market values of the firms and the relative sizes of the credit agreements in the two groups. Hence, it is more appropriate to compare the characteristics of firms and loans for

Table 5

Descriptive statistics for a sample of 180 new bank credit agreements made on more favorable terms than the previous agreements and 259 favorably-revised bank credit agreements for NYSE- and AMEX-listed companies, 1976–1986.

Variable	New agreements			Favorably-revised agreements		
	Range	Mean	Median	Range	Mean	Median
Amount of credit agreement (millions of dollars)	3.0–3000	100.7	40.0	2.0–4800	112.3	45.0
Market value of equity[a] (millions of dollars)	2.7–2918	285.8	81.4	1.2–4846	262.7	83.4
Amount of credit agreement/ market value of equity	0.04–3.6	0.62	0.41	0.003–33.5	1.10	0.50
Maturity of credit agreement (years)	0.5–13.0	6.4	7.0	0.1–15.0	5.6	6.0

[a]Number of shares of common stock outstanding multiplied by the market price per share five days prior to announcement of the credit agreement.

favorably-revised credit agreements and those with new loans made on more favorable terms than the previous credit agreement. Descriptive statistics for these two samples are presented in table 5. The differences between the two groups are far less dramatic than those shown in table 2. Still, it is possible that the loans and the firms in the sample of favorably-revised loans differ from those in the sample of new loans, and it is this difference that drives the differences in the announcement-period excess returns for the two groups.

Loans can differ on a number of dimensions. We consider four on which we have data for at least some of the credit agreements: (1) relative size, (2) maturity, (3) whether the loans are secured or unsecured, and (4) structure (whether the loan is a revolving credit agreement or a term loan). The various samples of favorably-revised credit agreements and new loans made on more favorable terms are categorized on these dimensions and announcement-period returns are generated. The results, presented in table 6, panel A through D, do not suggest that the differential in excess returns between new and revised loans is due to any of these characteristics. For the sample of favorably-revised loans, the announcement-period excess return is positive for 10 of the 11 subgroups of loans considered and it significantly greater than zero for 6 of them. Contrarily, for the various samples of new credit agreements, approximately half of the announcement-period excess returns are negative, half are positive, and none is significantly different from zero. Thus, on the basis of univariate tests, the distinguishing characteristic among bank credit agreements – at least so far as the capital-market response is concerned – is whether the agreement is new or revised.

Table 6

Average announcement-period excess returns, significance tests, and proportion of positive excess returns for a sample of 180 new bank credit agreements made on more favorable terms than previous agreements and 259 favorably-revised bank credit agreements for NYSE- and AMEX-listed companies with subsamples based on dollar value, maturity, security, and structure of the credit agreement.

Sample	Number of observations	Announcement-period excess return (%)	z-statistic	Announcement-period proportion of positive excess returns
(A) Classification of samples based on relative value of the credit agreement[a]				
All new credit agreements				
Relative value < 0.4	85	−0.13	0.24	0.447
Relative value > 0.4	95	0.44	1.08	0.484
Credit agreements identified as new in annual report				
Relative value < 0.4	63	−0.40	−0.04	0.476
Relative value > 0.4	72	0.11	0.23	0.444
Credit agreements with new banks identified in annual report				
Relative value < 0.4	256	0.56	0.57	0.538
Relative value > 0.4	32	−0.24	−0.12	0:.406
Favorably-revised credit agreements				
Relative value < 0.4	99	0.74	1.87	0.576[e]
Relative value > 0.4	158	0.94[c]	3.28	0.544[e]
(B) Classification of samples based on maturity of the credit agreement				
All new credit agreements				
Six years or less	46	0.87	1.69	0.565
Seven years or more	90	−0.20	−0.64	0.411
Maturity unknown	44	0.22	1.11	0.477
Credit agreements identified as new in annual report				
Six years or less	32	−0.19	−0.19	0.420
Seven years or more	69	−0.38	−0.87	0.529
Maturity unknown	34	0.45	1.72	0.600
Credit agreements with new banks identified in annual reports				
Six years or less	18	−0.54	−0.50	0.389
Seven years or more	25	0.37	−0.11	0.440
Maturity unknown	15	0.50	1.27	0.600
Favorably-revised credit agreements				
Six years or less	101	0.38	1.35	0.505
Seven years or more	94	0.66[d]	2.05	0.574[e]
Maturity unknown	64	1.97[c]	3.38	0.609[e]
(C) Classification of samples based on security supporting the credit agreement[b]				
All new credit agreements				
Unsecured	18	−0.29	−0.93	0.444
Secured	13	−0.57	0.42	0.538
Security unknown	148	0.15	1.14	0.459

Table 6 (continued)

Sample	Number of observations	Announcement-period excess return (%)	z-statistic	Announcement-period proportion of positive excess returns
Credit agreements identified as new in annual report				
Unsecured	13	−1.19	−1.76	0.462
Secured	13	0.57	0.42	0.538
Security unknown	109	−0.08	0.62	0.450
Credit agreements with new banks identified in annual report				
Unsecured	6	1.97	0.81	0.667
Secured	7	−0.41	−0.15	0.429
Security unknown	45	−0.05	0.10	0.444
Favorably-revised credit agreements				
Unsecured	33	2.50[c]	3.49	0.697[f]
Secured	19	1.10	1.12	0.526
Security unknown	206	0.60[d]	2.48	0.539[e]
(D) Classification of samples based on structure of the credit agreement				
All new credit agreements				
Revolving credit agreement	148	0.11	0.82	0.466
Term loan	20	0.46	0.38	0.400
Structure unknown	12	0.47	0.31	0.583
Credit agreements identified as new in annual report				
Revolving credit agreement	114	−0.19	0.15	0.456
Term loan	12	−0.23	−0.54	0.333
Structure unknown	9	0.87	0.66	0.667
Credit agreements with new banks identified in annual report				
Revolving credit agreement	47	0.17	0.47	0.468
Term loan	6	−0.47	−0.59	0.333
Structure unknown	5	0.32	0.20	0.600
Favorably-revised credit agreements				
Revolving credit agreement	222	1.05[c]	4.19	0.581[f]
Term loan	25	−0.39	−0.47	0.400
Structure unknown	12	0.25	0.11	0.417

[a]Relative value is the dollar value of the agreement divided by the market value of the firm's common equity five days before to the announcement. The amount of the agreement is unknown for one new agreement and two favorably-revised agreements.

[b]One new agreement and one favorably-revised agreement were guaranteed by a government or government agency. Those observations are not included in any of these subsamples.

[c]Announcement-period excess return is significantly different from zero at the 0.01 level.

[d]Announcement-period excess return is significantly different from zero at the 0.05 level.

[e]Proportion of positive announcement-period excess returns is significantly different from the proportion of positive residuals during the market-model estimation period at the 0.05 level.

[f]Proportion of positive announcement-period excess returns is significantly different from the proportion of positive residuals during the market-model estimation period at the 0.01 level.

5.8. Multivariate analysis

To further examine factors that might affect announcement-period returns, we estimate three multivariate regressions for the 259 announcements of favorably-revised loans combined with the samples of 180, 135, and 58 announcements concerning new loans on more favorable terms than the firm's prior credit agreement. In each regression the dependent variable is the announcement-period excess return and the independent variables are:

Four dummy variables, each indicating whether there is information on a particular characteristic of the credit agreement. The four characteristics are (i) the dollar value of the credit agreement, (ii) the maturity of the loan, (iii) whether the loan is secured or unsecured, and (iv) whether the credit agreement is a revolving facility or a term loan. If information regarding a characteristic is available, the respective dummy variable has a value of 1; otherwise it is zero.

Four dummy variables, each describing a characteristic of the credit agreement. The four characteristics are (i) whether the credit agreement is unsecured (coded as a 0) or secured (coded as a 1), (ii) whether the agreement is guaranteed by either a government or government agency (0) or not (1), (iii) whether the loan is revolving (0) or term (1), and (iv) whether the announcement is of a new credit agreement (0) or a revision to an existing agreement (1).

Two continuous variables measuring (i) the logarithm of the maturity of the credit agreement and (ii) the ratio of the dollar value of the credit agreement to the market value of the common equity of the firm.

The basic model is

$$ER_i = B_0 + \sum_i B_i X_i + \varepsilon_i,$$

where ER_i is the two-day excess announcement return for firm i, $B_0, \ldots, B_{10}$ are the regression coefficients, $X_1, \ldots, X_{10}$ are the variables described above, and ε_i is the disturbance term with zero mean. Because cross-sectional stock returns exhibit heteroskedaticity, both sides of the regression equation are divided by s_i, where s_i is the standard deviation of the prediction derived from the market-model estimation. The revised regression equation is

$$SER_i = B_0/s_i + \sum_i B_i X_i/s_i + \varepsilon_i/s_i,$$

Table 7

Results of regression of standarized excess returns on various standarized continuous and dummy variables for sample of 180 new bank credit agreements made on more favorable terms than the previous credit agreement and 259 favorably-revised bank credit agreements for NYSE- and AMEX-listed companies, 1976–1986 (t-statistics in parentheses).

	Coefficient of variable in percent		
Variable	Favorably-revised agreements and all new agreements on more favorable terms than prior agreement	Favorably-revised agreements and new credit agreements on more favorable terms than prior agreement and identified as new in annual report	Favorably-revised agreements and new credit agreements on more favorable terms than prior agreement, and new bank identified in annual report
Number of observations	439	394	317
New or revised (0 if new, 1 if revised)	0.41 (1.37)	0.49 (1.83)[c]	0.46 (1.13)
Unknown if secured (0 if unknown, 1 if known)	0.24 (0.46)	0.18 (0.34)	1.18 (1.97)[c]
Government guaranteed (0 if guaranteed, 1 if not guaranteed)	−0.87 (−0.31)	2.20 (0.65)	2.10 (0.62)
Secured (0 if unknown or unsecured, 1 if secured)	−0.10 (−0.12)	0.05 (0.06)	−1.02 (−1.08)
Unknown structure (0 if unknown, 1 if known)	0.83 (1.18)	0.73 (0.89)	0.89 (0.92)
Revolving or term loan (0 if revolving or unknown, 1 if term)	−0.45 (−1.35)	−0.70 (−1.99)[c]	−0.42 (−1.06)
Unknown maturity (0 if unknown, 1 if known)	−0.21 (−0.23)	−0.63 (−0.67)	−0.42 (−0.43)
Standardized log of maturity (0 if unknown)[a]	−0.13 (−0.29)	−0.01 (−0.03)	−0.10 (−0.22)
Unknown amount of agreement (0 if unknown, 1 if known)	1.09 (0.38)	−1.43 (−0.41)	−1.83 (−0.52)
Standardized relative value of agreement (0 if unknown)[b]	0.30 (1.70)[c]	0.27 (1.51)[c]	0.25 (1.36)
R-squared	0.02	0.03	0.03

[a]Computed as log of the maturity of the credit agreement divided by estimated standard error of two-day return.

[b]Computed as amount of the credit agreement divided by the market value of equity, and divided by estimated standard error of two-day return.

[c]Coefficient is significantly different from zero at the 0.10 level.

where SER_i is the standarized announcement-period excess return for announcement i.

The regression results are presented in table 7. The coefficient of the dummy variable indicating whether the loan is a revision or new is positive in each regression, but is significantly greater than zero at only the 0.09, 0.04, and 0.13 levels, respectively, for the three samples. Thus, the results are consistent with (albeit at weak levels of significance) the hypothesis that announcements of favorably-revised bank credit agreements provide a positive signal to outside claimholders and that announcements of new bank loans do not.

6. Summary and conclusion

Previous documentation, by James (1987) and Mikkelson and Partch (1986), of positive excess stock returns surrounding announcements of bank credit agreements appears to show that banks are a unique source of corporate financing. Our analysis suggests another interpretation of the data. When a sample of bank loan announcements is split into those concerning new credit agreements and those concerning revisions to existing agreements, the former set has virtually no impact on stock prices, while the latter group has a significant excess return of +1.24%. The absence of a significant market reaction to announcements of new bank loans is consistent with studies that report an insignificant market reaction to the announcement of new public debt issues and new private placements of debt.

Further analysis of the sample of credit agreement revisions indicates that, as suggested by Fama (1985), the bank loan review and renewal process plays an important role in transmitting information in capital markets. Announcements of favorable loan renewals and revisions are accompanied by a stock-price increase, while announcements of loan reductions and cancellations are accompanied by a stock-price decline. Further, when the loan cancellations are initiated by the bank, the stock-price reaction is even more negative than average, whereas when the cancellation is initiated by the borrower, there is no stock-price response. This result indicates that it is the action of the bank, rather than the borrower's decision about to the use of debt, that signals information.

Finally, the strongest positive stock-price response is associated with announcements of loan renewals for which previously-published information indicated that the loan was in trouble. Typically, these announcements involve a restructuring of the loan that will allow the borrower to avoid technical default. In exchange, the bank receives additional security or a higher interest rate. In either case, the bank – presumably on the basis of inside information – is signaling its intent to continue to work with the borrower. Apparently, the market interprets this as a very positive signal.

The analysis leaves us with one unsatisfying result. If investors form unbiased expectations and if the loan renewal process is only signaling borrowers' creditworthiness, the average stock-price response across all announcements of credit agreement revisions should be zero. For our sample, the average response is significantly positive, suggesting that either our sample selection procedure is biased or that loan renewals and revisions, on average, create value. The problem with the second interpretation is that, if the renewal and revision process creates value and if investors form unbiased expectations, value should be capitalized when new loans are announced, and the average stock-price response at the initiation of the loan should be positive and significant. It is not. We are thus lead to the conclusion that our sample selection procedure is biased, probably because firms and banks are less likely to announce negative than positive information.

Our results do not support the contention the banks are unique in the sense that they possess a competitive advantage over other lenders in making credit decisions at the outset of a loan. At least any uniqueness in the bank credit decision process does not manifest itself in a stock-price reaction for corporate borrowers when the establishment of a credit agreement is announced. However, the results do support the view that decisions made by banks as a result of a continuing lending relationship with a corporate borrower serve as influential signals of firm value. Thus, the results indicate that banks are important and credible transmitters of firm-specific information to the capital market.

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Event Studies in Economics and Finance

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1. *Introduction*

ECONOMISTS are frequently asked to measure the effects of an economic event on the value of firms. On the surface this seems like a difficult task, but a measure can be constructed easily using an event study. Using financial market data, an event study measures the impact of a specific event on the value of a firm. The usefulness of such a study comes from the fact that, given rationality in the marketplace, the effects of an event will be reflected immediately in security prices. Thus a measure of the event's economic impact can be constructed using security prices observed over a relatively short time period. In contrast, direct productivity related measures may require many months or even years of observation.

The event study has many applications. In accounting and finance research, event studies have been applied to a variety of firm specific and economy wide events. Some examples include mergers and acquisitions, earnings announcements, issues of new debt or equity, and announcements of macroeconomic variables such as the trade deficit.[1] However, applications in other fields are also abundant. For example, event studies are used in the field of law and economics to measure the impact on the value of a firm of a change in the regulatory environment (see G. William Schwert 1981) and in legal liability cases event studies are used to assess damages (see Mark Mitchell and Jeffry Netter 1994). In the majority of applications, the focus is the effect of an event on the price of a particular class of securities of the firm, most often common equity. In this paper the methodology is discussed in terms of applications that use common equity. However, event studies can be applied using debt securities with little modification.

Event studies have a long history. Perhaps the first published study is James Dolley (1933). In this work, he examines the price effects of stock splits, studying nominal price changes at the time of the split. Using a sample of 95 splits from 1921 to 1931, he finds that the price in-

[1] The first three examples will be discussed later in the paper. Grant McQueen and Vance Roley (1993) provide an illustration of the fourth using macroeconomic news announcements.

creased in 57 of the cases and the price declined in only 26 instances. Over the decades from the early 1930s until the late 1960s the level of sophistication of event studies increased. John H. Myers and Archie Bakay (1948), C. Austin Barker (1956, 1957, 1958), and John Ashley (1962) are examples of studies during this time period. The improvements included removing general stock market price movements and separating out confounding events. In the late 1960s seminal studies by Ray Ball and Philip Brown (1968) and Eugene Fama et al. (1969) introduced the methodology that is essentially the same as that which is in use today. Ball and Brown considered the information content of earnings, and Fama et al. studied the effects of stock splits after removing the effects of simultaneous dividend increases.

In the years since these pioneering studies, a number of modifications have been developed. These modifications relate to complications arising from violations of the statistical assumptions used in the early work and relate to adjustments in the design to accommodate more specific hypotheses. Useful papers which deal with the practical importance of many of the complications and adjustments are the work by Stephen Brown and Jerold Warner published in 1980 and 1985. The 1980 paper considers implementation issues for data sampled at a monthly interval and the 1985 paper deals with issues for daily data.

In this paper, event study methods are reviewed and summarized. The paper begins with discussion of one possible procedure for conducting an event study in Section 2. Section 3 sets up a sample event study which will be used to illustrate the methodology. Central to an event study is the measurement of an abnormal stock return. Section 4 details the first step—measuring the normal performance—and Section 5 follows with the necessary tools for calculating an abnormal return, making statistical inferences about these returns, and aggregating over many event observations. The null hypothesis that the event has no impact on the distribution of returns is maintained in Sections 4 and 5. Section 6 discusses modifying this null hypothesis to focus only on the mean of the return distribution. Section 7 presents analysis of the power of an event study. Section 8 presents nonparametric approaches to event studies which eliminate the need for parametric structure. In some cases theory provides hypotheses concerning the relation between the magnitude of the event abnormal return and firm characteristics. Section 9 presents a cross-sectional regression approach that is useful to investigate such hypotheses. Section 10 considers some further issues relating event study design and the paper closes with the concluding discussion in Section 11.

2. *Procedure for an Event Study*

At the outset it is useful to briefly discuss the structure of an event study. This will provide a basis for the discussion of details later. While there is no unique structure, there is a general flow of analysis. This flow is discussed in this section.

The initial task of conducting an event study is to define the event of interest and identify the period over which the security prices of the firms involved in this event will be examined—the event window. For example, if one is looking at the information content of an earnings with daily data, the event will be the earnings announcement and the event window will include the one day of the announcement. It is customary to define the event window to be larger than the specific period of interest. This permits examination of periods surrounding the event. In practice, the period of interest is often expanded to multiple days, including at least the day of the announcement and the day after the announcement. This captures the price effects of announcements which occur after the stock market closes on the announcement day. The periods prior to and after the event may also be of interest. For example, in the earnings announcement case, the market may acquire information about the earnings prior to the actual announcement and one can investigate this possibility by examining pre-event returns.

After identifying the event, it is necessary to determine the selection criteria for the inclusion of a given firm in the study. The criteria may involve restrictions imposed by data availability such as listing on the New York Stock Exchange or the American Stock Exchange or may involve restrictions such as membership in a specific industry. At this stage it is useful to summarize some sample characteristics (e.g., firm market capitalization, industry representation, distribution of events through time) and note any potential biases which may have been introduced through the sample selection.

Appraisal of the event's impact requires a measure of the abnormal return. The abnormal return is the actual ex post return of the security over the event window minus the normal return of the firm over the event window. The normal return is defined as the expected return without conditioning on the event taking place. For firm i and event date τ the abnormal return is

$$AR_{i\tau} = R_{i\tau} - E(R_{i\tau}|X_\tau) \tag{1}$$

where $AR_{i\tau}$, $R_{i\tau}$, and $E(R_{i\tau}|X_\tau)$ are the abnormal, actual, and normal returns respectively for time period τ. X_τ is the conditioning information for the normal return model. There are two common choices for modeling the normal return—the *constant mean return model* where X_τ is a constant, and the *market model* where X_τ is the market return. The constant mean return model, as the name implies, assumes that the mean return of a given security is constant through time. The market model assumes a stable linear relation between the market return and the security return.

Given the selection of a normal performance model, the estimation window needs to be defined. The most common choice, when feasible, is using the period prior to the event window for the estimation window. For example, in an event study using daily data and the market model, the market model parameters could be estimated over the 120 days prior to the event. Generally the event period itself is not included in the estimation period to prevent the event from influencing the normal performance model parameter estimates.

With the parameter estimates for the normal performance model, the abnormal returns can be calculated. Next comes the design of the testing framework for the abnormal returns. Important considerations are defining the null hypothesis and determining the techniques for aggregating the individual firm abnormal returns.

The presentation of the empirical results follows the formulation of the econometric design. In addition to presenting the basic empirical results, the presentation of diagnostics can be fruitful. Occasionally, especially in studies with a limited number of event observations, the empirical results can be heavily influenced by one or two firms. Knowledge of this is important for gauging the importance of the results.

Ideally the empirical results will lead to insights relating to understanding the sources and causes of the effects (or lack of effects) of the event under study. Additional analysis may be included to distinguish between competing explanations. Concluding comments complete the study.

3. *An Example of an Event Study*

The Financial Accounting Standards Board (FASB) and the Securities Exchange Commission strive to set reporting regulations so that financial statements and related information releases are informative about the value of the firm. In setting standards, the information content of the financial disclosures is of interest. Event studies provide an ideal tool for examining the information content of the disclosures.

In this section the description of an example selected to illustrate event study methodology is presented. One particular type of disclosure—quarterly earnings announcements—is considered. The objective is to investigate the information content of these announcements. In other words, the goal is to see if the release of accounting information provides information to the marketplace. If so there should be a correlation between the observed change of the market value of the company and the information.

The example will focus on the quarterly earnings announcements for the 30 firms in the Dow Jones Industrial Index over the five-year period from January 1989 to December 1993. These announcements correspond to the quarterly earnings for the last quarter of 1988 through the third quarter of 1993. The five years of data for 30 firms provide a total sample of 600 announcements. For each firm and quarter, three pieces of information are compiled: the date of the announcement, the actual earnings, and a measure of the expected earnings. The source of the date of the announcement is Datastream, and the source of the actual earnings is Compustat.

If earnings announcements convey information to investors, one would expect the announcement impact on the market's valuation of the firm's equity to depend on the magnitude of the unexpected component of the announcement. Thus a measure of the deviation of the actual announced earnings from the market's prior expectation is required. For constructing such a measure, the mean quarterly earnings forecast reported by the Institutional Brokers Estimate System (I/B/E/S) is used to proxy for the market's expectation of earnings. I/B/E/S compiles forecasts from analysts for a large number of companies and reports summary statistics each month. The mean forecast is taken from the last month of the quarter. For example, the mean third quarter forecast from September 1990 is used as the measure of expected earnings for the third quarter of 1990.

To facilitate the examination of the impact of the earnings announcement on the value of the firm's equity, it is essential to posit the relation between the information release and the change in value of the equity. In this example the task is straightforward. If the earnings disclosures have information content, higher than expected earnings should be associated with increases in value of the equity and lower than expected earnings with decreases. To capture this association, each announcement is assigned to one of three categories: good news, no news, or bad news. Each announcement is categorized using the deviation of the actual earnings from the expected earnings. If the actual exceeds expected by more than 2.5 percent the announcement is designated as good news, and if the actual is more than 2.5 percent less than expected the announcement is designated as bad news. Those announcements where the actual earnings is in the 5 percent range centered about the expected earnings are designated as no news. Of the 600 announcements, 189 are good news, 173 are no news, and the remaining 238 are bad news.

With the announcements categorized, the next step is to specify the parameters of the empirical design to analyze the equity return, i.e., the percent change in value of the equity. It is necessary to specify a length of observation interval, an event window, and an estimation window. For this example the interval is set to one day, thus daily stock returns are used. A 41-day event window is employed, comprised of 20 pre-event days, the event day, and 20 post-event days. For each announcement the 250 trading day period prior to the event window is used as the estimation window. After presenting the methodology of an event study, this example will be drawn upon to illustrate the execution of a study.

4. *Models for Measuring Normal Performance*

A number of approaches are available to calculate the normal return of a given security. The approaches can be loosely grouped into two categories—statistical and economic. Models in the first category follow from statistical assumptions concerning the behavior of asset returns and do not depend on any economic arguments. In contrast, models in the second category rely on assumptions concerning investors' behavior and are not based solely on statistical assumptions. It should, however, be noted that to use economic models in practice it is necessary to add statistical assumptions. Thus the potential advantage of economic models is not the absence of statistical assumptions, but the opportunity to calculate more precise measures of the normal return using economic restrictions.

For the statistical models, the assumption that asset returns are jointly multivariate normal and independently and identically distributed through time is imposed. This distributional assumption is sufficient for the constant mean return model and the market model to be correctly specified. While this assumption is strong, in practice it generally does not lead to problems because the assumption is empirically reasonable and inferences using the normal return models tend to be robust to deviations from the assumption. Also one can easily modify the statistical framework so that the analysis of the abnormal returns is autocorrelation and heteroskedasticity consistent by using a generalized method-of-moments approach.

A. *Constant Mean Return Model*

Let μ_i be the mean return for asset i. Then the constant mean return model is

$$R_{it} = \mu_i + \zeta_{it} \tag{2}$$

$$E(\zeta_{it}) = 0 \qquad \text{var}(\zeta_{it}) = \sigma^2_{\zeta_i}.$$

where R_{it} is the period-t return on security i and ζ_{it} is the time period t disturbance term for security i with an expectation of zero and variance $\sigma^2_{\zeta_i}$.

Although the constant mean return model is perhaps the simplest model, Brown and Warner (1980, 1985) find it often yields results similar to those of more sophisticated models. This lack of sensitivity to the model can be attributed to the fact that the variance of the abnormal return is frequently not reduced much by choosing a more sophisticated model. When using daily data the model is typically applied to nominal returns. With monthly data the model can be applied to real returns or excess returns (the return in excess of the nominal risk free return generally measured using the U.S. Treasury Bill with one month to maturity) as well as nominal returns.

B. *Market Model*

The market model is a statistical model which relates the return of any given security to the return of the market portfolio. The model's linear specification follows from the assumed joint normality of asset returns. For any security i the market model is

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \tag{3}$$

$$E(\varepsilon_{it} = 0) \qquad \text{var}(\varepsilon_{it}) = \sigma^2_{\varepsilon_i}$$

where R_{it} and R_{mt} are the period-t returns on security i and the market portfolio, respectively, and ε_{it} is the zero mean disturbance term. α_i, β_i, and $\sigma^2_{\varepsilon_i}$ are the parameters of the market model. In applications a broad based stock index is used for the market portfolio, with the S&P 500 Index, the CRSP Value Weighted Index, and the CRSP Equal Weighted Index being popular choices.

The market model represents a potential improvement over the constant mean return model. By removing the portion of the return that is related to variation in the market's return, the variance of the abnormal return is reduced. This in turn can lead to increased ability to detect event effects. The benefit from using the market model will depend upon the R^2 of the market model regression. The higher the R^2 the greater is the variance reduction of the abnormal return, and the larger is the gain.

C. *Other Statistical Models*

A number of other statistical models have been proposed for modeling the normal return. A general type of statistical model is the *factor model*. Factor models are motivated by the benefits of reducing the variance of the abnormal return by explaining more of the variation in the normal return. Typically the factors are portfolios of traded securities. The market model is an example of a one factor model. Other multifactor models include industry indexes in addition to the market. William Sharpe (1970) and Sharpe, Gordon Alexander, and Jeffery Bailey (1995, p. 303) provide discussion of index models with factors based on industry classification. Another variant of a factor model is a procedure which calculates the abnormal return by taking the difference between the actual return and a portfolio of firms of similar size, where size is measured by market value of equity. In this approach typically ten size groups are considered and the loading on the size portfolios is restricted to unity. This procedure implicitly assumes that expected return is directly related to market value of equity.

Generally, the gains from employing multifactor models for event studies are limited. The reason for the limited gains is the empirical fact that the marginal explanatory power of additional factors the market factor is small, and hence, there is little reduction in the variance of the abnormal return. The variance reduction will typically be greatest in cases where the sample firms have a common characteristic, for example they are all members of one industry or they are all firms concentrated in one market capitalization group. In these cases the use of a multifactor model warrants consideration.

The use of other models is dictated by data availability. An example of a normal performance return model implemented in situations with limited data is the market-adjusted return model. For some events it is not feasible to have a preevent estimation period for the normal model parameters, and a market-adjusted abnormal return is used. The market-adjusted return model can be viewed as a restricted market model with α_i constrained to be zero and β_i constrained to be one. Because the model coefficients are prespecified, an estimation period is not required to obtain parameter estimates. An example of when such a model is used is in studies of the under pricing of initial public offerings. Jay Ritter (1991) presents such an example. A general recommendation is to only use such restricted models if necessary, and if necessary, consider the possibility of biases arising from the imposition of the restrictions.

D. *Economic Models*

Economic models can be cast as restrictions on the statistical models to provide more constrained normal return models. Two common economic models which provide restrictions are the Capital Asset Pricing Model (CAPM) and the Arbitrage Pricing Theory (APT). The CAPM due to Sharpe (1964) and John Lintner (1965) is an equilibrium theory where the expected return of a given asset is determined by its covariance with the market portfolio. The APT due to Stephen Ross (1976) is an asset pricing theory where the expected return of a given asset is a linear combination of multiple risk factors.

The use of the Capital Asset Pricing Model is common in event studies of the 1970s. However, deviations from the CAPM have been discovered, implying that the validity of the restrictions imposed by the CAPM on the market model is questionable.[2] This has introduced the possibility that the results of the studies may be sensitive to the specific CAPM restrictions. Because this potential for sensitivity can be avoided at little cost by using the market model, the use of the CAPM has almost ceased.

Similarly, other studies have employed multifactor normal performance models motivated by the Arbitrage Pricing Theory. A general finding is that with the APT the most important factor behaves like a market factor and additional factors add relatively little explanatory power. Thus the gains from using an APT motivated model versus the market model are small. See Stephen Brown and Mark Weinstein (1985) for further discussion. The main potential gain from using a model based on the arbitrage pricing theory is to eliminate the biases introduced by using the CAPM. However, because the statistically motivated models also eliminate these biases, for event studies such models dominate.

5. *Measuring and Analyzing Abnormal Returns*

In this section the problem of measuring and analyzing abnormal returns is considered. The framework is developed using the market model as the normal performance return model. The analysis is virtually identical for the constant mean return model.

Some notation is first defined to facilitate the measurement and analysis of abnormal returns. Returns will be indexed in event time using τ. Defining $\tau = 0$ as the event date, $\tau = T_1 + 1$ to $\tau = T_2$ represents the event window, and $\tau = T_0 + 1$ to $\tau = T_1$ constitutes the estimation window. Let $L_1 = T_1 - T_0$ and $L_2 = T_2 - T_1$ be the length of the estimation window and the event window respectively. Even if the event being considered is an announcement on given date it is typical to set the event window length to be larger than one. This facilitates the use of abnormal returns around the event day in the analysis. When applicable, the post-event window will be from $\tau = T_2 + 1$ to $\tau = T_3$ and of length $L_3 = T_3 - T_2$. The timing sequence is illustrated with a time line in Figure 1.

[2] Eugene Fama and Kenneth French (1996) provide discussion of these anomalies.

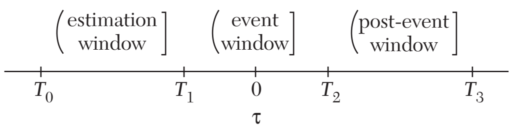

Figure 1. Time line for an event study.

It is typical for the estimation window and the event window not to overlap. This design provides estimators for the parameters of the normal return model which are not influenced by the returns around the event. Including the event window in the estimation of the normal model parameters could lead to the event returns having a large influence on the normal return measure. In this situation both the normal returns and the abnormal returns would capture the event impact. This would be problematic because the methodology is built around the assumption that the event impact is captured by the abnormal returns. On occasion, the post event window data is included with the estimation window data to estimate the normal return model. The goal of this approach is to increase the robustness of the normal market return measure to gradual changes in its parameters. In Section 6 expanding the null hypothesis to accommodate changes in the risk of a firm around the event is considered. In this case an estimation framework which uses the event window returns will be required.

A. *Estimation of the Market Model*

Under general conditions ordinary least squares (OLS) is a consistent estimation procedure for the market model parameters. Further, given the assumptions of Section 4, OLS is efficient. For the i^{th} firm in event time, the OLS estimators of the market model parameters for an estimation window of observations are

$$\hat{\beta}_i = \frac{\sum_{\tau=T_0+1}^{T_1} (R_{i\tau} - \hat{\mu}_i)(R_{m\tau} - \hat{\mu}_m)}{\sum_{\tau=T_0+1}^{T_1} (R_{m\tau} - \hat{\mu}_m)^2} \quad (4)$$

$$\hat{\alpha}_i = \hat{\mu}_i - \hat{\beta}_i \hat{\mu}_m \quad (5)$$

$$\hat{\sigma}^2_{\varepsilon_i} = \frac{1}{L_1 - 2} \sum_{\tau=T_0+1}^{T_1} (R_{i\tau} - \hat{\alpha}_i - \hat{\beta}_i R_{m\tau})^2 \quad (6)$$

where

$$\hat{\mu}_i = \frac{1}{L_1} \sum_{\tau=T_0+1}^{T_1} R_{i\tau}$$

and

$$\hat{\mu}_m = \frac{1}{L_1} \sum_{\tau=T_0+1}^{T_1} R_{m\tau}.$$

$R_{i\tau}$ and $R_{m\tau}$ are the return in event period τ for security i and the market respectively. The use of the OLS estimators to measure abnormal returns and to develop their statistical properties is addressed next. First, the properties of a given security are presented followed by consideration of the properties of abnormal returns aggregated across securities.

B. *Statistical Properties of Abnormal Returns*

Given the market model parameter estimates, one can measure and analyze the abnormal returns. Let $\widehat{AR}_{i\tau}$, $\tau = T_1 + 1, \ldots, T_2$, be the sample of L_2 abnormal returns for firm i in the event window. Using the market model to measure the normal return, the sample abnormal return is

$$\widehat{AR}_{i\tau} = R_{i\tau} - \hat{\alpha}_i - \hat{\beta}_i R_{m\tau}. \quad (7)$$

The abnormal return is the disturbance term of the market model calculated on an out of sample basis. Under the null hypothesis, conditional on the event window market returns, the abnormal returns will be jointly normally distributed with a zero conditional mean and conditional variance $\sigma^2(\widehat{AR}_{i\tau})$ where

$$\sigma^2(\widehat{AR}_{i\tau}) = \sigma^2_{\varepsilon_i} + \frac{1}{L_1}\left[1 + \frac{(R_{m\tau} - \hat{\mu}_m)^2}{\hat{\sigma}^2_m}\right]. \quad (8)$$

From (8), the conditional variance has two components. One component is the disturbance variance $\sigma^2_{\varepsilon_i}$ from (3) and a second component is additional variance due to the sampling error in α_i and β_i. This sampling error, which is common for all the event window observations, also leads to serial correlation of the abnormal returns despite the fact that the true disturbances are independent through time. As the length of the estimation window L_1 becomes large, the second term approaches zero as the sampling error of the parameters vanishes. The variance of the abnormal return will be $\sigma^2_{\varepsilon_i}$ and the abnormal return observations will become independent through time. In practice, the estimation window can usually be chosen to be large enough to make it reasonable to assume that the contribution of the second component to the variance of the abnormal return is zero.

Under the null hypothesis, H_0, that the event has no impact on the behavior of returns (mean or variance) the distributional properties of the abnormal returns can be used to draw inferences over any period within the event window. Under H_0 the distribution of the sample abnormal return of a given observation in the event window is

$$\widehat{AR}_{i\tau} \sim N(0,\sigma^2(\widehat{AR}_{i\tau})). \quad (9)$$

Next (9) is built upon to consider the aggregation of the abnormal returns.

C. *Aggregation of Abnormal Returns*

The abnormal return observations must be aggregated in order to draw overall inferences for the event of interest. The aggregation is along two dimensions—through time and across securities. We will first consider aggregation through time for an individual security and then will consider aggregation both across securities and through time. The concept of a cumulative abnormal return is necessary to accommodate a multiple period event window. Define $\widehat{CAR}_i(\tau_1,\tau_2)$ as the sample cumulative abnormal return (CAR) from τ_1 to τ_2 where $T_1 < \tau_1 \le \tau_2 \le T_2$. The CAR from τ_1 to τ_2 is the sum of the included abnormal returns,

$$\widehat{CAR}_i(\tau_1,\tau_2) = \sum_{\tau=\tau_1}^{\tau_2} \widehat{AR}_{i\tau}. \quad (10)$$

Asymptotically (as L_1 increases) the variance of $\widehat{CAR}_i$ is

$$\sigma_i^2(\tau_1,\tau_2) = (\tau_2 - \tau_1 + 1)\,\sigma^2_{\varepsilon_i}. \quad (11)$$

This large sample estimator of the variance can be used for reasonable values of L_1. However, for small values of L_1 the variance of the cumulative abnormal return should be adjusted for the effects of the estimation error in the normal model parameters. This adjustment involves the second term of (8) and a further related adjustment for the serial covariance of the abnormal return.

The distribution of the cumulative abnormal return under H_0 is

$$\widehat{CAR}_i(\tau_1,\tau_2) \sim N(0,\sigma_i^2(\tau_1,\tau_2)). \quad (12)$$

Given the null distributions of the abnormal return and the cumulative abnormal return, tests of the null hypothesis can be conducted.

However, tests with one event observation are not likely to be useful so it is necessary to aggregate. The abnormal return observations must be aggregated for the event window and across observations of the event. For this aggregation,

TABLE 1

Event Day	Market Model					
	Good News		No News		Bad News	
	AR	CAR	AR	CAR	AR	CAR
−20	.093	.093	.080	.080	−.107	−.107
−19	−.177	−.084	.018	.098	−.180	−.286
−18	.088	.004	.012	.110	.029	−.258
−17	.024	.029	−.151	−.041	−.079	−.337
−16	−.018	.011	−.019	−.060	−.010	−.346
−15	−.040	−.029	.013	−.047	−.054	−.401
−14	.038	.008	.040	−.007	−.021	−.421
−13	.056	.064	−.057	−.065	.007	−.414
−12	.065	.129	.146	.081	−.090	−.504
−11	.069	.199	−.020	.061	−.088	−.592
−10	.028	.227	.025	.087	−.092	−.683
−9	.155	.382	.115	.202	−.040	−.724
−8	.057	.438	.070	.272	.072	−.652
−7	−.010	.428	−.106	.166	−.026	−.677
−6	.104	.532	.026	.192	−.013	−.690
−5	.085	.616	−.085	.107	.164	−.527
−4	.099	.715	.040	.147	−.139	−.666
−3	.117	.832	.036	.183	.098	−.568
−2	.006	.838	.226	.409	−.112	−.680
−1	.164	1.001	−.168	.241	−.180	−.860
0	.965	1.966	−.091	.150	−.679	−1.539
1	.251	2.217	−.008	.142	−.204	−1.743
2	−.014	2.203	.007	.148	.072	−1.672
3	−.164	2.039	.042	.190	.083	−1.589
4	−.014	2.024	.000	.190	.106	−1.483
5	.135	2.160	−.038	.152	.194	−1.289
6	−.052	2.107	−.302	−.150	.076	−1.213
7	.060	2.167	−.199	−.349	.120	−1.093
8	.155	2.323	−.108	−.457	−.041	−1.134
9	−.008	2.315	−.146	−.603	−.069	−1.203
10	.164	2.479	.082	−.521	.130	−1.073
11	−.081	2.398	.040	−.481	−.009	−1.082
12	−.058	2.341	.246	−.235	−.038	−1.119
13	−.165	2.176	.014	−.222	.071	−1.048
14	−.081	2.095	−.091	−.312	.019	−1.029
15	−.007	2.088	−.001	−.314	−.043	−1.072
16	.065	2.153	−.020	−.334	−.086	−1.159
17	.081	2.234	.017	−.317	−.050	−1.208
18	.172	2.406	.054	−.263	.066	−1.142
19	−.043	2.363	.119	−.144	−.088	−1.230
20	.013	2.377	.094	−.050	−.028	−1.258

TABLE 1 (*Cont.*)

Constant Mean Return Model					
Good News		No News		Bad News	
AR	CAR	AR	CAR	AR	CAR
.105	.105	.019	.019	−.077	−.077
−.235	−.129	−.048	−.029	−.142	−.219
.069	−.060	−.086	−.115	−.043	−.262
−.026	−.086	−.140	−.255	−.057	−.319
−.086	−.172	.039	−.216	−.075	−.394
−.183	−.355	.099	−.117	−.037	−.431
−.020	−.375	−.150	−.266	−.101	−.532
−.025	−.399	−.191	−.458	−.069	−.601
.101	−.298	.133	−.325	−.106	−.707
.126	−.172	.006	−.319	−.169	−.876
.134	−.038	.103	−.216	−.009	−.885
.210	.172	.022	−.194	.011	−.874
.106	.278	.163	.–031	.135	-.738
−.002	.277	.009	−.022	−.027	−.765
.011	.288	−.029	−.051	.030	−.735
.061	.349	−.068	−.120	.320	−.415
.031	.379	.089	−.031	−.205	−.620
.067	.447	.013	−.018	.085	−.536
.010	.456	.311	.294	−.256	−.791
.198	.654	−.170	.124	−.227	−1.018
1.034	1.688	−.164	−.040	−.643	−1.661
.357	2.045	−.170	−.210	−.212	−1.873
−.013	2.033	.054	−.156	.078	−1.795
.088	1.944	−.121	−.277	.146	−1.648
.041	1.985	.023	−.253	.149	-1.499
.248	2.233	−.003	−.256	.286	−1.214
−.035	2.198	−.319	−.575	.070	−1.143
.017	2.215	−.112	−.687	.102	−1.041
.112	2.326	−.187	−.874	.056	−.986
−.052	2.274	−.057	−.931	−.071	−1.056
.147	2.421	.203	−.728	.267	−.789
−.013	2.407	.045	−.683	.006	−.783
−.054	2.354	.299	−.384	.017	−.766
−.246	2.107	−.067	−.451	.114	−.652
−.011	2.096	−.024	−.475	.089	−.564
−.027	2.068	−.059	−.534	−.022	−.585
.103	2.171	−.046	−.580	−.084	−.670
.066	2.237	−.098	−.677	−.054	−.724
.110	2.347	.021	−.656	−.071	−.795
−.055	2.292	.088	−.568	.026	−.769
.019	2.311	.013	−.554	−.115	−.884

Abnormal returns for an event study of the information content of earnings announcements. The sample consists of a total of 600 quarterly announcements for the 30 companies in the Dow Jones Industrial Index for the five year period January 1989 to December 1993. Two models are considered for the normal returns, the market model using the CRSP value-weighted index and the constant return model. The announcements are categorized into three groups, good news, no news, and bad news. AR is the sample average abnormal return for the specified day in event time and CAR is the sample average cumulative abnormal return for day –20 to the specified day. Event time is days relative to the announcement date.

it is assumed that there is not any clustering. That is, there is not any overlap in the event windows of the included securities. The absence of any overlap and the maintained distributional assumptions imply that the abnormal returns and the cumulative abnormal returns will be independent across securities. Later inferences with clustering will be discussed.

The individual securities' abnormal returns can be aggregated using $\widehat{AR}_{i\tau}$ from (7) for each event period, $\tau = T_1 + 1, \ldots, T_2$. Given N events, the sample aggregated abnormal returns for period τ is

$$\overline{AR}_\tau = \frac{1}{N}\sum_{i=1}^{N} \widehat{AR}_{i\tau} \qquad (13)$$

and for large L_1, its variance is

$$\text{var}(\overline{AR}_\tau) = \frac{1}{N^2}\sum_{i=1}^{N} \sigma^2_{\varepsilon_i}. \qquad (14)$$

Using these estimates, the abnormal returns for any event period can be analyzed.

The average abnormal returns can then be aggregated over the event window using the same approach as that used to calculate the cumulative abnormal return for each security i. For any interval in the event window

$$\overline{CAR}(\tau_1, \tau_2) = \sum_{\tau=\tau_1}^{\tau_2} \overline{AR}_\tau, \qquad (15)$$

$$\text{var}(\overline{CAR}(\tau_1, \tau_2)) = \sum_{\tau=\tau_1}^{\tau_2} \text{var}\,(\overline{AR}_\tau). \qquad (16)$$

Observe that equivalently one can form the CAR's security by security and then aggregate through time,

$$\overline{CAR}(\tau_1, \tau_2) = \frac{1}{N}\sum_{i=1}^{N} \widehat{CAR}_i\,(\tau_1, \tau_2) \qquad (17)$$

$$\text{var}(\overline{CAR}(\tau_1, \tau_2)) = \frac{1}{N^2}\sum_{i=1}^{N} \sigma_i^2(\tau_1, \tau_2). \qquad (18)$$

For the variance estimators the assumption that the event windows of the N securities do not overlap is used to set the covariance terms to zero. Inferences about the cumulative abnormal returns can be drawn using

$$\overline{CAR}(\tau_1, \tau_2) \sim N[0, \text{var}(\overline{CAR}\,(\tau_1, \tau_2))] \qquad (19)$$

to test the null hypothesis that the abnormal returns are zero. In practice, because $\sigma^2_{\varepsilon_i}$ is unknown, an estimator must be used to calculate the variance of the abnormal returns as in (14). The usual sample variance measure of $\sigma^2_{\varepsilon_i}$ from the market model regression in the estimation window is an appropriate choice. Using this to calculate $\text{var}(\overline{AR}_\tau)$ in (14), H_0 can be tested using

$$\theta_1 = \frac{\overline{CAR}(\tau_1, \tau_2)}{\text{var}(\overline{CAR}\,(\tau_1, \tau_2))^{\frac{1}{2}}} \sim N(0,1). \qquad (20)$$

This distributional result is asymptotic with respect to the number of securities N and the length of estimation window L_1.

Modifications to the basic approach presented above are possible. One common modification is to standardize each abnormal return using an estimator of its standard deviation. For certain alternatives, such standardization can lead to more powerful tests. James Patell (1976) presents tests based on standardization and Brown and Warner (1980, 1985) provide comparisons with the basic approach.

D. *CAR's for the Earnings Announcement Example*

The information content of earnings example previously described illustrates the use of sample abnormal residuals and sample cumulative abnormal returns. Table 1 presents the abnormal returns av-

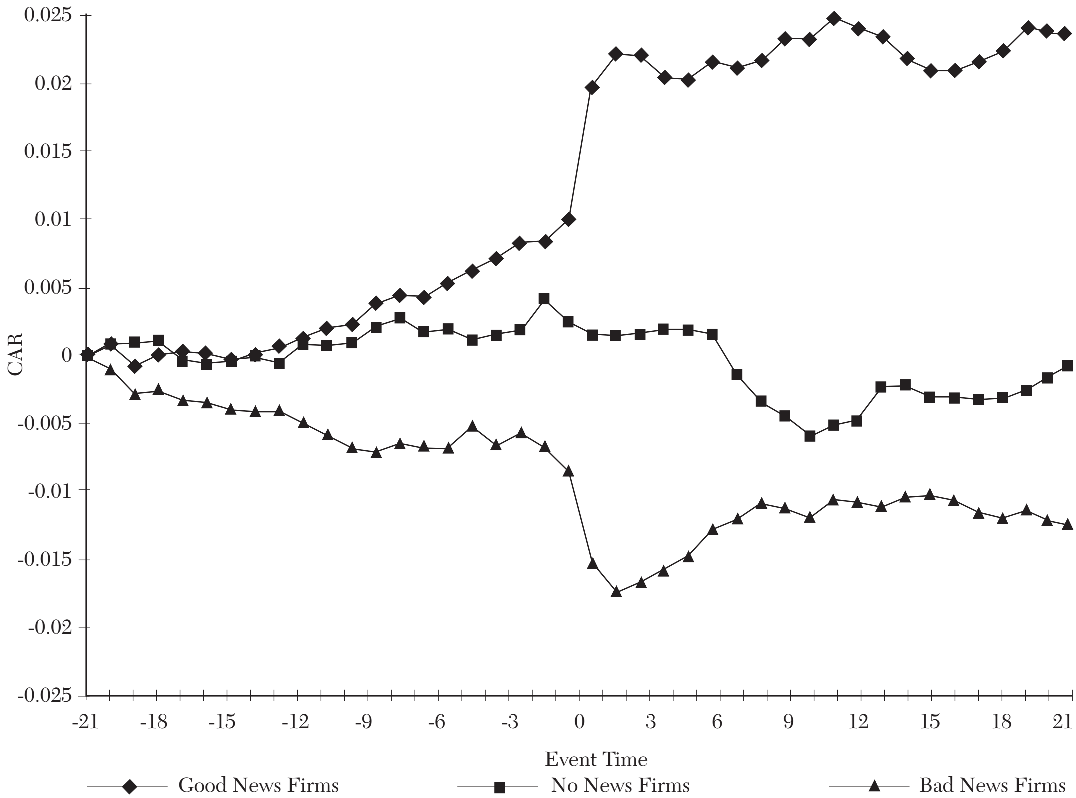

Figure 2a. Plot of cumulative abnormal return for earning announcements from event day -20 to event day 20. The abnormal return is calculated using the market model as the normal return measure.

eraged across the 600 event observations (30 firms, 20 announcements per firm) as well as the aggregated cumulative abnormal return for each of the three earnings news categories. Two normal return models are considered; the market model and for comparison, the constant mean return model. Plots of the cumulative abnormal returns are also included, with the CAR's from the market model in Figure 2a and the CAR's from the constant mean return model in Figure 2b.

The results of this example are largely consistent with the existing literature on the information content of earnings. The evidence strongly supports the hypothesis that earnings announcements do indeed convey information useful for the valuation of firms. Focusing on the announcement day (day 0) the sample average abnormal return for the good news firm using the market model is 0.965 percent. Given the standard error of the one day good news average abnormal return is 0.104 percent, the value of θ_1 is 9.28 and the null hypothesis that the event has no impact is strongly rejected. The story is the same for the bad news firms. The event day sample abnormal return is −0.679 percent, with a standard error of 0.098 percent, leading to θ_1 equal to −6.93 and again strong evidence against the null hypothesis. As would be expected, the abnormal return of the no news firms is small at −0.091 percent and

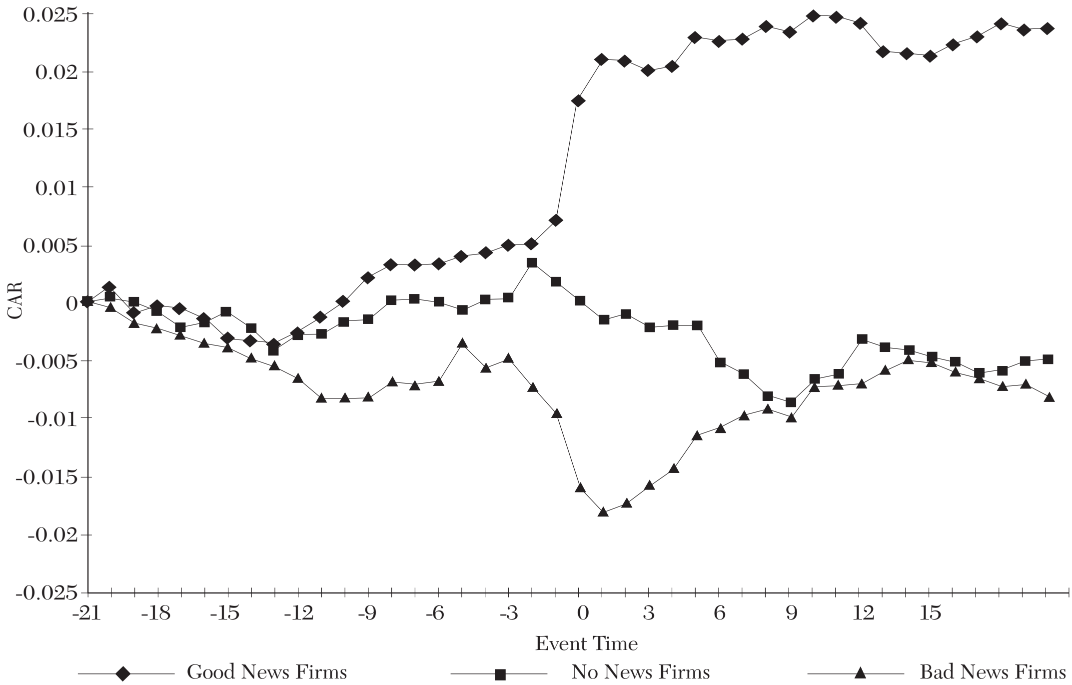

Figure 2b. Plot of cumulative abnormal return for earning announcements from event day -20 to event day 20. The abnormal return is calculated using the constant mean return model as the normal return

with a standard error of 0.098 percent is less than one standard error from zero. There is some evidence of the announcement effect on day one. The average abnormal return is 0.251 percent and –0.204 percent for the good news and the bad news firms respectively. Both these values are more than two standard errors from zero. The source of these day one effects is likely to be that some of the earnings announcements are made on event day zero after the close of the stock market. In these cases, the effects will be captured in the return on day one.

The conclusions using the abnormal returns from the constant return model are consistent with those from the market model. However, there is some loss of precision using the constant return model, as the variance of the average abnormal return increases for all three categories. When measuring abnormal returns with the constant mean return model the standard errors increase from 0.104 percent to 0.130 percent for good news firms, from 0.098 percent to 0.124 percent for no news firms, and from 0.098 percent to 0.131 percent for bad news firms. These increases are to be expected when considering a sample of large firms such as those in the Dow Index because these stocks tend to have an important market component whose variability is eliminated using the market model.

The CAR plots show that to some extent the market gradually learns about the forthcoming announcement. The average CAR of the good news firms gradually drifts up in days –20 to –1 and the average CAR of the bad news firms gradually drifts down over this period. In the days after the announcement the CAR is relatively stable as would be expected, although there does tend to be a slight (but statistically insignificant) increase with the bad news firms in days two through eight.

E. *Inferences with Clustering*

The analysis aggregating abnormal returns has assumed that the event windows of the included securities do not overlap in calendar time. This assumption allows us to calculate the variance of the aggregated sample cumulative abnormal returns without concern about the covariances across securities because they are zero. However, when the event windows do overlap and the covariances between the abnormal returns will not be zero, the distributional results presented for the aggregated abnormal returns are no longer applicable. Victor Bernard (1987) discusses some of the problems related to clustering.

Clustering can be accommodated in two ways. The abnormal returns can be aggregated into a portfolio dated using event time and the security level analysis of Section 5 can applied to the portfolio. This approach will allow for cross correlation of the abnormal returns.

A second method to handle clustering is to analyze the abnormal returns without aggregation. One can consider testing the null hypothesis of the event having no impact using unaggregated security by security data. This approach is applied most commonly when there is total clustering, that is, there is an event on the same day for a number of firms. The basic approach is an application of a multivariate regression model with dummy variables for the event date. This approach is developed in the papers of Katherine Schipper and Rex Thompson (1983, 1985) and Daniel Collins and Warren Dent (1984). The advantage of the approach is that, unlike the portfolio approach, an alternative hypothesis where some of the firms have positive abnormal returns and some of the firms have negative abnormal returns can be accommodated. However, in general the approach has two drawbacks—frequently the test statistic will have poor finite sample properties except in special cases and often the test will have little power against economically reasonable alternatives. The multivariate framework and its analysis is similar to the analysis of multivariate tests of asset pricing models. MacKinlay (1987) provides analysis in that context.

6. *Modifying the Null Hypothesis*

Thus far the focus has been on a single null hypothesis—that the given event has no impact on the behavior of the returns. With this null hypothesis either a mean effect or a variance effect will represent a violation. However, in some applications one may be interested in testing for a mean effect. In these cases, it is necessary to expand the null hypothesis to allow for changing (usually increasing) variances. To allow for changing variance as part of the null hypothesis, it is necessary to eliminate the reliance on the past returns to estimate the variance of the aggregated cumulative abnormal returns. This is accomplished by using the cross section of cumulative abnormal returns to form an estimator of the variance for testing the null hypothesis. Ekkehart Boehmer, Jim Musumeci, and Annette Poulsen (1991) discuss methodology to accommodate changing variance.

The cross sectional approach to estimating the variance can be applied to the average cumulative abnormal return ($\overline{CAR}(\tau_1,\tau_2)$). Using the cross-section to form an estimator of the variance gives

$$\text{var}(\overline{CAR}(\tau_1,\tau_2)) = \frac{1}{N^2}\sum_{i=1}^{N}(\widehat{CAR}_i(\tau_1,\tau_2) - \overline{CAR}(\tau_1,\tau_2))^2. \quad (21)$$

For this estimator of the variance to be consistent, the abnormal returns need to be uncorrelated in the cross-section. An absence of clustering is sufficient for this requirement. Note that cross-sectional homoskedasticity is not required. Given this variance estimator, the null hypothesis that the cumulative abnormal returns are zero can then be tested using the usual theory.

One may also be interested in the question of the impact of an event on the risk of a firm. The relevant measure of risk must be defined before this question can be addressed. One choice as a risk measure is the market model beta which is consistent with the Capital Asset Pricing Model being appropriate. Given this choice, the market model can be formulated to allow the beta to change over the event window and the stability of the risk can be examined. Edward Kane and Haluk Unal (1988) present an application of this idea.

7. *Analysis of Power*

An important consideration when setting up an event study is the ability to detect the presence of a non-zero abnormal return. The inability to distinguish between the null hypothesis and economically interesting alternatives would suggest the need for modification of the design. In this section the question of the likelihood of rejecting the null hypothesis for a specified level of abnormal return associated with an event is addressed. Formally, the power of the test is evaluated.

Consider a two-sided test of the null hypothesis using the cumulative abnormal return based statistic θ_1 from (20). It is assumed that the abnormal returns are uncorrelated across securities; thus the variance of $\overline{CAR}$ is $1/N^2\sum_{i=1}^{N}\sigma_i^2(\tau_1,\tau_2)$ and N is the sample size. Because the null distribution of θ_1 is standard normal, for a two sided test of size α, the null hypothesis will be rejected if θ_1 is in the critical region, that is,

$$\theta_1 < c\left(\frac{\alpha}{2}\right) \text{ or } \theta_1 > c\left(1-\frac{\alpha}{2}\right)$$

where $c(x) = \phi^{-1}(x)$. $\phi(\cdot)$ is the standard normal cumulative distribution function (CDF).

Given the specification of the alternative hypothesis H_A and the distribution of θ_1 for this alternative, the power of a test of size α can be tabulated using the power function,

$$P(\alpha,H_A) = pr\left(\theta_1 < c\left(\frac{\alpha}{2}\right) \mid H_A\right) + pr\left(\theta_1 > c\left(1-\frac{\alpha}{2}\right) \mid H_A\right). \quad (22)$$

The distribution of θ_1 under the alternative hypothesis considered below will be normal. The mean will be equal to the true cumulative abnormal return divided by the standard deviation of $\overline{CAR}$ and the variance will be equal to one.

To tabulate the power one must posit economically plausible scenarios. The alternative hypotheses considered are four levels of abnormal returns, 0.5 percent, 1.0 percent, 1.5 percent, and 2.0 percent and two levels of the average variance for the cumulative abnormal return of a given security over the event period, 0.0004 and 0.0016. The

TABLE 2

Sample Size	Abnormal Return .005	.010	.015	.020	Abnormal Return .005	.010	.015	.020
	σ = 0.02				σ = 0.04			
1	0.06	0.08	0.12	0.17	0.05	0.06	0.07	0.08
2	0.06	0.11	0.19	0.29	0.05	0.06	0.08	0.11
3	0.07	0.14	0.25	0.41	0.06	0.07	0.10	0.14
4	0.08	0.17	0.32	0.52	0.06	0.08	0.12	0.17
5	0.09	0.20	0.39	0.61	0.06	0.09	0.13	0.20
6	0.09	0.23	0.45	0.69	0.06	0.09	0.15	0.23
7	0.10	0.26	0.51	0.75	0.06	0.10	0.17	0.26
8	0.11	0.29	0.56	0.81	0.06	0.11	0.19	0.29
9	0.12	0.32	0.61	0.85	0.07	0.12	0.20	0.32
10	0.12	0.35	0.66	0.89	0.07	0.12	0.22	0.35
11	0.13	0.38	0.70	0.91	0.07	0.13	0.24	0.38
12	0.14	0.41	0.74	0.93	0.07	0.14	0.25	0.41
13	0.15	0.44	0.77	0.95	0.07	0.15	0.27	0.44
14	0.15	0.46	0.80	0.96	0.08	0.15	0.29	0.46
15	0.16	0.49	0.83	0.97	0.08	0.16	0.31	0.49
16	0.17	0.52	0.85	0.98	0.08	0.17	0.32	0.52
17	0.18	0.54	0.87	0.98	0.08	0.18	0.34	0.54
18	0.19	0.56	0.89	0.99	0.08	0.19	0.36	0.56
19	0.19	0.59	0.90	0.99	0.08	0.19	0.37	0.59
20	0.20	0.61	0.92	0.99	0.09	0.20	0.39	0.61
25	0.24	0.71	0.96	1.00	0.10	0.24	0.47	0.71
30	0.28	0.78	0.98	1.00	0.11	0.28	0.54	0.78
35	0.32	0.84	0.99	1.00	0.11	0.32	0.60	0.84
40	0.35	0.89	1.00	1.00	0.12	0.35	0.66	0.89
45	0.39	0.92	1.00	1.00	0.13	0.39	0.71	0.92
50	0.42	0.94	1.00	1.00	0.14	0.42	0.76	0.94
60	0.49	0.97	1.00	1.00	0.16	0.49	0.83	0.97
70	0.55	0.99	1.00	1.00	0.18	0.55	0.88	0.99
80	0.61	0.99	1.00	1.00	0.20	0.61	0.92	0.99
90	0.66	1.00	1.00	1.00	0.22	0.66	0.94	1.00
100	0.71	1.00	1.00	1.00	0.24	0.71	0.96	1.00
120	0.78	1.00	1.00	1.00	0.28	0.78	0.98	1.00
140	0.84	1.00	1.00	1.00	0.32	0.84	0.99	1.00
160	0.89	1.00	1.00	1.00	0.35	0.89	1.00	1.00
180	0.92	1.00	1.00	1.00	0.39	0.92	1.00	1.00
200	0.94	1.00	1.00	1.00	0.42	0.94	1.00	1.00

Power of event study methodology for test of the null hypothesis that the abnormal return is zero. The power is reported for a two-sided test using θ_1 with a size of 5 percent. The sample size is the number of event observations included the study and σ is the square root of the average variance of the abnormal return across firms.

sample size, that is the number of securities for which the event occurs, is varied from one to 200. The power for a test with a size of 5 percent is documented. With $\alpha = 0.05$, the critical values calculated using $c(\alpha/2)$ and $c(1 - \alpha/2)$ are -1.96 and 1.96 respectively. Of course, in applications, the power of the test should be considered when selecting the size.

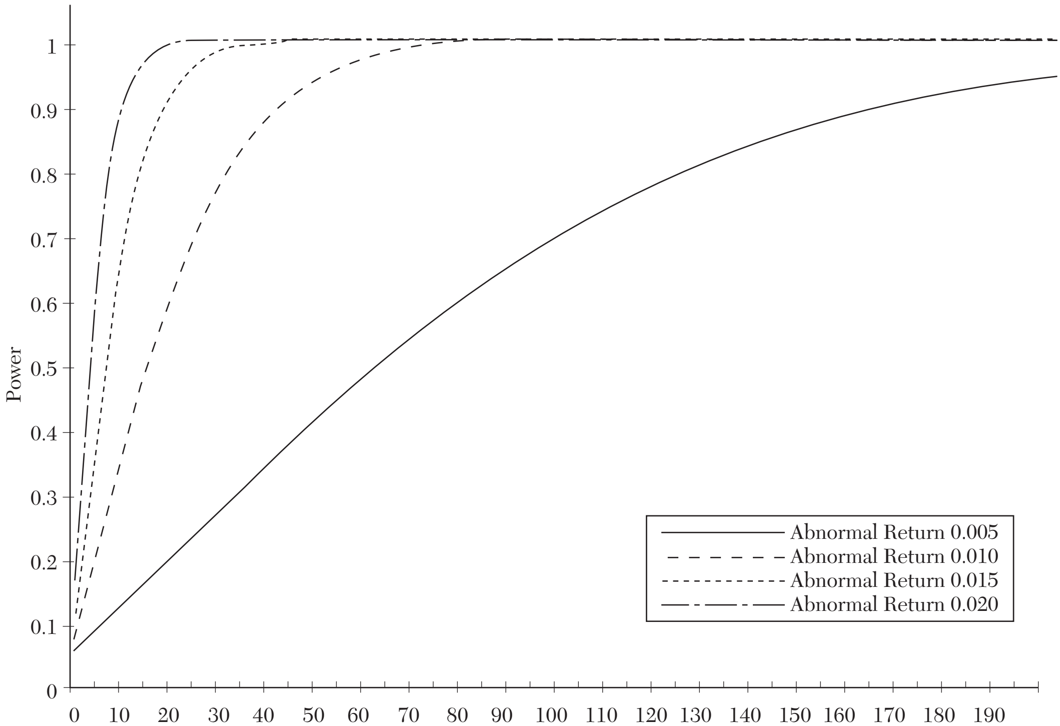

Figure 3a. Power of event study test statistic θ_1 to reject the null hypothesis that the abnormal return is zero, when the square root of the average variance of the abnormal return across firms is 2 percent.

The power results are presented in Table 2, and are plotted in Figures 3a and 3b. The results in the left panel of Table 2 and Figure 3a are for the case where the average variance is 0.0004. This corresponds to a cumulative abnormal return standard deviation of 2 percent and is an appropriate value for an event which does not lead to increased variance and can be examined using a one-day event window. In terms of having high power this is the best case scenario. The results illustrate that when the abnormal return is only 0.5 percent the power can be low. For example with a sample size of 20 the power of a 5 percent test is only 0.20. One needs a sample of over 60 firms before the power reaches 0.50. However, for a given sample size, increases in power are substantial when the abnormal return is larger. For example, when the abnormal return is 2.0 percent the power of a 5 percent test with 20 firms is almost 1.00 with a value of 0.99. The general results for a variance of 0.0004 is that when the abnormal return is larger than 1 percent the power is quite high even for small sample sizes. When the abnormal return is small a larger sample size is necessary to achieve high power.

In the right panel of Table 2 and in Figure 3b the power results are presented for the case where the average variance of the cumulative abnormal return is 0.0016. This case corresponds roughly to either a multi-day event window or to a one-day event window with the event leading to increased variance

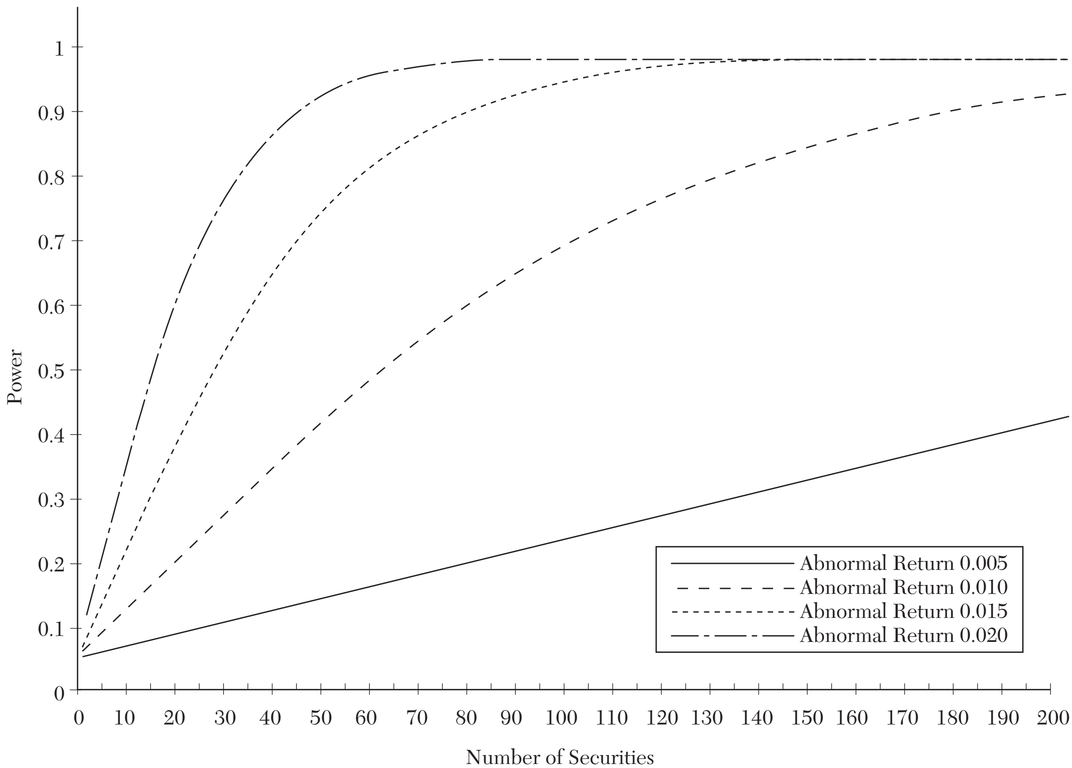

Figure 3b. Power of event study test statistic θ_1 to reject the null hypothesis that the abnormal return is zero, when the square root of the average variance of the abnormal return across firms is 4 percent.

which is accommodated as part of the null hypothesis. When the average variance of the CAR is increased from 0.0004 to 0.0016 there is a dramatic power decline for a 5 percent test. When the CAR is 0.5 percent the power is only 0.09 with 20 firms and is only 0.42 with a sample of 200 firms. This magnitude of abnormal return is difficult to detect with the larger variance. In contrast, when the CAR is as large as 1.5 percent or 2.0 percent the 5 percent test is still has reasonable power. For example, when the abnormal return is 1.5 percent and there is a sample size of 30 the power is 0.54. Generally if the abnormal return is large one will have little difficulty rejecting the null hypothesis of no abnormal return.

In the preceding analysis the power is considered analytically for the given distributional assumptions. If the distributional assumptions are inappropriate then the results may differ. However, Brown and Warner (1985) consider this possible difference and find that the analytical computations and the empirical power are very close.

It is difficult to make general conclusions concerning the adequacy of the ability of event study methodology to detect non-zero abnormal returns. When conducting an event study it is best to evaluate the power given the parameters and objectives of the study. If the power seems sufficient then one can proceed, otherwise one should search for ways of increasing the power. This can be done by increasing the sample size, shortening the event window, or by developing more specific predictions to test.

8. *Nonparametric Tests*

The methods discussed to this point are parametric in nature, in that specific assumptions have been made about the distribution of abnormal returns. Alternative approaches are available which are nonparametric in nature. These approaches are free of specific assump- tions concerning the distribution of returns. Common nonparametric tests for event studies are the sign test and the rank test. These tests are discussed next.

The sign test, which is based on the sign of the abnormal return, requires that the abnormal returns (or more generally cumulative abnormal returns) are independent across securities and that the expected proportion of positive abnormal returns under the null hypothesis is 0.5. The basis of the test is that, under the null hypothesis, it is equally probable that the CAR will be positive or negative. If, for example, the null hypothesis is that there is a positive abnormal return associated with a given event, the null hypothesis is $H_0{:}p \leq 0.5$ and the alternative is $H_A{:}p > 0.5$ where $p = pr[CAR_i \geq 0.0]$. To calculate the test statistic we need the number of cases where the abnormal return is positive, N^+, and the total number of cases, N. Letting θ_2 be the test statistic,

$$\theta_2 = \left[\frac{N^+}{N} - 0.5\right]\frac{\sqrt{N}}{0.5} \sim N(0,1). \qquad (23)$$

This distributional result is asymptotic. For a test of size $(1 - \alpha)$, H_0 is rejected if $\theta_2 > \Phi^{-1}(\alpha)$.

A weakness of the sign test is that it may not be well specified if the distribution of abnormal returns is skewed as can be the case with daily data. In response to this possible shortcoming, Charles Corrado (1989) proposes a nonparametric rank test for abnormal performance in event studies. A brief description of his test of no abnormal return for event day zero follows. The framework can be easily altered for more general tests.

Drawing on notation previously introduced, consider a sample of L_2 abnormal returns for each of N securities. To implement the rank test, for each security it is necessary to rank the abnormal returns from one to L_2. Define $K_{i\tau}$ as the rank of the abnormal return of security i for event time period τ. Recall, τ ranges from $T_1 + 1$ to T_2 and $\tau = 0$ is the event day. The rank test uses the fact that the expected rank of the event day is $(L_2 + 1)/2$ under the null hypothesis. The test statistic for the null hypothesis of no abnormal return on event day zero is

$$\theta_3 = \frac{1}{N}\sum_{i=l}^{N}\left(K_{i0} - \frac{L_2 + 1}{2}\right) / s(K) \qquad (24)$$

where

$$s(K) = \sqrt{\frac{1}{L_2}\sum_{\tau = T_1 + 1}^{T_2}\left(\frac{1}{N}\sum_{i=1}^{N}\left(K_{i\tau} - \frac{L_2 + 1}{2}\right)\right)^2}. \qquad (25)$$

Tests of the null hypothesis can be implemented using the result that the asymptotic null distribution of θ_3 is standard normal. Corrado (1989) includes further discussion of details of this test.

Typically, these nonparametric tests are not used in isolation but in conjunction with the parametric counterparts. Inclusion of the nonparametric tests provides a check of the robustness of conclusions based on parametric tests. Such a check can be worthwhile as illustrated by the work of Cynthia Campbell and Charles Wasley (1993). They find that for NASDAQ stocks daily returns the nonparametric rank test provides more reliable inferences than do the standard parametric tests.

9. *Cross-Sectional Models*

Theoretical insights can result from examining the association between the magnitude of the abnormal return and characteristics specific to the event observation. Often such an exercise can be helpful when multiple hypotheses exist for the source of the abnormal return. A cross-sectional regression model is an appropriate tool to investigate this association. The basic approach is to run a cross-sectional regression of the abnormal returns on the characteristics of interest.

Given a sample of N abnormal return observations and M characteristics, the regression model is:

$$AR_j = \delta_0 + \delta_1 x_{1j} + \cdots + + \delta_M x_{Mj} + \eta_j \qquad (26)$$

$$E(\eta_j) = 0 \qquad (27)$$

where AR_j is the j^{th} abnormal return observation, $x_{mj}, m = 1, \ldots, M$, are M characteristics for the j^{th} observation and η_j is the zero mean disturbance term that is uncorrelated with the x's. δ_m, $m = 0, \ldots, M$ are the regression coefficients. The regression model can be estimated using OLS. Assuming the η_j's are cross-sectionally uncorrelated and homoskedastic, inferences can be conducted using the usual OLS standard errors. Alternatively, without assuming homoskedasticity, heteroskedasticity-consistent t-statistics using standard errors can be derived using the approach of Halbert White (1980). The use of heteroskedasticity-consistent standard errors is advisable because there is no reason to expect the residuals of (26) to be homoskedastic.

Paul Asquith and David Mullins (1986) provide an example of this cross-sectional approach. The two day cumulative abnormal return for the announcement of an equity offering is regressed on the size of the offering as a percentage of the value of the total equity of the firm and on the cumulative abnormal return in the eleven months prior to the announcement month. They find that the magnitude of the (negative) abnormal return associated with the announcement of equity offerings is related to both these variables. Larger pre-event cumulative abnormal returns are associated with less negative abnormal returns and larger offerings are associated with more negative abnormal returns. These findings are consistent with theoretical predictions which they discuss.

Issues concerning the interpretation of the results can arise with the cross-sectional regression approach. In many situations, the event window abnormal return will be related to firm characteristics not only through the valuation effects of the event but also through a relation between the firm characteristics and the extent to which the event is anticipated. This can happen when investors rationally use the firm characteristics to forecast the likelihood of the event occurring. In these cases, a linear relation between the valuation effect of the event and the firm characteristic can be hidden. Paul Malatesta and Thompson (1985) and William Lanen and Thompson (1988) provide examples of this situation.

Technically, with the relation between the firm characteristics and the degree of anticipation of the event introduces a selection bias. The assumption that the regression residual is uncorrelated with the regressors breaks down and the OLS estimators are inconsistent. Consistent estimators can be derived by explicitly incorporating the selection bias. Sankarshan Acharya (1988) and B. Espen Eckbo, Vojislav Maksimovic, and Joseph Williams (1990) provide examples of this approach. N. R. Prabhala (1995) provides a good discussion of this problem and the possible solutions. He argues that, despite an incorrect specification, under weak conditions, the OLS ap-

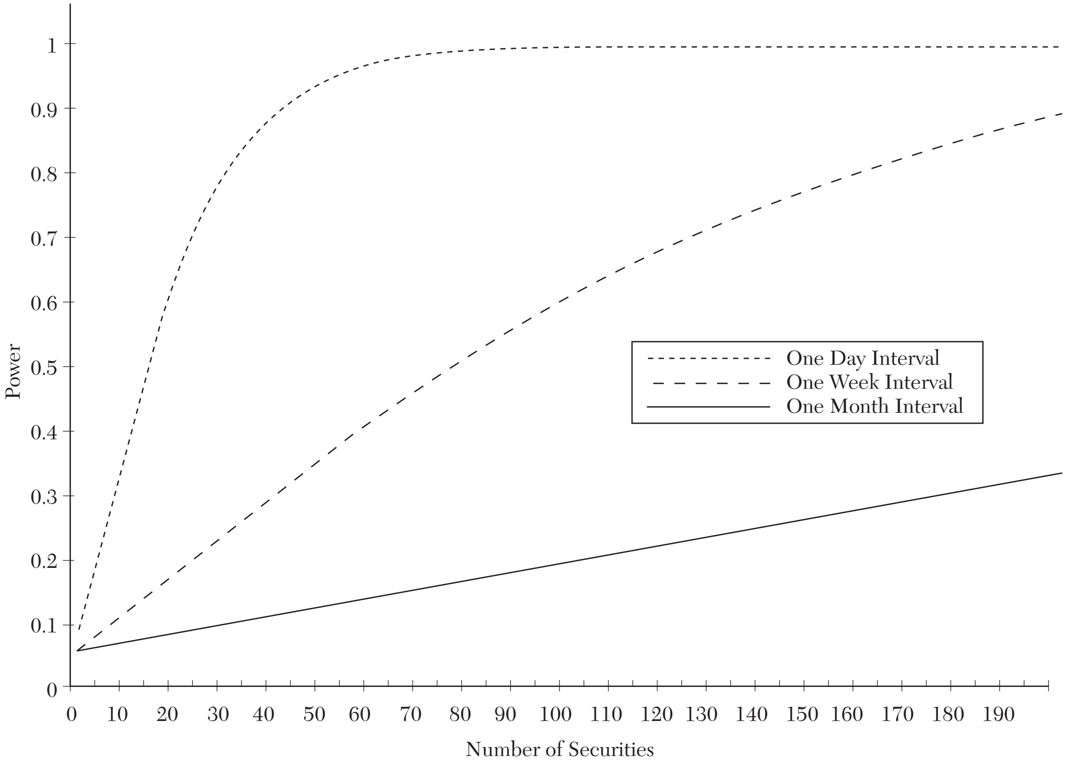

Figure 4. Power of event study test statistic θ_1 to reject the null hypothesis that the abnormal return is zero, for different sampling intervals, when the square root of the average variance of the abnormal return across firms is 4 percent for the daily interval. Size of test is 5 percent.

proach can be used for inferences and that the t-statistics can be interpreted as lower bounds on the true significance level of the estimates.

10. *Other Issues*

A number of further issues often arise when conducting an event study. These issues include the role of the sampling interval, event date uncertainty, robustness, and some additional biases.

A. *Role of Sampling Interval*

Stock return data is available at different sampling intervals, with daily and monthly intervals being the most common. Given the availability of various intervals, the question of the gains of using more frequent sampling arises. To address this question one needs to consider the power gains from shorter intervals. A comparison of daily versus monthly data is provided in Figure 4. The power of the test of no event effect is plotted against the alternative of an abnormal return of one percent for 1 to 200 securities. As one would expect given the analysis of Section 7, the decrease in power going from a daily interval to a monthly interval is severe. For example, with 50 securities the power for a 5 percent test using daily data is 0.94, whereas the power using weekly and monthly data is only 0.35 and 0.12 respectively. The clear message is that there is a substantial payoff in terms of increased power from reducing the sampling interval. Dale Morse (1984) presents detailed analysis of the choice of daily versus monthly data and draws the same conclusion.

A sampling interval of one day is not the shortest interval possible. With the increased availability of transaction data, recent studies have used observation intervals of duration shorter than one day. However, the net benefit of intervals less than one day is unclear as some complications are introduced. Discussion of using transaction data for event studies is included in the work of Michael Barclay and Robert Litzenberger (1988).

B. *Inferences with Event-Date Uncertainty*

Thus far it is assumed that the event date can be identified with certainty. However, in some studies it may be difficult to identify the exact date. A common example is when collecting event dates from financial publications such as the *Wall Street Journal*. When the event announcement appears in the paper one can not be certain if the market was informed prior to the close of the market the prior trading day. If this is the case then the prior day is the event day, if not then the current day is the event day. The usual method of handling this problem is to expand the event window to two days—day 0 and day +1. While there is a cost to expanding the event window, the results in Section 6 indicated that the power properties of two day event windows are still good suggesting that the costs are worth bearing rather than to take the risk of missing the event.

Clifford Ball and Walter Torous (1988) have investigated the issue. They develop a maximum likelihood estimation procedure which accommodates event date uncertainty and examine results of their explicit procedure versus the informal procedure of expanding the event window. The results indicates that the informal procedure works well and there is little to gain from the more elaborate estimation framework.

C. *Robustness*

The statistical analysis of Sections 4, 5, and 6 is based on assumption that returns are jointly normal and temporally independently and identically distributed. In this section, discussion of the robustness of the results to departures from this assumption is presented. The normality assumption is important for the exact finite sample results to hold. Without assuming normality, all results would be asymptotic. However, this is generally not a problem for event studies because for the test statistics, convergence to the asymptotic distributions is rather quick. Brown and Warner (1985) provide discussion of this issue.

D. *Other Possible Biases*

A number of possible biases can arise in the context of conducting an event study. Nonsynchronous trading can introduce a bias. The nontrading or nonsynchronous trading effect arises when prices, are taken to be recorded at time intervals of one length when in fact they are recorded at time intervals of other possibly irregular lengths. For example, the daily prices of securities usually employed in event studies are generally "closing" prices, prices at which the last transaction in each of those securities occurred during the trading day. These closing prices generally do not occur at the same time each day, but by calling them "daily" prices, one is implicitly and incorrectly assuming that they are equally spaced at 24-hour intervals. This nontrading effect induces biases in the moments and co-moments of returns.

The influence of the nontrading effect on the variances and covariances of individual stocks and portfolios naturally feeds into a bias for the market model beta. Myron Scholes and Williams (1977) present a consistent estimator of beta in the presence of nontrading based on the assumption that the true return process is uncorrelated through time. They also present some empirical evidence which shows the nontrading-adjusted beta estimates of thinly traded securities to be approximately 10 to 20 percent larger than the unadjusted estimates. However, for actively traded securities, the adjustments are generally small and unimportant.

Prem Jain (1986) considers the influence of thin trading on the distribution of the abnormal returns from the market model with the beta estimated using the Scholes-Williams approach. When comparing the distribution of these abnormal returns to the distribution of the abnormal returns using the usual OLS betas finds that the differences are minimal. This suggests that in general the adjustments for thin trading are not important.

The methodology used to compute the cumulative abnormal returns can induce an upward bias. The bias arises from the observation by observation rebalancing to equal weights implicit in the calculation of the aggregate cumulative abnormal return combined with the use of transaction prices which can represent both the bid and the offer side of the market. Marshall Blume and Robert Stambaugh (1983) analyze this bias and show that it can be important for studies using low market capitalization firms which have, in percentage terms, wide bid offer spreads. In these cases the bias can be eliminated by considering cumulative abnormal returns which represent buy and hold strategies.

11. *Concluding Discussion*

In closing, examples of event study successes and limitations are presented. Perhaps the most successful applications have been in the area of corporate finance. Event studies dominate the empirical research in this area. Important examples include the wealth effects of mergers and acquisitions and the price effects of financing decisions by firms. Studies of these events typically focus on the abnormal return around the date of first announcement.

In the 1960s there was a paucity of empirical evidence on the wealth effects of mergers and acquisitions. For example, Henry Manne (1965) discusses the various arguments for and against mergers. At that time the debate centered on the extent to which mergers should be regulated in order to foster competition in the product markets. Manne argued that mergers represent a natural outcome in an efficiently operating market for corporate control and consequently provide protection for shareholders. He downplayed the importance of the argument that mergers reduce competition. At the conclusion of his article Manne suggested that the two competing hypotheses for mergers could be separated by studying the price effects of the involved corporations. He hypothesized that, if mergers created market power, one would observe price increases for both the target and acquirer. In contrast, if the merger represented the acquiring corporation paying for control of the target, one would observe a price increase for the target only and not for the acquirer. However, Manne concludes, in reference to the price effects of mergers, that "no data are presently available on this subject."

Since that time an enormous body of empirical evidence on mergers and acquisitions has developed which is dominated by the use of event studies. The general result is that, given a successful takeover, the abnormal returns of the targets are large and positive and the abnormal returns of the acquirer are close to zero. Gregg Jarrell and Poulsen (1989) document that the average abnormal return for target shareholders exceeds 20 percent for a sample of 663 successful takeovers from 1960 to 1985. In contrast the abnormal returns for acquirers is close to zero. For the same sample, Jarrell and Poulsen find an average abnormal return of 1.14 percent for acquirers. In the 1980s they find the average abnormal return is negative at -1.10 percent. Eckbo (1983) explicitly addresses the role of increased market power in explaining merger related abnormal returns. He separates mergers of competing firms from other mergers and finds no evidence that the wealth effects for competing firms are different. Further, he finds no evidence that rivals of firms merging horizontally experience negative abnormal returns. From this he concludes that reduced competition in the product market is not an important explanation for merger gains. This leaves competition for corporate control a more likely explanation. Much additional empirical work in the area of mergers and acquisitions has been conducted. Michael Jensen and Richard Ruback (1983) and Jarrell, James Brickley, and Netter (1988) provide detailed surveys of this work.

A number of robust results have been developed from event studies of financing decisions by corporations. When a corporation announces that it will raise capital in external markets there is, on average, a negative abnormal return. The magnitude of the abnormal return depends on the source of external financing. Asquith and Mullins (1986) find for a sample of 266 firms announcing an equity issue in the period 1963 to 1981 the two day average abnormal return is −2.7 percent and on a sample of 80 firms for the period 1972 to 1982 Wayne Mikkelson and Megan Partch (1986) find the two day average abnormal return is −3.56 percent. In contrast, when firms decide to use straight debt financing, the average abnormal return is closer to zero. Mikkelson and Partch (1986) find the average abnormal return for debt issues to be −0.23 percent for a sample of 171 issues. Findings such as these provide the fuel for the development of new theories. For example, in this case, the findings motivate the pecking order theory of capital structure developed by Stewart Myers and Nicholas Majluf (1984).

A major success related to those in the corporate finance area is the implicit acceptance of event study methodology by the U.S. Supreme Court for determining materiality in insider trading cases and for determining appropriate disgorgement amounts in cases of fraud. This implicit acceptance in the 1988 Basic, Incorporated v. Levinson case and its importance for securities law is discussed in Mitchell and Netter (1994).

There have also been less successful applications. An important characteristic of a successful event study is the ability to identify precisely the date of the event. In cases where the event date is difficult to identify or the event date is partially anticipated, studies have been less useful. For example, the wealth effects of regulatory changes for affected entities can be difficult to detect using event study methodology. The problem is that regulatory changes are often debated in the political arena over time and any accompanying wealth effects generally will gradually be incorporated into the value of a corporation as the probability of the change being adopted increases.

Larry Dann and Christopher James (1982) discuss this issue in the context of the impact of deposit interest rate ceilings for thrift institutions. In their study of changes in rate ceilings, they decide not to consider a change in 1973 because it was due to legislative action. Schipper and Thompson (1983, 1985) also encounter this problem in a study of merger related regulations. They attempt to circumvent the problem of regulatory changes being anticipated by identifying dates when the probability of a regulatory change being passed changes. However, they find largely insignificant results leaving open the possibility the of absence of distinct event dates as the explanation of the lack of wealth effects.

Much has been learned from the body of research based on the use of event study methodology. In a general context, event studies have shown that, as would be expected in a rational marketplace, prices do respond to new information. As one moves forward, it is expected that event studies will continue to be a valuable and widely used tool in economics and finance.

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Syndicated Loan Announcements and the Market Value of the Banking Firm

MANY STUDIES HAVE ANALYZED the shareholder wealth effects of investment decisions made by nonfinancial corporations. McConnell and Muscarella (1985), Office of Chief Economist (1985), and the extensive literature on mergers and acquisitions provide examples. In contrast, little research has focused on the corporate policy choices made by financial institutions. We expand this literature by examining the valuation effects on commercial bank stocks of announcements of syndicated loans. James (1987), Lummer and McConnell (1989), and Wansley, Elayan, and Collins (1992) consider bank investment decisions from the opposite perspective—that of the borrowers—and report the market effect of loan announcements on borrowing firms. In contrast, we examine stock-market reaction to bank lending (rather than corporate borrowing) and present evidence on the motivations and effects of bank lending decisions.

Syndicated loans represent major investment decisions on the part of financial institutions (loan size in our sample averages \$397 million) and are virtually the only type of lending arrangements publicly announced by commercial banks. Our sample of 774 syndicated loan announcements covers some of the largest loans made by U.S. money-center banks over the years 1966 through 1989. We partition

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our sample to develop cross-sectional information on whether the valuation effects of loan announcements vary with type of borrower, use of funds, or time period in which the loan is made. Specifically, we consider announcements of loans to less-developed countries (LDCs), to non-U.S. OECD countries, and to U.S. corporations. Loans to U.S. corporations include loans for leveraged acquisitions and managerial buyouts, which we collectively call LBOs. Describing these loans as "highly levered transactions" or HLTs, bank regulators required banks to report such loans on a special schedule, apparently in anticipation of an HLT debt crisis similar to the LDC debt crisis. Our LDC and LBO loan announcements represent some of the most publicized forms of bank lending of the 1970s and 1980s. Announcements of other syndicated bank loans serve as control groups for our empirical analysis.

Our null hypothesis is that announcements of competitively priced loans, whether anticipated or not, would not generate significant stock-price reactions. We suggest four alternative hypotheses that might result in significant market reactions to syndicated loan announcements: (1) mispricing of syndicated loans, (2) return to liquidity, (3) disclosure of information about growth opportunities in the loan announcement, and (4) non-share-price-maximizing goals of managers. Depending on the category of the borrower, a positive market reaction could suggest a return to liquidity (for an LBO loan) or information on growth options (for an LDC loan) for lending banks. A negative market reaction would be consistent with several alternative explanations, including mispricing or managerial goals inconsistent with share-price maximization.

We use event-study methods to measure shareholder wealth effects of 774 syndicated loan announcements by fifteen U.S. money-center banks participating in each loan from 1966 through 1989. Our major empirical findings and conclusions are:

- Syndicated loans to both private and public borrowers in foreign industrial countries are associated with insignificant shareholder returns as would be expected if the loans contain no information other than the issuance of a competitively priced loan.
- Syndicated loans to Latin American countries, mainly for the years 1966 to 1979, are associated with significant reductions in shareholder wealth of the participating banks. The continued issuance of these loans throughout the 1970s raises questions about the motives of bank managers or their susceptibility to political pressure or both.
- Syndicated loans to U.S. corporate borrowers in the 1980s, when the syndicated loan market shifted heavily toward corporate rather than sovereign borrowers, are associated with significantly positive abnormal returns. Such returns are consistent with a return-to-liquidity hypothesis or a signal about positive growth opportunities or both.
- Loans made to U.S. firms to fund takeover activity dominate our sample of U.S. corporate loans, accounting for about two-thirds of the total value of such loans. These loans generate strong positive returns to lending banks, significantly greater than returns associated with other domestic loans. The need for quick access to large sums of money in many takeovers may enable banks to earn large returns in these transactions.[1]

1. Waheed and Mathur (1993) analyze a sample of 225 bank loan announcements for the years 1968 through 1989. They find negative abnormal returns for announcements of foreign lending agreements by banks but do not partition their sample and isolate announcements of LDC loans to Latin American borrowers over the years 1966 through 1979 as the source of the negative market reaction. They find no market reaction associated with the announcements of domestic lending agreements but do not partition their domestic sample and isolate the positive abnormal returns associated with the announcements of loans to finance takeover activity.

This paper is organized as follows. Section 1 discusses bank corporate policy choices and presents testable hypotheses and predictions. Section 2 describes the market for syndicated loans and our sample of syndicated-loan announcements. Section 3 presents the empirical findings. The last section summarizes and concludes the paper.

1. BANK CORPORATE POLICY CHOICES, HYPOTHESES, AND PREDICTIONS

The environment for syndicated lending over the period of our study changed significantly. In the 1970s, banks were flush with petrodollars and faced weak corporate loan demand. At this time, LDCs may have been able to obtain loans at favorable rates at the expense of syndicated lenders. In addition, in the 1970s and 1980s U.S. money-center banks faced political pressure to recycle "petrodollars" to LDCs or, after the international debt crisis began in 1982, to continue lending to LDCs as part of a strategy to stabilize international financial markets (for example, by keeping LDC debt current through new loans, bankers and regulators could claim that the loans were performing and large banks were at least book-value solvent). A negative market reaction to loan announcements would be expected if LDC loans were made with conditions too favorable to the borrowers or if political pressure resulted in banks making poor investment decisions. In addition, regulation severely restricted the market for corporate control in banking in the 1970s, allowing bank managers to pursue objectives other than maximization of shareholder wealth (for example, size or resource-control maximization).

In the 1980s, takeover finance developed as an important use of syndicated loans for domestic borrowers. For this category of loans, where borrowers need to acquire financing quickly, banks may be able to charge higher rates than they could for alternative lending, leading to excess stock price returns. Since securities regulation is such that alternative lending sources face restrictions in providing speedy financing, these excess returns could persist for a substantial period.

A. *Testable Hypotheses and Predictions*

Our empirical investigation primarily focuses on the market reaction to the announcement of syndicated loans to LDCs and for LBOs and whether these reactions changed over the period 1966 through 1989. Loans to developed countries and loans to U.S. corporations but not for takeover finance provide control groups. Our null hypothesis is that competitive pressures ensure than bank investment decisions in the form of syndicated loans should be zero NPV projects and therefore have no impact on share price. We suggest several hypotheses that might be consistent with nonzero shareholder wealth effects.

i. The Mispricing Hypothesis. If banks face limited investment opportunities and yet they have abundant deposits, they may make underpriced loans that are negative NPV projects. And, even if profitable investment opportunities exist, lenders may misprice loans. Modern theories of financial intermediation, which are information-based paradigms built on the agency problems inherent in borrower-lender contracting, suggest potential reasons for loan mispricing. As delegated monitors (Diamond 1984; Booth 1992), banks are responsible for scrutinizing borrowers for their lenders (for example, depositors). In a regulated environment that restricts diversification opportunities, misprices deposit insurance, and does not permit big banks (or their holding companies) to fail, banks may shirk their responsibilities as delegated monitors since the government guarantees all bank debt (see, for example, Kane 1985 and 1989). In neglecting their duties as delegated monitors, banks may misprice loans. The market would view unanticipated underpricing negatively.

ii. The Return-to-Liquidity Hypothesis. A borrower needing large sums of money quickly (for example, to finance a takeover) may have to pay a premium for liquidity. Lenders with the ability to provide such funding will be rewarded for providing quick financing and stock-price reactions at the announcements of the loans will be positive if the loans were not anticipated. As long as they maintain their creditworthiness, money-center banks have the ability to raise large sums of money quickly. Thus, they have a comparative advantage in providing such financing, which should generate a return to liquidity. To spread the risk of such financing, banks engage in syndicated lending.

iii. The Growth-Opportunities Hypothesis. Announcements of syndicated loans may provide information about the present value of future growth opportunities in the bank's local market. However, since the signal could be one of either increased or decreased growth options, the market might react either positively (for example, the bank is being aggressive and innovative by seeking new markets) or negatively (for example, the bank is making LDC loans because "local" opportunities are limited and core business growth will be slow). Thus, in the case of a positive market reaction, we cannot distinguish between the return-to-liquidity hypothesis and information about increased growth opportunities. Similarly, in the case of a negative market reaction, we cannot distinguish between mispricing and reduced growth opportunities.

iv. The Non-Share-Price-Maximization Hypothesis. Regulatory coercion to make certain loans or managerial goals such as maximizing bank size or managerial prestige and reputation may lead banks to make negative NPV loans. For example, if the regulatory authorities (acting as agents for presidential and congressional principals) have a political agenda that encourages banks to make certain types of loans, banks may be forced to make negative-NPV loans. The quid pro quo for the banks is a federal safety net in the form of the too-big-to-fail (TBTF) doctrine. Bank managers may have persisted in making such decisions due to the lack of an effective takeover market in banking (for example, due to restrictions on who can own a bank), especially before the mid-1980s. If syndicated loans are not made to maximize shareholder value, their announcement may elicit a negative market reaction.

B. Distinguishing between Different Types of Loans and Different Time Periods

During our test period, several important changes occurred in the syndicated loan market and in the banking industry as a whole. To attempt to distinguish among our hypotheses, we conduct cross-sectional and time-series tests based on various subsamples of our loan announcements. We rule out regulatory pressure on banks to make LBO loans but we cannot say the same thing about LDC loans. Since quick financing was not important for LDC loans, the return-to-liquidity hypothesis applies only to loans for financing LBOs. In the absence of enforcement mechanisms within international contract law, it is difficult for banks to write loan agreements that control LDC borrowers' behavior. In contrast, syndicated loans made to U.S. domestic corporations benefit from cross-monitoring, knowledge of the use of the loan proceeds, and a stronger ability to impose and enforce restrictive covenants on the borrower. These considerations make it more likely that LDC loans will be mispriced than LBO loans. When banks make important loans that compete with direct-investor-held debt such as commercial paper and corporate bonds, they signal their ability to compete with the instruments of direct finance, expanding their growth opportunities.[2]

The market for corporate control in banking changed substantially during the 1980s and early 1990s as hostile takeovers, mega-mergers, and financial difficulties produced consolidation. Accordingly, we hypothesize that bank managers would be more responsive to shareholder interests after the mid-1980s as a result of the more active takeover market. This consideration would predict less support for the hypothesis of non-share-price maximization vis-à-vis regulatory intervention in the period after the mid-1980s.

Regarding structural changes in the LDC loan market, a number of watersheds in LDC lending occurred that could have changed that market: in particular, the first oil shock in 1973–1974; the second oil shock in 1979 and the Federal Reserve's "Saturday Massacre" of October 6, 1979 (as a signal of both higher levels and greater future volatility of interest rates as well as a strengthening of the U.S. dollar); Mexico's default in August 1982; Brazil's default in February 1987; and Citicorp's $3 billion loan-loss provision in May 1987 were important events that could have affected lenders, regulators, and investors. In partitioning our sample over time, we selected October 1979 and August 1982 as critical dates. While the first date highlights potential interest-rate risk (due to the Fed's shift to a monetary-aggregates target), it also permits us to distinguish between market reaction associated with lending related to the first oil shock and that associated with the second oil shock. The second date brought credit or default risk to the forefront and marked the beginning of a five-year period in which banks may have been forced into making LDC loans. Such coercion effectively ended with Citicorp's $3 billion reserve decision in May 1987.

C. *Recapitulation*

In an efficient market, competitively priced loans, whether anticipated or not, would not generate stock-price reactions unless the loan announcements provide additional information about the future prospects of the bank or the state of the overall

2. Berger and Udell (1993) discuss the "borrower-information continuum" and how changes in the ability to monitor borrowers corresponds to changes in the types of loans made by public, private, and bank lenders.

economy. Regulation of the banking and securities industries, however, may lead to nonzero price reactions through the encouragement of bad lending policies, restrictions in the corporate control market, or the protection of the syndicated loan market from competition from other public lenders.

A negative market reaction for either LDC or LBO loans could be explained by mispricing, restricted growth options, or regulatory intervention; a positive market reaction could be explained by expanded growth opportunities or overpricing in the case of LDC loans or by a return to liquidity in the case of LBO loans. Assuming error learning by lenders after their first episode of recycling petrodollars, the mispricing hypothesis applied to LDC loans made after 1979 becomes less tenable. After the mid-1980s, managerial goals inconsistent with share price maximization become less tenable for any loan because of increased takeover activity in banking.

2. THE SYNDICATED-LOAN MARKET AND LOAN ANNOUNCEMENTS

Table 1 details the growth of the international syndicated-loan market, classified by category of borrower, from 1974 (the first year *Euromoney* began systematically collecting data) to the first quarter of 1989. During the 1970s, the syndicated-loan market was primarily devoted to sovereign lending (see Sachs and Huizinga 1987; Ajami and Khambata 1986; Lessard and Williamson 1985). However, the Mexican debt moratorium in August 1982, which marked the start of the international debt crisis, undoubtedly suppressed sovereign lending to LDCs. At that time, the nine largest U.S. commercial banks had LDC loans outstanding equal to over 275 percent of their primary capital. It wasn't until May 1987, however, that large banks, led by Citicorp, began setting aside massive provisions for LDC loan losses (Musumeci and Sinkey 1990b). Studies of the Mexican and Brazilian (1987) debt moratoriums and Citicorp's reserve decision suggest that these events conveyed new information to the market and that the buildup of LDC debt may not have been watched closely.[3] Voluntary syndicated lending to LDC borrowers essentially ended in 1985, and a secondary market for syndicated loans sprang up shortly thereafter. The wave of LDC loan renegotiations and consolidations after 1982 promoted the growth of this new market (see Boehmer and Megginson 1990).

Our sample of syndicated loan announcements made by fifteen U.S. money-center banks spans the years 1966 through 1989. We partition our sample by type of borrower and use of the loan. Specifically, we have announcements of loans to LDCs, to non-U.S. OECD countries, and to U.S. corporations including a subset of loan announcements dealing with leveraged acquisitions and managerial buyouts, which we collectively call LBOs. Since LDC and LBO loans represent two of the

3. Studies by Bruner and Simms (1987), Cornell and Shapiro (1986), Saunders (1987), Schoder (1986), and Smirlock and Kaufold (1987) suggest that the market did not completely anticipate Mexico's debt moratorium in 1982. In addition, as Musumeci and Sinkey (1990a) show, the severity of Brazil's debt moratorium in February 1987 was not completely anticipated by the market.

TABLE 1

SYNDICATED LOANS, BY ECONOMIC AREA, IN $ U.S. MILLION, 1974–1989

Year	OECD	Non-OPEC LDCs	OPEC	Comecon	Supranational
1974	17,270	9,711	151	909	14
1975	5,069	12,463	6	2,515	65
1976	9,923	11,168	4,012	2,370	352
1977	12,841	12,943	5,898	3,030	147
1978	34,096	28,065	13,470	5,449	683
1979	34,213	43,833	13,727	8,300	1,539
1980	42,417	28,333	11,228	5,037	966
1981	111,794	49,347	14,494	4,324	1,290
1982	83,054	43,475	16,448	7,953	1,945
1983	63,991	22,309	8,293	1,222	2,815
1984	161,673	27,981	5,752	3,478	2,609
1985	175,975	41,867	3,930	5,651	4,077
1986	162,928	37,319	3,207	5,970	1,240
1987	278,448	46,431	4,999	4,626	2,917
1988	383,002	63,520	2,137	7,313	3,071
1989 (first quarter)	82,237	15,180	1,048	297	1,010
Total	1,658,931	493,945	108,800	68,440	24,740

NOTES: OECD = Organization for Economic Cooperation and Development; OPEC = Organization of Petroleum Exporting Countries; Comecon = Council for Mutual Economic Assistance (a trade organization of European Socialist countries); and Supranational = World Bank, IMF, and other international organizations.

Source: *Euromoney* Special Supplement (June 1989).

most highly publicized and criticized forms of bank lending,[4] we have an important and interesting set of announcements. Moreover, the loans not included in these two categories provide control groups for our empirical analysis. We use the *Wall Street Journal Index* (*WSJI*) to identify 774 syndicated loan announcements made by fifteen U.S. money-center banks from 1966 through 1989.[5] The banks in our sample are Bank of America, Bank of New York, Bankers Trust, Chase Manhattan Bank, Chemical Bank, Citicorp, Continental Illinois (Continental Bank), Crocker National, First Chicago, Irving Trust, Manufacturers Hanover, Mellon Bank, Morgan Guaranty Trust, Security Pacific, and Wells Fargo. We use information in the *Wall Street Journal* news story to determine, to the extent possible, loan size, type of loan, syndicate structure, lead manager(s), use of proceeds, and maturity.

We define a syndicated loan as a credit agreement involving at least two banks extending a loan to a single borrower. While this definition encompasses a handful of small loans involving five or fewer lenders, the majority of our sample loans are syndicated credits involving twelve or more banks with at least $100 million lines of credit or term loans. Loan mandates, which are agreements between a borrower and a lead bank that the bank will attempt (or even guarantee) to raise the agreed financing by organizing a lending syndicate, also are included in our sample.

4. For example, when banks became involved in financing takeovers, their regulators became concerned about the riskiness of such transactions and created another category of loans for examiners to watch, namely, "highly leveraged transactions" or HLTs. In retrospect, however, HLTs were not the financial disaster that LDC loans were in terms of loan losses, nonperforming loans, and renegotiated contracts.

5. We actually examine the *WSJI* sections beginning in 1962, but find no syndicated loan citations prior to November 1966.

Table 2 provides summary statistics for our sample of syndicated loans, and for subsamples classified by whether the borrower is an LDC, a non-U.S. OECD borrower, or a U.S. corporation. As reported in section 1, our full sample consists of 559 syndicated loans (many loans involve more than one of our sample banks), worth almost $222 billion, with a mean (median) value of $396.9 million ($120.0 million). Section II of the table provides data for LDC borrowers, classified further by whether the loans are extended to Latin American LDC borrowers or to other LDC borrowers. Of the $69 billion in total LDC lending, $45 billion was extended to borrowers in Latin America. Section III of Table 2 provides summary data for our subsample of non-U.S. OECD borrowers, most of whom are from Western Europe. Compared to loans to LDC borrowers, loans extended to Western borrowers are somewhat larger ($270.2 million versus $243.3 million using means, and $126 million versus $100 million using medians). Section IV of Table 2 provides summary statistics for the subsample of syndicated loans extended to U.S. corporate borrowers. With an average (median) size loan of $721 million ($187.5 million) and over $125 billion in total credit, these loans are larger than those in the other two categories.

Table 3 provides further information on the U.S. corporate borrowers. As reported in section I, the majority of these loans were made during the 1980s with most of them arranged after 1983. The loans steadily increased in size rising from an average (median) of $149 million ($30 million) in the period prior to 1980, to $227.3 million ($100 million) in the 1980–1983 period, and finally to $1,123.1 million ($400 million) in the years after 1983 when $111 billion of the $125 billion in corporate financing occurred.

TABLE 2

Summary Statistics for the Full Sample of Syndicated Loans Made by Fifteen U.S. Money-Center Banks, Classified by Category of Borrowers, in $ U.S. Million, 1966–1989

Sample Partition	Number of Loans	Total Value of Loans	Mean and (Median) Value	Maximum and (Minimum) Value
I. All Borrowers	559	221,867	396.9 (120.0)	14,000.0 (4.0)
II. LDC Borrowers	283	68,854	243.3 (100.0)	5,000.0 (4.0)
• Latin American LDC Borrowers	156	45,178	289.6 (100.0)	5,000.0 (4.0)
• Non-Latin American LDC Borrowers	127	23,686	186.5 (125.0)	1,000.0 (4.0)
III. Non-U.S. OECD Borrowers	102	27,560	270.2 (126.0)	3,000.0 (6.4)
• Public-sector Borrowers	67	20,006	298.6 (200.0)	3,000.0 (8.0)
• Private-sector Borrowers	34	6,950	204.4 (49.5)	2,370.0 (6.4)
IV. U.S. Corporate Borrowers	174	125,454	721.0 (187.5)	14,000.0 (4.0)

Source *Wall Street Journal*

TABLE 3

SUMMARY STATISTICS FOR THE SAMPLE OF SYNDICATED LOANS MADE TO U.S. CORPORATE BORROWERS BY FIFTEEN U.S. MONEY-CENTER BANKS, IN $ U.S. MILLION, 1966–1989, CLASSIFIED BY TIME PERIOD, LOAN TYPE, LOAN STATUS, AND USE OF PROCEEDS BORROWED

Sample Partition	Number of Loans	Total Value of Loans	Mean and (Median) Value	Maximum and (Minimum) Value
I. Classified by Time Period				
• Pre-1980	19	2,831	149.0 (30.0)	650.0 (4.0)
• 1980–1983	56	12,729	227.3 (100.0)	2,000.0 (4.0)
• After 1983	99	111,187	1,123.1 (400.0)	14,000.0 (8.0)
II. Classified by Loan Type				
• Revolving Loans and Lines of Credit	91	65,338	718.0 (100.0)	14,000.0 (4.0)
• Term Loans and Unspecified	53	48,946	923.5 (325.0)	12,000.0 (6.0)
• Mixed Revolving and Term Loans	30	11,178	372.6 (145.0)	2,000.0 (12.0)
III. Classified by Loan Status				
• New Loan	135	108,276	802.1 (228.0)	14,000.0 (4.0)
• Renewal of Existing Loan	39	17,176	440.4 (100.0)	3,580.0 (6.0)
IV. Classified by Use of Proceeds Borrowed				
• Loans by Finance Takeover Activity	42	81,778	1947.1 (927.5)	14,000.0 (9.0)
• Loans to Retire Existing Debt	27	11,394	422.0 (96.0)	3,580.0 (4.0)
• Loans for Lines of Credit and to Back Commercial Paper	22	6,162	280.1 (82.5)	1,200.0 (10.0)
• Loans for Working Capital or General Corporate Purposes	71	23,302	328.2 (100.0)	3,000.0 (4.0)
• Loans for Other or Unspecified Purposes	12	2,819	234.9 (112.5)	1,230.0 (9.0)

SOURCE: *Wall Street Journal*

Section II of Table 3 classifies U.S. corporate borrowings by loan type and section III of Table 3 shows that new loans occurred more frequently in our sample (135 loans versus 39) and that they were much larger than renewals. While Lummer and McConnell (1989) distinguish between new loans and renewals to determine the information content of announcements for borrowing firms, we consider this classification for its implication regarding the market value of the banking firm. To the extent that new loans represent the establishment of new customer relationships for banks, they may be seen by the market as more valuable than loan renewals to the banking firm because they present greater growth opportunities.

Section IV of Table 3 presents summary data for the U.S. corporate loan sample classified by use of loan proceeds. The two most common purposes described in the *Wall Street Journal* announcements are to finance takeover activity (forty-two loans) and to arrange loans for working capital or for general corporate purposes (seventyone loans). Loans to finance takeover activity account for almost \$82 billion of the \$125 billion in total financing with an average (median) loan size of \$1,947 million (\$927.5 million).

3. EMPIRICAL RESULTS

We examine the stock-market reaction to syndicated loan announcements of U.S. commercial banks participating in each loan through event-study methodology. Our methodology is similar to that used in Dodd and Warner (1983). We obtain stock returns for the fifteen banks in our sample from CRSP and regress the bank returns from 170 days before to 20 days before each loan announcement in which the respective banks participate on the CRSP equally weighted NYSE and AMEX index to determine market model parameters. These parameters are used to predict returns in the event period and determine excess returns. We compute significance levels using z-statistics from standardized prediction errors. In addition, we report the percent negative abnormal returns with significance levels based on binomial tests.

We report the level, percent negative, and statistical significance of the cumulative abnormal returns over two event periods: $(-5, +1)$ days and $(-1, 0)$ days, where day 0 is the day the loan is announced in the *Wall Street Journal*. If the loan announcement is not anticipated, the shorter window should isolate the effect of the *WSJ* information. The longer window is reported in case the information about impending loan announcements is reflected in stock prices in the week before the *WSJ* story.

Section I of Table 4 presents event-study results for the full sample of 774 syndicated loan announcements. On average, the market viewed the announcement of loan syndications in our sample as zero NPV projects for the participating fifteen money-centered banks. Over the two-day window, however, the frequency of negative abnormal returns (53.9 percent) is statistically significant ($t = 2.16$).

Given the different nature of the various borrowers in our sample, Sections II, III, and IV of Table 4 present results for bank returns according to category of borrower. We discuss these categories in the sections below. We also look more closely at the timing of loans made to LDC borrowers (Table 5) and the use of funds as disclosed by U.S. corporate borrowers (Table 6).

A. Loans to LDC Borrowers

We find significant negative abnormal returns in the two-day window related to the 421 announcements of loans to LDC borrowers, as reported in section II of Table 4. The significantly negative abnormal returns are concentrated in the 216 Latin American borrowers with a two-day CAR of -0.29 percent as opposed to the other 205 LDC borrowers with a two-day CAR of 0.01 percent. These CARs are significantly different from each other at the 1 percent level ($t = 2.35$). We selected this partition for two reasons: (1) the adverse publicity associated with Latin American debt and its linkage to the international debt crisis and (2) the relatively underdeveloped legal systems and contract-enforcement mechanisms existing in Latin

TABLE 4

EVENT-STUDY RESULTS FOR FIFTEEN MONEY-CENTER BANKS BASED ON ANNOUNCEMENTS OF SYNDICATED LOANS BY THE BANKS, CLASSIFIED BY CATEGORY OF BORROWERS, FOR THE ENTIRE STUDY PERIOD OF 1966–1989

Sample Partition	Number of Observations	Event Period	Cumulative Abnormal Returns (%)	z-Statistic	Fraction Negative	Binominal Test Statistic for Fraction Negative
I. All Borrowers	774	(−5, +1)	0.076	0.07	52.4	1.36
		(−1, 0)	−0.026	−0.80	53.9	2.16**
II. LDC Borrowers	421	(−5, +1)	−0.16	−1.49	54.9	2.00*
		(−1, 0)	−0.14	−1.91*	55.5	2.29**
• Latin American LDC Borrowers	216	(−5, +1)	−0.05	−0.57	52.8	0.82
		(−1, 0)	−0.29	−2.34**	59.2	2.72**
• Non-Latin American LDC Borrowers	205	(−5, +1)	−0.29	−1.54	57.1	2.03**
		(−1, 0)	0.01	−0.33	51.7	0.49
• Corporate Borrowers	51	(−5, +1)	0.55	1.28	49.0	−0.14
		(−1, 0)	−0.02	−0.09	58.8	1.26
• Sovereign Borrowers	370	(−5, +1)	−0.26	−2.06**	55.7	2.18**
		(−1, 0)	−0.16	−2.00**	55.1	1.97**
III. Non-U.S. OECD Borrowers	130	(−5, +1)	0.28	0.64	53.8	0.88
		(−1, 0)	0.16	1.08	49.2	−0.17
IV. U.S. Corporate Borrowers	223	(−5, +1)	0.41	1.68*	47.1	−0.87
		(−1, 0)	0.08	0.31	53.4	1.00

* Significant at the 10 percent level
** Significant at the 5 percent level

American countries during the 1970s compared to other LDC borrowers (for example, Korea or India). In contrast, loans to non-U.S. OECD borrowers (section III of Table 4) over the years 1966 to 1989 were, as expected, associated with insignificant changes in the value of the firm.

Table 5 presents event-study results for the subsample of LDC borrowers partitioned by time period and by whether the borrower resided in Latin America or elsewhere. We identify three time periods based on the historical development of the sovereign loan market: (1) the period 1966 to October 1979 corresponds to the initial phase of syndicated lending to LDC borrowers, as well as the first oil shock and its aftermath; (2) the second period from October 1979 to August 1982 covers the second phase of intense lending to LDCs and includes both the second oil price shock and the years of rapidly increasing total indebtedness of LDC governments and corporations, and marks the beginning of the Fed's focus on a monetary-aggregates target; and (3) the period after the Mexican debt moratorium in August 1982 corresponds to the era of severe contraction in LDC lending and to the rescheduling of existing LDC terms.

As reported in Table 5, the stock market reacted negatively to Latin American LDC lending only during our first subperiod of 1966 to 1979. The CAR for the two-day window is -0.40 percent ($t = -2.59$) with 60.3 percent of the returns negative ($t = 2.23$). For non-Latin American LDC loan announcements over the same period, neither the seven-day nor the two day CARs were significantly different from zero, although 57.0 percent of the seven-day CARs were negative ($t = 1.76$). The wealth effects associated with Latin American loans in the early period were significantly lower than the non-Latin American loans in the shorter window ($t = 2.20$). None of the other tests in Table 5 generated statistically significant results.[6] For example, we find no significant differences between the early Latin American loans and loans in other time periods, possibly because of the relatively larger standard errors in the smaller samples. Our results of significantly lower returns for all Latin American loans versus other LDC loans and the significant difference in the early period suggest early stock-market recognition of the potential problems with Latin American lending.

The negative abnormal returns for Latin American borrowers are perplexing. If Western banks were mispricing loans because they lacked the monitoring technology to generate reliable information about these borrowers, and/or if they lacked the legal/economic power to control borrowers' behavior toward assets and loan proceeds, why did they make the loans and why weren't bank shareholders and bank regulators doing something about it?[7]

6. We used regression analysis (not reported here) to examine whether the abnormal returns were systematically related to loan size and borrower-specific variables such as (1) exports/GNP, (2) total debt/GNP, (3) reserves/GNP, and (4) dummy variables indicating whether the borrower was a public or private entity and whether the borrower resided in a Latin American country. Only the Latin American dummy variable was negative and significant; all other models were not meaningful. We also examined whether returns were systematically related to whether a lender was a leader or coleader of the loan syndicate or merely a member and to the size of the loan. We found no significant relations.

7. Theoretical issues related to the valuation, monitoring, and enforcement of LDC loan contracts are addressed in Eaton and Gersovitz (1981), Grossman and Van Huyck (1988), Bulow and Rogoff (1989a, b) and James (1990).

TABLE 5

EVENT-STUDY RESULTS FOR FIFTEEN MONEY-CENTER BANKS BASED ON ANNOUNCEMENTS OF SYNDICATED LOANS BY THE BANKS TO LATIN AMERICAN AND NON-LATIN AMERICAN LDC BORROWERS DURING 1966 TO 1989, PARTITIONED BY TIME PERIOD

Sample Partition	Number of Observations	Event Period	Cumulative Abnormal Returns (%)	z-Statistic	Fraction Negative	Binominal Test Statistic for Fraction Negative
Latin American LDC Borrowers, 1966–October 1979	116	(−5, +1)	−0.13	−0.75	50.9	0.18
	116	(−1, 0)	−0.40	−2.59**	60.3	2.23**
Latin American LDC Borrowers, October 1979–August 1982	67	(−5, +1)	−0.27	−0.50	59.7	1.59
	67	(−1, 0)	−0.05	−0.11	58.2	1.34
Latin American LDC Borrowers, after August 1982	33	(−5, +1)	0.70	0.66	45.4	−0.52
	33	(−1, 0)	−0.37	−0.98	57.6	0.87
Non-Latin American LDC Borrowers, 1966–October 1979	156	(−5, +1)	−0.22	−1.32	57.0	1.76*
	156	(−1, 0)	−0.04	−0.75	51.3	0.32
Non-Latin American LDC Borrowers, October 1979–August 1982	17	(−5, +1)	−1.56	−1.60	70.6	1.70
	17	(−1, 0)	0.60	1.47	41.2	−0.73
Non-Latin American LDC Borrowers, after August 1982	32	(−5, +1)	0.06	0.18	50.0	0.00
	32	(−1, 0)	−0.09	−0.26	59.4	1.06

* Significant at the 10 percent level.
** Significant at the 5 percent level.

Two potential reasons are political pressure to lend to LDCs or the lack of a market for corporate control in banking or both. Either of these factors could result in non-share-price maximization. During this period the U.S. government, in promoting economic growth in developing countries, encouraged the recycling of petrodollars (which were accumulating in vast amounts in Western banks) to these countries. The policy, however, was at the expense of large banks and their shareholders. After the international debt crisis began in 1982, the political and regulatory pressure turned from recycling petrodollars to stabilizing international financial markets by keeping LDCs from defaulting.

The lack of a market for corporate control in banking during the 1970s offers an explanation for why bankers persisted in making unprofitable (negative-share-price-response) loans to borrowers. Mergers, acquisitions, and hostile takeovers of major bank LDC lenders did not begin until after the bulk of LDC lending had occurred. Because of the separation of banking and commerce in the United States, the set of potential acquirers of large commercial banks is restricted. This lack of corporate-control discipline may explain why bankers were able to engage in non-share-price-maximizing behavior for so long. Even if stock prices declined in response to these loan announcements, unless a credible threat of executive removal or a properly crafted incentive compensation scheme or both existed, bankers would rationally choose to maximize firm size rather than profitability.

B. Sovereign versus Corporate Borrowing

Using all 774 loan announcements, we split our sample into corporate (319 announcements) and sovereign (455 announcements) categories. We find significant negative CARs for the sovereign loan announcements and significant fractions negative. These findings are consistent with either our mispricing or reduced-growth-opportunities hypotheses. Since most sovereign loans were made as "umbrella deals," in which the lender lost control over how the loan proceeds were used, monitoring and enforcing sovereign LDC loans would be more difficult and costly than monitoring and enforcing corporate LDC loans. Under this scenario, mispricing would be more likely for sovereign loans, especially if the loans involved government coercion.

C. Results for U.S. Corporate Borrowers

Section IV of Table 4 reports bank returns based on loans to U.S. corporate borrowers. For the sample of 223 announcements, the CARs over the seven-day window are positive and statistically significant at the 10 percent level (CAR = 0.41 percent) with 52.9 percent of the returns positive. Over the two-day window, however, neither test generates statistically significant findings.

Table 6 further analyzes how bank market returns were affected by the announcement of syndicated loans to U.S. corporations based on the intended use of the loan. First, loans made to finance takeover activity are associated with positive returns for the seven-day window. The 1.64 percent CAR associated with the sixty-three an-

TABLE 6

EVENT-STUDY RESULTS FOR FIFTEEN MONEY-CENTER BANKS BASED ON ANNOUNCEMENTS OF SYNDICATED LOANS BY THE BANKS TO U.S. CORPORATE BORROWERS, CLASSIFIED BY THE USE OF PROCEEDS BY BORROWER, 1966–1989

Sample Partition	Number of Observations	Event Period	Cumulative Abnormal Returns (%)	z-Statistic	Fraction Negative	Binominal Test Statistic for Fraction Negative
I. Loans to Finance Takeover Activity	63	(−5, +1)	1.64	2.99**	36.5	−2.14**
	63	(−1, 0)	0.38	0.97	50.8	0.13
• Financing Acquisition by Bidder	47	(−5, +1)	1.11	2.11**	36.2	−1.90*
	47	(−1, 0)	0.02	−0.07	55.3	0.73
• Financing Going Private Transaction	9	(−5, +1)	2.05	1.18	44.4	−0.33
	9	(−1, 0)	0.52	0.83	44.4	−0.33
• Financing Takeover Defenses	7	(−5, +1)	4.69	2.16*	28.6	−1.13
	7	(−1, 0)	0.36	1.00	28.6	−1.13
II. Loans to Retire Existing Debt	36	(−5, +1)	−1.97	−1.70	66.7	2.00*
	36	(−1, 0)	−0.28	−0.69	63.9	1.67
III. Loans for Lines of Credit or to Back Commercial Paper	29	(−5, +1)	0.99	1.01	44.8	−0.56
	29	(−1, 0)	0.24	0.75	44.8	−0.56
• Loans to Replace/Renew Existing Lines of Credit	22	(−5, +1)	1.94	2.04*	31.8	−1.71*
	22	(−1, 0)	0.36	1.00	40.9	−0.85
• Loans to Back Commercial Paper	7	(−5, +1)	−1.99	−1.57	85.7	−1.71*
	7	(−1, 0)	−0.12	−0.26	57.1	0.38
IV. Loans for General Corporate Purposes or Working Capital Expenditures	75	(−5, +1)	0.49	0.96	49.3	−0.11
	75	(−1, 0)	−0.12	−0.57	53.3	0.58
V. Loans for Other or Unspecified Purposes	20	(−5, +1)	−0.31	−0.48	40.0	−0.89
	20	(−1, 0)	0.34	0.45	55.0	0.45

*Significant at the 10 percent level.
**Significant at the 5 percent level.

nouncements of "takeover activity" is significant at the 1 percent level ($t = 2.99$) and only 36.5 percent of the returns are negative ($t = -2.14$), that is, 63.5 percent are positive. In addition, the CAR is significantly greater than that observed for the remaining 160 loan announcements ($t = 2.08$).[8] For the shorter two-day window, however, neither the CAR nor the percent test is significant. If leakage of information concerning loan announcements exists, we would expect it to be most significant in the takeover-related cases because of the large amount of interest and news preceding these transactions.

Although we partition takeover-related loans more finely, two of the categories shown in Table 6 have only nine ("financing going-private transactions") and seven ("financing takeover defense") observations. However, for forty-seven announcements related to "financing acquisition by bidder," the results are similar to those for the full subsample of sixty-three announcements. We also compared the first LBO announcement for each bank (only ten loans) with the fifty-three subsequent LBO loan announcements to determine if the earlier loans were more profitable when they were new investment opportunities for the banks. In neither the seven-day nor the two-day windows did significant differences exist between the first and subsequent announcements. Over the two-day window, none of the tests were significant, which is consistent with the leakage of information on LBOs. On balance, the findings suggest that the market viewed bank financing of takeover activities as positive NPV projects. Takeover finance may generate positive abnormal returns for banks because the lending syndicates are able to respond to the need for large amounts of funds quickly. Lending syndicates may be able to extract higher loan rates for financing such transactions.

The only other use of funds associated with significant abnormal returns, as reported in Table 6, is for loans to replace or renew existing lines of credits, where the seven-day CAR of 1.94 percent is significant ($t = 2.04$). Lummer and McConnell (1989) find that borrowing firms also experience positive significant returns for favorable loan renewals. Since banking convention requires borrowers to clean up their lines of credit annually, the renewal of a line may provide new information to the market about the profitability of the customer relationship for the upcoming year. In addition, because of the increased competitiveness of the banking and financial-services industries, renewals also may signal that banks are maintaining their competitiveness.

To summarize, the results for U.S. corporate borrowers are, on average, associated with normal returns for bank shareholders. The loans that yield significant positive abnormal returns—loans to finance takeover activity—are concentrated in areas in which large banks probably have some degree of market power and hence potential to generate a return to liquidity. Our evidence suggests that, given the difficulty of arranging large loans quickly and the regulatory restrictions on alternative

8. Since LBO loans are substantially larger than the other loans, we tested for the effects of size of the loan on the CARs for the 223 announcements of loans to U.S. corporate borrowers using weighted least squares. We found no significant relation between the size of the loan and the CARs.

sources of financing, large banks have benefitted significantly from the provision of takeover financing.

4. SUMMARY AND CONCLUSIONS

We examine the stockholder wealth effects for fifteen participating money-center banks associated with 774 announcements of syndicated loans extended to Western and developing-country borrowers during the period 1966 through 1989. Since the banking crisis of the 1980s and early 1990s has been most visible in money-center banks, the lending policies of these banks is of concern to bank managers, regulators, investors, lawmakers, and taxpayers. Our empirical results suggest that, on average, syndicated loans are viewed by the market as non-positive NPV projects. The average, however, disguises some important distinctions in our sample. We find that announcements of loans to Latin American borrowers are associated with significantly negative abnormal returns. This finding is consistent with several or our alternative hypotheses: that banks did not recognize the true risk of the loans and mispriced them, that negative information about growth options was released simultaneously with the loan announcements, or that bank managers have goals inconsistent with share-price maximization. Managers might have alternative goals because of political pressure to lend to LDCs or because of the lack of an effective market for corporate control in banking before the mid-1980s.

As the market for syndicated loans changed to one dominated by domestic corporate borrowings in the 1980s, the loan announcements were no longer associated with negative wealth effects. In particular, we find that loans for takeover financing were associated with significant positive returns to lending-bank shareholders while most other corporate uses were associated with insignificant returns. Because of the need for quick financing in such transactions, we interpret this finding as primarily supporting our return-to-liquidity hypothesis rather than providing information about growth opportunities. Nevertheless, because of the erosion of bank corporate lending (for example, by commercial paper), when banks make important loans that compete with the instruments of direct finance, they signal their viability.

Although we do not argue that banks made investment decisions differently in the 1970s than in the 1980s, we contend that the market for corporate control in banking was different in these two periods. Without a credible threat of takeover in the 1970s and in the face of weak corporate loan demand, money-center banks could recycle petrodollars to LDCs without concern for maximizing shareholder wealth. During the last half of the 1980s, however, the market for bank corporate control became much stronger as money-center banks faced serious restructuring problems due to the LDC debt crisis, the imposition of risk-based capital requirements, and increased competition from foreign banks and domestic nonbanking firms.

This paper complements the literature on market valuation of investment decisions by firms. While earlier work ignores investments by financial firms, we look at announcements of syndicated loans by money-center banks. Our focus provides evidence on the motivations and effects of bank investment decisions confronted with regulatory intervention and an evolving market for bank corporate control.

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Transactions Accounts and Loan Monitoring

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We show that transactions accounts, by providing ongoing data on borrowers' activities, help financial intermediaries monitor borrowers. This information is most readily available to commercial banks, which offer these accounts and lending together. We find that (1) monthly changes in accounts receivable are reflected in transactions accounts; (2) borrowings in excess of collateral predict credit downgrades and loan write-downs; and (3) the lender intensifies monitoring in response. This is evidence on a key issue in financial intermediation—there is an advantage to providing deposit-taking and lending jointly. But this advantage may have fallen as the cost of communication has declined. (*JEL* G10, G20, G21)

Transactions are inherently informative. Thus, observing transactions should help financial intermediaries monitor borrowers. But how precisely? We provide evidence that information on the cash flows into and out of a borrower's transactions account can help an intermediary monitor the changing value of collateral that a commercial borrower has posted for an operating loan. We analyze a unique set of data that includes monthly and annual information on transactions account balances and posted collateral—namely, accounts receivable and inventories—for small-business borrowers at a Canadian bank that wishes to remain anonymous.

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We establish that the transactions account provides useful information to the lender and characterize how the lender responds to the information. Specifically, we find that (1) monthly changes in accounts receivable are transparently perceivable in changes in transactions account balances when the borrower has an exclusive banking relationship with the lender; (2) the number of prior borrowings in excess of collateral is an important predictor of credit downgrades and loan write-downs, and the lender uses this information promptly; and (3) the lender intensifies monitoring as loans deteriorate—loan reviews become lengthier and are more frequent. Taken together, these findings establish a set of links showing that financial intermediaries can and do use transactions accounts to monitor accounts receivable and inventories.

Transactions account information is most readily available to commercial banks; thus, our results provide a rationale for the coexistence of deposit-taking and lending within a single institution, that is, the commercial bank. This is a key question in the theory of financial intermediation. Our results are consistent with the view of Black (1975) and Fama (1985) that banks are "special" monitors of their borrowers because their role in the payments system gains them privileged information.[1] Udell (2004) notes that monitoring "inside" collateral provides information to the lender about the borrower's most information-intensive assets. Our theory and evidence supports this rationale for transaction-based lenders preferring "inside" collateral over outside collateral such as residential real estate.

However, the "specialness" of commercial banks has likely fallen over time, because declines in the cost of information processing and communication over the postwar period have lowered the cost of the duplication of bank services. This is one of the factors that have contributed to the substantial increase in finance company lending relative to commercial bank lending to businesses over the past 30 years.[2] According to Udell (2004), finance companies and other asset-based lenders typically require their borrowers to establish special bank accounts to keep track of loans collateralized by accounts receivable. This deposit account, called a cash collateral account, is used strictly for the purpose of receiving all remittances on collected receivables. If the asset-based lender is not a bank, then the account is set up at a bank that works with the asset-based lender. Remittances are sent to this bank and typically are held for several days by the bank to cover deposit collectability. Then, the asset-based lender draws down these funds and applies them to reducing the loan. The

[1] The importance of proprietary information and banking, using the example of R&D contests, is explored in Bhattacharya and Chiesa (1995).

[2] Data from the Federal Reserve Flow of Funds Accounts show that the ratio of finance company loans (as reported in Flow of Funds Table L.216, line 31) to commercial bank C&I loans (as reported in Table L.110, line 16) has risen from about 17% in 1975 to 43% in 2005.

borrower sets up a separate checking account from which it makes disbursements. The asset-based lender can monitor the cash flows into and out of this account to obtain the same kind of information on its borrowers that a commercial bank lender can obtain from the borrower's checking account.[3]

Because the asset-based lender needs to contract with another intermediary to maintain the transactions accounts while the bank lender maintains the checking account on its own, it is likely that the asset-based lender faces higher costs than would a bank. However, these costs of access have surely declined as information processing and communication costs have declined in recent years. The shrinking cost advantage banks have from the checking account information means there is less of an offset to the higher regulatory costs banks face when lending to riskier borrowers. This may be one of the factors leading to finance companies' specialization in lending to riskier borrowers, particularly more leveraged borrowers, as shown by Carey, Post, and Sharpe (1998).

Other theories in recent articles on the synergies between deposit-taking and lending cannot explain the rise in finance company lending. Kashyap, Rajan, and Stein (2002) argue that taking deposits and offering lines of credit are forms of liquidity provision that are optimally bundled together. An intermediary offering either demand deposits or loan commitments must hold liquid balances to meet deposit withdrawals or loan takedowns. As long as these demands are not perfectly positively correlated, the intermediary can economize on these liquid balances, holding less than if the deposit and loan services were offered in two specialized institutions. Thus, deposits make lending more efficient because they can help share some of the overhead costs of the intermediary's having to remain liquid. This theory cannot explain the rise of finance company lending in recent years, as finance companies do not offer demand deposits.

Diamond and Rajan (2001) argue that by taking demand deposits, banks commit themselves to bearing withdrawal risk. This commitment is beneficial, because it commits the bank to using its skill to monitor and collect from borrowers to repay depositors. (If a lender did not try to collect payment from borrowers, a run would be precipitated and the bank would fail.) This commitment means that deposits that are withdrawn from the bank to meet unforeseen liquidity needs can be replaced by new deposits, because new depositors are confident the bank will work to collect from borrowers to repay depositors. At the same time, borrowers are insulated from unforeseen liquidity needs of direct investors. This model cannot explain why finance companies, which issue risky and

[3] Indeed, by segregating the flow of funds from accounts receivable from other flows, these accounts allow the asset-based lender to more easily keep track of accounts receivable than in the checking account at the Canadian bank we describe. This checking account is a single account for payments in and out.

illiquid loans, are able to make such loans without issuing demand deposit contracts.

Gatev and Strahan (2006) provide evidence that banks can hedge liquidity risk from the commercial paper market because they receive offsetting inflows into transactions accounts. Our article provides a rationale for those offsetting inflows: banks are best able to detect changes in risk because of superior monitoring capability that derives from transactions accounts.

To our knowledge, our article is the first direct empirical test of the usefulness of transactions account information in monitoring commercial borrowers. Previous empirical research has documented the value of lending relationships to firms by examining loan rates [e.g., Petersen and Rajan (1994), Berger and Udell (1995), Berlin and Mester (1998)]. Other studies have documented a positive abnormal stock-price reaction to announcements of new or continuing bank loan agreements or loan commitments [e.g., Lummer and McConnell (1989), Billet, Flannery, and Garfinkel (1995), Preece and Mullineaux (1996)]. Berlin and Mester (1999) present empirical evidence for an explicit link between banks' liability structure and their distinctive lending behavior. Yet none of these previous articles directly examines the mechanism through which a financial intermediary with access to transactions account data is able to gain an information advantage over other types of lenders. This is the focus of our article.

Our data set includes 1200 firm-months of data. Even though our data come from a particular bank, the bank does not control these cash-flow movements (most obviously for healthy borrowers). Thus, in our view, the results based on this data set are likely to be broadly representative of how transactions account information can be used to monitor collateralized asset-based loans to small-business borrowers in general.

1. The Mechanics of Loan Monitoring

When a borrower suffers unexpected losses, its probability of bankruptcy rises and, by a familiar moral hazard mechanism, its incentive to invest optimally falls [Myers and Majluf (1984)]. A lender who monitors the borrower's account and is able to detect such losses may be able to create incentives for the borrower to take actions that improve expected return [Nakamura (1993a)]. In particular, the lender acts to ensure that the operating loan finances operations and not unexpected equity losses. It is, thus, an important advantage to a lender to be able to detect changes in normal seasonal borrowing needs, that is, flows of inventory and accounts receivable.

Although the banking literature cites a commercial bank's ability to monitor borrowers as one of its special talents, what gives the bank its monitoring advantage over other types of lenders has remained unexplored empirically. We argue that a commercial bank loan officer (or finance company lender) can observe transactions on an item-by-item basis and compare them with the borrower's pro forma business plan. The continuing operation of a business demands that it must have cash to pay its employees, suppliers, and others in a timely fashion. The cash flows of the business are recorded in its transactions account.[4] This account information is likely to be the timeliest source of information available to the lender. Moreover, as Nakamura (1993a,b) has argued, checking account information is relatively more transparent and complete for a small-business borrower whose banking relationship is exclusive to a single lender.

Borrowers at our bank are contractually required to provide a flow of information about accounts receivable and inventory, but this information may be unreliable. The loan contract restricts the amount of the loan to certain percentages of accounts receivable and of inventory. It also requires the borrower to report shipments to customers that constitute new accounts receivable as well as customer payments on accounts receivable.[5]

In fact, every month, the loan officer can do an item-by-item reconciliation of the accounts receivable: beginning-of-month receivables + sales (operating revenues; also new receivables) – cash inflows (checks) = end-of-month receivables. If the borrower accurately reports beginning-of-month, new receivables, and end-of-month receivables, then the information on cash inflows is redundant. However, there will be an ever-present temptation to report inaccurately because of time pressure or to permit higher borrowing. The checking account provides a check not just on the veracity of the borrower but on how carefully the business manages accounts receivable, itself a telling sign. The converse is that if a lender cannot easily check on the accuracy of the borrower's statement, then the borrower may drift into habitual mendacity.[6] As we note below, when exclusive borrowers become troubled and their incentive to hide information rises, the information content of their transactions accounts deteriorates somewhat but remains high. A lender

[4] In the US accounting system, the borrower's checking account and operating loan account are two separate accounts. In the English system, which is used by the Canadian bank, the two accounts are aggregated into a single account. Thus, the US bank accounting system provides somewhat more information, and it is possible that drawdowns of the operating loan may represent separate signals the bank can interpret. Thus, if anything, the results found using our Canadian data should indicate the lower bound on the information available in US-style banking systems. On the other hand, the bank's gross liability to the borrower and vice versa are greater under the US system because the transactions account and loan account are not netted.

[5] The Appendix shows language from a representative loan contract for the bank we study.

[6] If the borrower were to attempt to cut off the flow of information by opening a checking account with a different bank without informing the lending bank, the absence of the borrower's payments for inventory and of payments received for accounts receivable would quickly reveal this chicanery.

without access to transactions account information would observe only the loan balance and not detailed individual payments.

Accounts receivable and inventories, so-called inside collateral, are the core operating variables of these borrowers. Unexpected operating losses are reflected in changes in inside collateral vis-a-vis the checking account balance, as we show in the simple accounting model in the Appendix. Our measures reveal empirically why Udell (2004) can refer to inside collateral as "information-intensive" for the lender.

We now describe our data set more fully and then turn to our empirical implementation and results.

2. The Data Set

The banking data were made available to one of the coauthors under certain confidentiality provisions, such as keeping the identity of the bank and the borrowers confidential. The objective of this collaboration was to assess the bank's management practices in monitoring its loan portfolio. The bank was representative of Canadian banks at that time in terms of the health of its portfolio; access to the data was not related to any action by bank regulators. There is nothing to suggest that the transactions data, which are not under the control of the bank, are not representative of how transactions account information can be used to monitor collateralized loans to small-business borrowers in general. We are not aware of any previous study in which researchers have obtained access to such high-frequency details of bank monitoring.

The data contain information on 100 small-business borrowers who are customers of the Canadian bank. A small business is defined as one with authorized credit between C$500,000 and C$10,000,000 and whose shareholders are managers of the firm. The average sum actually borrowed in our sample is about C$1,500,000. The selected firms have been active for at least three years: public utilities, management firms, and financial companies are excluded. Fifty of these loans were declared troubled by the bank during the period studied (which falls between 1988 and 1992), and these loans constitute substantially all of the bank's troubled loans during this period that meet our criteria. The other 50 loans in the sample were loans that remained healthy and were chosen to match an individual troubled loan by industry, level of annual sales, and loan amount.

Declaring a loan troubled is a highly consequential act for the lender, as it is the point when the bank acknowledges a high probability of loss on the loan. Panel A of Table 1 summarizes the outcomes for the troubled loans. For the vast majority (36 of 50, i.e., 72%) of these loans, the borrowing firms ended up going into bankruptcy or were privately

Table 1
Loan summary statistics

	Troubled loans [*n* (%)]	Exclusive, troubled loans [*n* (%)]	Nonexclusive, troubled loans [*n* (%)]
Panel A: Final outcome of the 50 firms whose loans became troubled: number and (percent) of the 50 troubled loans in the data set			
Bankruptcy of the firm	10 (20)	6 (12)	4 (8)
Private liquidation of the firm	26 (52)	20 (40)	6 (12)
Loan remained troubled	9 (18)	3 (6)	6 (12)
Loan repaid	4 (8)	3 (6)	1 (2)
Loan upgraded to healthy	1 (2)	0 (0)	1 (2)

	All loans	Healthy loans	Troubled loans	Exclusive loans	Nonexclusive loans	Exclusive, healthy loans	Nonexclusive, healthy loans	Exclusive, troubled loans	Nonexclusive, troubled loans
Panel B: Average loan size and average business sales (in thousands of Canadian dollars)[1]									
Average loan size									
All three years	1496.3	1269.9	1741.1	1365.8	1745.3	883.4	1849.9	1802.5	1585.9
	(2485.8)	(2828.8)	(2024.3)	(1994.6)	(3207.9)	(1612.5)	(3945.6)	(2197.5)	(1491.1)
Three years prior to reference date	1250.8	1126.4	1400.8	1088.5	1593.0	797.3	1705.7	1396.6	1412.2
	(2216.9)	(2546.4)	(1730.1)	(1682.3)	(3028.2)	(1494.6)	(3674.8)	(1813.2)	(1495.1)
Two years prior to reference date	1500.9	1231.5	1783.7	1364.9	1762.3	836.7	1843.7	1839.7	1646.6
	(2388.7)	(2608.3)	(2099.8)	(2096.2)	(2853.8)	(1686.6)	(3516.8)	(2307.0)	(1472.2)
One year prior to reference date	1679.4	1426.2	1938.5	1592.1	1832.9	1014.2	1953.8	2056.4	1642.8
	(2745.7)	(3229.3)	(2113.2)	(2095.8)	(3613.7)	(1635.3)	(4462.9)	(2302.1)	(1508.6)
Average annual business sales									
All three years	16,898.0	12,805.2	20,990.8	10,108.8	26,667.9	10,742.0	15,040.4	9,609.8	43,083.4
	(36,811.3)	(16,445.5)	(49,327.0)	(9,379.2)	(55,321.0)	(10,363.2)	(21,199.6)	(8,657.9)	(80,721.0)
Three years prior to reference date	15,885.3	10,846.5	20,924.0	9,746.7	24,718.8	10,405.2	11,324.6	9,227.8	43,628.2
	(38,803.3)	(10,836.6)	(53,599.2)	(10,120.9)	(58,672.9)	(10,448.1)	(11,448.5)	(9,987.4)	(88,141.0)
Two years prior to reference date	18,112.0	14,028.5	22,195.4	9,934.8	29,879.1	10,855.6	17,465.9	9,209.3	47,403.6
	(42,688.4)	(23,514.0)	(55,631.4)	(9,497.2)	(64,333.9)	(10,958.3)	(31,995.2)	(8,272.5)	(91,203.8)
One year prior to reference date	16,696.9	13,540.6	19,853.1	10,644.8	25,406.0	10,965.2	16,330.6	10,392.3	38,218.2
	(30,621.6)	(17,004.6)	(39,812.2)	(10,173.4)	(45,154.4)	(9,796.3)	(22,273.3)	(10,605.1)	(63,923.3)

Table 1
(continued)

			Reservations			Troubled		
	Superior = 1	Standard = 2	Mild = 3	Average = 4	Strong = 5	Standard = 6	Severe = 7	Very Severe = 8
Panel C: Credit ratings for loans								
Healthy loans								
Number of loans at $t-3$	4	15	23	0	8			
Number of loans at $t-2$	3	17	23	0	7			
Number of loans at $t-1$	4	19	18	0	9			
Exclusive, healthy loans								
Number of loans at $t-3$	2	9	11	0	4			
Number of loans at $t-2$	2	10	12	0	2			
Number of loans at $t-1$	3	12	8	0	3			
Nonexclusive, healthy loans								
Number of loans at $t-3$	2	6	12	0	4			
Number of loans at $t-2$	1	7	11	0	5			
Number of loans at $t-1$	1	7	10	0	6			
Troubled loans								
Number of loans at $t-3$	3	15	28	0	4	0	0	0
Number of loans at $t-2$	1	2	14	1	31	0	0	0
Number of loans at $t-1$	0	1	2	1	6	29	5	6
Exclusive, troubled loans								
Number of loans at $t-3$	1	8	29	0	4	0	0	0
Number of loans at $t-2$	1	1	9	1	20	0	0	0
Number of loans at $t-1$	0	1	2	1	3	19	4	3
Nonexclusive, troubled loans								
Number of loans at $t-3$	2	7	8	0	0	0	0	0
Number of loans at $t-2$	0	1	5	0	11	0	0	0
Number of loans at $t-1$	0	0	0	0	3	10	1	3

[1]Averaged over months and firms, with standard deviation (SD) of loan size or business sales in parentheses. For healthy loans, the reference date is the last time the firm's credit file was reviewed by the bank. For troubled loans, the reference date is the date when the loan was declared troubled.

Table 2
Distribution of loans by industry[1]

	% of sample (100 loans)	% of exclusive loans (59 loans)	% of nonexclusive loans (41 loans)	% of healthy loans (50 loans)	% of troubled loans (50 loans)
Manufacturing	42.0	42.4	41.5	42.0	42.0
Wholesale trade	20.0	27.1	9.8	20.0	20.0
Services	20.0	15.3	26.8	20.0	20.0
Retail trade	10.0	8.5	12.2	10.0	10.0
Construction	6.0	5.1	7.3	6.0	6.0
Primary (mining, agriculture, fishing, and forestry)	2.0	1.7	2.4	2.0	2.0

[1]Exclusive loans are loans made to firms that have an exclusive banking relationship with the bank. Nonexclusive loans are loans made to firms that have relationships with other banks as well. Note, the distributions of healthy and troubled loans by industry are identical because pairs were matched on industry category. Second and third columns do not sum to 100% due to rounding.

liquidated.[7] Of the other loans, nine remained troubled, four were repaid, and one was upgraded. The Canadian category "troubled" matches reasonably well with the US category "doubtful" and similarly requires a substantial write-down of assets.[8]

Most of these troubled loans were so classified between 1990 and 1992 (only three loans were classified as troubled before 1990); healthy loans were last reviewed by the bank at some date in 1991 or 1992. Six industrial sectors are represented in the data (see Table 2).

For each loan, we have both annual and monthly data. For a troubled loan, the annual data pertain to the firm's three fiscal years prior to the loan's being declared troubled, and the monthly data pertain to the three calendar years prior to the firm's being declared troubled. (The data are not necessarily complete for each loan.) For the matched healthy loan, we have comparable information, with the reference date being the last time the firm's credit file was reviewed by the bank. For example, consider a firm whose loan was declared troubled in April 1991 and whose fiscal year runs from October to September. Our annual data on this firm would cover the firm's fiscal years FY1988, FY1989, and FY1990, which run

[7] A private liquidation is a cooperative sell-off of assets without a court settlement. When the owner has signed a personal guarantee as a part of the loan agreement, such a private liquidation is likely to be efficient, as the owner is strongly motivated to maximize liquidation value of the firm and minimize his personal liability. Of course, if there are other claimants, liquidation may be complicated and bankruptcy entered into.

[8] "Doubtful" is one of the categories of "regulatory problem assets" identified by Treacy and Carey (1998) in their interviews with large US banks. In the United States, a "doubtful" loan has a recommended specific reserve of 50%. Such a loan has all the weaknesses inherent in a substandard loan and "collection/liquidation in full, on [the] basis of currently existing conditions, is highly questionable or improbable." For loans in this category, "specific pending factors may strengthen credit." The loans are treated "as loss deferred until [the] exact status can be determined" [Treacy and Carey (1998)].

from October 1987 through September 1990, and the monthly data would run from January 1988 through December 1990.[9]

An important variable included in our data set is whether the firm has an *exclusive* banking arrangement with the bank. In our data, of the 50 troubled loans, 33 of the borrowers have an exclusive relationship with the bank, and of the 50 healthy loans, 26 have an exclusive relationship. This variable allows us to segment the loans into "exclusive" and "non-exclusive" categories, providing a metric against which we can partially measure the quality of the bank's information. In general, having more than one banking relationship weakens the bank's information. We can subdivide nonexclusive borrowers into two types: those with exclusive operating loan balances with our bank and at least one term loan (which includes mortgages) with another bank and those with operating loan balances with another bank. Of the 41 nonexclusive borrowers, 27 have exclusive operating loans, while 14 have operating loan balances with another bank. Under our hypothesis of information-based monitoring, the information on those borrowers with exclusive operating loans should be of higher quality than on those with nonexclusive operating loans.

In fact, our bank has relatively little information about the borrowers with operating loan balances at another bank. In 10 of these 14 loans, the borrower's loan file does not have monthly transactions account information. The bank in these cases generally relies on the other bank to monitor the borrower and is typically offering the loan facility as part of the bank's relationship with the other bank. We generally lack the data to perform our tests on these borrowers. By contrast, with exclusive operating loans, the bank is typically the primary lender, even though its relationship with the customer may not be as tight as with an exclusive client. When we analyze informational flows in Section 3, the informational contrasts we draw between exclusive and nonexclusive borrowers will almost entirely reflect the contrast between borrowers who have exclusive client relationships and borrowers who have term loans at another bank (but operating loans at our bank).

2.1 Annual data

The annual data contain information typically found on a firm's financial statement, for example, balance-sheet data, such as the book value of accounts receivable and inventories, income-statement data, some items from the statement of changes in financial position, and information in

[9] Because the reference dates for a matched troubled loan and healthy loan differ, the data on two matched loans could potentially cover substantially different time periods, with significantly different macroeconomic conditions. But this does not seem to pose a large problem here, because the difference in reference dates was under two years in all but four cases, and the maximum difference was three and a half years for one loan pair.

the firm's credit file. Our data set also contains some information from the outside auditor's report on the firm, for example, whether there were any qualifications in the auditor's report and the date of the audit. These data would be available to any lender the firm approached for a loan. Nonexclusive borrowers generally tend to have larger sales and often represent borrowers who are being accommodated by our bank because they have a plant or subsidiary outside their primary bank's territory.[10]

The credit file contains annual information about the firm's sales, the level of authorized credit the firm has gotten from the bank for an operating loan, additional credit for seasonal loans, and other temporary loans. In addition, there is information on whether the loan has covenants. A crucial datum in each annual credit review is the credit rating assigned to the loan by the bank's credit department upon completion of the review. This credit rating is arranged on a scale of 1–8, with 1 being the best, and 6–8 being different degrees of "trouble."

Panel B of Table 1 summarizes some of the annual data on our borrowers. The first four rows summarize the average loan sizes (measured by the average amount actually borrowed) for all the loans and for the healthy and troubled loan subsamples over the entire three-year period covered by the data and over each year individually, where the years are measured relative to the reference date (i.e., for a troubled loan, the three fiscal years prior to the loan being declared troubled, and for a healthy loan, the three fiscal years prior to the firm's last credit review by the bank) cross-classified by exclusive and nonexclusive client relationships. It is evident that the bank does not use its information about troubled borrowers to substantially reduce its exposure to loss, rather, if anything, troubled loans rise in average size. Because the bank has very good information on exclusive borrowers, one might have thought that the bank would restrain lending to them as they get into trouble. But we find that such loans continue to rise in size, on average, despite the deterioration of the borrowers.

The next four rows summarize the average annual business sales for all firms and for the healthy and troubled loan subsamples, again cross-classified by exclusive and nonexclusive relationships. Note that troubled borrowers do not generally have obviously declining average sales compared with healthy ones. Many of these troubled borrowers get into trouble by expanding too aggressively. As might be expected, firms that

[10] One such borrower with unusually large sales of over $300 million distorts the data on "nonexclusive-troubled" borrowers. When that borrower is omitted, average sales for all three years falls to $14.5 million for troubled loans, to $18.8 million for nonexclusive loans, and to $24.5 million for nonexclusive-troubled loans. We concentrate on results pertaining to exclusive borrowers below. But our results using both exclusive and nonexclusive borrowers, which are similar to the results for exclusive borrowers, are not materially affected by this borrower's data. Indeed, when this borrower is omitted, the results of our statistical tests are, on average, slightly more favorable to our hypotheses.

are larger, as measured by sales, tend not to have an exclusive relationship with the bank under study.

Panel C of Table 1 summarizes the evolution of the borrowers' credit ratings over time. At the dates when the loans were matched (i.e., at $t-3$), there are 19 loans rated superior or standard in the group of loans that do not become troubled loans and 31 such loans with substandard credit ratings. At the final rating period ($t-1$), there are 23 loans rated superior or standard. By contrast, although 18 of the troubled loans are rated superior or standard in the initial period, only one is so rated two reviews later. The divergent movements of the two sets of loans are due to the selection process; all the loans that worsen to troubled are selected into the "troubled" group.

These credit ratings are effective on the date the credit department signs off on the credit review. This sign-off date is typically later than the planned credit review date, as the loan officer doing the review may ask the borrower for additional information. In addition, the interval between planned credit reviews is not always one year but may be shorter or longer.

2.2 Monthly data

The monthly data contain information on the value that the bank assigns to the firm's accounts receivable and inventories as well as the end-of-month balance in the firm's bank account. The bank's *valuation* of accounts receivable and inventories is an important ingredient in determining how much the bank is willing to lend to a commercial borrower. To restrict the use of the operating loan to purely operational ends and to ensure that the borrower has adequate collateral for the loan, the bank verifies on a monthly basis that the amount borrowed does not exceed the estimated value of the firm's operating assets that serve as collateral.

The bank's valuation includes subjective discounts (haircuts) from book value (note, we have annual data but do not have monthly information on these book values). These haircuts provide a comfort level for the lender; they also reflect the liquidity and quality of accounts receivable and inventories. For example, as accounts receivable remain uncollected, their quality (i.e., the probability they will ultimately be collected) may deteriorate. Also, the stage to which the inventory is processed reflects its liquidity—works-in-progress inventory is the least valuable, because it is the most difficult to convert to other uses and, therefore, to sell to other producers. In general, our data indicate that this bank values accounts receivable at two-thirds to three-quarters of book value, while it values inventories at between one-quarter and two-fifths of book value. The low valuation on inventories also reflects binding ceilings on the amount of inventory on which the bank permits the firm to borrow. On the other hand, credit rating does not seem to have much impact on the size of a haircut, although borrowers with a credit rating in the "troubled" range may receive a bigger haircut on their accounts receivable than do other borrowers. This presumably reflects the aging of some proportion of the accounts receivable.[11]

3. Empirical Results

Our empirical work has three nested parts. We test for the transparency of the bank's information, then for the usefulness of this information in forecasting loan problems, and finally for how the bank changes its behavior in response to the signals and to the loan problems. First, we hypothesize that for exclusive borrowers, the borrower's bank balance will provide a transparent window on accounts receivable. This implies, as we show, that the correlation between changes in the bank balance and changes in accounts receivable is 0.5. This transparency of information is crucial for the bank's ability to easily follow collateral through the transaction account. Second, we hypothesize that signals based on borrowings that are unsupported by collateral movement will predict loan problems as measured by declarations of trouble and credit downgrades. We test the usefulness of this information versus signals based on the degree of utilization of credit, which does not require information about collateral. Our hypothesis is that the bank account signal will contain additional information. We also test how quickly the signals from the bank balance feed into signs of loan problems, a measure of how tight the informational link is, hypothesizing that older information will be relatively uninformative. Last, we examine how the bank changes its loan monitoring in reaction to signals of loan problems and test whether the bank intensifies its monitoring by extending the time spent on loan reviews and shortening the time between reviews. Our hypotheses are that banks will intensify monitoring in reaction both to bank-information-derived signals of loan problems and to credit downgrades.

3.1 The relationship between loan balances and the bank's valuation of accounts receivable

First, we turn to the transparency of the bank balance in providing information on accounts receivable. If we had complete data on loan balances, accounts receivable, and inventories, then, under the hypothesis of transparency, almost all the movements in bank balances would be accounted for by movements in accounts receivable and inventories. However, in our data, it appears that there is a limit on the amount the bank is willing to lend against inventory. That is, there is a binding ceiling on the bank's inventory valuation, so that changes in inventory are

[11] The mean haircut on accounts receivable was 0.29 for borrowers rated superior or standard and 0.36 for borrowers rated as troubled (with one of the three worst credit ratings). The mean haircut on inventories was 0.62 for borrowers rated superior or standard and 0.66 for borrowers rated as troubled.

typically not reflected in our inventory valuations data. For this reason, we focus on the relationship between loan balances and accounts receivable. As discussed in Section 1, to the extent that there is a high correlation between bank account balances and changes in accounts receivable and inventories, changes in the firm's bank account balance can be used to monitor a firm's operations. But how high can we expect this correlation to be? Loan balances change only in response to payments, which represent only half of the changes in accounts receivable. This suggests that the correlation between accounts receivable and loan balances should be positive and roughly one-half. In the Appendix, we formalize this conjecture. Note that a similar calculation can be performed for the correlation between the change in bank account balance and the change in inventories.

To be precise, we examine the correlations between changes from the beginning to the end of each month in the firm's checking account balance and the bank's valuations of the firm's accounts receivable and inventories. As discussed in Section 2, we hypothesize that the correlation would be stronger for firms that have an exclusive relationship with the bank than for firms that do not. So, we repeat the correlation analysis for the exclusive and nonexclusive subsamples, and we also divide these subsamples into their healthy and troubled loan subgroups, to control for any loan performance effect. Thus, we perform the analysis for seven groups: all loans, exclusive, nonexclusive, exclusive-healthy, nonexclusive-healthy, exclusive-troubled, and nonexclusive-troubled. In this analysis, we normalize the variables by the firm's annual sales to control for heteroscedasticity.[12]

As shown in Appendix Table A.1, the correlation between changes in bank balances and changes in accounts receivable is 0.44 for all loans and is higher for exclusive loans (0.49) than for nonexclusive loans (0.31). Thus, our data for exclusive loans are showing about as high a level of correlation as one should expect; the correlation for exclusive loans is not significantly different from 0.5 (at the 5% level of significance), while that for nonexclusive loans is. In addition, the exclusive-troubled borrowers' correlation between movements in the bank account balance and accounts receivable, at 0.44, is lower than for exclusive-healthy borrowers (and significantly different from 0.5 at the 10% level) but remains high.[13] It is significantly greater than the 0.31 correlation coefficient for

[12] To normalize, we use the earliest annual sales figure available for each firm. For troubled loans, this is sales in the fiscal year three years prior to the loans' being declared troubled, and for healthy loans, this is sales in the fiscal year three years prior to the last credit file review.

[13] This may reflect the fact that when loans become troubled, the bank may lower its valuations and the loan limits may become binding on the firm. Alternatively, some of the lack of transparency might be due to unexpected losses.

nonexclusive borrowers. (Based on Fisher's z-scores, we can reject the hypothesis of equal correlation with a p-value of 2.3%.)

The correlations between changes in inventories and changes in either bank balances or accounts receivable are much smaller than the correlations between changes in bank balances and accounts receivable. This is because there is generally much less variation in changes in inventory valuations than in the other variables. Indeed, roughly 20% of the monthly observations of the bank's valuation of inventories appear to be at an upper limit. These are cases where there are more than two observations at the same valuation, and that valuation is the highest observed for that borrower. This bank's monitoring operation does not include collecting detailed information on inventory. This may be contrasted with those finance companies that focus on inventory, where lenders regularly make site visits to evaluate this collateral [Udell (2004)].

This analysis suggests that changes in accounts receivable potentially contain useful information about firm operations; however, our data do not permit us to reach a similar conclusion about inventories. The empirical analysis in the next sections determines whether this information predicts loan problems and how the bank changes its monitoring in response.

3.2 The relationship between signals of loan problems, credit downgrades, and troubled firms

The monthly data allow the lender to detect two signals of potential loan problems. The first signal is when the bank's loan balance exceeds the bank's valuation of collateral, that is, of accounts receivable and inventory. The second signal is whether the borrower is consistently borrowing an amount close to or exceeding the credit line authorized at the beginning of the credit year. These two signals differ sharply on what kinds of lenders can use them. The first type of signal is likely to be accurate only for lenders with access to transactions account data, because only such a lender can track the high-frequency movements in collateral valuations and thus can create a reliable signal based on them. On the other hand, a signal based just on information on the firm's loan balance and its credit limit would be available to any lender.

Our measures of these two types of signals are *exceed* and *utilization*. *Exceed* is the amount the firm has borrowed minus the firm's collateral (as measured by the bank's valuation of the firm's accounts receivable and inventories and other guarantees posted by the firm) as a percent of the firm's authorized credit line. *Utilization* is the firm's borrowing as a percent of its authorized credit line. Borrowers with loan problems are likely to have higher, and possibly positive, values of *exceed* and higher values of *utilization*. These higher valuations are usually due to excessive borrowing but also may on occasion be due to declines in the bank's valuations of accounts receivable and inventory and in the borrower's credit line.

Both *exceed* and *utilization* are computed using the monthly data on the firm, and thus, they are likely to be better signs of loan problems for exclusive borrowers than for nonexclusive borrowers, because the bank has more accurate monthly data on exclusive borrowers. As expected, we found higher mean values of *exceed* and *utilization* for exclusive-troubled firms than for exclusive-healthy firms. In our tests, we focus on exclusive borrowers, as our theory and data suggest that banks have the best information on these borrowers. However, broadly similar results are obtained for nonexclusive borrowers. This is not surprising because all but one of the nonexclusive borrowers used in our tests have an exclusive operating loan with our bank.[14]

When *exceed* turns positive, the bank is at risk, in that the borrower's ability to relatively quickly pay off the loan has become stretched. This is a warning signal to the loan officer and to the bank. How useful is this signal? We define a variable, *violations*, which equals the number of months for which *exceed* is positive over the three years prior to our reference date (either the date when a loan was declared troubled or the date of a healthy loan's last credit review). We also define *violations_i*, $i =$ 1, 2, 3, which is the number of months *exceed* is positive in the ith year before the reference date. Similarly, we define *nonviolations* and *nonviolations_i*, $i = 1, 2, 3$, which are the number of months for which *exceed* is negative. Note that *violations* and *nonviolations* will not necessarily sum to 36, because these data are often incomplete. This allows us to include both *violations* and *nonviolations* in the regressions. Doing so yields meaningful information because lack of data has a different meaning from *nonviolations*, as suggested by the negative coefficients on *nonviolations*.

We are interested in two nested types of outcomes: downgrades of a loan's credit rating and, among these, downgrades to "troubled." The declaration that a borrower is troubled requires an immediate write-down of the loan and is also tantamount to failure of the borrower; in almost all cases, the ultimate outcome is bankruptcy or liquidation (see panel A of Table 1). Failure of the borrower is a more clearly objective event than a credit downgrade, which need not have immediate consequences.

3.3 Usefulness of the bank balance data for monitoring borrowers

We ran OLS regressions and logit regressions of whether a loan was eventually declared troubled on *violations*, *nonviolations*, and *utilization*. The OLS results for exclusive clients are summarized in Table 3.[15] First,

[14] The results of all tests using all loans—exclusive and nonexclusive—are available upon request from the authors.

[15] The logit results are qualitatively the same and are available upon request from the authors.

Table 3
Results of regression of exclusive-troubled loans on signs of loan problems in all three prior years[1]

	Dependent variable: dummy variable equal to 1 for loans declared troubled and equal to 0 otherwise		
Intercept	0.366** (0.202) $p = .076$	0.568* (0.227) $p = .016$	0.341* (0.082) $p = .000$
Violations	0.0137 (0.0095) $p = .154$	0.0186** (0.0093) $p = .051$	0.0248* (0.0062) $p = .000$
Nonviolations	−0.0078 (0.0065) $p = .237$	−0.0082 (0.0074) $p = .276$	
Credit utilization	0.389* (0.114) $p = .001$		
Asymptotic F-test for violations and nonviolation exclusion	$F(2,52) = 5.18$* $p = .0089$	$F(2,54) = 10.15$* $p = .0002$	
Number of observations	56	57	57

Violations is the number of months in the three years prior to the reference date in which the amount the firm has borrowed is greater than the firm's collateral (as measured by the bank's valuation of the firm's accounts receivable and inventories and other guarantees posted by the firm); the reference date is the date when a loan was declared troubled for troubled loans and the date of a healthy loan's last credit review for healthy loans. Similarly, *nonviolations* is the number of months in the three years prior to our reference date in which borrowing is less than collateral. Months in which our data are incomplete so that *violations* and *nonviolations* cannot be computed do not increase either *violations* or *nonviolations*. Thus, if data are missing, or if the firm is just borrowing an amount equal to the bank's valuation of its collateral, the sum of *violations* and *nonviolations* will differ from 36, and therefore, both variables can be included in the regression. *Credit utilization* is the firm's borrowing as a percent of its authorized credit line. The mean and standard deviations (SDs) (in parentheses) of the variables used in the regressions in the sample with 56 observations are as follows: *violations*: 7.89 (8.15); *nonviolations*: 21.43 (10.17); *credit utilization*: 0.587 (0.428); and *declaration of troubled*: 0.536 (0.503).
[1]Includes all exclusive loans with information on violations or nonviolations. OLS regressions. White robust standard errors in parentheses.
*Significant at 5% level.
**Significant at 10% level.

note that the coefficients have the expected signs. Moreover, asymptotic F-tests indicate that the null hypothesis that the *violations* and *nonviolations* can be excluded is rejected at a high level of significance. The results are little changed if we exclude borrowers for which the bank lacks information about violations.

The coefficients are also economically significant. The coefficient on *violations* is .0137, and *violations* has a standard deviation (SD) of 8.2. The coefficient on *nonviolations* is –.0078, and *nonviolations* has an SD of 10.2. Thus, a 1-SD increase in either increases the probability of being declared troubled by roughly 10%. As we shall see, these results understate the value of these data, as it is mainly recent violations that determine credit rating changes and declarations of "troubled."

3.4 Speed with which the lender acts on signals from the bank balance

How quickly is this information used? Two pieces of evidence suggest that the information is used relatively soon after it is available. Most of the information that determines whether a loan is declared troubled is in violations in the most recent fiscal year before a declaration of trouble, as summarized in Table 4. Here, we use our disaggregated measures of violations, *violations*_1, *violations*_2, and *violations*_3, which give separate counts of the number of violations according to how far in advance they

Table 4
Results of regressions of exclusive-troubled loans, credit downgrades in the second year before classification, and negative profits in the year before classification on signs of loan problems in each of three prior years[1]

	Dependent variable: dummy variable equal to 1 for loans declared troubled and equal to 0 otherwise	Dependent variable: dummy variable equal to 1 for loans whose credit rating was lowered in the next to last credit review before being declared troubled and equal to 0 otherwise	Dependent variable: dummy variable equal to 1 for loans whose profits were negative at the time of last credit review before being declared troubled and equal to 0 otherwise
Intercept	0.1122 (0.0758) p = .147	0.00954 (0.0744) p = .899	0.1187 (0.0833) p = .162
Violations, one year prior to declaration of "troubled"	0.0897* (0.0227) p = .000	0.02796 (0.0251) p = .272	0.0455* (0.0210) p = .036
Violations, two years prior to declaration of "troubled"	−0.0499** (0.0267) p = .070	0.0587** (0.0316) p = .071	−0.0686* (0.0243) p = .045
Violations, three years prior to declaration of "troubled"	0.0335 (0.0197) p = .207	−0.0337 (0.0213) p = .123	0.0608* (0.0293) p = .045
Credit utilization	0.2572** (0.1328) p = .060	0.2987 (0.1549) p = .186	0.0925 (0.1553) p = .555
Asymptotic F-test for excluding the variables violations one, two, and three years prior to declaration of "troubled"	$F(3,39)$ = 6.32* p = .0013	$F(3,39)$ = 4.49* p = .0084	$F(3,39)$ = 4.12* p = .0125
Asymptotic F-test for excluding violations:	Two and three years prior: $F(2,39)$ = 1.74 p = .1885	One and three years prior: $F(2,39)$ = 2.11 p = .1349	Two and three years prior: $F(2,39)$ = 4.19* p = .0225
Number of observations	44	44	44

Violations_i is the number of months in year i prior to the reference date in which the amount the firm has borrowed is greater than the firm's collateral (as measured by the bank's valuation of the firm's accounts receivable and inventories and other guarantees posted by the firm), i = 1, 2, 3; the reference date is the date when a loan was declared troubled for troubled loans and the date of a healthy loan's last credit review for healthy loans. Similarly, *nonviolations_i* is the number of months in year i prior to our reference date in which borrowing is less than collateral. *Credit utilization* is the firm's borrowing as a percent of its authorized credit line. The mean and standard deviations (SDs) (in parentheses) of the variables used in the regressions in the sample with 44 observations are as follows: *violations_*1: 3.36 (3.55); *violations_*2: 2.97 (3.54); *violations_*3: 2.48 (3.27); *credit utilization*: 0.590 (0.469); *declaration of troubled*: 0.500 (0.506); *downgrade two years prior*: 0.318 (0.471); and *negative profit one year prior*: 0.273 (0.451).
[1]Exclusive loans with information on violations or nonviolations in the third year. OLS regressions. White robust standard errors in parentheses.
*Significant at 5% level.
**Significant at 10% level.

took place before the loan was declared troubled (or before the final fiscal year for healthy borrowers). The results in Table 4 are based on the sample of exclusive loans, omitting those for which there was no information on violations during the third year prior to declaration. The first column of Table 4 summarizes the regression results for whether or not loans were declared "troubled." The coefficients on the three violations variables are jointly strongly significantly different from zero. The bulk of the information is derived from the last year: the coefficients on violations in the two earlier years are jointly statistically insignificant.

Violations in the last year (*violations_1*) are important economically. The coefficient on *violations*_1 is .0897, and the SD of this variable is 3.55, so a 1-SD increase in violations in the last year raises the probability of being declared troubled by 32 percentage points.

The coefficient on *credit utilization* is .2572, and the SD of this variable is 0.469, so a 1-SD increase in credit utilization raises the probability of being declared troubled by 12 percentage points, an important amount, but less than for violations in the last year. It is interesting that temporally disaggregating credit utilization does not improve the fit. Indeed, substituting year-by-year data on credit utilization results in a jointly insignificant set of parameters (this result is not summarized in the table but is available from the authors upon request).

Now, consider downgrades of loans at the second review date, that is, at least a year prior to when the loan was declared troubled.[16] Here, we would expect that the most important information would be violations that occurred in the second year prior to the declaration that the loan is troubled, that is, in the year prior to this particular downgrade. The second column in Table 4 summarizes that is indeed the case. Again, the coefficients on the three violations variables are jointly strongly significantly different from zero. Almost all the information provided by violations in explaining downgrades in the second year is contained in violations that occurred in the year prior to the downgrade (*violations*_2): violations in the two other years are statistically insignificant. In addition, the information is quantitatively important: a 1-SD change in violations in the second year raises the probability of a decline in credit rating by 21 percentage points. Again, temporally disaggregating credit utilization results in insignificant parameter estimates.

A third piece of evidence concerns profit movements. Somewhat to our surprise, declarations of troubled are not always preceded by negative profits; indeed, 16 of the 50 loans declared troubled had positive profits in the last annual report before being declared troubled. Reported accounting profits may be a noisy measure of true profitability, and solvency likely depends on longer run profitability; in particular, assets that expanding firms have booked can lose value suddenly. Nevertheless, it is of interest to see whether violations are useful in signaling negative accounting profits. The results are in the third column in Table 4. Violations in all three years are related to negative profits in the last year before being declared troubled. Violations taken together are statistically significant, but the economic importance of violations in the last year is somewhat diminished compared with their economic importance in predicting whether the loan will be declared troubled or downgraded.

Taken together, these results show that information on violations is highly significant and quantitatively important in periods immediately preceding exclusive loans' being declared troubled and credit

[16] Because the results for downgrades at the final review date are virtually identical to the results for declarations of "trouble," we omit them here for brevity; they are available upon request from the authors.

downgrades. Violations are also informative about future borrower profitability.

3.5 Impact of violations on monitoring

Results shown in our final two tables indicate that the lender intensifies its monitoring of risky loans by spending more time in loan review and by reducing the time between loan reviews. Evidence was gleaned by examining the date on which a credit review was completed relative to the date the review was planned to be completed and changes in the frequency of planned reviews.

We expect that violations trigger more intensive monitoring of loans. For loans with violations, the completion of the credit review should be later than the planned completion date relative to loans without violations, because the reviewer is likely to review loans with violations more closely. A credit review is typically prolonged by the bank's requests for additional information, such as more complete financial statements and more details about projected disbursements from the bank account. The bank may negotiate changes in the terms of the loan (e.g., asking for personal guarantees, such as the pledge of property), and such negotiations may take time. Thus, a lengthy delay between the expected loan review date and the sign-off by the loan officer is a strong sign that monitoring has been intensified. Similarly, we expect that violations are likely to trigger more frequent examination of the loans. Clearly, more frequent loan reviews are signs of more intensive monitoring, as they require more data collection and analysis per unit of time.

Table 5 sorts exclusive loans on the number of *violations* they eventually have—in particular, we divide the loans into two groups: those with *violations* less than or equal to the median level of *violations* over the sample of loans and those with *violations* greater than the median level. (The median level is 2.5 *violations* for all loans, exclusive and nonexclusive.) This is information that the bank can discern from a firm's checking account. First, we find that loans with greater numbers of *violations* do have their credit reviews delayed relative to loans that have fewer *violations*: for example, in the third year prior to our reference date, 86% of loans with fewer *violations* have a delayed review, while in the first year prior, only 67% do; the length of delay declines from 108 days, on average, to 32 days. For loans with a greater number of *violations*, there is little decline in the number of delayed reviews and a much smaller decline in the average length of delay, compared with loans with fewer *violations*. Note that there is a significant difference in days delayed in the year prior to the reference date between loans with more violations and loans with fewer violations.

Panel B shows that the number of days between planned reviews increases for loans with fewer *violations* but declines for loans with a

Table 5
Evidence of more intensive monitoring in response to violations based on the monthly bank account information for exclusive loans[1]

	% of delayed reviews			Average number of days delayed			Median number of days delayed		
	Third year prior	Second year prior	Year prior	Third year prior	Second year prior	Year prior	Third year prior	Second year prior	Year prior
Panel A: Delayed completion of review									
Loans with less than or equal to median number of violations	86	81	67	107.9	90.8	31.6*	118.0	102.0	24.0*
Loans with greater than median number of violations	89	86	81	145.0	109.3	120.8*	131.0	100.5	92.5*

	Average number of days between planned reviews		Average change in number of days between planned reviews	Percentage of loans whose days between planned reviews are			
				>390	<340	>390	<340
	Third year prior to second year prior	Second year prior to year prior	Between third year prior to second year prior and second year prior to year prior	Third year prior to second year prior		Second year prior to year prior	
Panel B: Times between planned reviews							
Loans with less than or equal to median number of violations	372.3	387.2**	Number of days between planned reviews increases, on average, by 14.9 days	9.5	9.5**	33.3	9.5
Loans with greater than median number of violations	357.5	344.9**	Number of days between planned reviews decreases, on average, by 13.2 days	22.9	28.6**	25.0	27.8

A *delayed review* is one in which the credit review is completed after the planned credit review date. The *number of days delayed* is the calendar number of days from the planned credit review date to the credit review completion date. Similarly, the *number of days between planned reviews* is the calendar number of days from one planned credit review to the next. Each entry is calculated based on the sample of exclusive borrowers for which the particular variable can be calculated. One firm lacked a planned review in the third year prior to being declared troubled. If we omit this firm throughout the table, the results would be slightly more favorable to our hypotheses.

[1]For all exclusive loans categorized by whether the number of violations is greater or less than the median number of violations in the sample of all loans.

*Values for loans with the number of violations less than or equal to the median are significantly different from the values for loans with the number of violations greater than the median at the 5% level.

**Values for loans with the number of violations less than or equal to the median are significantly different from the values for loans with the number of violations greater than the median at the 10% level.

greater number of *violations*, and there is a statistically significant difference in the average number of days between planned reviews in the second year prior to the reference date for the two groups of loans.[17,18]

3.6 Monitoring troubled loans

We see similar patterns, and somewhat stronger ones, when we compare healthy and troubled loans. The evidence is that as loans deteriorate, monitoring becomes more intensive and costly. At the beginning of the period covered by our data ($t - 3$), healthy loans were approximately as creditworthy as the troubled loans. Over time, the healthy loans, on average, improve in quality, while the troubled loans, by definition, deteriorate. Table 6 summarizes that among healthy loans, delays in loan reviews decrease compared with planned dates. For example, in the third year prior to our reference date, 88% of healthy loans have a delayed review, while in the first year prior, only 69% do. Moreover, the length of delay is cut by three-fourths—from about 131 days to 40 days, on average. In contrast, for loans that remain troubled, there is little lessening in the number of delayed reviews or average length of delay, and the difference in the average number of days delayed in the year prior between the healthy and troubled loans is statistically significant.

The lower part of Table 6 summarizes that over time, as the troubled loans worsen, the time planned between credit reviews shortens on average, while for loans that improve in health, the time between reviews increases. For example, as summarized in the third column of panel B of Table 6, for troubled loans, on average, the time between planned reviews decreases by about 33 days over the three years, whereas for healthy loans, on average, planned reviews become less frequent by about 32 days.

Overall, the results in Tables 5 and 6 indicate that borrowers whose borrowing needs exceed the bank's valuations of accounts receivable and inventories and loans that become troubled have their credit ratings downgraded at the next credit review. Together with downgrading of credit, scrutiny appears to become stronger, with the credit review itself dragging on and the time between reviews sometimes becoming shorter.

[17] The right side of the bottom panel of Table 5 indicates that there is little change over the three years in the number of high-violation loans whose planned reviews are significantly more than a year apart and there is little change in those whose planned reviews are less than a year apart. However, over the three years, the number of low-violation loans whose reviews are significantly more than a year apart increases. This increase is about the same as the increase in the number of low-violation loans whose reviews are significantly less than a year apart.

[18] Similar results are obtained if instead of dividing the loans into two groups, we divide them into three groups: *violations* = 0; 0 < *violations* $\leq$ 10; and *violations* > 10.

Table 6
Evidence of more intensive monitoring as loans deteriorate for exclusive loans[1]

	% of delayed reviews			Average number of days delayed			Median number of days delayed		
	Third year prior	Second year prior	Year prior	Third year prior	Second year prior	Year prior	Third year prior	Second year prior	Year prior
Panel A: Delayed completion of review									
Healthy loans	88	85	69	131.4	85.1	40.3*	122.5	100.5	19.5
Troubled loans	87	84	81	130.7	117.1	127.8*	120.0	114.0	107.0

	Average number of days between planned reviews		Average change in number of days between planned reviews	Percentage of loans whose days between planned reviews are			
				>390	<340	>390	<340
	Third year prior to second year prior	Second year prior to year prior	Between third year prior to second year prior and second year prior to year prior	Third year prior to second year prior		Second year prior to year prior	
Panel B: Times between planned reviews							
Healthy loans	370.9	402.8*	Number of days between planned reviews increases, on average, by 31.88 days*	11.5	11.5**	38.5	3.8*
Troubled loans	356.3	325.0*	Number of days between planned reviews decreases, on average, by 32.6 days*	23.3	30.0**	19.4	35.5*

A *delayed review* is one in which the credit review is completed after the planned credit review date. The *number of days delayed* is the calendar number of days from the planned credit review date to the credit review completion date. Similarly, the *number of days between planned reviews* is the calendar number of days from one planned credit review to the next. Each entry is calculated based on the sample of exclusive borrowers for which the particular variable can be calculated. One firm lacked a planned review in the third year prior to being declared troubled. If we omit this firm throughout the table, the results would be slightly more favorable to our hypotheses.

[1]For all exclusive loans categorized by healthy versus troubled.

*Values for healthy and troubled loans are significantly different from each other at the 5% level.

**Values for healthy and troubled loans are significantly different from each other at the 10% level.

4. Conclusions

This article has described the efforts of one Canadian bank to use information in transactions accounts to scrutinize the activities of small-business borrowers. It is clear from the evidence that the bank does use instances where borrowings exceed the bank's own valuation of a firm's accounts receivable and inventories as a signal of deterioration in credit. Moreover, movements in checking account balances are closely related to movements in the bank's valuation of accounts receivable and inventories, suggesting strongly that the checking account provides a relatively transparent window on these aspects of a firm's activity. Although our results pertain to only one bank, we believe that these results taken together provide detailed micro-level evidence that transactions account data are useful for monitoring borrowers.

While any asset-based lender with access to transactions account data, such as finance companies, could use the information for monitoring the borrowers' operating loans, commercial banks are likely to be the most efficient at doing so, because they offer the transactions accounts. Thus, our article offers evidence on one of the key questions in the financial intermediation literature, namely, is there an advantage to housing deposit-taking and lending in the same institution? At the same time, our results offer insight into why finance company lending has been on the rise. While asset-based lenders face higher costs for accessing transactions account cash-flow information than a bank does, these costs have likely declined as information processing and communication costs have declined in recent years. Thus, the bank's advantage over other types of lenders has likely declined.

Appendix

Representative Loan Contract

A representative loan contract for the bank we study included the following language:

> Total outstandings are not to exceed 75% of good accounts receivable, excluding accounts over 90 days and inter-company accounts plus 50% of inventory, up to a maximum of $5 million, including raw material, work in process and finished products, less priority claims.
>
> The Borrower will deliver to the Bank such financial information as the Bank may reasonably request including but not limited to the following:
>
> a) audited annual financial statements of the Borrower, within 90 days after the fiscal year end;
>
> b) in-house monthly financial statements of the Borrower within 20 days after the end of the month;
>
> c) monthly aged listing of accounts receivable and inventory reports within 20 days after the end of month.

A simple accounting model

A simple accounting model shows the relationship between changes in accounts receivable, inventories, and bank account balance. In month t, the borrowing firm makes expenditures x_t to make products that increase the firm's inventories. It also makes shipments, y_t, which reduce inventories and increase accounts receivable. Then, if the firm sells its products at a constant markup of m, shipments will increase accounts receivable by $y_t(1+m)$. At time t, the firm will also receive some payments z_t on past shipments, which decrease accounts receivable. Net operating outlays are then $x_t - z_t$. Let all other net outlays be w_t; these will include liquidity declines caused by unanticipated operating losses or expenditures.

Let the firm's bank balance (i.e., what it owes the bank lender, on net) be B_t, and let the monthly interest rate on the loan (assumed constant over time) be r. Then $B_t = B_{t-1}(1+r) + x_t - z_t + w_t$. Similarly, let R_t be accounts receivable and S_t be inventories. Then $R_t = R_{t-1} + y_t(1+m) - z_t$ and $S_t = S_{t-1} + x_t - y_t$.

The changes in bank balances, accounts receivable, and inventories are:

$$\Delta B_t = B_{t-1}r + x_t - z_t + w_t, \tag{A1}$$

$$\Delta R_t = y_t(1+m) - z_t, \tag{A2}$$

and

$$\Delta S_t = x_t - y_t. \tag{A3}$$

The sum of changes in accounts receivable and inventories will approximately equal changes in bank balance, depending on the relative size of interest accruals (which depend on r), markup (m), and net other outlays (w_t). The size of interest accruals are, of course, known to the lender, as is the expected markup. Thus, if the lender knows the changes in inventories and accounts receivable, then knowledge of the bank balance is equivalent to knowledge of other net outlays.

The reverse is true too. If movements in w_t are infrequent, the bank balance can generally be used to monitor changes in inventory and accounts receivable.

The correlation between changes in the loan balance and the bank's valuation of accounts receivable

To the extent that there is a high correlation between bank account balances and changes in accounts receivable and inventories, changes in the firm's bank account balance can be used to monitor a firm's operations.

We can derive approximate values of the correlations under certain simplifying assumptions. For example, suppose the bank values the collateral represented by the accounts receivable at vR. (It applies a haircut, because there is some chance the accounts receivable will not be collected.) Then, using Equation (A2), the change in the bank's valuation of accounts receivable is $\Delta vR_t = vR_t - vR_{t-1} = v[y_t(1+m) - z_t]$. If m is small, then

$$\Delta vR_t \approx v(y_t - z_t). \tag{A4}$$

The correlation between the change in the firm's bank account balance and the change in the bank's valuation of the firm's accounts receivable is

$$\mathrm{corr}(\Delta B_t, \Delta v R_t) = \frac{\mathrm{cov}(\Delta B_t, \Delta v R_t)}{\mathrm{var}(\Delta B_t)^{1/2}\mathrm{var}(\Delta v R_t)^{1/2}}.$$

Using Equations (A1) and (A4), and assuming r is small, then

$$\mathrm{corr}\ (\Delta B_t, \Delta v R_t) \approx \frac{\mathrm{cov}\ (x_t - z_t + w_t, v\ (y_t - z_t))}{\mathrm{var}\ (x_t - z_t + w_t)^{1/2}\ \mathrm{var}\ (v(y_t - z_t))^{1/2}}$$

$$= \frac{v\ \mathrm{cov}\ (x_t, y_t) - v\ \mathrm{cov}\ (x_t, z_t) - v\ \mathrm{cov}\ (z_t, y_t) + v\ \mathrm{var}\ (z_t) + v\ \mathrm{cov}(w_t, y_t) - v\ \mathrm{cov}\ (w_t, z_t)}{[\mathrm{var}\ (x_t) + \mathrm{var}\ (z_t) + \mathrm{var}\ (w_t) - 2\mathrm{cov}\ (x_t, z_t) - 2\mathrm{cov}\ (z_t, w_t) + 2\mathrm{cov}\ (x_t, w_t)]^{1/2}[v^2\ \mathrm{var}\ (y_t) + v^2\ \mathrm{var}\ (z_t) - 2v^2\ \mathrm{cov}\ (y_t, z_t)]^{1/2}}.$$

As an approximation, assume x_t, y_t, z_t, and w_t are independent. Then,

$$\mathrm{corr}(\Delta B_t, \Delta v R_t) = \frac{\mathrm{var}(z_t)}{[\mathrm{var}(x_t) + \mathrm{var}(z_t) + \mathrm{var}(w_t)]^{1/2}[\mathrm{var}(y_t) + \mathrm{var}(z_t)]^{1/2}}.$$

If other payments are not variable, that is, $\mathrm{var}(w_t) = 0$ and the variance in goods purchased, goods sold, and payments received is similar, that is, $\mathrm{var}(x_t) = \mathrm{var}(y_t) = \mathrm{var}(z_t)$, then

$$\mathrm{corr}(\Delta B_t, \Delta v R_t) \approx \frac{\mathrm{var}(z_t)}{[2\mathrm{var}(z_t)]^{1/2}[2\mathrm{var}(z_t)]^{1/2}} = \frac{1}{2}.$$

A similar calculation can be performed for the correlation between the change in bank account balance and the change in inventories. Table A1 summarizes the correlations by loan category.

Obviously, this is a rough approximation, based on several simplifying assumptions [namely, $m \approx 0$, $r \approx 0$, $\mathrm{var}(w_t) = 0$, and $\mathrm{var}(x_t) = \mathrm{var}(y_t) = \mathrm{var}(z_t)$]. But it gives an idea of the magnitude of the correlation we would need to find to anticipate that the bank account balance might be a useful indicator of firm operations.

Table A1
Correlations and variances of monthly changes in bank account balances, bank's valuation of accounts receivable, and inventories[1]

	Total	Exclusive loans	Nonexclusive loans	Exclusive, healthy loans	Nonexclusive, healthy loans	Exclusive, troubled loans	Nonexclusive, troubled loans
Correlations between changes in							
Bank account balances and accounts receivable	0.44*,**	0.49*	0.31*,**	0.54*	0.34*,**	0.44*,***	0.28*,**
Bank account balances and inventories	0.19*,**	0.13*,**	0.28*,**	0.18*,**	0.36*,**	0.11*,**	0.19*,**
Inventories and accounts receivable	–0.08*,**	–0.10*,**	–0.06**	–0.10*,**	0.07**	–0.10*,**	–0.20*,**
Number of observations	1327	1024	303	514	142	510	161
Variances of changes in							
Bank account balances	0.00233	0.00209	0.00315	0.00207	0.00367	0.00211	0.00272
Accounts receivable	0.00198	0.00204	0.00178	0.00226	0.00177	0.00182	0.00180
Inventories	0.00053	0.00040	0.00098	0.00023	0.00112	0.00057	0.00085

[1]This table reports the correlations and variances by category of loan of monthly changes in the borrowers' bank account balances and the bank's valuation of the borrowers' accounts receivable and inventories. A positive bank account balance corresponds to a firm's borrowings exceeding its deposits, and a negative bank account balance corresponds to a firm's deposits exceeding its borrowings. Thus, positive bank account balances indicate the firm is borrowing, on net. The correlations are between monthly changes, scaled by dividing by annual sales. For troubled loans, this is sales in the fiscal year three years prior to the loans' being declared troubled, and for healthy loans, this is sales in the fiscal year three years prior to the last credit file review.
*Significantly different from 0 at the 5% level.
**Significantly different from 0.5 at the 5% level.
***Significantly different from 0.5 at the 10% level.

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