The Causal Effect of Single-Sex Schooling on Education and Crime for Low-Achieving Students: Evidence from School Conversions to Single-Sex in Trinidad and Tobago

By C. Kirabo Jackson

In 2010, the Ministry of Education in Trinidad and Tobago converted 20 low-performing pilot secondary schools from coed (coed) to single sex. I exploit the within-school conversions to identify the causal effect of single-sex schooling holding other school inputs constant. After accounting for student selection, both boys and girls in single-sex cohorts at pilot schools have about 0.25 standard deviation higher test scores and course grades. Additionally, the all-girls cohorts have less high school dropout, and the all-boys cohorts have fewer arrests. Consistent with models of tracking, additional tests show that these single-sex effects reflect both direct gender peer effects due to interactions between classmates and indirect effects generated through changes in teacher behavior. Importantly, these benefits are achieved at zero financial cost. (JEL I20, J00)

It is well-documented that boys and girls often react differently to the same educational interventions and contexts.2 Also, some education-related problems appear to be gender specific; for example males are disproportionately likely to have behavior problems, and females are underrepresented in math and science fields. In addition, recent studies find that, in some contexts, boys and girls have better academic performance when exposed to more same-sex peers in the classroom (Lu and Anderson 2015, Whitmore 2005).3 These research findings, have led some to advocate for single-sex education – a form of tracking such that boys and girls are educated in separate classrooms or schools. This paper presents the first analysis of a large-scale policy to expand single-sex public-school education. This paper analyzes the effect on academic achievement and crime of a policy experiment in Trinidad and Tobago under which twenty low-performing coeducational (hereinafter coed) schools were converted to single-sex.

---

1 Jackson: Department of Education and Social Policy, Northwestern University, 2120 Campus Drive, Evanston 60660 (kirabo-jackson@northwestern.edu). I thank …….
2 For example, Jackson (2010) and Deming, Hastings and Staiger show that girls benefit more from attending better schools than do boys. For example Pan et al find that girls tend to underperform relative to boys in high stakes testing contexts, and girls appear to have improved outcomes in MTO while boys outcomes are worse (ref).
3 Two well-known papers on gender peer effects, Hoxby 2001 and Lavy and Schlosser (2012), find that all students benefit from having more female classmates. However, the extent to which this is universally true across social context, age, and achievement level is unknown.
More than one-third of Americans feel that parents should have the option of sending their children to single-sex schools (Howell, West and Peterson 2008). Also, parents in other nations perceive single-sex schools as being superior to coed schools (Jackson 2012, Park et al 2013). These beliefs are supported by casual observational evidence. In the United States, Urban Prep Academy, Boys Latin, Eagle Academy, and Ivy Prep all enroll low-income ethnic-minority students and boast graduation and college-going rates well above average for schools serving similar populations (Chavous 2013). Outside of the United States, single-sex schools tend to have better outcomes on average than coed schools (e.g. Trinidad and Tobago, Korea, and the United Kingdom). Because of possible student selection to schools, it is unclear whether these apparent successes reflect causal relationships. More importantly, even if the relationships are causal such that single-sex schools do improve student outcomes, because schools do not become single-sex at random, these benefits may not be due to single-sex education *per se*.

In theory, holding other schooling attributes fixed, single-sex education may improve outcomes because (a) single-sex classrooms allow for instruction tailored to the specific needs of each sex, (b) single-sex classrooms may allow the teacher to better focus in instruction and (c) the presence of the opposite sex may be distorting and affect social dynamics in ways not conducive to learning. If it were to work, single sex instruction would be tremendously cost effective as it involves only the re-allocation of existing resources and no additional financial costs. However, even at a theoretical level, single-sex education may not improve outcomes in all contexts. To help fix ideas, I present a model of single sex schooling based on the (Duflo, Dupas and Kremer 2011) model of tracking. The key insight from this model is that the extent to which single-sex education improves outcomes for any sex (relative to coed education) depends on both (a) the extent to which outcomes for that sex improve in classrooms with larger shares of same-sex peers due to direct social interaction effects, and (b) the extent to which teachers change the alignment of instruction toward that sex between coed and single-sex classrooms (an indirect peer effect). I derive testable implications that I evaluate empirically.

A recent literature has emerged that relies on random or quasi-random assignment of students to schools to compare outcomes at single-sex schools to those at coed schools among
students who are similar in both observable and unobservable ways. Among these, some find positive effects of both all-boys and all-girls schools (Park, Behrman and Choi 2013, Ku and Kwak 2013), some find positive effect of all-boys schools only (Lee, et al. 2014), and others find positive effects of all-girls schools only (Jackson 2012). These cross-school comparisons speak to the question of whether a particular set of single sex schools cause students to have better outcomes than if they attended a particular set of coed schools. For parents, this is important because it speaks to the question of whether a student will be better off attending one group of schools over another. However, because single-sex schools may differ from coed schools in a variety of unobserved ways these cross-school comparison preclude a compelling like-with-like comparison. Indeed, both Jackson (2012) and Ku and Kwak (2013) show that single sex schools in Trinidad and Tobago and Korea tend to have better observable school-level characteristics than coed schools. Accordingly, these cross-school comparisons (while important for parents) do not inform the policy-relevant question of whether students benefit from single-sex education.

To address the limitation in the extant literature this paper aims to (a) use a unique policy experiment to isolate the single-sex education effect from other potentially confounding school characteristics, and (b) determine whether introducing single-sex education into existing low-performing coed schools affects student outcomes. I analyze a policy experiment carried out by the Ministry of Education (MOE) in Trinidad and Tobago that allows one to compare outcomes in single-sex and coed environments holding all other school characteristic fixed. In 2010, the Trinidad and Tobago MOE looked to single sex schooling as possible low cost way to improve student outcomes. The MOE identified 10 pairs (20 in total) of geographically close, similarly sized, low-performing coed public secondary schools. They then selected one school in each pair

---

4 There is a large older research literature on single sex schooling that suffered from student selection bias because researchers were unable to credibly disentangle the effects of single-sex schooling from the characteristics of the students who chose to attend single sex schools (see Jackson 2012 for a review).
5 A Few studies look at single sex classrooms within coed schools. Lee (2014) find that boys have worse outcomes in all-boy classrooms within coed schools.
6 To my knowledge, there is one other paper that addresses this issue. Ku and Kwak (2013) study outcomes at nine single-sex male schools and four single-sex female schools that changed from single sex to coed and find that males performed better in coed environments while females fared worse. Unfortunately, data limitations do not allow the authors of this study to rule out bias due to student selection or selective test taking. Another paper that is likely not subject to this source of bias is (Booth, Cardona-Sosa and Nolen 2013) who randomly assign students to all-girls and all-boys discussion sections in a University Economics course. The authors find positive effects for females and no effect for males. Because gender peer effects likely operate very differently for teenagers than young adults, and college students are a very select slice of the general population, it is unclear that these results will generalize to the context of secondary school children from disadvantaged backgrounds.
to be converted to all-boys and the other to be converted to all-girls. The transition to single-sex schooling was gradual such that the incoming 6th grade cohorts after 2010 were single sex while the previously admitted cohorts remained coed. The selected schools had no control over this decision so that these changes were exogenous to any within-school changes over time. To ensure a clean experiment, the MOE dictated that the curriculum “would not be tampered with” and that there be no other changes at these schools. Because this experiment allows for the comparison of students who attended the same school under both coed and single-sex regimes, one can isolate the effect of adopting a single-sex policy from that of other unobserved differences that might exist between coed and single-sex schools.\(^7\)

To exploit this policy experiment, I link student admission records prior to secondary school entry to national examination data taken in secondary school three years later, and the secondary school leaving examination taken five years. These data allow me to analyze the effect of single-sex education on a broad array of academic outcomes. These outcomes include standardized test performance and course grades in a variety of subjects (including non-academic subtests such as physical education), the choice of which upper level subjects to take, high school dropout and completing high school with a school leaving credential. I also link the secondary school admissions data with arrest records to present the first analysis of the effect of single-sex education on juvenile crime. I supplement these administrative data with survey data collected during the policy experiment to present evidence on mechanisms, and test the theoretical model.

To identify the effect of the transition from coed to single sex holding other school inputs constant (i.e. a single-sex effect), I compare the outcomes of student cohorts who attended the same secondary school but who were admitted under coed versus single-sex regimes (i.e. before versus after the phased transition to single-sex). In many instances these cohorts attended the same schools at the same time so that school inputs are unchanged across cohorts. While this transition allows one to hold both other observed and other unobserved school inputs fixed, it does not ensure that the student populations are comparable across cohorts. To address this concern, I exploit the fact that schools in Trinidad and Tobago assign students to secondary schools based on a known

\(^7\) Similar arguments are made in (Fryer 2014) and (Jackson 2013) that the injecting the best practices of successful schools into regular schools may not yield the same effect as that of attending a successful school versus a regular school. While the student level differences across schools are interesting to parents, they can only provide suggestive evidence on what school practices and policies drive the effect. Only by comparing outcomes when a school changes its practices (holding other practices fixed) can one speak to the broad policy question of how to improve schools.
algorithm (Jackson 2010, 2012, 2014). I exploit discontinuities in the school assignment rules to isolate exogenous variation in school attendance and remove bias due to student selection to schools. In essence, I combine exogenous variation in school assignments with exogenous within-school changes in single sex status to compare the causal effect of attending an experimental school in the coed regime to the causal effect of attending that same school under the single sex regime. I present several empirical tests that this strategy is valid.

Simple comparisons show that all-boys cohorts within pilot schools had much worse outcomes than coed cohorts, while all-girls cohorts had better outcomes. However, using exogenous variation and including controls for student selection, I find large positive effects of about 0.25σ on both boys’ and girls’ academic achievement on test taken 3 years after secondary school entry. Importantly, I document that relying only on cross-school variation does not isolate the effect of single-sex education, and confounds any correlated school-level effects with the single-sex education effect—validating the use of within-school variation. While boys improve in both academic subjects and non-academic subjects (i.e. art, physical education, and technology), girls only improve in academic subjects. The positive effects for girls were similar across all academic subjects and were not just driven by math and science—counter to claims that single-sex education largely improves girls outcomes in male-dominated subjects. Further analysis reveals that the positive test score effects are driven largely by improvements in the lower tail of the achievement distribution. Looking at non-test score outcomes five years after secondary school entry, boys are more likely to take advanced math while girls are more likely to take advanced English in single sex cohorts. Also, girls are more likely to earn a secondary school leaving credential, while boys are less likely to be arrested—suggesting that single sex education improves both cognitive and soft skills (Jackson 2013, J. Heckman 1999, Heckman and Kautz 2012).

One key limitation of the existing literature on single-sex education is a lack of evidence on underlying causal mechanisms. In an attempt to contribute in this regard, student and teacher surveys were sent out to all pilot schools and a set of geographically close comparison schools in 2013, 2014, and 2015. The surveys were designed to allow one to test for the key mechanisms outlined in the theoretical model. The survey results reveal that gender peer effects may be quite complex. For boys, there may be some negative direct gender peer effects for boys associated with more disruption and distracting peers (consistent with existing studies on gender peer effects such and Lavy and Shclosser 2001), but there is also some positive direct gender peer effects due to
males being less anxious in all boys settings. For girls, the surveys evidence suggests positive
direct and indirect peer effects through less peer distractions, less peer disruptions, and peer
learning. Also, the results suggest some positive indirect peer effects for both boys and girls
operating through teachers behaviors. Consistent with greater alignment to each sex, teachers
encouraged more classroom participation in the all-girls environments and less in the all-boys
classrooms. Importantly, there is evidence of efficiency gains to single sex classrooms (likely due
to greater classroom homogeneity) because teachers spend more on-on-one time with students in
both all-girls and all-boys classrooms. The pattern of positive effects overall for all groups are in

To put these effects into perspective, these estimated test score effects are as large as those
found from reducing class size by 30 percent, increasing teacher quality by two standard
deviations, or providing teachers with large increases is performance based pay. In this context,
by leveraging the power of both direct and indirect social interaction effects, single-sex education
promotes greater allocative efficiency of students to peers and was able to have similar effects as
large expensive interventions at zero financial cost. Importantly, the theoretical model provides
some guidance regarding which contexts to which these results may generalize.

This paper makes a few contributions to existing literatures. First, it lays out a theoretical
framework within which to understand the effects of single-sex education. This model, in
conjunction with rich survey data allow for the investigation of casual mechanisms not possible in
previous studies. This paper also contributes to the empirical literature on single-sex education by
exploiting within-school variation in single-sex education that allows one to isolate the casual
effect of single sex instruction from that of other potentially confounding differences that might
existing across single sex and coed schools. Also, this is the first paper to identify the policy-
relevant effect of converting coed schools to single-sex. The results also contribute to the literature
on gender peer effects; they present new evidence on the nature of gender peer effects, distinguish
between direct and indirect effects, and present new evidence on mechanisms. The findings also
speak to broader literatures on how certain types of schools can help economically disadvantaged
youth (e.g. Fryer 2013, Deming, Hastings, and Staiger 2013).

Even though these results indicate positive single-sex schooling effects, single sex
schooling may not improve outcomes in all contexts. As indicated by the model and supported by
the data, single sex schooling is most likely to improve outcomes in setting where students benefit
from being with same gender classmates and classroom instruction is not well aligned to the needs of any sex. This suggest that further research is needed in different contexts with special attention paid to underlying causal mechanisms. It is important to note that while this study find positive effect on a broad set of academic outcomes, socio-behavioral outcomes, dropout and crime, I cannot rule out possible negative effects in other unmeasured outcomes.

The remainder of the paper is as follows: Section I lays out a simple theoretical model of single-sex schooling and derives some testable predictions. Section II describes the policy landscape, the policy experiment, and describes the data used in the study. Section III lays out the empirical strategy. Section IV presents the main empirical results, robustness checks and evidence on mechanisms. Section V presents a discussion and concludes.