School Quality and Student Achievement in Kenya[*]

Isaac M. Mbiti[†]

Southern Methodist University

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Abstract

I utilize data from the Kenyan secondary school system to obtain causal estimates of the effects of school quality on student achievement. Whereas most studies on the effects of school quality on student achievement generally face difficulties in obtaining unbiased estimates due to the non-random selection of students into schools, the placement of students into government secondary schools in Kenya is based on national primary schools test scores and district quotas. Using a unique data set containing high school and primary school test scores, district of origin and school level information for every high school exam taker in the country, I compare the high school examination outcomes of students from the same district who had very similar primary school test scores but were assigned to different schools due to the quota. I extend the analysis to examine whether peer effects or school inputs have a greater effect on student performance. .

JEL codes: I21, O12, O15

1 Introduction

There have been numerous studies examining the effects of school quality on student educational achievement. However, despite the large number of studies published over the years, there little to no consensus in the literature regarding the impact of various elements of school quality on student educational achievement. A major criticism of a number of these studies is that they fail to adequately account for the non-random placement of students into schools. If better students attend better schools, then this would lead to upward bias in the estimates of the effects of school quality on student achievement. In this study I circumvent this endogeneity issue by exploiting the centralized system of student placement into secondary schools in Kenya. The placement of students into government secondary schools in Kenya is based national primary school test scores. The process is centralized and performed by the Ministry of Education in Nairobi. Students will gain entrance into elite Public schools if they score above a certain cutoff. Using a regression-discontinuity design, I exploit the random variation around the cutoff point to estimate the effects of school quality on student achievement in the national high school examination. I use a broad classification schools as a measure of quality. Government schools are divided into 3 categories, National, Provincial and District, where National schools are the best schools, Provincial schools are second best type of school, and District schools are marginal schools. Unlike most other countries, Private schools in Kenya generally perform worse than government schools. With the exception of perhaps two or three Private schools, no Private school can compete with the performance of the National secondary schools.

There is surprisingly mixed evidence on the effects of school quality on student achievement. Hanushek (1995) reviews 96 studies that examine the effect of various measures of school quality on student achievement. Of these studies he finds very mixed evidence concerning the effect of class size, teacher education, teacher experience, teacher salary and expenditure per pupil. While Hanushek (1995) paints a gloomy picture on the effects of school quality on student performance, many of the studies cited by Hanushek suffer from identification problems related to endogenous school choice.

Most studies examining school quality have tried to correct of endogenous school choice using the regional availability of schools as an instrument for school choice. Using data from Ghana, Glewwe and Jacoby (1994) examine the effect of school quality on achievement correcting for the selectivty bias using the characteristics of the schools not chosen as an instrument for school choice. They find that teacher experience raised both Mathematics and Reading test scores. Surprisingly, they found that school facilities, such as Blackboards and repairing leaking classrooms had larger effects than teacher experience. There are also a number of studies that examine the effects of different types of schools on student achievement, where type can be thought of as a broad measure of quality. Neal (1997) examines the effect of Catholic Schooling on educational achievement in the United States.

Using variation in access to Catholic schools as an instrument for Catholic school attendance, he finds that for students in urban settings, Catholic school attendance dramatically increased the probability of high school graduation for Minorities, but had small effects on Whites. He argues that Minorities benefited the most from Catholic schools as their public school alternatives were worse than that of Whites. A weakness of Neal's study is that his strategy ignores that fact that parents makes joint residential and schooling decisions. This would invalidate his instrumental variable approach if families that valued education moved to areas with higher access to Catholic schools. Newhouse and Beegle (2006) investigate the effects of different types of secondary schools on the educational achievement of students in Indonesia. They examine the effect of Public schools, Public Madrassah, Secular Private schools, Private Muslim (non Madrassah), Private Religious (Non-Muslim) and Private Madrassah schools on the test scores. They find that students in Public schools and Private non-Muslim Religious schools (e.g. Catholic schools), performed better than students in other schools. As in Neal (1997), they also use school availability as an instrument for the type of school that a student attends. This instrument is once again subject to the same criticism as before, as residential location may be a reflect parental preferences to quality of education, thus invalidating the IV approach.

Other authors have taken different approaches to address issues of quality and student achievement. Angrist and Lavy (1999) use a regression-discontinuity framework to estimate the effect of class size on student achievement in Israel. Using the discontinuity induced by the government policy that governs class size, they find that reducing class size leads to significant scholastic achievement in Mathematics and Reading for fifth grade students. Glewwe et al. (2003) and (2004) evaluate experimental evidence from Kenya to examine the effect of school inputs on student test scores. Using a randomized intervention, Glewwe et al. (2004) find that the provision of flip charts to schools had no effect on test scores. Glewwe et al. (2003) find that the provision of textbooks did not have significant impacts on test scores of students. A potential weakness of these randomized evaluations is that the sample sizes used in these interventions were small. Additionally, the external validity of these estimates is unclear as these trials were conducted in certain region of Kenya.

We argue that the use of a regression discontinuity approach provides a credible estimate of the effects of school type on student achievement. In a small interval around the cutoff, the students will be essentially identical. Additionally since all students in the country take the same examinations, we can use large administrative datasets to examine the effect of school type on student achievement. This allows us to get precise estimates of the effects. Furthermore, in contrast with the small randomized evaluations, this study is covers the whole country. However, the estimates obtained will only pertain to the students around the cutoff. Our estimates indicate that attending better schools is associated with large significant increases in academic achievement. Boys attending elite public schools gained about 10 percentage points in their overall high school examination score,

while surprisingly we see no effect for girls attending elite public schools. We further show that the biggest gains for boys were in the Mathematics and in the Sciences. We show some evidence that suggests that the differences between boys and girls performance in these elite schools is driven by differential resource allocation to these schools. The remainder of the paper is organized as follows: Section 2 provides background information on the contextual setting. Section 3 describes the empirical strategy for estimating the effect of school type on student achievement. Section 4 describes the data used in this paper. Section 5 and 6 provide results while Section 7 provides concluding remarks.

2 Institutional Setting

The Kenyan education system is structured such that students receive 8 years of Primary schooling, 4 years of secondary (or technical schooling) and 4 years of university education. There are approximately 18,000 primary schools in Kenya with a total enrollment of over 5 million students (World Bank, 2004).The net enrollment rate in primary schooling was approximately 76 percent in 2004, while the gross enrollment rate was 110 percent (World Bank, 2007).[1] There are large regional variations in enrollment rates with Northeastern province, the poorest region of Kenya, lagging in enrollment rates. A major constraint in the education system is the lack of access to secondary schools. There are only about 4,000 secondary schools in Kenya, with a total enrollment of approximately 700,000 students, which is reflected in the low 2004 gross and net enrollment rates of 48 and 40 percent respectively and a low primary to secondary transition rate. (World Bank, 2004). The transition rate from primary school to secondary school was approximately 40 percent in 1999. This is mainly attributable to the limited supply of secondary schools although the higher cost of secondary education relative to primary education also contributes to the low primary to secondary transition rate.

At the end of primary school in Standard 8 (Grade 8), students will sit for the national primary school examination, called the Kenya Certificate of Primary Education (KCPE). The KCPE score is currently based on examinations in five subjects; English, Swahili, Mathematics, Science and Social Studies (GHCR).[2] Prior to 1999 the exam was based on 7 subjects, where the additional examinable subjects were arts and music and home science/business. Performance in this examination is the crucial determinant in gaining access to secondary education.

Secondary school Students will sit for the Kenya Certificate of Secondary Education (KCSE) examination at the end of their fourth year of high school (Grade 12). There are a total of 30

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[1] Both Net and Gross Primary school enrollments increased by over 10 percentage points following the introduction of free primary school education in 2003.

[2] Social studies are Geography, History, Civics and Religious education, commonly referred to as GHCR

examinable subjects in the KCSE examination. Students take a minimum of seven subjects and a maximum of nine. English, Swahili and Math are compulsory subjects, while students must sit for 2 examinations in the sciences, a humanity and a practical subject[3] Admission to universities is again based on performance in this examination. Students scoring above C plus average can gain admission to the public universities, however due to the limited space students now need a B plus average to be certain of admission.

After gaining independence from the United Kingdom in 1963, the Kenya Commission on Education promoted the use of secondary schools as vehicles to promote national unity (Gould, 1973). Instead of adopting the Commission's proposal of a uniform quota system throughout the country, whereby each secondary boarding school would have at least twenty percent of its student body from other regions, the Government instituted a three tiered system based primarily on merit and secondarily on region (Gould, 1973). The top tier, National Schools, are the most prestigious secondary schools in the country. These schools admit the top performing primary school candidates from across the nation and are consistently among the top performing secondary schools in terms of the KCSE examination. Relative to other schools, they have both better teachers and better facilities. The second tier, Provincial Schools, will admit the top remaining students from the province. The bottom tier, District schools, will draw students from the district who could not gain admission into National or Provincial schools. Generally speaking, National school students will outperform students from all other schools, while students from Provincial schools tend to perform rather well but students at District schools generally perform poorly and are unlikely to score above a C grade. Private schools are mainly concentrated around cities. Private schools follow the same curriculum, and utilize the same materials as Public schools as all students must take the same high school examination. There is a substantial amount of variance in the performance of Private schools. Although there are some elite Private schools, in general Private Secondary school performance is substantially lower than the performance of National and Provincial Schools.

A newsletter published by an NGO, the Nomadic Kenyan Children's Education Fund (NKCEF), vividly described the differences between these schools. The newsletter describes a District school that is located within the community it serves as a school with no electricity except in the administration building, where students have to use their own kerosene lanterns to study in the evening. It adds that each dorm room houses 18 students where the whole dorm shares one sink and one latrine and students even have to provide their own dishes in the dining room. The school is described to have mostly old books and newspapers in the library and a rudimentary computer lab with six donated computers that run on a generator (NKCEF,2004). The newsletter further describes a Provincial school in the same community as one with similar physical facilities to the

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[3]Sciences include Biology, Physics or Chemistry. Humanities include Geography, History and Religious Studies. Practical subjects include Computer Studies, Commerce, Art and Design, Home Science, Carpentry, Metalwork, Music, Accounting, French, Arabic and German among others.

District school but with a greater number of buildings having electricity. According to the NGO, at the time of publication the Provincial school had 820 students and a total of 34 teachers out of whom 24 were university graduates. The newsletter finally describes a National school as one that "In stark contrast to the District and Provincial schools, ... boasts a large, bright dining hall and assembly building, faculty housing, a computer center and a several-storied library with large plate glass windows" (NCKEF, 2004). Although the newsletter does not provide statistics on teachers at this National school, it is clear that almost all teachers at National schools would be university graduates. These descriptions capture the vast differences in quality of education across this tier, but it should be noted that there is substantial variation in school quality and facilities within each tier.

While there are 30 subjects in the KCSE syllabus, very few schools offer more than 12 subjects due to the high cost of acquiring the facilities and instructors. As Table 1 shows, the National schools offer an average of close to 20 subjects whereas Provincial schools offer about 14 subjects and District and Private schools both offer about 12 subjects. It is also interesting to note that the extra subjects offered are quite costly as they require special teachers and in many cases special facilities. For example, almost all National schools will offer foreign languages such as French and German and also offer computer studies.

The 2003 Ministry of Education guidelines stipulated that tuition and boarding fees at National schools be 26,900 Kenyan Shillings, while the fees at Provincial schools were set at 20,900 Shillings.[4] However data gathered from a National school and a Provincial school in Nairobi show that schools charge sums far in excess of these guidelines. The National school in Nairobi that we contacted reported that they charged about 70,000 Shillings, while the Provincial school reported that they charged 50,000 shillings which is almost triple the amount set by the government. Although it is clear that National schools receive more funds from the government than Provincial schools, we do not have data on government expenditures to these schools to asses the size of these differences.

Placement of students into government schools is performed by the Ministry of Education in Nairobi. The Ministry selects candidates into National schools overwhelmingly on performance. However, due to the policy of national unity they will make some ad -hoc adjustments to ensure regional equality in terms of access. Conventional wisdom suggests that students who scored above 400 out of 500 on the KCPE would gain admission to National schools.[5] While we were unable to verify this with the Ministry of Education, they did inform us that the selection into National schools was based on merit. As Table 1 shows, there are only 18 National schools in the country, with approximately 3,500 exam takers in 2005, representing about 1.5 percent of the exam takers in 2005. There were 864 Provincial schools with 34 percent of the exam candidates, 3305 District schools with 52 percent of the candidates and 696 Private schools, with 12 percent of the candidates.

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[4]This translates to approximately $360 in National Schools and $280 in Provincial schools.

[5]The 400 cutoff is usually cited in newspapers such as the Daily Nation (www.Nationmedia.com).

Further more Table 1 shows that the average quality of National school students was significantly higher than at other schools and these students consequently outperformed their peers in the high school (KCSE) examination scores. The average student at a National school scored approximately 78 percent on the primary school (KCPE) examination, while Provincial school students scored 61 percent and students at both Private and District schools scored an average of 53 percent. In terms of high school examination performance (KCSE), we see similar patterns where the average score at National schools was approximately 75 percent, while the average score at Provincial schools was 52 percent and the Private and District schools students averaged 37 percent

3 Estimation Method

I exploit the Ministry of Education's selection policy using a regression discontinuity design (RD) framework. If students were placed randomly into schools, then we could estimate the treatment effect of attending a National school as follows:

$$Y_i = \beta_0 + \beta_1 T + \varepsilon_i \tag{1}$$

Where Y_i is the outcome variable, in this case high school test scores. T_i is a binary variable that indicates if the student attended a National school and ε is the idiosyncratic error. Unfortunately, students self select into schools, whereby better students attend better schools. This will cause T and ε to be related and thus OLS estimates of equation 1 will produce inconsistent estimates of T. However, we can exploit the selection policy to circumvent this issue. We know that selection into schools is based almost exclusively on the score of the primary school test denoted by A_i. Students are offered a place into a National school if their score is above the cutoff such that

$$O_i = 1 \text{ if } A_i > U \tag{2}$$
$$0 \text{ otherwise}$$

Where O_i is a binary variable indicating receipt of a place in a National school, A_i, is the primary school test and U is the cutoff score. Actual attendance at a National school is going to be a function of the O_i such that

$$T = \delta_0 + \delta_1 O_i + \nu \tag{3}$$

Since National school attendance is partly determined by a discontinuous function of test scores, we can employ a discontinuity design to estimate the treatment effect of attending a National

school. In traditional application of regression discontinuity also known as the sharp RD design, the assignment of treatment status is completely deterministic (Van Der Klaauw, 2001). However, in our application the assignment of treatment status is stochastically where the probability of treatment (or the propensity score, $\Pr(T = 1|A)$) has a discontinuity at the cutoff. This design, known as the "fuzzy regression-discontinuity" was explicitly cast into an Instrumental Variable framework by Van der Klaauw (2001) and implemented by Angrist and Lavy (1999). Here the stochastic nature of the problem arises due to the endogenous uptake of the treatment. Uptake is stochastic as students may decide to go to Private school or as in many cases cannot afford to go school.[6] Following Angrist and Lavy (1999), we can estimate the "fuzzy regression-discontinuity" using the discontinuity in the National school offer as an instrument for attending a National school.

Following Van Der Klaauw (2001), under the "fuzzy RD" design β_1 is identified by:

$$\frac{\lim_{A\uparrow U} E[Y|A] - \lim_{A\downarrow U} E[Y|A]}{\lim_{A\uparrow U} E[O|A] - \lim_{A\downarrow U} E[O|A]} \tag{4}$$

where the denominator of equation 4 is non-zero due to the discontinuity. Equation 4 estimates the "Treatment effect on the Treated" and is essentially the IV estimator. The identification assumption here is that as the region around the discontinuity gets smaller the individuals above and below the cutoff are essentially identical. Thus we would expect that in the absence of treatment, these students would have similar outcomes in terms of academic achievement. It is important to note that the estimate of β_1 only pertains to those students at the cutoff and it cannot inform us of the treatment effect at other points of the primary school achievement distribution.

To implement this strategy I estimate the following instrumental variable regression within a small interval around the cutoff point where I instrument T using the cutoff score and introduce a set of controls, X,

$$Y_i = \beta_0 + \beta_1 T_i + \beta_2 X_i + \varepsilon_i \tag{5}$$

I employ a variety of intervals around the cutoff. I first use a five point interval around the cutoff as my baseline, and then use a three point interval and finally a one point interval.

4 Data

The data used in this study are administrative records provided by the Kenya National Examination Council. KCSE examination registration information provides information on the students age, gender and district of birth. It also provides information on the performance on each subject examination taken and which school they were enrolled in. The KCPE data contain similar

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[6]There are very few elite private schools and these are almost all located in Nairobi. Only two to three Private schools consistently perform at the level of National Schools.

information collected at the primary level. The data also contain information on the student's preferences for schools. Students are required to select 2 schools of each type (National, Provincial and District) to as an indication of their preferences. The ability to link these two data is feasible due to the availability of prior examination information collected at registration. Candidates registering for any examination are required to provide prior registration information for the last examination they took (if any). This information includes the prior candidate number and the year of examination which allows us to match the KCSE data to the KCPE data.

I link the 2001 KCPE examination records to the 2005 examination records. There were 260,643 high school exam takers in 2005 and 514,076 primary school exam takers in 2001. I exclude high school examination repeaters from the data as they would have taken their KCPE examination in a different year. Linking the records together and excluding the KCSE repeaters from the data, leaves us with a sample of 254,384 students taking the exam in 2005. The data have limited information on school and individual attributes. The data have information on whether the school is a boarding school, and whether the school is a single sex school or a mixed school. However, the data do not have information on teachers, school facilities, and other measures of school quality. Additionally, there are also no household level characteristics in this data such as parental education or wealth.

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