



# Mean and distributional impact of single-sex high schools on students' cognitive achievement, major choice, and test-taking behavior: Evidence from a random assignment policy in Seoul, Korea



Hosung Sohn\*

Center for Policy Research, Maxwell School of Citizenship and Public Affairs, Syracuse University, 426 Eggers Hall, Syracuse, NY 13244-1020, USA

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## ABSTRACT

Single-sex schooling has been considered in many countries as a way to promote student achievement. This paper estimates the mean and distributional impact of single-sex high schools on students' cognitive achievement, major choice, and test-taking behavior—by exploiting the random assignment policy adopted in Seoul, Korea. Based on administrative data for a period of seven years, I find that, on average, the positive effects of single-sex schooling on test scores are small, especially when the parental and teacher sorting are accounted for. Although the magnitude of the estimated effects is small, I find that the effect is relatively larger for students in quantiles 0.5–0.8 of the distribution of test scores. The impact is trivial, on the other hand, for students located at the very bottom and the very top quantiles. Moreover, I do not find any differences, both practically and statistically, in major choice and test-taking behavior.

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## 1. Introduction

Parents put much consideration into the choice of educational inputs such as teacher quality inasmuch that their decisions affect their child's academic achievement. Among these inputs, parents are selective in determining their child's peer group, believing that peer groups are an important factor for child's academic and non-academic achievements. One of the peer effects that parents and education policy makers pay attention to is the gender peer effect. This is due, in part, to a pervasive view that students (especially female students) learn better when they are with same-sex peers. Accordingly, implementation of single-sex education has been considered in many coun-

tries and has also been popular in the United States. As such, credible evidence on the efficacy of single-sex education is necessary.

As demonstrated by Manski (1993), estimating the effect of attending a single-sex school is difficult because, in general, it is an endogenous consequence of individual choice. As such, unobservable attributes that determine the selection of a single-sex school and unobservable factors that affect student performance may exist, introducing bias to estimates of single-sex schooling. For this reason, there is relatively little convincing evidence on the effects of single-sex education despite a long literature on single-sex schooling. The most convincing method for addressing the endogeneity problem is to randomly assign students to single-sex and coeducational schools. Middle school students in Seoul, the capital of South Korea, are randomly assigned to either a single-sex or coeducational high school

\* Tel.: +1 510 926 1211.

E-mail address: [hsohn@syr.edu](mailto:hsohn@syr.edu), [sohnhosung@gmail.com](mailto:sohnhosung@gmail.com)

upon graduation. Hence, in this study, I exploit this random assignment policy to analyze the effect of attending single-sex school.

Ideally, one needs information on the initial assignment of students to fully leverage the benefits of a randomized experiment. The data used in this study, however, do not contain this information. As documented by Krueger (1999) and Krueger and Zhu (2004), there may be potential biases associated with not complying with the initial assignment as well as differential sample dropout rates. In the results to follow, I present some facts and statistical tests to argue that these may not be a large source of bias in this study (see Section 5.2 and 5.3). I further note that the data used in the analyses are limited because some information is lacking at the individual level, and these limitations do not allow me to conduct ideal tests of balance in baseline student characteristics. I argue, however, that the baseline student covariates are balanced across the two types of schools by analyzing school-level data that are derived from student-level data.

Note that random assignment of students to either a single-sex or coeducational school solves the endogenous selection of students into either of these schools. And comparing student achievement in single-sex schools with that of coeducational schools will provide an effect of “attending” single-sex schools. This comparison, however, provides less insight unless one speaks to underlying mechanisms. That is, because we are making comparisons across schools, it is important to identify the differences between the two types of schools that might give rise to the estimated effects. Moreover, to draw policy implications from analyzing the effect of single-sex education, it is desirable to derive an effect estimate that is not driven by many kinds of factors—the estimated effects are likely to be driven by differences in school-, teacher-, and student-related characteristics. In Korea, school characteristics (e.g., school resources and curricula) are extremely homogeneous across high schools because the government is strongly committed to establishing homogeneity in these characteristics.<sup>1</sup> On the other hand, the case may not be true for teacher quality. If we believe that teachers may prefer to teach in single-sex schools, it is likely that such schools may have more qualified teachers because they will be the ones, among their competitors, to get the job. Provided that single-sex schools have better teachers, estimated effects on single-sex schooling will reflect both the teacher-related and gender peer-related effects, and we cannot determine the magnitude of the effect of each factor. Hence, it is necessary to control for endogenous sorting of teachers, especially for the case of Korea, so that the estimated effects are not driven by teacher-related factors.

In South Korea, teachers cannot select the public school they wish to work for. Furthermore, neither can a public school choose its teachers. Rather, the Office of Education in each city assigns newly hired teachers to each of their public schools and rotates existing teachers

every five years within the school district.<sup>2</sup> As a consequence of this rigid nature of teacher assignment policy, I find that observable teacher characteristics are equally balanced across both types of public schools. Focusing on public high schools, therefore, is quite favorable for solving the bias associated with endogenous teacher sorting. I note, however, that although the rigid nature of assignment policy adopted in public schools will reduce the amount of teacher sorting that takes place, the estimated effect could still be driven by teacher quality in dimensions that are not measured in the data.

Exploiting the aforementioned setting—random assignment of students, the way in which teachers are assigned to a public school, and homogeneity in school characteristics—I compare test scores of students in single-sex public high schools with those of coeducational public high schools and attempt to derive single-sex schooling effects that are not driven by the differences in teacher- and school-related characteristics. It is important to note, however, that the estimated effects may still reflect other unobservable mechanisms other than the above factors.

In this study, because prior research focuses only on mean effects, I delineate distributional impact of single-sex schooling by conducting an unconditional quantile regression method. Furthermore, I analyze not only the achievement effect, but also look into whether attending a single-sex school affects students’ major choices and test-taking behavior.

The results of the analysis show that, on average, both boys and girls in boys- and girls-only schools scored about two percentile points higher in the reading and English sections of the college entrance exams compared with boys and girls in coeducational schools. Once endogenous sorting of parents and teachers are accounted for, however, the estimated mean effect decreases to around one percentile point for female students, and is close to zero for male students. Moreover, unconditional quantile regressions show heterogeneity in the estimated treatment effects for English exams. Single-sex education is favorable for students in quantiles 0.5–0.8 of the distribution of percentile ranks; the estimated treatment effects for these students are higher than the mean effects. On the other hand, the magnitude of the treatment effect is inconsequential for students at the very bottom and the very top quantiles of the distribution. Hence, although single-sex education may not benefit students, in expectation, it may be desirable for the above-average students.

I also find that single-sex schooling does not affect a student’s major choice and test-taking behavior. When endogenous sorting of parents and teachers are not accounted for, I find that male and female students are 1.2 and 2.9 percentage points more likely to choose a natural science major during high school. Moreover, male students are 2.1 and 3.2 percentage points more likely to take the advanced version of math and science college entrance exams. When such sorting is controlled for,

<sup>1</sup> It is obvious that if these are not balanced across schools, parents will resist the random policy adopted by the Office of Education.

<sup>2</sup> A teacher’s school district will be assigned according to his or her home address. Also, in general, a teacher may not request for an exception to this assignment policy.

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