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The Heterogeneous Effects of Ability Grouping on National College Entrance Exam Performance Evidence from a Typical Municipality in China

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Introduction

**Background
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**Between-school Ability Grouping
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Empirical Results from PSM and OLS

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Conclusions and Discussion

A brief history of school system reform in China

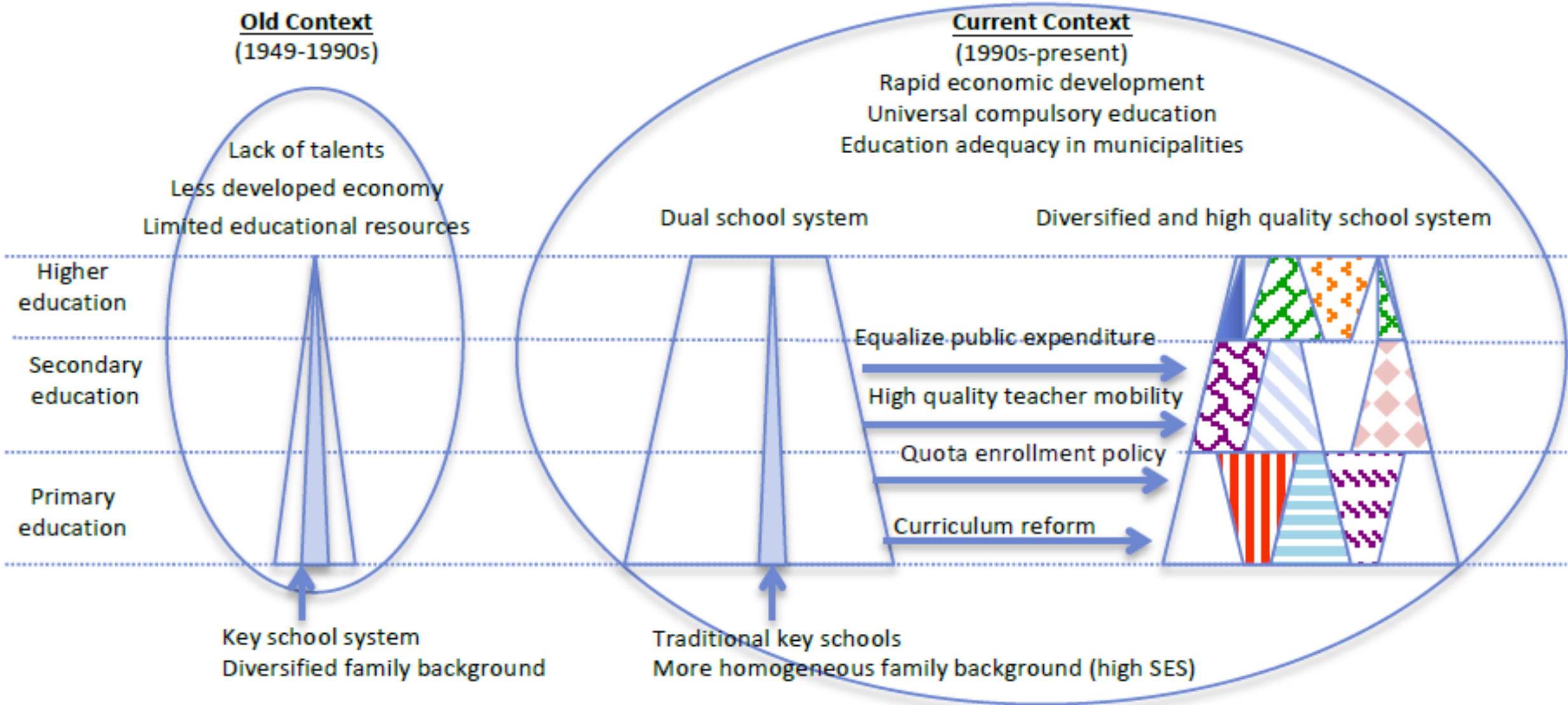
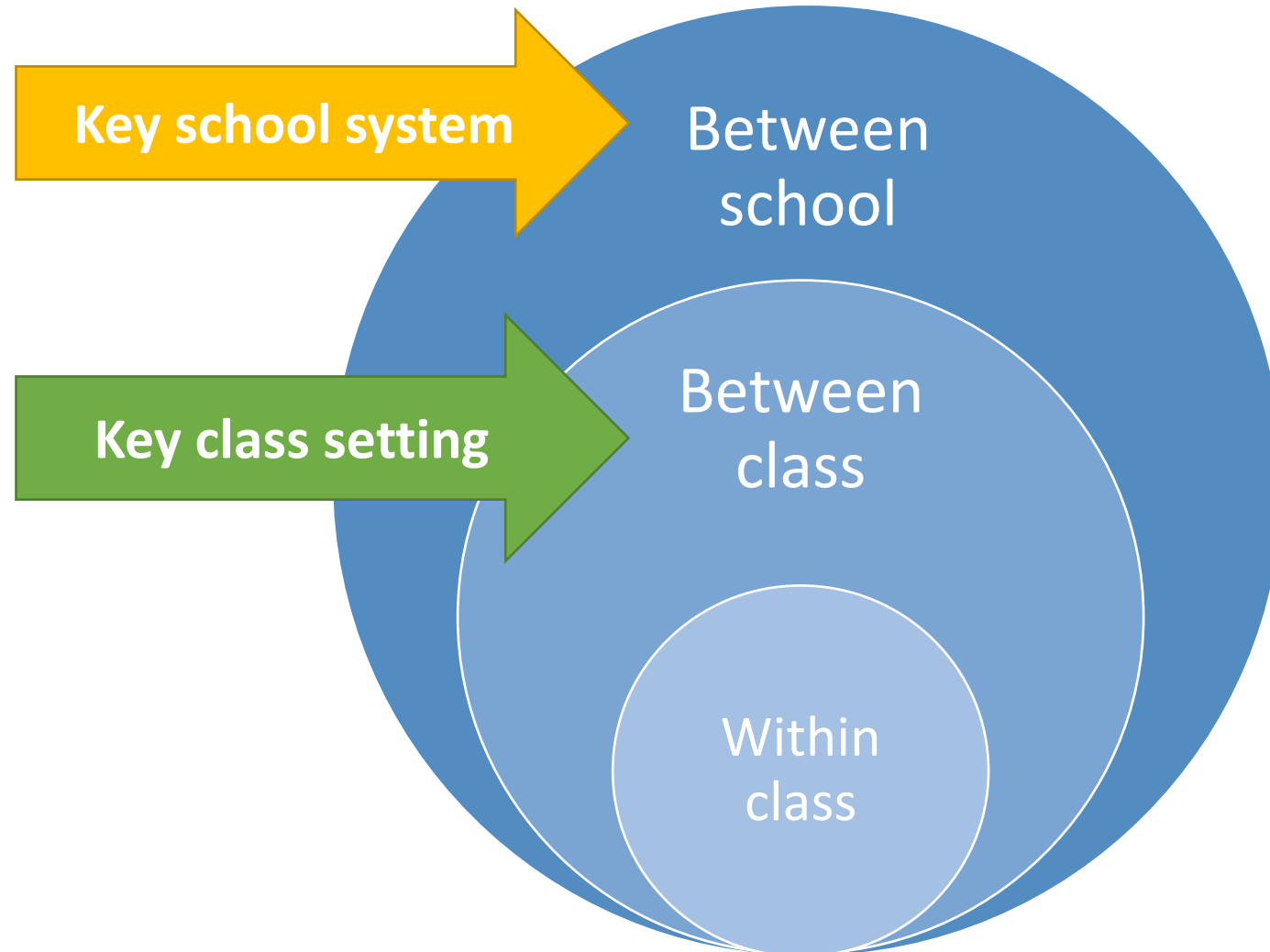


Figure 1. School System Reform across Chinese Municipalities

Ability Grouping

a common educational practice to reduce heterogeneity of instructional groups and to improve teaching quality.



Between school ability grouping

1st tier schools

High-performing schools

High ability group

2nd tier schools

Average-performing schools

Heterogeneous group

3rd tier schools

Low-performing schools

Low ability group

Frequency Distribution of HSEE Total Score by Three Tiers of Schools

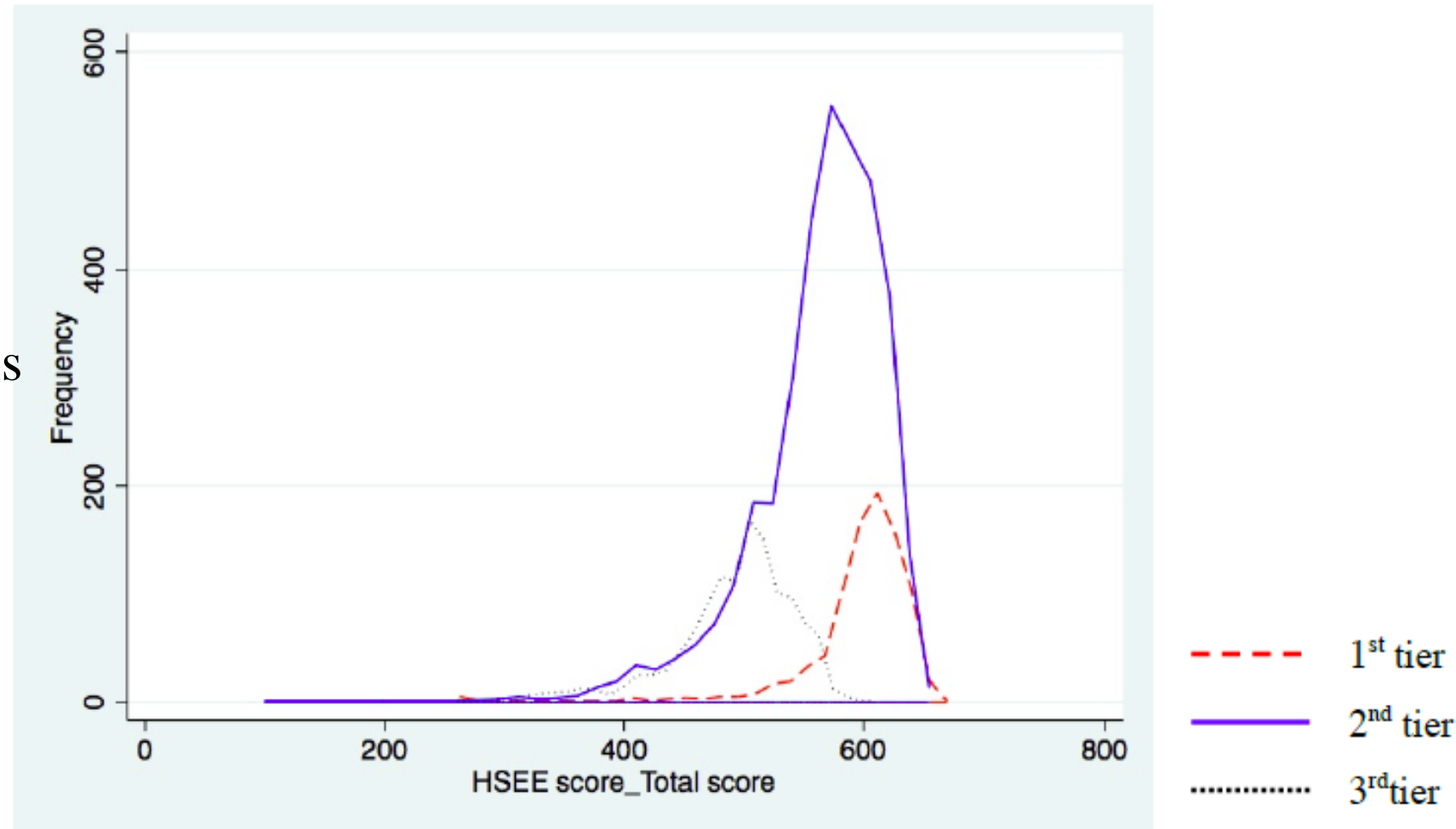


Figure 2. Frequency Distribution of HSEE Total Score by Ability Groups

Between class ability grouping

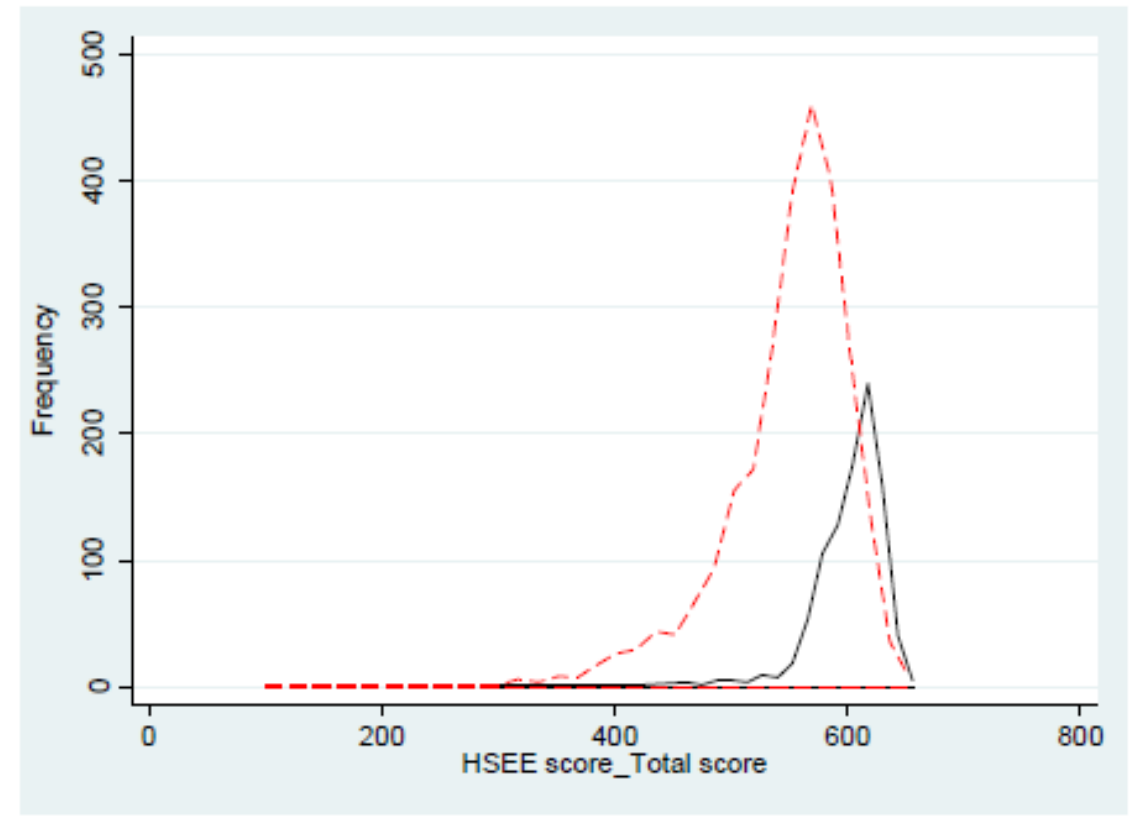
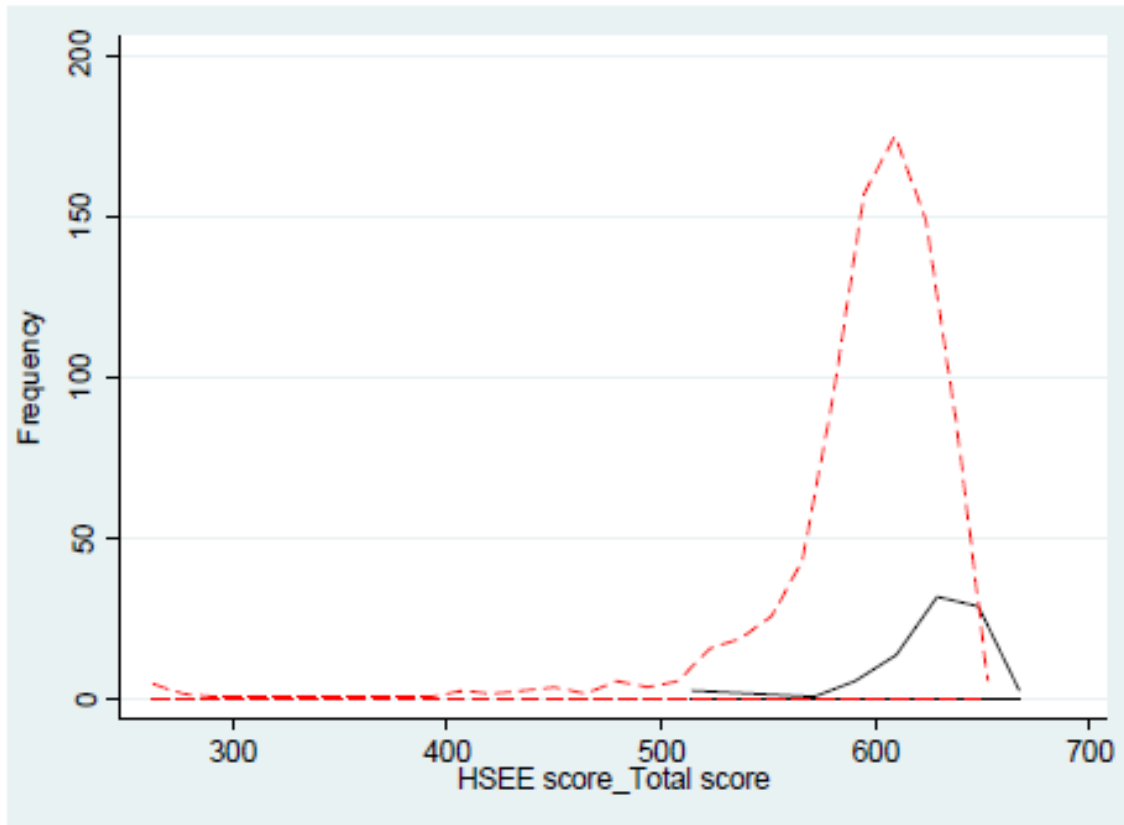
Key class (high ability grouping)

Non-key class (heterogeneous grouping)

Frequency Distribution of HSEE Total Score by Class Type

Among 1st tier schools

Among 2nd tier schools



— Key class - - - Non-key class

— Key class - - - Non-key class

Figure 2. Frequency Distribution of HSEE Total Score by Ability Groups

1

Between-school Ability Grouping

few English literatures nor any Chinese literature with empirical evidence

2

Between-class Ability Grouping

- Kulik & Kulik (1982): significantly positive but small
Slavin (1990): overall little effect for all subjects
Betts & Shkolik (2000): no significant effect
Burris, Huebert, & Levin (2006): high demanding curriculum instead of grouping
- Limitation
selection bias, grouping or curriculum, the U.S context and the Chinese setting

1

Compared with high ability grouping (1st tier schools), does heterogeneous group (2nd tier schools) undermine the academic achievement of the initial high achievers?

2

Compared with the heterogeneous group (2nd tier schools), does low ability grouping (3rd tier schools) increase the achievement gap?

3

Can between class grouping improve student achievement?

A provincial capital in eastern China

economic development, social structure and educational policy

Non-proportional stratified cluster sampling strategy

25 out of 34 public regular high schools

within each school, 3-5 G12 classes, all students

sample size : 5841 students

Key school and key class

the 1st tier schools (4), the 2nd tier schools(16), the 3rd tier schools (5)

At least one key class within each school

1st step of PSM : the Probit Model

HSEE total score, gender, rural status, socioeconomic status(SES), cultural capital

$$P(\text{treatment} = 1|X) = \alpha_0 + \alpha_1 \vec{X} + \varepsilon \quad (1)$$

2nd step of PSM : nearest neighbor method

OLS:

NCEE total score

$$y = \beta_0 + \beta_1 \vec{X} + \tau T + \mu \quad (2)$$

treatment assignment variable

Empirical Results

Table 1. Empirical Results on the Effects of Ability Grouping on NCEE Score

	Variable	Sample	Treated (1)	Controls (2)	Difference (3)	S.E. (4)
Panel 1: 1&2 tier schools <i>Treatment: 1st tier schools</i> <i>Control: 2nd tier schools</i>	Total score	Unmatched	0.578	0.195	0.383**	0.033
		PSM	0.578	0.602	-0.024	0.057
		OLS			-0.007	0.032
	Mathematics	Unmatched	0.447	0.195	0.252**	0.034
		PSM	0.447	0.514	-0.067	0.056
		OLS			-0.054	0.033
	Chinese	Unmatched	0.494	0.148	0.346**	0.035
		PSM	0.494	0.602	-0.108	0.060
		OLS			-0.069	0.037
	English	Unmatched	0.677	0.145	0.532**	0.034
		PSM	0.677	0.578	0.099	0.057
		OLS			0.094**	0.033
Panel 2: 2&3 tier schools <i>Treatment: 3rd tier schools</i> <i>Control: 2nd tier schools</i>	Total score	Unmatched	-0.967	0.195	-1.162**	0.030
		PSM	-0.967	-0.698	-0.269**	0.046
		OLS			-0.299**	0.041
	Mathematics	Unmatched	-0.861	0.195	-1.056**	0.031
		PSM	-0.861	-0.650	-0.211**	0.051
		OLS			-0.217**	0.043
	Chinese	Unmatched	-0.763	0.148	-0.911**	0.031
		PSM	-0.763	-0.571	-0.192**	0.051
		OLS			-0.189**	0.042
	English	Unmatched	-0.899	0.145	-1.044**	0.030
		PSM	-0.899	-0.680	-0.219**	0.049
		OLS			-0.216**	0.041

After controlling for selection bias, there is **no** significant effect of 1st tier schools on student achievement in NCEE.

There is a significantly **negative** effect of low-performing schools on student performance in NCEE, even after taking into account of selection bias.

Empirical Results

Key classes in the 1st tier schools do **not** have a significant effect on student NCEE performance after controlling for selection bias.

The key classes in average-performing schools **have** a significantly positive effect on academic achievement.

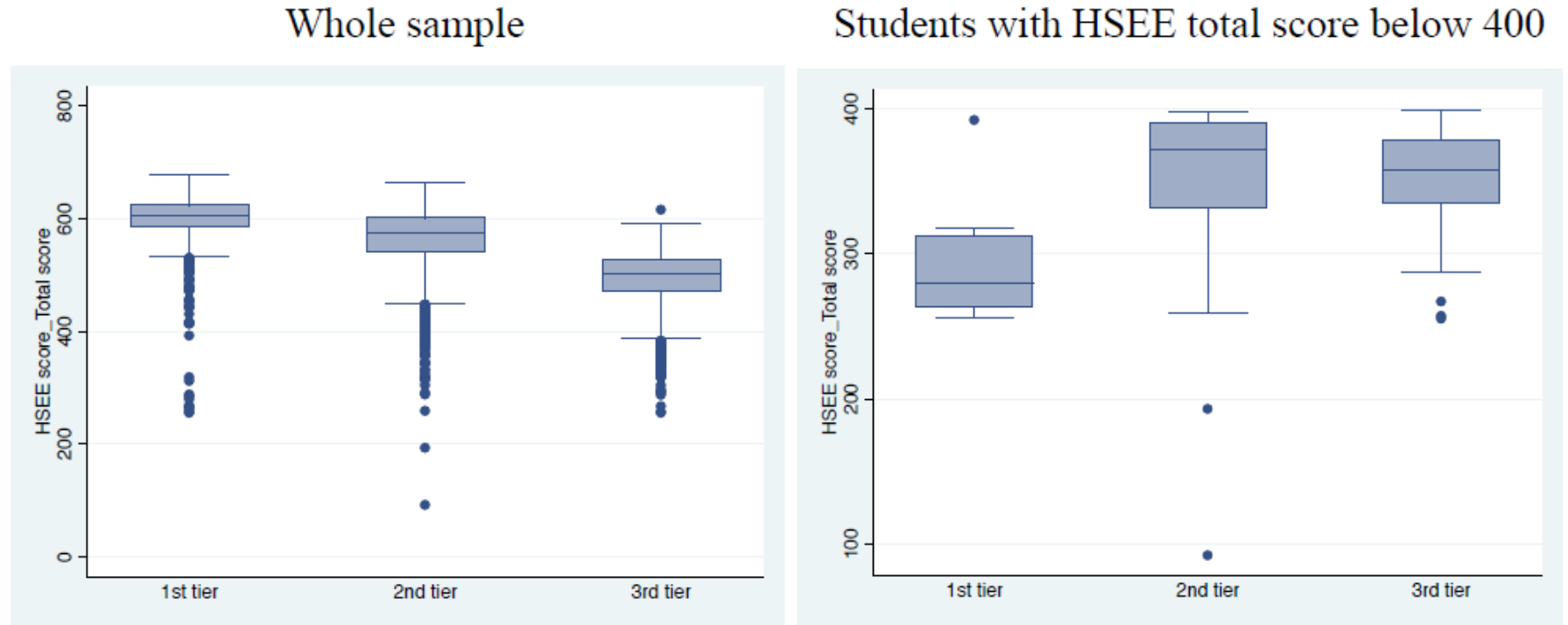
Table 1. Empirical Results on the Effects of Ability Grouping on NCEE Score

Variable	Sample	Treated (1)	Controls (2)	Difference (3)	S.E. (4)	
Panel 3: Key class V.S. non-key class within 1 st tier schools <i>Treatment: key class</i> <i>Control: non-key class</i>	Total score	Unmatched	0.967	0.534	0.433**	0.078
		PSM	0.967	0.955	0.013	0.103
		OLS			0.128*	0.064
	Mathematics	Unmatched	0.782	0.409	0.373**	0.084
		PSM	0.782	0.785	-0.003	0.110
		OLS			0.077	0.068
	Chinese	Unmatched	0.885	0.450	0.435**	0.089
		PSM	0.885	0.859	0.026	0.123
		OLS			0.185**	0.082
English	Unmatched	1.013	0.639	0.374**	0.080	
	PSM	1.013	1.032	-0.019	0.101	
	OLS			0.081	0.065	
Panel 4: Key class V.S. non-key class within 2 nd tier schools <i>Treatment: key class</i> <i>Control: non-key class</i>	Total score	Unmatched	0.991	-0.096	1.087**	0.030
		PSM	0.991	0.720	0.272**	0.042
		OLS			0.400**	0.032
	Mathematics	Unmatched	0.884	-0.057	0.942**	0.031
		PSM	0.884	0.665	0.219**	0.044
		OLS			0.272**	0.032
	Chinese	Unmatched	0.783	-0.085	0.868**	0.033
		PSM	0.783	0.636	0.148**	0.051
		OLS			0.269**	0.037
English	Unmatched	0.867	-0.119	0.986**	0.031	
	PSM	0.867	0.633	0.233**	0.044	
	OLS			0.364**	0.032	

Empirical Results

Additional Analysis on the Initial Low Achievers

Figure 3.
Box Graph of
HSEE Total Score
by School Tiers



		N	Original score				Standardized score			
			Mean	S.D.	Min	Max	Mean	S.D.	Min	Max
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1 st tier	HSEE	11	289.4	39.8	255.5	392	-4.15	0.63	-4.68	-2.53
	NCEE	11	465.8	118.8	300	651	-0.05	1.12	-1.61	1.69
2 nd tier	HSEE	52	352.0	54.7	92	398	-3.16	0.86	-7.25	-2.44
	NCEE	52	314.7	89.7	144	648	-1.47	0.84	-3.08	1.66
3 rd tier	HSEE	80	353.2	33.7	255	399	-3.14	0.53	-4.69	-2.42
	NCEE	80	270.3	49.1	181	413	-1.89	0.46	-2.73	-0.55

Table 2.
HSEE Total Score
of **Low Achieving**
Students by
School Tiers

Empirical Results

Additional Analysis on the Initial Low Achievers

after controlling for selection bias, the initial low achievers' NCEE scores in the 1st tier schools significantly **outweigh** the scores in the 2nd tier schools by about **2 standard deviations** across subjects

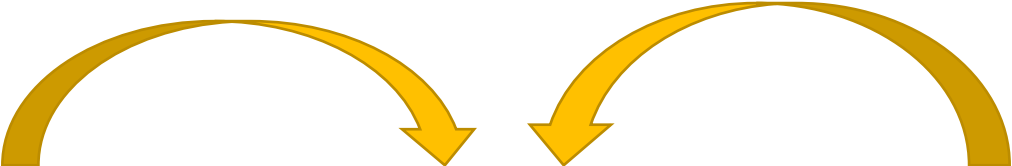
the advantage of the initial low achievers from the 1st tier schools is also around 2 standard deviations

Table 3. School effects for students with **HSEE score below 400**

Variable	Sample	Treated (1)	Controls (2)	Difference (3)	S.E. (4)
1st tier – 2nd tier					
Total score	Unmatched	-0.053	-1.616	1.563**	0.268
	PSM	-0.053	-2.179	2.126**	0.648
Mathematics	Unmatched	-0.170	-1.740	1.570**	0.274
	PSM	-0.170	-2.172	2.002**	0.680
Chinese	Unmatched	-0.146	-1.571	1.425**	0.324
	PSM	-0.146	-1.955	1.809**	0.727
English	Unmatched	0.104	-1.538	1.642**	0.297
	PSM	0.104	-2.241	2.345**	0.513
1st tier – 3rd tier					
Total score	Unmatched	-0.053	-1.985	1.933**	0.180
	PSM	-0.053	-2.217	2.164**	0.384
Mathematics	Unmatched	-0.170	-2.104	1.934**	0.201
	PSM	-0.170	-2.241	2.071**	0.387
Chinese	Unmatched	-0.146	-1.856	1.710**	0.268
	PSM	-0.146	-2.424	2.278**	0.701
English	Unmatched	0.104	-1.851	1.955**	0.193
	PSM	0.104	-1.347	1.451**	0.611

Notes: ** significant at 0.01 level, * significant at 0.05 level.

Table 4. Differences of **Student Background** across Three Tiers of Schools



Variable	N	1 st tier school		N	2 nd tier school		N	3 rd tier school	
		Mean	S.D.		Mean	S.D.		Mean	S.D.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
NCEE Score									
Total	924	0.575	0.700	3642	0.191	0.914	1275	-0.963	0.756
Mathematics	924	0.440	0.754	3642	0.187	0.917	1275	-0.854	0.895
Chinese	924	0.480	0.804	3642	0.146	0.937	1275	-0.765	0.889
English	924	0.676	0.709	3642	0.144	0.917	1275	-0.901	0.785
HSEE Score									
Total	899	0.675	0.798	3588	0.169	0.860	1267	-0.957	0.822
Mathematics	899	0.488	0.704	3593	0.185	0.860	1271	-0.868	1.037
Chinese	899	0.741	0.786	3593	0.049	0.932	1271	-0.663	0.899
English	899	0.561	0.512	3593	0.153	0.858	1271	-0.829	1.137
Female	919	0.541	0.499	3636	0.508	0.500	1272	0.594	0.491
Rural	920	0.042	0.202	3627	0.592	0.492	1269	0.512	0.500
SES	893	1.968	1.489	3562	-0.296	1.496	1236	-0.598	1.259
Cultural Capital	872	1.185	1.072	3459	-0.202	1.314	1184	-0.262	1.220

Notes: All the mean differences between two tier schools re significant at 0.01 level, except that the difference of gender proportion between the first two tiers are not significant.

Table 5. **School Input** Comparison across Three Tiers of Schools

	1 st tier school			2 nd tier school			3 rd tier school		
	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Total student number	4	4289	1541	16	3691	993	5	2006**	453
Per student computer	4	0.136	0.034	16	0.167	0.062	5	0.167	0.064
Per student physics lab	4	0.049	0.035	16	0.071	0.045	5	0.060	0.023
Per student chemistry lab	4	0.050	0.034	16	0.063	0.035	5	0.064	0.017
Per student biology lab	4	0.046	0.033	16	0.046	0.026	5	0.045	0.028
Per student book in library	4	10.051**	5.568	16	24.360	9.982	5	22.941	14.022
Per student sport field	4	5.546	3.070	14	6.780	3.112	5	2.773*	1.891
Per student teaching building area	4	4.765	3.193	14	5.080	2.773	5	3.014	0.771
Per student revenue	3	7666	4744	15	6867	3056	4	6484	3734
Per student government appropriation	3	3849	2545	14	4628	2451	4	4622	3645
Student teacher ratio	4	0.077	0.017	16	0.090	0.017	5	0.092	0.011
Per student provincial level special class teacher	4	0.001**	0.000	13	0.000	0.000	3	0.000	0.000
Per student advanced high school teacher	4	0.022	0.004	16	0.015	0.006	5	0.023*	0.008
Per student teacher with Associated Bachelor degree	4	0.002	0.003	15	0.002	0.002	5	0.021*	0.034
Per student teacher with Bachelor degree	4	0.061	0.019	16	0.077	0.016	5	0.074	0.014
Per student teacher with Master degree	4	0.006*	0.003	14	0.002	0.002	4	0.005	0.004
Percent of teacher transferred out	4	0.005	0.001	14	0.016	0.020	4	0.022	0.019
Principal's highest education degree	4	5.750	0.500	16	5.310	0.479	5	5.200	0.447
How many years have you taught?	4	26.750	6.185	16	25.310	5.828	5	27.200	4.919
How many years have you been a vice principal?	4	2.750	1.708	14	3.860	1.460	4	6.500	4.435
How many years have you been a principal in this school?	4	10.000**	5.477	16	4.156	3.021	5	3.400	2.881
How many years have you been a principal?	4	10.250	5.679	16	8.750	3.357	5	4.800*	3.114

** The mean difference between this value and the corresponding one of 2nd tier schools is significant at 0.01 level. * The mean difference is significant at 0.05 level.

Discussion

Table 6. Comparison of **Teacher Assessment** by Students by **School Categories**

Item	Subject	1st tier school			2nd tier school			3rd tier school		
		N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
My teacher has strong academic background and the instruction is very clear.	Mathematics	908	4.42	0.75	3617	4.46	0.77	1256	4.33**	0.84
	Chinese	911	4.29	0.90	3612	4.33	0.83	1259	4.21**	0.83
	English	903	4.19**	0.96	3603	4.29	0.88	1255	4.06**	0.97
My teacher knows how to stimulate my enthusiasm on study.	Mathematics	901	4.16	0.95	3593	4.18	0.94	1246	4.01**	1.02
	Chinese	897	4.03**	1.05	3594	4.15	0.99	1250	4.02**	1.00
	English	898	3.98*	1.08	3588	4.06	1.02	1243	3.80**	1.08
My teacher has very charming personality.	Mathematics	896	4.21	0.98	3591	4.18	1.00	1246	3.97**	1.04
	Chinese	898	4.10	1.08	3590	4.16	1.03	1244	3.94**	1.09
	English	897	3.99**	1.10	3585	4.10	1.03	1248	3.78**	1.09

** The mean difference between this value and the corresponding one of 2nd tier schools is significant at 0.01 level. * The mean difference is significant at 0.05 level.

Across the three tiers of schools, there is **not so much difference in physical inputs and teacher credentials**, but the 3rd tier schools have lower “soft” inputs.

Discussion

Table 7. Comparison of **Teacher Assessment** by Students by **Class Types**

			Key Class			Non-key Class			Difference	
			N	Mean	S.D.	N	Mean	S.D.	Mean Diff.	Std. Err.
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Panel 1: 1st tier school</i>										
My teacher has strong academic background and the instruction is very clear.	Mathematics		96	4.63	0.62	815	4.25	0.92	0.37**	0.097
	Chinese		95	4.28	0.88	813	4.44	0.73	-0.15	0.081
	English		94	4.40	0.79	809	4.17	0.97	0.23*	0.104
My teacher knows how to stimulate my enthusiasm on study.	Mathematics		95	4.34	0.75	802	4.00	1.07	0.34**	0.113
	Chinese		96	3.98	1.05	805	4.19	0.94	-0.21*	0.103
	English		95	4.15	0.98	803	3.96	1.09	0.19	0.117
My teacher has very charming personality.	Mathematics		94	4.52	0.71	804	4.05	1.10	0.48**	0.116
	Chinese		95	4.29	0.98	801	4.20	0.98	0.10	0.106
	English		96	4.32	0.89	801	3.95	1.11	0.38**	0.118
<i>Panel 2: 2nd tier school</i>										
My teacher has strong academic background and the instruction is very clear.	Mathematics		973	4.41	0.81	2639	4.30	0.84	0.11**	0.031
	Chinese		973	4.62	0.66	2644	4.40	0.80	0.22**	0.029
	English		969	4.52	0.74	2634	4.21	0.92	0.31**	0.033
My teacher knows how to stimulate my enthusiasm on study.	Mathematics		967	4.17	0.99	2627	4.14	0.99	0.03	0.037
	Chinese		971	4.34	0.88	2622	4.12	0.96	0.22**	0.035
	English		965	4.27	0.93	2623	3.98	1.05	0.30**	0.038
My teacher has very charming personality.	Mathematics		968	4.29	0.95	2622	4.12	1.05	0.17**	0.039
	Chinese		970	4.43	0.86	2621	4.08	1.04	0.34**	0.037
	English		967	4.34	0.89	2618	4.01	1.06	0.33**	0.038

** The mean difference is significant at 0.01 level. * The mean difference is significant at 0.05 level.

key classes of the 1st tier schools have better teachers in math and English

key classes of the 2nd tier schools have better teachers in all the three subjects

Discussion

School level

The results are positive to the heterogeneous grouping. Low-performing schools have a significantly negative effect on the initial low achievers. In the meanwhile, the initial high achievers are not influenced by their low-performing peers.

The reasons for the negative effect of the 3rd tier schools should be explored.

Class level

This may provide the evidence to the claim that it is the curriculum instead of grouping that works.

Thank You !

Q&A

