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Academic performance and single-sex schooling: Evidence from a natural experiment in Switzerland[☆]

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ABSTRACT

We study the effects of random assignment to coeducational and single-sex classes on the academic performance of female high school students who all face the same curriculum. The students' academic performance is observed over a time period of up to four years. Our estimation results show that single-sex schooling improves the performance of female students in mathematics. This positive effect is particularly large for female students with high ex-ante ability. An accompanying survey reveals that single-sex schooling also strengthens female students' self-confidence and renders the self-assessment of their mathematics skills more level-headed.

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1. Introduction

Gender gaps in academic performance, especially in mathematics, continue to be observed worldwide (Guiso et al., 2008; Else-Quest et al., 2010). Since low achievement in mathematics may discourage women from pursuing a career in high-paying occupational fields such as engineering, it is conceivable that the inferior math performance of female students contributes to the persistence of the gender wage gap. The identification of the root causes of gender differences in academic performance is therefore a fundamental economic issue. Especially the relative importance of societal factors as opposed to biological differences influencing the gender gap in mathematics has recently been a focus of economic research.

Our study investigates a particular aspect of the social environment – the gender composition of female students' peer groups in the classroom. So far, the gender composition of peer groups has received little attention in empirical education

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economics due to a lack of suitable data. The gender composition often does not vary a great deal across classes or schools, and the data is almost always plagued with (self-)selection problems which make it impossible to identify the causes of the observed differences in academic performance.

One approach taken in the literature is to consider the dichotomy between single-sex education and coeducation which is also the focus of our study. Lee and Lockheed's (1990) study on ninth-grade students in Nigeria, for example, indicates that single-sex schools improve girls' mathematics achievements and engender less stereotype threat in mathematics.¹ The authors acknowledge, however, that a self-selection bias, i.e. differences between the types of students choosing to attend single-sex and coeducational schools, may to some extent be responsible for their result. This is in line with Halpern et al.'s (2011) conclusion that although single-sex schooling "may at first appear promising, apparent advantages dissolve when outcomes are corrected for preexisting differences" (p. 1706).² Lee and Lockheed's results also suffer from a second selection bias: in the Nigerian all-girls schools considered in this study, mathematics teachers happen to be exclusively female, implying that the authors cannot isolate gender-specific peer effects from a potential indirect peer effect working through the teacher's gender.

Jackson (2012) exploits data from Trinidad and Tobago where the attendance of single-sex high schools is partially beyond the control of the students. After having taken the Secondary Education Assessment (SEA) exam, the Ministry of Education assigns the students to a high school by using a rule-based mechanism which factors in the students' SEA scores and their preference lists of four schools. Making use of this peculiar institutional setup, Jackson employs a cleverly designed difference-in-difference instrumental variables strategy that isolates the effect of the students' preferred school choice from the effect of single-sex schooling. The results indicate that gaining admission to a preferred school (be it a single-sex or a co-educational school) is associated with better educational outcomes. For most students single-sex education does not appear to provide any additional benefits on top of this positive school-choice effect. Only students expressing very strong preferences for single-sex schooling derive some additional benefits, and among this group girls benefit much more from single-sex schooling than boys. An interesting side effect uncovered by Jackson's study is that girls attending single-sex schools take fewer science courses. One may therefore wonder whether the failure to identify stronger all-girls schooling effects, in particular in mathematics, is a consequence of this course-selection effect working in the opposite direction. It is therefore of special interest to explore the effects of single-sex schooling on the math gender gap in reference groups experiencing identical curricula.

Park et al. (2012) analyze the largest natural experiment on single-sex education so far, the random assignment of South Korean students into single-sex versus coeducational instruction in school districts in Seoul. The authors find that attending single-sex schools, rather than coeducational schools, leads to higher test scores and a higher likelihood of attending four-year colleges. The results hold for boys and girls. However, South Korean coeducational and single-sex schools differ systematically in more than one dimension. Most notably, South Korean single-sex schools are more likely to be private schools with a large degree of autonomy in teacher selection and teacher tenure policies.

While the above studies focus on secondary education, other contributions analyze exogenous variation in gender composition in tertiary education. Booth et al. (2013) analyze pass rates, grades, and course choices in a coeducational university in the UK where students were assigned randomly to coeducational or single-sex classes. The authors observe a positive effect of single-sex education on the performance of female students but no effect on their subsequent course choices. Oosterbeek and van Ewijk (2014) do, however, not find any strong effects at a Dutch university where they exogenously vary the shares of females in workgroups for first-year students in economics and business.

The objective of our study is to follow up the literature on gender differences in educational outcomes by investigating the impact of gender-specific peer effects (single-sex education versus coeducation) on the academic performance of female high school students. Our identification strategy exploits a natural experiment at a high school in the German-speaking part of Switzerland. Just as the vast majority of Swiss high schools, this school is run and financed by the local canton and applies standard curricula and teacher recruitment policies. Since the school has a focus on teaching pedagogics it attracts many female students. In order to provide male students with more peers of their gender in their classes the school board assigns incoming female students to coeducational and single-sex classes. Because of this objective the school board does not apply any specific criteria in this assignment of female students to the different types of classes. Moreover, students and their parents cannot influence the assignment so that the assignment is de facto random. The course program at this school comprises four years, which provides us with a micro panel data-set. All students face at each point of their school career the same curriculum in the core subjects. This renders the students' grades in math and German across parallel classes comparable.³

Compared to the traditional research designs of single-sex education studies, we are thus in the fortunate position to perform our investigation in an environment in which the same teachers at the same school teach single-sex and coeducational classes. Moreover, problems of self-selection into classrooms and curricula can be ruled out. Hence, we provide

¹ In this context, stereotype threat represents the experience of anxiety or concern in a situation where a female student faces the risk of confirming the negative stereotype about females' inferior mathematics ability (Steele, 1997).

² Halpern et al. (2011) refer to Marsh and Rowe (1996), Thomson and Ungerleider (2004) as well as Smithers and Robinson (2006).

³ In the first two years, students receive a report card after each semester; in the third and fourth year, they receive only one report card at the end of each year. Hence, up to six grades are recorded for each student per subject.

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