Does It Pay to Attend More Selective High

Schools? Evidence from China

Bin Huang (NJU), Bo Li (NUFE)

Ian Walker (Lancaster) and Yu Zhu (Dundee)

European Economic Association 2022 Conference

Milan, 24th August 2022

Preview

- Motivated by the Regression Discontinuity Design (RDD) literature on academically selective high school 0453 attendance
- Leverage administrative data that matches stated HS preferences of the population of urban middle school graduates in one Chinese prefecture in 2010 with register-based HS student records.
- Combine a conventional normalizing and pooling Juzzy KDD strategy with a cumulative multi-cutoff 800 setup to address the complexity of the under-funded Chinese public education system which provides for an alternative admissions channel for low-ability fee-paying students alongside the meritbased standard channel and contextual admissions for disadvantage students
- Both estimation strategies based on publicly announced city-wide High School Entrance Exam (HSEE) scores show that attending elite or normal schools has a zero effect on Nigh School General Exam 845GE3 scores, relative to attending the less selective normal or private schools respectively.
- in contrast, attending the most selective flagship school has a large significant negative effect, drives by the much lower relative performance in science-track subjects by students who barely made it into the flagship school.

Literature Review

- RDD based on public admission cut-offs in entrance exams offers the most convincing approach to identify causal effect of attending elite public schools.
- marginal students who scored just above or below the admission cut-off could be regarded as if randomly assigned
- US evidence suggests no causal effect for marginal students of exposure to high-achieving and more homogeneous peers at elite schools on standardised test scores, college enrolment, graduation, and college quality (Abdulkadiroglu, Angrist and Pathak (2014); Dobbie & Fryer (2014))
- UK evidence based on Grammar School attendance finds only small and statistically insignificant results on the Grade 9 standardised test scores (Clark (2000))
- In contrast, RDD evidence from developing countries indicates a large and often statistically significant effect of attending elite schools, see Jackson (2010) for Trinidad and Tobago, Pop-Eleches & Urguiloa (2013) for Romania, and Dustan et al (2017) for Mexico

Institutional Background

- A unique dual-channel admissions system for under-funded public schools since 1980s. allowing "school choice with Chinese characteristics" (Wu 2012, Loyalka et al 2014).
- The standard channel admits students in order of HSEE scores and stated school preferences until the school-specific student quotas set by the local education authorities are filled. These students only pay basic tuition fees (CNX830, or \$49, per annum)
 - A growing share of the standard channel places is given to the Assignment mode students from disadvantaged schools in recent years ("Contextual Admissions")
- The (regulated) alternative channel admits students who score below the admissions cutoff for the standard channel (but above a lower cut-off for the alternative channel) conditional on paying extra tuition fees (of CNWB000-10000, or \$1182-1477 p.a.) retained by elite schools as supplementary revenues to inadequate government funding (Lovalka et al 2014).
- Moreover, the unregulated alternative channel admits students with HSEE scores well below the official "selection-fee" cut-offs, and are charged privately much higher fees (Dee and Lan, 2015)

Data

- A novel administrative dataset for the population of HS students enrolled in 2010, in one prefecture [identity withheid] in north central China
- Prefecture has a population of 2m+, and is middle ranked in development
- This study focuses on the urban sample for which we have the HS applications records (hurs) students sat a different service of HSEE and faced a different set of eligible HSI
- In 2009, 36.5k students registered for the HSEE in the whole prefecture, of which 42N were urban students. About 5N were repeating middle school graduates.
- Total enrolment quota for academic HS was 16k, of which 13k reserved for public schools. Total enrolment quota for the less prestigious vocational HS is Bk
- Still just over one-third of HSEE takers could not proceed to post-compulsory education stage Excluded 3% of urban elite school students who attended schools outside the designated urban areas and 0.4% of students who are ethnic minorities (eligible for bonus points)
- Able to account for stated school preferences using the matched HS applications information based on full date of birth, sex and full name for 97% of H5 students (Dale and Krueger 2002, 2014)

Sample

- Sample (N=5,238): urban students who took the city-wide HSEE in 2000 and Have an adjusted total HSIE score of at least 400 points (minimum for public HSI
 - Eligible to apply to the same set of 18 urban academic H1 (7 public and 11 private) With full information on HSEE & HSGE scores, stated HS preferences and artual admission mode
 - With information on parental background, date of birth, hukov status, middle school attended etc. Basic admin into on school and teacher characteristics and class sizes in 2012
- HS admission procedures:
- Student took the city wide WAT first
- After the exam (but before results known), students complete the HS application form
- Students can list up to 18 choices in the centralized & computerized admissions system
- City Education Bureau publicly announces the admission cut-offs for various admission modes, in Tiers Admission proceeds strictly by the order of school admission tiers: Flagship (Tier J) +Elite & Normal Public (Tier 2) >Private (Tier 2), then order of school preferences, then made (undied envolments-pasignments-selection-feel, then Hidd acores

Outcome variable: scores of HSGE taken at the end of the penultimate year of HS Omportant though not as high-stake as the Notional College Entrance Exam).

HS School Choice under Dual Admissions

Standard Channel (unified enrolment), by HSEE scores



Alternative Channel (selection fee), by HSEE scores

Empirical Results

Cumulative) Multiple Cutoffs RDD Analysis



Concluding Remarks

Using a unified cumulative multiple cutoffs RDD setting, we show how the treatment effects of attending elite schools vary by school selectivity in China, a country with a dual-channel admissions system

- In contrast to the positive causal effect of elite school attendance found in many developing countries, attending academically selective public high schools in China results in zero effect, at best, on high school exit exam scores for marginal students who barely passed the admission cutoffs, regardless of the application type.
- The insignificant effects (for normal and elite schools) found are consistent with the existing Chinese RDD evidence (Dee and Lan, 2015; Zhang, 2016).

The significant and negative effect of attending a flagship school is a novel finding but contradicts the positive and significant effect of attending flagship (Tier 1) elite high school in China suggested by Hoesktra et al (2018 JoLE).

Differences in sample (less competition for suburban students) & outcomes (higher-stakes NCEE)

Limitations and planned future work

Limitations:

- · Results based on LATE estimators only apply to marginal students who have barely made or missed for admissions cutoffs.
- . No information on NCEE, actual academic track chosen (in final grade) or within-HS tracking.

Future Work:

- . To examine the inherent efficiency-equity trade-off in the unique dual-channel admissions system in China;
- · Rich and not-so-smart kids (about one-third) cross-subsidizing the smart not-so-rich kids in public high schools (offers clue to China's remarkable PISA performance?)
- To explore peer-effects (exploiting middle-school peers)

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- Leverage administrative data that matches stated HS preferences of the population of urban middle school graduates in one Chinese prefecture in 2010 with register-based HS student records.
- Combine a conventional *normalizing-and-pooling fuzzy RDD* strategy with a *cumulative multi-cutoff RDD* setup to address the complexity of the under-funded Chinese public education system which provides for an alternative admissions channel for low-ability fee-paying students alongside the merit-based standard channel and contextual admissions for disadvantage students
- Both estimation strategies based on publicly announced city-wide *High School Entrance Exam (HSEE)* scores show that attending elite or normal schools has a zero effect on *High School General Exam (HSGE)* scores, relative to attending the less selective normal or private schools respectively.
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 - The **standard channel** admits students in order of HSEE scores and stated school preferences until the school-specific student quotas set by the local education authorities are filled. These students only pay basic tuition fees (CN¥330, or \$49, per annum)
 - A growing share of the standard channel places is given to the Assignment mode students from disadvantaged schools in recent years ("Contextual Admissions")
 - The (regulated) **alternative channel** admits students who score below the admissions cutoff for the standard channel (but above a lower cut-off for the alternative channel) conditional on paying extra tuition fees (of CN¥8000-10000, or \$1182-1477 p.a.) retained by elite schools as supplementary revenues to inadequate government funding (Loyalka et al 2014).
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- In 2009, 36.5k students registered for the HSEE in the whole prefecture, of which 42% were urban students. About 5% were repeating middle school graduates.
 - Total enrolment quota for academic HS was 16k, of which 12k reserved for public schools.
 - Total enrolment quota for the less prestigious vocational HS is 8k
 - Still just over one-third of HSEE takers could not proceed to post-compulsory education stage
- Excluded 3% of urban elite school students who attended schools outside the designated urban areas and 0.4% of students who are ethnic minorities (eligible for bonus points)
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- Sample (N=5,239): urban students who took the city-wide HSEE in 2010 and
 - Have an adjusted total HSEE score of at least 400 points (minimum for public HS)
 - Eligible to apply to the same set of 18 urban academic HS (7 public and 11 private)
 - With full information on HSEE & HSGE scores, stated HS preferences and actual admission mode
 - With information on parental background, date of birth, *hukou* status, middle school attended etc.
 - Basic admin info on school and teacher characteristics and class sizes in 2012

• HS admission procedures:

- Student took the city-wide HSEE first
- After the exam (but before results known), students complete the HS application form
- Students can list up to 13 choices in the centralized & computerized admissions system
- City Education Bureau publicly announces the admission cut-offs for various admission modes, in Tiers
- Admission proceeds strictly by the order of school admission tiers: Flagship (Tier 1) >Elite & Normal Public (Tier 2) >Private (Tier 3), then order of school preferences, then mode (unified enrolment>assignment>selection-fee), then HSEE scores
- **Outcome variable:** scores of HSGE taken at the end of the penultimate year of HS (important though not as high-stake as the *National College Entrance Exam*).

High schools in the 2010 Urban Sample

	School type	Catchment	Admission tier	High- school student numbers in 2012	High- school Average class size in 2012	Senior- rank teachers (%)	Unified enrolment cut-off	Selection- fee cut-off (tentative)	Sample share (%)	
Flags	hip Public High Scho	ools:					\frown			
F	Provincial key & provincial exemplary	Prefecture- wide	1	4,488	62.3	32.1	623	606	21.9	
Elite 1	Public High Schools:									
E1	Provincial key & provincial exemplary	Prefecture- wide	2	3,717	60.0	27.8	590	544	18.5	
E2	Provincial key & provincial exemplary	Urban & County Z	2	2,859	63.5	9.3	587	532	12.0	
Norm	al Public High Schoo	ols:								
N1	Provincial exemplary, non-boarding only	Urban & County Z	2	1,330	66.5	28.2	567	526	4.8	
N2	Normal	Urban & County Z	2	1,561	55.4	11.9	567	518	7.8	
N3	Normal	Urban & County Z	2	1,969	54.7	24.0	550	496	9.5	
N4	Normal, non-boarding only	Urban & County Z	2	1,937	64.6	19.0	532	482	8.0	
Priva	Private High Schools:									
P1- P11	Non-elite	Prefecture- wide	3	-	-		-	-	17.5	

18 academic high schools in descending order of selectivity:

- 1 flagship (F)
- 2 elite (E1+E2)
- 4 normal public (N1-N4)
- 11 private (P1-P11)

Max. HSEE point scores is 690, summed over 7 subjects.

0.8% of students get up to 10 bonus points for provincial-level achievements.

Numbers highlighted are the critical cut-offs for flagship, elite and normal schools respectively. 8

Distribution of admission mode by high school type

	Public Schools by Type		All Public	All	All	
	Flagship School	Elite Schools	Normal Public Schools	Schools	Private Schools	Schools
	(1)	(2)	(3)	(4)	(5)	(6)
Standard Channel:		\bigcirc				
Unified-enrolment	57.6	68.7	83.6	71.2	93.3	75.3
Assignment (CA)	11.2	5.7	-	5.1	-	4.2
Alternative Channel:						
Selection-Fee (regulated)	19.0	13.8	10.7	14.1	4.7	12.5
Other (unregulated)	12.2	11.8	5.7	9.7	2.1	8.3
Total	100.0	100.0	100.0	100.0	100.0	100.0
Observations	1,148	1,597	1,576	4,321	918	5,239

- Standard channel students account for about 69% and 74% of admissions at flagship and elite schools respectively
- Alternative channel admissions (both regulated and unregulated) prevalent across all public HS, even in the non-elite schools.

Raw HSEE scores by school



- Clear hierarchy of HS across school types (flagship > elite > normal public > private)
- Two important cut-offs for identification:
 - Solid red vertical line shows the flagship admission cut-offs for unified-enrolment (623)
 - dashed red line for selection-fee mode (606) for flagship school.
 - Solid black vertical line show the elite school admission cut-offs for unified-enrolment (587).

HSEE scores dist. by admission mode, flagship and elite



HS School Choice under Dual Admissions

Standard Channel (unified enrolment), by HSEE scores



Alternative Channel (selection fee), by HSEE scores

Identification Strategies (basic setup)

For student *i*, we standardise the adjusted HSEE score S_i around the *k*-th (k=1,2,3 for **flagship**, elite and **normal schools** respectively) most selective school type, using the *unified-enrolment* admissions threshold S_k :

$$S_{ik} = \frac{HSEE_i - S_k}{Standard Deviation of HSEE_i} \quad k = 1, 2, 3$$
(1)

The outcome variable as measured by the standardised HSGE score for student *i* around elite school type *k* admission cut-offs can be modelled as

$$HSGE_{ik} = \beta_k T_{ik} + \gamma_k Z_{ik} + e_{ik} \qquad \text{where } T_i = I(S_{ik} \ge S_k) \qquad (2)$$

where T_{ik} denotes the **treatment status** which takes the value of 1 for attending elite school type k and 0 otherwise, the vector Z_{ik} denotes exogenous (or "pre-intervention") covariates, and e_{ik} is the error term. The standardised HSEE score S_{ik} re-centred around the relevant admission cut-offs S_k is the **running variable** which determines the treatment status in a fuzzy manner.

Empirical Results

Cumulative) Multiple Cutoffs RDD Analysis



(Cumulative) Multiple Cutoffs RDD Analysis (Cont'd)

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	Normal vs	Elite vs	Flagship vs		т	
	Privat	Normal	Elite	Т		
Running variable (HSEE):					•	
Cutoff	532	587	623	×		
Range	400-560	561-605	606-659	effec	Ţ	Т
Attend more selective schools (1st stage)	0.182	0.169	0.415			
P (Robust biased-corrected)	0.131	0.180	0.000^{***}	Treat		•
Bandwidth est (left / right of cut-off)	31.19/14.72	11.28/6.28	7.47/11.60	4		
Effective # of Observations	823	722	539			
Standardised HSGE score (2nd stage)	-0.078	0.025	-0.324	۔ س		
P (Robust biased-corrected)	0.525	0.374	0.004^{***}	Normal/Private	Elite/Normal	Flagship/Elit
Bandwidth est (left / right of cut-off)	47.55 / 17.65	17.74 / 12.77	6.91 / 11.18		Cutoff	
Effective # of Observations	1,098	1,207	505		● Estimate	

Flagship-Elite School Cutoff: Heterogeneity by HS Application types



At the HS application stage:

- Unified enrolment option is strategy proof
- CA option determined by middle school attended and teacher assessed exams
- Willingness to pay determined by credit constraint and stated preferences for education of the family

Different application types face different cutoffs:

- Not eligible for CA & not willing to pay:
 623
- Not eligible for CA but willing to pay: 606
- Eligible for CA (very fuzzy): 593 (but subject to total and middle-school-specific quotas)

RDD plots at the normalized-and-pooled flagship-elite school cutoff



Robustness checks

Overlooking heterogeneity in stated school preferences across application types results in model misspecification (failing the RD manipulation test (McCrary 2008)), and in the under-estimation of the causal effect of flagship attendance on HSGE scores by around 20%.

Preferred (normalising-and-pooling) specification: with *Local Linear RD point estimator* using the *Epanechnikov kernel function* with *two-way MSE-optimal bandwidth* selectors, controlling for age, gender and district/county.

However, results are highly robust with respect to:

- Omitting the covariates
- Imposing symmetric band widths (interval lengths) around the admission cut-offs: 0.35 or 0.25 SDs
- Alternative kernel functions: *triangular* or *uniform* instead of *Epanechnikov*
- Alternative bandwidth selection specifications: *Coverage Error-rate(CER) optimal bandwidth* selector instead of *Mean Squared Error (MSE) optimal, common bandwidth* for both sides of the cut-off instead of two-way selectors

Heterogeneous treatment effects by application types, separately and pooled, Flagship School Cut-off

	Subsample analysis by application types				Full sample analysis		
Models	Not eligible for CA & not willing to	Eligible for CA & not willing to pay	Not eligible for CA & willing to pay	Eligible for CA & willing to pay	No normalizing	Normalizing & pooling	
	pay						
Cutoff	623	593	606	593	623	623/593/606	
HSEE (running variable)	601.2	601.5	601.0	610.6	603.2	603.2	
mean [range]	[567, 655]	[567, 655]	[567, 659]	[567, 656]	[567, 659]	[567, 659]	
Elite school attendance	.981	.067	.175	-0.013	.400	.342	
S.E	.029	.039	.154	.1/6	.062	.050	
P (Robust)	0.000	0.008	0.441	0.784	0.000	0.000	
P-value (RD manipulation) test	0.614	0.808	0.046**	0.133	0.027**	0.931	
	401	1.052	2 (22	((40	(22	755	
Std. HSGE score (SD)	421	-1.052	-3.623	6649	033	/55	
S.E	.151	1.926	3.934	93.108	.195	.253	
P (Robust)	0.012**	0.870	0.281	0.678	0.006***	0.004***	
Obs	859	768	331	513	2,471	2,471	
Sample share (%)	34.8	31.1	13.4	20.8	100.0	100.0	

Note: Conditional on HSEE scores no less than 567 (cutoff for unified-enrolment for the most selective normal school). ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels respectively.

Heterogeneous treatment effects

By gender:

- Smaller negative (but still significant) effect of flagship school attendance on HSGE for girls
- Larger but statistically insignificant negative effect of flagship attendance for boys

By area type:

• Rural students appear to have larger adverse effect of flagship school attendance on HSGE scores than their urban counterparts

Heterogenous effects by academic track and interval lengths, Flagship School Cut-off

HSEE range/Interval lengths	Full ra (HSEE 56	inge 67-659)	Within 0.25 SD of cutoff		
Academic Track-specific standardised HSGE scores	Social Studies	Science	Social Studies	Science	
Flagship school attendance	.338	.341	.353	.348	
S.E	.058	.057	.068	.066	
P (Robust)	0.000***	0.000***	0.000***	0.000***	
Std. HSGE score (SD)	-0.310	-0.861	-0.673	-0.913	
S.E	0.291	0.303	0.355	0.354	
P (Robust)	0.260	0.008***	0.036**	0.018**	
Obs	2,471		1,62	3	

Explaining the adverse effect of Flagship school attendance

- The large negative effect of attending flagship school on HSGE scores is largely driven by the science track subjects (statistical significance for the Social Studies subjects depends on bandwidths)
- One possible additional channel is the almost universal within-school tracking in Chinese high schools
 - Canaan et al (2022) show that elite school resources are concentrated on preparing students in the high-achieving classrooms (determined by placement exams upon HS entry) for the NCEE in flagship schools.
 - Marginal students are unlikely to benefit from the high-achieving classrooms, but more likely to opt for the easier Social Studies track to avoid stigma (Dee & Lan 2015)

Concluding Remarks

- Using a unified cumulative multiple cutoffs RDD setting, we show how the treatment effects of attending elite schools vary by school selectivity in China, a country with a dual-channel admissions system
- In contrast to the positive causal effect of elite school attendance found in many developing countries, attending academically selective public high schools in China results in zero effect, at best, on high school exit exam scores for marginal students who barely passed the admission cutoffs, regardless of the application type.
 - The insignificant effects (for normal and elite schools) found are consistent with the existing Chinese RDD evidence (Dee and Lan, 2015; Zhang, 2016).
- The significant and negative effect of attending a flagship school is a novel finding but contradicts the positive and significant effect of attending flagship (Tier 1) elite high school in China suggested by Hoesktra et al (2018 JoLE).
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Limitations and planned future work

Limitations:

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Future Work:

- To examine the inherent efficiency-equity trade-off in the unique dual-channel admissions system in China:
 - Rich and not-so-smart kids (about one-third) cross-subsidizing the smart not-so-rich kids in public high schools (offers clue to China's remarkable PISA performance?)
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Extra slides

RDD Studies using Chinese data:

In a similar setting, Dee and Lan (2015, EcEdRev) examine the effect of elite high school attendance for "*selection-fee*" students only, in a city in north central China between 2006-2008.

- They find no positive effect of elite school attendance on scores in the annual city exam, study track choice or scores in the high-stakes **NCEE**, relative to their counterparts attending regular (normal) high schools.
- However, one important limitation is their inability to account for sorting into the selection-fee option, which involved paying about \$3,000 lump-sum fee on top of the \$125 annual regular tuition fee.



RDD Studies using Chinese data (Cont'd)

Using the population of **suburban districts students** starting HS in 2007 in one provincial capital, Hoekstra et al (2018, JoLE) show that

- The only significant positive causal effect occurs from attending flagship (Tier 1) elite high schools, driven by the higher concentration of **superior quality teachers** (rather than peer quality or class size).
- Attending the **flagship** rather than elite schools increase the high-stakes NCEE scores by 0.07 SD.
- Another difference is that they restrict the sample to suburban districts students who must attend a school in the home district of *hukou* registration, resulting in more significant sorting by peer ability.

Using admin data on 3 cohorts from the **flagship school** in Qinyang prefecture, Gansu province, Canaan et al (2022, IZA DP) study the impact of **within-school tracking**:

- Within-school tracking is almost universal in HS according to own online survey of university students.
- RDD estimates based on the **standardised classroom placement** exams following **flagship** enrolment improves math test scores by 0.23 SD, but not on Chinese or English.
- While **high-achieving classroom placement** has no overall significant impact on college enrolment, it does significantly increase the **NCEE** scores, which increases enrolment probability in elite universities.
- Students in **high-achieving classrooms** enjoy higher-ability peers, smaller class sizes, and better-quality teachers, as well instructions that delve deeper into topics and at a faster pace.

Sample means by school status

	Flagship or Elite Schools	Other Schools	Difference
School characteristics:			
Private (minban) school	0.000	0.368	-0.368***
Private school outside urban area	0.000	0.039	-0.039***
Flagship school (F)	0.418	-	0.418^{***}
Elite schools (E1 & E2)	0.582	-	0.582^{***}
(Adjusted total) HSEE (<i>zhongkao</i>) score			
Standardised total score	0.758	0.094	0.664^{***}
HSEE Total score	586.1	518.4	67.7***
>=623: above flagship <i>unified-</i> <i>enrolment</i> cut-off	0.181	0.000	0.181***
587-622: Between F and E2 <i>unified-</i> <i>enrolment</i> cut-offs	0.496	0.046	0.450***
532-586: between E2 unified-enrolment & selection-fee cut-offs	0.200	0.470	-0.269***
400-531: between E2 <i>selection-fee</i> & normal public high school cut-offs	0.122	0.484	295***
Standardised HSGE (<i>huikao</i>) scores			
Raw total scores	483.0	427.4	55.6***
Standardised total scores	0.645	0.014	0.630***
Student characteristics:			
Age	15.79	16.02	-0.233***
Boy	0.459	0.446	0.013
Observations	2,745	2,494	-
Share of sample (%)	52.4.11	47.6	-

Note: ***, ** and * indicate statistical significance at 1%, 5% and 10% respectively.

Compared to nonelite counterparts, flagship and elite school students have:

- 0.66 SDs higher (adj.) HSEE scores
- 0.23 years younger
- Much less likely to come from disadvantaged families (not shown)
- Parental background failed the covariate balance test, thus not included as controls in RDD

Geographical location of HS and middle schools by school type

