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Abstract

Researchers typically explain inequalities in access to elite high schools by looking at gaps that appear before the high school admissions process. However, even when disadvantaged students reach the stage of high school admissions with identical qualifications as advantaged students, mechanisms particular to the high school admissions process may prevent disadvantaged students from accessing elite high schools. The overall goal of this paper is to examine the degree to which the high school admissions process deters disadvantaged students from accessing elite high schools. To fulfill this goal, we analyze longitudinal, administrative data on approximately 24,000 students in one region of China. In this setting, according to our data, the rural-urban gap in elite high school attendance can be larger than 50 percentage points (even though rural students comprise well more than half of the high school student population). Our results show that the five subject exams of the high school entrance exam (HSEE) are biased against rural students. If the HSEE dropped two of the most biased subject exams from the HSEE, access to elite high schools among rural students would increase by 4 percentage points (or 8 percent). Furthermore, conditional on HSEE scores, rural students are 13 percentage points less likely than urban students to apply for elite high schools. Finally, conditional on HSEE scores *and* application choices, the existence of an alternative admissions channel that charges extra admissions fees further reduces rural access by 18 percentage points.

Is the high school admissions process fair? Explaining inequalities in elite high school enrollments in developing countries

As part of their efforts to raise human capital, policymakers in a number of developing countries have increased high school enrollments. The overall gross high school enrollment rate in developing countries has risen from 37% in 1999 to 54% in 2011 (UNESCO 2014). The gross high school enrollment rate in developing countries in East Asia and the Pacific has increased even more rapidly over the same period, from 44% to 70% (UNESCO 2014).

In addition to increasing high school enrollments, policymakers in developing countries have also increased enrollments in *elite high schools* (Benavot 2006; Cuadra and Moreno 2005). Compared to non-elite high schools, elite high schools theoretically improve student achievement by providing greater resources per student and through positive peer effects (Abdulkadiroğlu, Angrist, and Pathak 2014; Dobbie, Fryer, and Fryer Jr 2013; de Janvry, Dustan, and Sadoulet 2013). Indeed, empirical studies in countries as diverse as Hungary (Hermann 2013), Mexico (de Janvry et al. 2013), and Romania (Pop-Eleches and Urquiola 2013) confirm that attending elite high schools increases student achievement.

Although increasing elite high school enrollments may raise student achievement, it may also contribute to greater social and economic inequality. Systems that promote elite high schools may experience higher inequality because disadvantaged students often fail to access elite high schools at the same rate as more advantaged students (Heath and Sullivan

2011; Lewin 2007). When disadvantaged students fail to access elite high schools at the same rate, they often have fewer opportunities to gain skills that may increase their lifetime income (Li and Luo 2011; World Bank 2005). Hence, understanding the reasons behind inequality in access to elite high schools may therefore be important for reducing social and economic inequality in developing countries.

Researchers typically explain inequality in access to elite high schools by looking at gaps that appear between disadvantaged and advantaged students in compulsory schooling (grades 1-9), before the high school admissions process. Compared to advantaged students, disadvantaged students are more likely to drop out of compulsory schooling—thereby eliminating the possibility that they even apply for high school (Filmer and Pritchett 1999; Machin 2006). Although the disadvantaged students that reach the stage of high school admissions are likely a select (high-achieving) group, they often have lower levels of ability than advantaged students that reach the same stage (Schutz, Ursprung, and Wossmann 2008).

However, even when disadvantaged students successfully make it to the stage of high school admissions *with identical levels of ability*, there are reasons to believe that the admissions process itself may prevent them from accessing elite high schools. Similar to developed countries (Abdulkadiroğlu et al. 2014), qualifying for admissions to elite high schools in developing countries is largely based on scores on a competitive entrance exam (called the *high school entrance exam* or *HSEE* in this paper). If the content of the HSEE were to be (for example, culturally) biased against disadvantaged students, they would perform less well on the exam and would be less likely to access elite high schools (Bourdieu 1973; Grodsky, Warren, and Felts 2008).

Although some disadvantaged students perform just as well on the HSEE as their advantaged peers, they may be less likely to apply to elite high schools. That is, even conditional on HSEE performance, disadvantaged students may fail to access elite high schools at the same rate as advantaged students because of their application choices. We call such choices *suboptimal*. A small literature on college choice from developed countries has shown, for example, that disadvantaged students fail to apply to more selective colleges even when they can qualify for these colleges (Hoxby and Avery 2013).

Finally, it could be that even when disadvantaged students have the same HSEE performance and application choices as advantaged students, they may still fail to gain access to elite high schools. This is because a number of developing countries (such as Russia, India and China—see Carnoy et al. 2013) have admissions policies that allow students who fail to qualify for admissions through the standard channel to pay extra admissions fees and enter through an alternative channel. Unfortunately, these extra admissions fees (which may make the price of attending school considerably higher than that for students entering through the standard channel) can prove prohibitively expensive for most disadvantaged students.

In spite of these potential barriers, little is known about the extent to which the high school admissions process may deter disadvantaged students in developing countries from accessing elite high schools. Only a few studies from developed countries have examined the degree to which biased entrance exams create inequalities in access to college and elite colleges (Berberoglu 1996; Stobart and Elwood 1992). Only a limited number of papers go on to examine whether disadvantaged students make suboptimal application choices (and only in the context of college access—Hoxby and Avery 2013; Calsamiglia, Haeringer, and Klijn 2010). To the best of our knowledge, no study has examined the degree to which entrance exams, application choices and extra admissions fees (associated with an alternative channel) create inequalities in access to elite high schools.

The overall goal of this paper is to examine the degree to which the high school admissions process in developing countries deters disadvantaged students from accessing elite high schools. Our specific objectives are as follows. First, we seek to examine whether the HSEE is biased against disadvantaged students and whether such exam bias may create inequalities in access to elite high schools. Second, we examine the degree to which disadvantaged students may fail to apply for elite high schools. Third, we examine the degree to which alternative channels (that allow students to pay additional fees to enter elite high schools) contribute to inequalities in access.

To fulfill these objectives, we analyze administrative data on approximately 24,000 students navigating the high school admissions process in one region of northwest China. Our results show that certain subject exams of the HSEE are indeed biased against disadvantaged students (which in the case of China means rural students). We also find that disadvantaged students apply to elite high schools at much lower rates than advantaged students: disadvantaged students appear to be making suboptimal choices when choosing to go to elite high schools. Finally, our results suggest that alternative admissions channels (in which students with lower entrance scores can pay extra admissions fees) prevent disadvantaged students from gaining access to elite high schools.

2. Research Design

2.1 Potential Inequalities in High School Admissions in China

We seek to examine potential inequalities in the high school admissions process in the developing world by taking China as an example. There are several reasons why it is worthwhile to investigate the high school admissions process in China. Similar to other developing countries, policymakers in China have promoted a system of elite high schools (Loyalka et al. 2015). Disadvantaged students in China are much less likely to access elite high schools as advantaged students (Loyalka et al. 2014). Finally, attending elite high schools in China appears to improve student achievement and access to college (Park et al. 2010). Because the situation in China is similar to that of a number of other developing countries, understanding inequalities between disadvantaged and advantaged students in the high school admissions process in China may provide important lessons for other countries.[1]

What is meant by *disadvantaged* in the context of this paper? Perhaps the most important disadvantaged group in China is its rural population (Sicular et al. 2007; Whyte

[1] Understanding inequalities surrounding the high school admissions process in China is also of inherent interest, as approximately 10 million students are potentially affected by the high school admissions process in China each year (UIS, 2014),

2010). Rural students comprise about 78% of the total student population of China (National Bureau of Statistics of China 2010). However, they are 6 times less likely to attend college and 11 times less likely to attend elite colleges than urban students (Li et al. 2013). During compulsory education (primary and junior high school), the achievement levels of rural students also lag far behind that of their urban peers (Fang et al. 2011; Kleiman-Weiner et al. 2013).

What is meant by *elite high schools* in the context of this paper? Within each region of China, local officials designate a small number of so-called top academic high schools as elite high schools. Elite high schools receive more resources per student (from both government grants and tuition) than non-elite high schools (Loyalka et al. 2015). Elite high schools also enroll the highest-achieving students through a competitive admissions process (which we describe immediately below).

The high school admissions process in China is comprised of three steps. First, similar to other developing countries, admission to elite high school in China is largely based on how well students rank on the HSEE. The HSEE is taken at the end of junior high school. During this time, students take a two-day exam that is composed of five core subject exams in math, sciences, Chinese language, politics, and English.[2] Because the HSEE score is by

[2] The sciences (physics and chemistry) subject exam has a maximum of 160 points. The Chinese language, math, and English subject exams each have a maximum of 120 points. Finally, the politics subject exam has a maximum of 100 points. Some prefectures impose auxiliary subject exams on top of the five core subject exams. Auxiliary subject exams range from physical education to science experiments. Compared to the five core subject exams, the auxiliary subject exams typically weigh about one tenth to one fourth of the lowest weight core subject exam. Auxiliary exams also exhibit much less variation in than core subject exams (and thus matter

far the most important determinant of admissions, much of the formal instruction in junior high schools centers on HSEE preparation (Loyalka et al. 2013).

After taking the HSEE, the second step in the admissions process requires students to submit official high school *application choices* to the local government. Students can list their first, second, and third choices (for up to three high schools). Local officials use the information on student HSEE scores and application choices to match students to high schools. Students cannot attend high schools that they do not list, even if their HSEE test scores are high enough.

Prefectural and county governments in China frequently use a *deferred acceptance algorithm* to match students with particular HSEE scores and application choices to high schools.[3] The admission process starts with the top-ranked high schools. For every school, all students who choose that school as their first choice (henceforth, *first choice applicants*) are admitted in order of HSEE score until the pre-determined quota (that is, the maximum

little for admissions).

[3] Although an examination of the repercussions of admissions matching mechanisms on inequality is beyond the scope of this paper, whether rural students make "suboptimal (application) choices" is likely influenced (in part) by the matching algorithm that is used to match students into high schools. In our sample county (see Section 2 below), local officials use a deferred acceptance algorithm to match students to high schools (Gale and Shapley, 1962). In this algorithm, the ordering of students' application choices reflects students' true preference ordering between different high schools. Some regions of China, however, use a variation of the "Boston mechanism" to match students to high schools (Abdulkadiroglu and Sonmez, 2003). Under the Boston mechanism, the first round of admissions decisions considers only first choice applicants who scored the highest on the HSEE. If there are still spots available at the high school, a second round of admissions considers (only) second choice applicants (starting with the remaining second choice applicants that scored highest on the HSEE). The admissions process continues in this manner until all of the spots are filled for that high school or until there are no more applicants left. One important downside of the Boston mechanism is that it discourages students from revealing their true (application choice) preferences (Abdulkadiroglu and Sonmez, 2003). In fact, under the Boston mechanism students are incentivized to strategize and misrepresent their true preference in order to out-compete competitors. Since our analysis of suboptimal (application) choices relies on data from a county that uses a deferred acceptance algorithm (in which students can theoretically reveal their true preferences without penalty), we hypothesize that our estimates of the sub-optimality of rural students' high school choices are lower than what would be estimated in counties that use the Boston mechanism.

number of students) for that school is filled. The admission decisions for the second-ranked high schools are made next. For each high school, remaining first choice applicants are pooled with applicants who choose this school as their second choice (*second choice applicants*). The individuals in this pool of applicants are again admitted in order of their HSEE scores. County education officials repeat this process for the third-ranked high schools.

The mechanism governing the admission process is complicated by the fact that high schools also typically award *bonus points* to first choice applicants when admitting students in order of HSEE scores. Before first choice applicants and second choice applicants are ranked by HSEE score, a certain number of bonus points are added to the HSEE scores of the first choice applicants. In general, high schools offer a 10-point advantage to first choice applicants over second choice applicants who had the same HSEE score. Similar systems that associate higher priority (for admissions) with first choices are not only used in China. These systems have been studied and have been shown to incentivize students to designate a lower-ranked school as their first choice to gain advantage in admissions (Abdulkadiroglu and Sonmez 2003). To the extent that disadvantaged students are more likely to underestimate their chances of success in the admissions process, the bonus point system reduces their chance of admission to elite high schools.

After HSEE scores have been released and application choices have been made, there is still one more step in the admissions process that has the potential to introduce inequality into final admissions decisions: the *dual-channel admissions system*. In the dual channel admissions system, students are admitted to high schools through one of two channels. In the standard channel, only student HSEE scores and application choices are factored into admissions decisions. Students admitted through the standard channel only pay the basic tuition fee (around 800 RMB per year). The alternative channel offers an opportunity for students who do not perform well enough on the HSEE to be admitted. Students can gain admission to the school of their choice by paying *extra admissions fees*. In China, the extra admissions fees are officially allowed to be as high as 4,000 RMB per student per year (or approximately 125% of rural per capita income).[4] Unofficially, the extra admissions fees can be as high as 5 times the official rate (Rosen 2004).

In sum, China's high school admissions process is composed of three chronological steps: students take the HSEE; students submit their high school application choices and are admitted to high school through the standard channel; students that score lower than the standard HSEE cutoff for a particular elite high school can enter the high school by paying extra admissions fees. All three steps may or may not be involved in creating inequality in access to elite high schools. The objective of the analysis in the rest of the paper is to examine which steps contribute to educational inequalities and quantify how large of share of the total gap is accounted for by each step.

[4] Annual rural per capita income in the region of interest was 3,181 RMB in 2007 (National Bureau of Statistics of China 2008).

2.2 Data

In this paper, we rely on administrative data from one region in northwestern China. These data are from two different data sets. Specifically, to examine whether the HSEE is biased against rural (versus urban) students, we use administrative data on all students that attended high school in 4 prefectures of the region (N=23,980). We call this dataset the *region-level dataset*. For our analysis of student application choices and the impact of the dual channel admission system, we draw on a smaller dataset from one county (N=2,181) that also provides unique information on high school application choices and dual channel admissions. We call this dataset the *county-level dataset*.

Our region-level dataset contains detailed information on HSEE performance and individual characteristics of students. In particular, there is information on each student's HSEE scores by subject. Since the HSEE is administered by and graded at the prefecture level, we standardize subject exam scores within each prefecture. The region-level dataset also includes information on student background characteristics including age, gender, rural or urban residential status, minority status and the county and prefecture of residence. Finally, the region-level dataset contains information on the high school in which the student enrolled and its elite/non-elite status.

The county-level dataset contains even richer information on students. Like the region-level dataset, the county-level dataset has information on student HSEE scores, which are also standardized by prefecture. There is also information on student background characteristics, including age, gender, rural/urban residential status, minority status, county/prefecture residence and elite/non-elite high school enrollment. Importantly for this study (and unlike the region-level dataset), the county-level dataset contains information on student high school application choices. By merging the county-level dataset with information on HSEE cut offs for each high school (as well as information on criteria for entry through the alternative channel), we are able to determine whether each student was admitted to high school through the standard or alternative channel.

To provide context for the study area in China, we present descriptive statistics using the region-level dataset (comparing students that attend elite high schools and non-elite high schools in the region—Table 1). With the exception of gender, there are significant differences in all other observed characteristics of students that attend elite versus non-elite schools. First, elite high schools enroll higher achieving students. Elite high school students score, on average, 0.69 standard deviations (SDs) higher than non-elite high school students on the (total) HSEE. The achievement gaps are also large in each HSEE subject exam, including English (0.86 SDs), science (0.59 SDs), Chinese language (0.55 SDs), politics (0.52 SDs) and math (0.51 SDs). Second, and more significantly, we find that rural students are much less likely to attend elite high schools than non-elite high schools. While the percentage of rural students in non-elite high schools is 64%, the percentage of rural students in elite high schools is only 24%. In sum, elite high schools in fact appear to be enrolling far fewer disadvantaged students. As a point of comparison we also present descriptive statistics from the county-level dataset in Table 2. The county-level data is similar to the regional-level dataset, in that elite high school students have higher achievement levels on average and are less likely to be from rural areas as compared to non-elite high school students.

2.3 Statistical Models

We conduct three sets of analyses to understand how the high school admissions process affects the chances of rural students (in attending elite high school). Our first set of analyses draws on the region-level dataset and examines potential biases in the HSEE (and its subject exam subcomponents) by employing a Oaxaca decomposition technique. We also conduct a simulation to estimate the impact of removing biased HSEE subject exams on the high school admissions rate of rural students. Our second and third set of analyses draw on the county-level data and use multivariate logistic regressions to a) examine whether rural students apply to elite high schools at lower rates than urban students and b) identify the role of the dual channel admissions system in producing inequality. Although the statistical approach underlying our second and third analyses is relatively simple, the logistic regression results combined with our substantive understanding of all of the major rules that govern admissions into elite high schools in the county enable us to come close to making causal inferences.

2.3.1 Examining Bias in the HSEE

To identify potential bias in the HSEE, we examine rural-urban differences in HSEE subject exam scores after controlling for rural-urban differences in ability. That is, a particular HSEE subject exam would be biased if it assigns lower scores to a rural student even after controlling for ability. Ideally, the ability measure would be obtained from an independent exam of sound validity and reliability (Angoff 1993; Shepard, Camilli, and Averill 1981). However, such external measures of ability are rarely available (Cole 1981; Shepard et al. 1981) and are not available for our study. As is commonly practiced in detecting exam bias (Shepard et al. 1981), we deal with this issue by using the vector of all subject exam scores (other than the subject exam being examined) as an internal proxy for ability. This internal proxy assumes that the vector of the scores of other subject exams (e.g., math, sciences, Chinese language, and English—if politics is the subject exam in question) is a relatively unbiased approximation of ability. An important limitation the approach imposes is that we are only able to detect bias that is different across subjects but not bias that is constant across all subjects (Shepard et al. 1981).

To formalize the identification strategy above, we use the Oaxaca-Blinder decomposition technique (Oaxaca 1973). The Oaxaca-Blinder decomposition technique is widely used in the economics and sociology literatures to identify discrimination. We apply the Oaxaca-Blinder technique by decomposing the rural-urban score gap into the part *explained* by student ability (all other HSEE subject exam scores except for the subject exam examined for bias) and background (all background factors except rural/urban status), and the part *unexplained* by ability and background. The explained part incorporates the contribution of factors, such as ability and background, to the difference in subject exam scores between rural and urban students. Users of the Oaxaca-Blinder method define the unexplained part, which is attributable only to rural/urban status, as bias.

Our model specification is as follows:

$$Y_U - Y_R = \beta_1(A_U - A_R) + \beta_2(X_U - X_R) + U \qquad (1)$$

where Y_U is the urban mean subject exam score and Y_R is the rural mean subject exam score. The independent variables on the right hand side, A_U and A_R, are vectors of all HSEE subject exam scores except the one on the right hand side (ability proxy) of urban and rural respectively. X_U and X_R are vectors containing background characteristics of gender, minority, prefecture. U is the unexplained part of the score gap.

If we find that some or all HSEE subject exams are indeed biased against rural students, we are interested in the impact of these exams on rural access to elite high schools. Taking advantage of the strict admission mechanism of China's high schools (based largely on HSEE score), we run a simulation to estimate how the rural-urban gap in elite high school attendance changes when the most biased HSEE subject exams are eliminated. We operationalize our simulation by first obtaining the annual elite high school quota (or equivalently the number of students that attend elite high schools) N_p for each prefecture p in our region-level data. Then, within each prefecture we rank each student (who, in actuality, attended an elite or non-elite high school) based on one of two scores: the original HSEE score (raw score of all five subject exams) and a revised HSEE score excluding subject exams that we find to be biased against rural students. In our simulation, the top ranking N_p students in each prefecture gain admission to elite high schools. The rest of the students in each prefecture gain admission to non-elite high schools. We can then compare the rural-urban gap from our simulation (which uses the revised HSEE that excludes biased subjects exams) with the rural-urban gap in actuality. The increase in the number of rural students who gain admission to elite high school by using the revised HSEE score over the original HSEE score is our estimated impact of HSEE bias.[5]

2.3.2 Do Rural Students Apply for Elite High Schools Less than Urban Students?

To examine whether rural students are less likely to apply for elite high schools compared to urban students (even conditional on HSEE performance), we run the following logistic regression model:

$$logit\{P(Y_i = 1|R, Score, M) = \beta_0 + \beta_1 R_i + \beta_2 Score_i + \beta_3 M_i + \varepsilon_i \quad (2)$$

where Y_i is a (binary) dependent variable equal to 1 if student i applied for an elite high school for their first application choice and 0 otherwise. Focusing on the first application choice is critical not only because it is considered first when matching students to high schools but also because (as noted earlier) 10 bonus points are added to the student's total HSEE score for his/her first application choice.

The independent variables on the right hand side of equation (2) include a binary indicator for whether a student is a rural (that is, not an urban) student (R_i), the student's

[5] Because students must attend high school in their home prefecture (for the most part) and students and parents strongly prefer attending elite high school (see Loyalka et al. 2015), the following assumptions for our simulation are likely justified: students stay within their prefecture for high school, and elite high schools get the highest scoring students.

HSEE score (total, not including the bonus— $Score_i$), and a binary indicator for minority status (M_i). By controlling for the total HSEE score, the model controls for the only criterion used to determine whether a student is qualified for an elite high school or not.[6] Therefore if the coefficient on the rural indicator (β_1) is significantly different from zero, rural-urban differences in first application choices will be due to factors outside of whether students qualify for an elite high school (such as risk-aversion or misinformation).

We use the above logistic regression model to determine whether rural students apply for elite high schools at lesser rates than urban students (conditional on HSEE scores). In doing so, we are able to identify whether the application choices of rural students are *suboptimal*. Choices would be suboptimal if *qualified* rural students (having HSEE scores above the standard HSEE cutoff for elite high schools) are less likely than equally qualified urban students to apply for elite high schools. Suboptimal used in this context refers to the fact that the student could have attended an elite high school but did not apply. In practice, by focusing on the subsample of (rural and urban) students that score above the HSEE cutoff for elite high schools, we can use equation (2) to examine whether rural students are prone to make application choices that hurt their relative chances of accessing elite high schools.

[6] Minority status is included because on rare occasions it factors into admissions decisions. Namely, a minority student with the same total HSEE score as a non-minority student may sometimes be granted preferential admission into an elite high school. We note, however, that our results are substantively the same whether or not we control for the minority indicator.

2.3.3 Estimating the Impact of Dual Channel Admissions System

To examine the impact of the dual channel admissions system on rural-urban inequalities in high school admissions, we run the following logistic regression model:

$$logit\{P(Z_i = 1|R, Score, M, Choices) = \alpha_0 + \alpha_1 R_i + \alpha_2 Score_i + \alpha_3 M_i + Choices_i \alpha' + \varepsilon_i \quad (3)$$

where Z_i is a (binary) dependent variable equal to 1 if student i entered an elite high school and 0 otherwise. Similar to equation (2), the right hand side of equation (3) includes a binary indicator for whether a student has a rural (versus an urban) residential permit (R_i), (total) HSEE score ($Score_i$), and a binary indicator for minority status (M_i). However, the right hand side of equation (3) also includes a series of dummy variables (or fixed effects) for student high school application choice sets (including all possible combinations of their first, second, and third application choices). Intuitively, by controlling for all factors that are used to determine admissions (HSEE scores and application choices), we can isolate the effect of individual characteristics (including rural residence) on the choice of elite high school. If the coefficient on the rural indicator (α_1) is negative and significantly different from zero, then the dual channel admissions system increases inequalities in high school admissions between rural and urban students.

In short, equation (3) enables us to examine the impact of the dual channel admissions system on rural-urban inequalities under relatively weak assumptions. In particular, we assume that after controlling for the only factors used in the admissions matching process (total HSEE score and binary indicators for application choice sets), the only deterrent to attending an elite high school is the financial cost of attending the elite high school. When making this assumption, it is important to note that the financial costs of attending elite and non-elite high schools are similar for students that score above the regular HSEE cutoff for an elite high school.[7]

We can conduct a more direct test of whether rural-urban differences in admissions are due to the extra costs associated with the dual channel admissions system. We do this by comparing the size of the rural-urban difference in high school admissions for the subsample of students that scored below the standard HSEE cutoff with that for the subsample of students that scored above of the standard HSEE cutoff (after conditioning on HSEE scores and application choices). If the extra costs associated with the dual channel admissions system are indeed responsible for inequalities in elite high school admissions, α_1 should be negative for the subsample of students that scored below the standard HSEE cutoff (those who had to enter by the alternative admissions channel) but not different from zero for the subsample of students that scored above the standard HSEE cutoff (those who entered using the standard admissions channel).

3. Results

3.1 Bias in the HSEE

[7] The cost of attending an elite high school under the standard channel is 800 RMB per year compared to 500 to 600 RMB for a non-elite high school. Besides tuition fees, there are few differences in costs between elite and non-elite high schools. This is because students only have the choice of attending an elite or non-elite high school in the same county and usually board at high schools. Thus transportation and boarding costs are comparable between elite and non-elite high schools. We obtained tuition rates from the local education officials in our sample region.

Our data show that rural students perform worse than urban students in all HSEE subject exams (Table 3).[8] The gaps in the politics and English subject exams are the largest (0.21 and 0.21SDs, see Table 3, Rows 4-5). The gap in the Chinese language subject exam is also substantial (0.18 SDs, see Table 3, Row 3). The gaps between urban and rural students in the sciences and math subject exams, by contrast, are relatively small (0.02 and 0.04 SDs , see Table 3, Rows 1-2). The existence of gaps is not surprising as students from lower social and economic backgrounds (i.e., rural students) typically score lower on standardized tests compared to students from higher social and economic backgrounds (Sicular et al. 2007; White 1982). What may be surprising, however, is that the gaps in the Chinese language, politics, and English subject exams are five to ten times larger than those in math and science.

There are two possible explanations for the rural-urban gaps in HSEE scores (and especially for the gaps in the Chinese language, politics and English HSEE subject exam scores). First, score gaps may reflect an ability gap: rural students may have received lower quality education in schools with fewer resources and therefore have lower academic ability than urban students at the time of the HSEE and thus receive lower exam scores. Second, score gaps may reflect exam bias. In the latter case, systematic bias in certain HSEE subject

[8] In both the region-level and county-level datasets, the rural (urban) variable is only available for students who graduated high school. Thus our analytical results are based on the high school graduates sample instead of the sample of all the students who took the HSEE (full sample). Realizing this limitation, we performed sensitivity tests by extrapolating the rural (urban) status from highly correlated background variables for all students who took the HSEE. We then compared our results with results obtained using this full sample. The two results were highly similar. While not perfect, this suggests our results are generalizable to the larger sample of students who took the HSEE (including both those admitted to high schools and those who were not admitted).

exams prevent rural students from performing as well as their urban counterparts, even if they all have identical ability.

Results from our Oaxaca decomposition analyses show that there are indeed biases against rural students. According to our analysis, two of the five subject exams (politics and English) are biased against rural students. Specifically, the difference between urban and rural students in the politics subject exam is 0.21 SDs (Table 4, Column 4). The decomposition exercise finds that 92% of this gap (0.20 SDs) is unexplained by ability and background. These results may be interpreted as revealing serious bias against rural students. Similarly, the difference between urban and rural students in the English subject exam is 0.21 SDs (Table 4, Column 5); 87% of this gap (0.18 SDs) is unexplained. By contrast, we find little evidence of bias against rural students in Chinese, math, and science subject exams.[9] In sum, our analysis suggests that for politics and English, differences in performance are due to rural-urban status alone (as opposed to differences in ability). The above results change little when we add different sets of background variables to our Oaxaca decomposition model.[10]

3.1.1 Estimating the Impact of Excluding Biased Subject Exams from the HSEE

Will removing heavily biased subject exams from the HSEE give rural students a better chance of gaining admission to elite high schools? Our results show that revising the HSEE to exclude the most biased subject exams (politics and English) would increase the

[9] While to a lesser degree than politics and English, the data also demonstrate that the Chinese language subject exam is potentially biased against rural students. The gap in the Chinese language subject exam is 0.18 SDs (Table 4, Column 3). Although most of the gap is explained by ability and background, 47% (0.09 SDs) is left unexplained.
[10] Results are omitted for the sake of brevity but are available from the authors upon request.

enrollment of rural students in elite high schools considerably. According to our simulations, if officials exclude the politics and English subject exams, rural attendance in elite high schools in our sample region would rise by 4.3 percentage points, or 8.3 percent (Table 6). Furthermore, the majority of rural students (52.6%) improved their HSEE score (ranking) after the removal of the politics and English subject exams. Students with improved HSEE scores may receive more favorable treatment from school administrators and teachers, even when the improvement in HSEE scores does not change the high school a student attends (Pop-Eleches and Urquiola, 2013).

3.1.2 Qualitative Examination of Biased Exams

To see why the politics and English subject exams appear to be especially biased against rural students, we examined the content of the politics and English subject exam items. For the politics subject exam, we find that approximately 20% of the exam items require rote memorization (rather than analysis) of current news and events. Rural students may be at a disadvantage when answering questions that are based on these items. It may be that households in rural areas have less access to news media through television and internet and, as such, have less contact with current news and events (Chen and Wellman 2005; Harwit 2004). A typical example of such an exam item in the politics subject exam from our sample region's 2007 HSEE is as follows (see Appendix 1 for more examples):

> *On Oct 22nd, 2006, which of the following events was hosted in Jiangtaibao, Jijiang County?*

A. *The 60-year commemoration of the War of Resistance against Japan*
B. *The 60-year commemoration of the end of the Second World War*
C. *The 70-year commemoration of the Victorious Completion of the Long March*
D. *The 70-year commemoration of the establishment of the Shanganning Province Hui minority self-governance in Yuhai County*

In terms of the English subject exam, we find that the questions may be culturally biased against rural students. English subject exam items are often grounded in urban (rather than rural) cultural contexts. Such cultural bias is illustrated by an excerpt from an English subject exam item (for more examples, see Appendix 1):

> *Rain is a Korean pop star whose real name is Jung Ji-hoon. He is loved in Asia for both his R&B music and TV roles. He lost his mother to diabetes six years ago. The huge sadness kept him away from drink, night life and girls. He concentrated on performing, as his mother gave up her medical care so he could train professionally. "I am like the average 25-year-old boy who wants to hang out with friends and have a girlfriend," Rain told the New York Daily News. "But when my mother passed away, I made up my mind that I would be the top star in the world to honor her. I don't feel sorry for this lifestyle."*

Such a question assumes that students are familiar with words frequently used in urban culture, such as “pop star”, “R&B”, and “night life.”

Although we lack individual item data to verify our findings, the above examples are potentially illustrative of why rural students may perform worse than urban students on politics and English subject exams. One type of bias may arise due to the greater access urban students have to current events, the news and other contemporary sources of information. The other type of bias may arise from the fact that the subject of exams are in part more culturally appropriate for urban students.

3.2 Application Choices

Even if rural students score just as well as their urban counterparts (on a competitive exam biased against them), they are still less likely to choose elite high schools in their first (and critical) application choice (Table 7). According to our logistic regression results, rural students are 13 percentage points less likely than urban students to list an elite high school for their first choice, even conditional on HSEE scores (Table 7, Columns 1-2). The result is statistically significant at the 5% level. In other words, even when rural students are equally qualified to apply to elite high schools as urban students, they are much less likely to list them for their first choice.

This result is consistent whether students are applying through the standard admissions channel (that has low tuition fees) or through the alternative admissions channel (that requires extra, high admissions fees—see Table 7). Among the subsample of students that score *below* the (regular admissions) HSEE cutoff for elite high schools, rural students are 16 percentage points less likely than urban students to list an elite high school as their first choice (Table 7, Columns 3-4). Among the subsample of students that score *above* the (regular admissions) HSEE cutoff for elite high schools, rural students are *still* 12 percentage points less likely than urban students to list an elite high school as their first choice (Table 7, Columns 5-6). Both results are significant at the 5% level. Taken together (and assuming elite high schools are better choices than non-elite high schools), rural students are clearly making suboptimal choices. These findings suggest that such choices are directly impairing their chances of attending elite high schools. Rural students who are equally as qualified as the urban students often are not choosing to even list elite high schools as their first choice.

Why are rural kids choosing not to list elite high schools as their first application choice? Whereas financial constraints may partially explain why rural students with scores below the HSEE cutoff do not list elite high schools as their first application choice, they fail to explain why rural students with scores above the HSEE cutoff make suboptimal choices. This is because, as explained in subsection 2.3.3, the costs of attending elite high schools are only 200-300 RMB (or only 6-9% of a rural family's per capita income) higher than the costs of attending non-elite high schools. It also is not likely that geographic distance plays a large role in rural students' application decisions since elite and non-elite high schools are both located in the county seat (and the majority of students board at these high schools).

Instead, we conjecture that since first choice applicants are awarded 10 bonus points in the admissions decision, risk-averse rural students may designate lower-ranked (non-elite) schools as their first choice. They do so out of concern that they will otherwise be unable to gain admittance to their first *or* second choice school. In other words, rural students may be more likely to pick the "second-best" non-elite high school rather than the elite high school to ensure that they can at least get into one high school.

3.3 Dual Channel Admissions System

The dual channel admissions system also prevents rural students from gaining equal access to elite high schools. According to the results of our logistic model specified in equation 3, even after fully controlling for HSEE scores and application choices, rural students are 13 percentage points less likely to access elite high schools compared to urban students (significant at the 1% level—see Table 8, Columns 1-2).

We also run our analysis separately for students who score below the standard HSEE cutoff (and must use the alternative admissions channel) versus those who score above the cutoff (and thus use the standard admissions channel). Rural students in the subsample of students that score below the standard HSEE cutoff for elite high schools are 18 percentage points less likely to access elite high schools (significant at the 1% level). By contrast, rural students in the subsample of students that scored above the standard HSEE cutoff are equally likely to access elite high schools as urban students (Table 8, Columns 3-4). In fact, conditional on HSEE scores and application choices, rural students that score above the standard HSEE cutoff are 3 percentage points *more* likely than urban students to access elite high schools (however, this result is not statistically significant—see Table 8, Columns 5-6). Such a finding suggests that rural students are particularly disadvantaged when they score under the HSEE cutoff. While urban students pay extra fees to enter elite high school, rural students almost certainly face financial barriers that bar their attendance. In sum, the results indicate that the alternative admissions channel (which requires extra and often exorbitant admissions fees) is likely a substantial barrier keeping rural kids from accessing elite high schools.

4. Discussion and Conclusion

There are many reasons why disadvantaged students do not access elite high schools at the same rate as urban students. Many disadvantaged students drop out before high school and many do not have the adequate preparation for elite high schools. However, even if disadvantaged students make it to the stage of high school and have the same level of ability as urban students, they might still face the following admissions barriers: the HSEE may be biased against them; they may fail to apply for elite high schools and even make suboptimal high school application choices; and they may face a dual channel admissions system that favors urban students.

Using administrative data from one region of China, we show that the high school admission process indeed creates substantial inequalities in elite high school access between rural and urban students. According to our empirical findings, different subject exams on the HSEE (especially politics and English) are heavily biased against rural students. By changing the HSEE to exclude the subject exams most biased against rural students, we show that the chances of rural students attending elite high school would increase by 4.3 percentage points. Admissions matching rules appear to cause *equally qualified* rural students to apply at far lower rates for elite high schools when compared to urban students. In particular, we find that when bonus points are given for the first application choices of students, such a system causes rural students (who may be more risk averse) to write in less risky, non-elite high schools as their first choice. In this way the application choices of rural students can be considered suboptimal. In most graphic terms, it can be said that rural students are sabotaging their own chances of gaining access to elite high schools. We find evidence that the dual channel admission system greatly favors those who can afford to pay extra admissions fees to attend high school—urban students. The dual channel admissions system appears to be a major barrier preventing disadvantaged (rural) students from accessing elite high school.

According to these findings, policymakers in developing countries can choose to substantially reduce educational inequality in access to elite high schools by making three policy changes. First, policymakers can commission the creation of standardized exams that are not biased against rural students. Second, policymakers can simply remove admissions rules (such as the bonus for the first application choice) that create inequality in access to elite high schools. Third, policymakers can abolish a major cause of inequality in high school admissions—the dual channel admission system.

These policy changes could have repercussions for tens of millions of rural students that are seeking a high quality high school education in developing countries. In China in 2011 alone, 8.4 million individuals enrolled as first-year students in academic high schools in China (National Bureau of Statistics of China 2012). Approximately 45% of these students were rural (3.9 million students). If policymakers in China were to reform high school admissions rules, a much larger proportion of these rural students would be able to attend elite rather than non-elite high schools. While the political will for such wide-reaching reforms is uncertain, it is clear that such a change would go far in potentially reversing or at least ameliorating trends of educational inequality.

Of course, the high school admissions process in developing countries may have been designed by policymakers precisely to perpetuate inequalities in access to elite high schools. Sociologists have long hypothesized that the establishment of elite high schools (and elite tracking in general) is for the purpose of maintaining elite advantage (Raferty and Hout 2001; Bourdieu 1998). The fact that policymakers have created complementary admissions rules that greatly exacerbate inequalities in elite high school access provides some (albeit inconclusive) support for this hypothesis. On the other hand, policymakers in developing countries may simply be unaware of the negative consequences of high school admissions rules on inequality and may wish to act upon the types of findings presented in this paper.

Finally, we acknowledge that our study is limited in terms of its external validity. The fact that we have one set of prefectures and one county limits our ability to generalize our findings. In particular, while the high school admissions policies in our sample locations are similar to those in other regions of China, more research is clearly needed on how the high school admissions process might create inequalities in other developing country contexts.

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Appendix 1: Example Items from Politics and English Subject Exams of the HSEE

Politics Subject Exam Example Items

Example Item 1:

The 26th conference of the International Astronomical Society decided to demote which of the following astronomical bodies from planetary status?

A. Mars
B. Pluto
C. Uranus
D. Neptune

Example Item 2:

On July 1st 2006, the Qinghai-Tibet railway officially commenced operations. The Qinghai-Tibet railway is the most challenging railway construction project in history, what are some of the most significant challenges it had to surmount?

I. Multi-year permafrost
II. Droughts
III. Thin air
IV. Fragile ecosystem

A. I, II, and III   B. II, III, and IV   C. I, II, and IV   D. I, III, and IV

English Subject Exam Example Items

Example Item 1

Listening comprehension

Please select the image that most precisely matches what you hear.


A.


B.


C.

Select the most appropriate response based on what you hear.

A. No, not at all. B. Do you really think so? C. Thank you for saying so.

Example Item 2:

Please read the following passage and complete the questions based on what you read.

Last summer I went to stay with my grandparents for two weeks. When I was younger, they had lived with us in Dallas. However, they moved back to Arizona to live in the Hopi village because they missed their old home. Dad said to me, "Anthony, this trip will be a wonderful opportunity for you. It will be a good time for you to learn more about Native American ways. "

The reader can tell that the bowl and the basket will be special gifts for Anthony's parents because________.

A. he made them himself

B. they are like the ones in Dallas

C. he bought them at the Hopi village

D. they are sold in stores in Arizona

Figure 1. Diagram of High School Admission Process in China

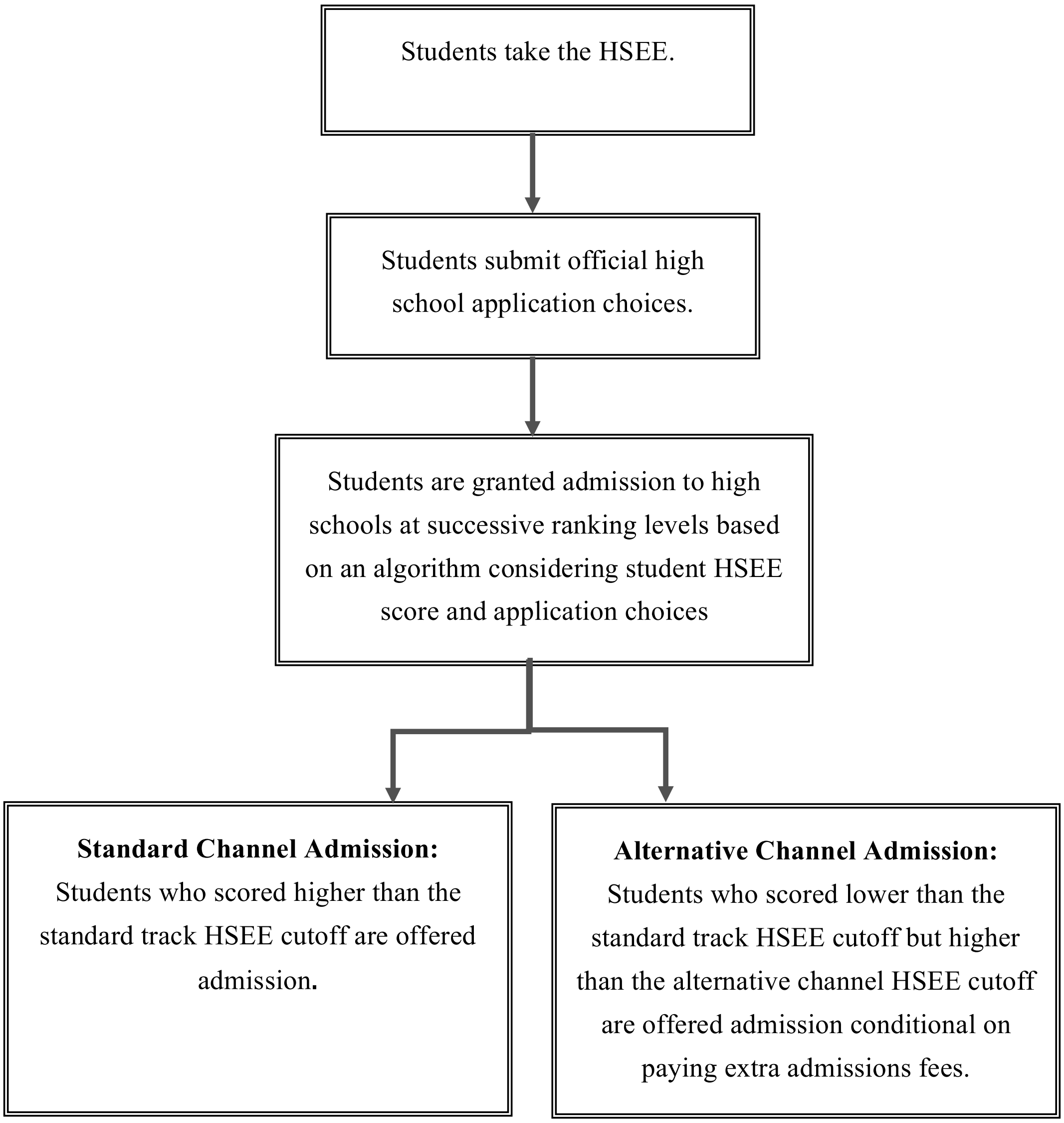

Table 1. Comparison of Student Background Characteristics across Elite and Non-elite High School (Region-level Dataset)

	Non-elite High School		Elite High School		T-Test	
	Mean	SD	Mean	SD	Diff	P-Value
	(1)	(2)	(3)	(4)	(5)	(6)
Rural	0.64	0.48	0.24	0.43	-0.4*** (0.04)	[0.00]
Female	0.52	0.50	0.51	0.50	-0.01 (0.01)	[0.43]
Minority	0.26	0.44	0.30	0.46	0.04* (0.02)	[0.07]
Total HSEE (z-score)	0.49	0.61	1.18	0.52	0.69*** (0.03)	[0.00]
HSEE Math (z-score)	0.47	0.68	0.98	0.56	0.51*** (0.03)	[0.00]
HSEE Science (z-score)	0.48	0.68	1.07	0.53	0.59*** (0.03)	[0.00]
HSEE Chinese (z-score)	0.35	0.67	0.90	0.59	0.55*** (0.02)	[0.00]
HSEE Politics (z-score)	0.34	0.66	0.86	0.51	0.52*** (0.04)	[0.00]
HSEE English (z-score)	0.39	0.84	1.25	0.70	0.86*** (0.04)	[0.00]

Notes:

a) Region-level dataset
b) The analytical sample sizes for non-elite high schools and elite high schools are 18596 and 5383 respectively.
c) *** p<0.01, ** p<0.05, * p<0.1
d) Robust standard errors clustering on junior high schools reported.

Table 2. Comparison of Student Background Characteristics across Elite and Non-elite High School (County-level Dataset)

	Non-elite High School		Elite High School		T-Test	
	Mean	SD	Mean	SD	Diff	P-Value
	(1)	(2)	(3)	(4)	(5)	(6)
Rural	0.53	0.50	0.35	0.48	-0.18 (0.09)	[0.20]
Female	0.51	0.50	0.54	0.50	0.02 (0.03)	[0.68]
Minority	0.54	0.50	0.44	0.50	-0.10*** (0.06)	[0.00]
Total HSEE (z-score)	0.24	0.65	1.12	0.60	0.88*** (0.09)	[0.00]
HSEE Math (z-score)	0.06	0.72	0.71	0.59	0.66*** (0.09)	[0.00]
HSEE Science (z-score)	0.24	0.77	1.03	0.64	0.79*** (0.08)	[0.00]
HSEE Chinese (z-score)	0.36	0.72	0.98	0.64	0.62*** (0.08)	[0.00]
HSEE Politics (z-score)	0.77	0.67	1.18	0.48	0.41*** (0.06)	[0.00]
HSEE English (z-score)	-0.12	0.76	0.93	0.78	1.05*** (0.11)	[0.00]

Notes:

a) County-level dataset

b) The analytical sample size for non-elite high schools and elite high schools are 1075 and 899 respectively.

c) *** p<0.01, ** p<0.05, * p<0.1

d) Robust standard errors clustering on junior high schools reported.

Table 3. Differences in HSEE Subject Exam Scores Between Rural and Urban Students

	Urban		Rural		T-Test	
	Mean	SD	Mean	SD	Diff	P-Value
	(1)	(2)	(3)	(4)	(5)	(6)
HSEE Math (z-score)	0.60	0.70	0.56	0.68	0.04*** (0.01)	[0.00]
HSEE Science (z-score)	0.62	0.72	0.60	0.68	0.02* (0.01)	[0.08]
HSEE Chinese (z-score)	0.57	0.69	0.39	0.68	0.18*** (0.01)	[0.00]
HSEE Politics (z-score)	0.58	0.62	0.36	0.68	0.21*** (0.01)	[0.00]
HSEE English (z-score)	0.70	0.90	0.49	0.87	0.21*** (0.01)	[0.00]

Notes:

a) Region-level dataset

b) The analytical sample size for rural students and urban students are 13,233 and 10,747 respectively.

c) *** p<0.01, ** p<0.05, * p<0.1

Table 4. Rural-Urban Gaps for HSEE Subject Exams (Oaxaca Decomposition)

	Math	Sciences	Chinese	Politics	English
	(1)	(2)	(3)	(4)	(5)
Urban	0.61***	0.62***	0.58***	0.58***	0.70***
	(0.05)	(0.04)	(0.04)	(0.05)	(0.07)
Rural	0.56***	0.60***	0.40***	0.36***	0.49***
	(0.02)	(0.03)	(0.02)	(0.04)	(0.03)
Difference	0.04	0.02	0.18***	0.21***	0.21***
	(0.04)	(0.02)	(0.03)	(0.04)	(0.06)
Explained part	0.02	0.15***	0.10***	0.02	0.03
	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Unexplained part	**0.03**	**-0.13*** **	**0.09*** **	**0.20*** **	**0.18*** **
	(0.03)	**(0.02)**	**(0.02)**	**(0.04)**	**(0.06)**
N	23980	23980	23980	23980	23980
Controls					
Ability Proxy	YES	YES	YES	YES	YES
Prefecture	YES	YES	YES	YES	YES
Ethnicity	YES	YES	YES	YES	YES
Gender	YES	YES	YES	YES	YES

Notes:

a) Region-level dataset

b) Results for subject exams are reported in terms of z-scores.

c) *** p<0.01, ** p<0.05, * p<0.1

Table 6. Simulated Admission Results for Revised HSEE
(Excluding Politics and English Subject Exams from the HSEE)

High School Quota	23980
Elite High School Quota	9506
Rural Enrollment in High school	13233
Rural Enrollment in Elite HS (ranked by original HSEE)	4322
Rural Enrollment in Elite HS (ranked by revised HSEE)	4506
Increase in Rural Enrollment in Elite HS	**184**
Ratio of Increase in Rural Enrollment	**4.3%**

Note: Region-level Dataset

Table 7: Rural-Urban Differences in Applying for Elite High Schools
(Conditional on HSEE Score, County-Level Dataset)

	All Students		Students below the HSEE cutoff		Students above the HSEE cutoff	
	(1)	(2)	(3)	(4)	(5)	(6)
Rural (yes/no)	-0.13**	-0.13**	-0.16**	-0.16**	-0.12**	-0.12**
	(0.06)	(0.06)	(0.07)	(0.07)	(0.07)	(0.07)
HSEE (total) Score	0.26**	0.26**	0.35***	0.35***	-0.23***	-0.22***
	(0.07)	(0.07)	(0.06)	(0.06)	(0.19)	(0.18)
Minority (yes/no)		-0.07		-0.05		-0.12***
		(0.06)		(0.05)		(0.07)
Observations	2,169	2,169	1,409	1,409	760	760
R-squared	0.13	0.13	0.11	0.11	0.06	0.09

Notes:

a) County-level dataset
b) Logit regressions (tests of significance from logit model)
c) Coefficients are presented as marginal effects estimates
d) Cluster-robust SEs (for marginal effects estimates) in parentheses
e) *** p<0.01, ** p<0.05, * p<0.1

Table 8: Rural-Urban Differences in Decision to Go to Elite High School
(Conditional on HSEE Score and Application Choices)

	All Students		Students below the HSEE cutoff		Students above the HSEE cutoff	
	(1)	(2)	(3)	(4)	(5)	(6)
Rural (yes/no)	-0.13***	-0.13***	-0.18***	-0.18***	0.03	0.03
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
HSEE (total) Score	0.32***	0.33***	0.04**	0.04*	0.04	0.04
	(0.03)	(0.03)	(0.03)	(0.03)	(0.18)	(0.18)
Minority (yes/no)		-0.08***		-0.11***		-0.02
		(0.02)		(0.02)		(0.02)
Controls for full set of application choices	YES	YES	YES	YES	YES	YES
Observations	2,169	2,169	1,396	1,396	759	759
R-squared	0.39	0.40	0.21	0.23	0.37	0.37

Notes:

a) County-level dataset

b) Logit regressions (tests of significance from logit model)

c) Coefficients are presented as marginal effects estimates

d) Cluster-robust SEs (for marginal effects estimates) in parentheses

e) *** p<0.01, ** p<0.05, * p<0.1