Abstract Title Page
Not included in page count.

Title:

Single-Sex Schools, Student Achievement, and Course Selection: Evidence from Rule-Based Student Assignments in Trinidad and Tobago

Authors and Affiliations:

C. Kirabo Jackson
Northwestern University, Institute for Policy Research, and NBER
Abstract Body

Limit 4 pages single-spaced.

Background / Context:
Description of prior research and its intellectual context.

The merits of single-sex schooling have been fiercely debated in European, Latin American, and Caribbean nations where single-sex schools are prevalent. This debate has recently been ignited in the US with the passage of Title IX regulations making it easier for school districts to provide single-sex schools (Weil 2008, Medina 2009). If students have better academic outcomes in single-sex than coeducational schools, then overall educational attainment can be increased by merely shuffling students across schools to achieve sex-segregation. Also, if single-sex schooling reduces gendered course taking, it may lead to more efficient allocations of talent to courses and improved matching of workers to occupations. Under these scenarios, by making all schools single-sex, with no increased spending one can have a better educated population and cost-savings that can be put into productive sectors of the economy.

One justification for single-sex education stems from the notion that boys and girls learn in different ways either due to different socialization or biological differences so that single-sex schools allow teachers to tailor instruction to the particular needs of each sex. Another justification is that the presence of the opposite sex is distracting and leads to lower academic engagement (Coleman 1961, Riordan 1990, Trickett and Trickett 1982). This is thought to be particularly important for girls because larger shares of boys within coed classrooms have been found to be associated with lower classroom achievement (Lavy and Schlosser 2009, Hoxy 2000). It is also argued that single-sex schooling increases the likelihood that boys/girls participate in traditionally female/male subjects either due to the salience of gender identities in coed settings (Jackson 2009) or by deemphasizing differences in the timing of neurological development between boys and girls (Spieelhofer et al. 2004, James and Richards 2003).

Despite theory suggesting benefits of single-sex schools, and the potential importance for education policy, there is little conclusive empirical evidence on the effects of single-sex schooling on student outcomes. The empirical evidence, to date, is based on comparisons between children who chose to attend single-sex schools and those who do not. This evidence is unlikely to isolate the effect of single-sex schooling on student outcomes due to two important limitations. First, because students who decide to attend single-sex schools may differ from those who decide to attend coed schools in important unobserved ways, such comparisons may be subject to self-selection bias. Second, because single-sex schools often differ in important unobserved ways from coed schools (e.g. curriculum, academic calendar, selectivity) these comparisons may confound a single-sex school effect with other differences. I propose solutions to both of these limitations in this study.

2 In 2006 Title IX regulations of the Education Amendments of 1972 were amended. Previously regulations permitted school districts to provide single-sex public schools only if they provided comparable single-sex public schools to both sexes. The new regulations only require providing equal coed schooling to students of the other sex (McLane et al 2006).
3 Pomerantz, Altermatt and Saxon (2002) and Beyer and Bowden (1997) find that girls are under-confident and Higgins (1991), Maccoby and Jacklin (1974), and Eagly (1978) find that girls care more about pleasing authority figures.
4 Lenroot, et al. (2007) find that girls complete about half of their brain development (as measured by adult mass) by age 11 compared to age 15 years for boys, and Killgore and Yurgelun-Todd (2004) find that in girls the language areas of the brain develop before the areas used for spatial relations and for geometry, while in boys, it's the other way around.
5 Because girls develop the math portions of the brain later than boys (Killgore and Yurgelun-Todd 2004), they are more likely to underperform in math and science at early ages and thus disengage from and avoid these subjects in a coed one-size-fits-all system. By the same logic, because boys develop the linguistic portions of the brain later than girls, boys are more likely to underperform in English and literature at early ages and disengage from and avoid these subject in coed settings.
6 Some US studies compare outcomes at single-sex catholic schools to outcomes in traditional public schools or coed catholic schools, (Lee and Bryk 1986, Marsh 1989, LePore and Warren 1997) while studies outside the US compare outcomes at single-sex and coed public schools (Jimenez and Lockheed 1989, Harker 2000, Malacova 2007). The findings are decidedly mixed and none of these studies adjust for selection to schools (other than controlling for lagged achievement).
Purpose / Objective / Research Question / Focus of Study:
Description of the focus of the research.

Using data from Trinidad and Tobago I aim to answer the following questions: (1) Does attending a single-sex secondary school from grades 6 through 10 affect 10th grade exam performance? (2) Do students with stronger preferences for single-sex schools experience larger benefits? (3) Do the effects vary by gender? (4) Do single-sex schools affect the course selection of girls and boys? This context is attractive for studying single-sex schools because about one quarter of public secondary schools are single-sex and institutional details allow one to remove self-selection bias while comparing students at coed and single-sex schools that are similar along key dimensions.

Setting:
Description of the research location.

I use data from Trinidad and Tobago. This context is attractive for studying single-sex schools because about one quarter of public secondary schools are single-sex and institutional details allow one to remove self-selection bias while comparing students at coed and single-sex schools that are similar along key dimensions.

Population / Participants / Subjects:
Description of the participants in the study: who, how many, key features, or characteristics.

The study covers all students entering secondary school in Trinidad and Tobago from 1995 through 2003. There are 123 schools covered in this study of which 34 are single sex.

Intervention / Program / Practice:
Description of the intervention, program, or practice, including details of administration and duration.

> Insert text here.

Research Design:
Description of the research design.

To address self-selection bias, I exploit the fact that students in Trinidad and Tobago are assigned to secondary schools by the Ministry of Education based on their performance on a secondary school entrance exam and a list of school choices — so that attendance to single-sex schools is partially beyond their control. I use the algorithm that assigns students to schools to form rule-based instrumental variables that predict single-sex school attendance, but are not subject to selection. Under the assignment rules the likelihood of assignment to a single-sex school is a deterministic, non-linear, non-monotonic, non-smooth function of student choices and incoming test scores. Specifically, (a) conditional on two students having the same test score, differences in school assignments are due to their different choices, and (b) conditional on two students having the same choices, differences in school assignments are due to small differences in their test scores. This allows for both a Regression Discontinuity (RD) strategy and a Difference-in-Differences (DID) Instrumental Variables (IV) strategy that identifies the causal relationship off the interaction between student choices and test scores. I show that each of the two strategies independently yield similar results to each other and the preferred IV strategy that exploits all sources of exogenous variation. I also present a variety of tests indicating the instruments are exogenous.

To address concerns that single-sex schools differ from coed schools in other important ways, I
focus the analysis to coed and single-sex public secondary schools that share the same curriculum, are subject to the same oversight, and follow the same regulations. As such, the single-sex and coed schools analyzed will not differ in most important dimensions that typically confound comparisons of schools in other contexts. While focusing on similar schools removes numerous sources of bias, there may still remain unobserved differences across schools that affect the interpretation of the findings. I document that single-sex schools are more selective than coed schools and they attract higher quality teachers. Based on this, I argue that the effects presented likely overstate the pure single-sex schooling effect.

A unique feature of these data is that I observe the number of single-sex schools a student lists in her school choices. Because this preference measure is strongly associated with single-sex school attendance, I can (a) determine if the treatment effect varies with preferences for single-sex schools, (b) determine if the treatment effect for those who typically apply to single-sex schools differ from that of the average student, and (c) speak to whether improved outcomes reflect better student-school matching or a technological improvement that benefits all students. The analysis is unique in this regard.

**Data Collection and Analysis:**
Description of the methods for collecting and analyzing data.

Data were collected from the ministry of education in Trinidad and Tobago.

**Findings / Results:**
Description of the main findings with specific details.

Under the assignment mechanism, students with higher entrance exam scores are more likely to be assigned to their more preferred schools. Because single-sex schools are often preferred, attending a single-sex school is also associated with attending a preferred school. While naive ordinary least squares yield large treatment effects, the instrumental variables results that account for selection show modest positive effects of gaining admission to a preferred single-sex school over a less preferred coed school. However, models that condition on gaining admission to a preferred school (of any type) yield treatment effects close to zero — indicating that the modest effects were due to gaining admission to a preferred school rather than attending a single-sex school per se. These average null effects mask considerable response heterogeneity. For students with weak preferences for single-sex schools (86 percent of all students) the effects are close to zero. However, for students with strong preferences for single-sex schools (14 percent of all students), there are sizable benefits. Most of the estimated benefits to attending single-sex schools are driven by girls with strong preferences for single-sex schools. Contrary to common belief, girls took fewer science courses and more traditionally female subjects at single-sex schools.

**Conclusions:**
Description of conclusions, recommendations, and limitations based on findings.

The results suggest that previous studies may have suffered from student-selection bias. The finding of heterogeneous treatment effects highlight that local treatment effects of schools for the typical applicant can be very misleading about effects for the average student. The results suggest that making single-sex schools available to those few students with strong preferences for single-sex schools may improve academic outcomes for these few students, but that expanding single-sex secondary schools to all students may have little effect on overall achievement, and may not be an effective tool for increasing female

---

7 Because school policies and inputs adjust endogenously in equilibrium to the student population, one could never expect a real-world situation where the only thing that differs between schools is whether they are single-sex. As such, a controlled randomized experiment in which the only thing that differed is that some schools were single-sex would not identify the policy relevant parameter (but would identify the short-run effect of making some schools single-sex). Thus, looking at actual schools, while imperfect, does allow one to say something about the policy relevant long-run effects.
representation in math, science, and engineering fields.
Appendices
Not included in page count.

Appendix A. References
References are to be in APA version 6 format.


McLan, Katherine, Chad Colby, Samara Yudof and Jim Bradshaw "Secretary Spellings Announces More Choices in Single Sex Education Amended Regulations Give Communities More Flexibility to Offer Single Sex Schools and Classes" US department of Education Press Release October 24, 2006


Appendix B. Tables and Figures
Not included in page count.