Mixed but not Scrambled
Gender Gaps in Single-Sex Classrooms*

Valentina Paredes†

September 25, 2018

Abstract

In this paper we study the effect on the math gender gap from attending a single-sex classroom in a coeducational school versus a coeducational classroom in a coeducational school. In contrast to the previous literature that has studied the effect of single-sex schools, the advantage of using single-sex classrooms is that we can calculate gender gaps within schools, and therefore the results are not confounded with other school characteristics that may correlate with the gender composition. We find that single-sex classrooms reduce the math gender gap by more than half, with no effect on the language gender gap. The effect is consistent with an increase in the math achievement of female students with no decrease in the achievement of male students. Moreover, this effect is not driven by teacher characteristics, but it seems to be driven by the gender composition of the classroom itself.

JEL codes: I20 J16.
Keywords: Math gender gap; Single-sex schools; Gender composition.

*I thank Fondecyt Inicio, project 11170968, and the Centre for Social Conflict and Cohesion Studies (CONICYT/FONDAP/15130009) for financial support. I would also like to thank Francisco Pino for his comments. The usual disclaimers apply.

†Department of Economics, Faculty of Economics and Business, Universidad de Chile. Email: vparedes@fen.uchile.cl

1 Introduction

Despite the improvements in education, in many developing countries have a persisting gender gap in math test scores. Even within OECD countries, data from PISA 2015 shows that, on average, boys outperformed girls in math by 8 points, which is equivalent to 0.16% of a year of schooling (OECD, 2013). Moreover, for the majority of the OECD countries, the math gender gap did not significantly decrease between 2012 and 2015 with the exception of Korea (Peña-López et al., 2016). In Chile, the subject of this paper, the raw gender gap in a standardized test in math for 10th grade students was 0.13 standard deviations in 2012, although female students represent 52% of the total enrollment and have surpassed men in higher education enrollment since 2009. These gaps in math achievement are especially important because they correlate with future income (Koedel and Tyhurst, 2012), and thus may be contributing to the gender wage gap. It is therefore essential to identify the factors determining this math gender gap, so that society can design policies to erase it.

One factor that is believed to affect the gender gap is the gender composition of the classroom. In particular, there is a prevalent view that single-sex schools are better, especially for female students, and thus can reduce gender gaps in student achievement. Several studies argue that single-sex schools might be better for girls than coeducational schools (Riordan, 1985; Jimenez and Lockheed, 1989; Bryk, Lee, and Holland, 1993; Eisenkopf, Hessami, Fischbacher, and Ursprung, 2015), although there are recent studies that have found no effect for female students (Park, Behrman, and Choi, 2018; Jackson, 2012), and even negative effects (Strain, 2013; Doris, O'Neill, and Sweetman, 2013). Moreover, even if we believe that single-sex schools improve girls? achievement, coeducational schools are generally more convenient for parents with children of opposite sexes especially when travel costs are important. An intermediate solution in terms of convenience for parents that can potentially have some of the benefits of single-sex schools, is to have single-sex classrooms inside coeducational schools. Single-sex classrooms are also a very cheap policy to implement because most schools have more than one class per grade (66% of all high schools in Chile had two or more classes per grade in 2012).

In this paper we study the effect on the math gender gap of attending a single-sex classroom in a coeducational school versus a coeducational classroom. The main identification concern is that schools with single-sex classrooms might differ from schools with coeducational classrooms in other dimensions than the gender composition of the classroom. In addition, students who choose to attend schools with single-sex classrooms might differ from students who choose to attend schools with coeducational classrooms. To alleviate these concerns, we use a school fixed effect approach. That is we study how single-sex classrooms may affect the gender gap within a school.

In contrast to some of the recent literature, our focus is the effect of the gender composition of the classroom on the gender gap, instead of the effect of the gender composition on the individual achievement of boys and girls. Because we study the effect of single-sex classrooms, instead of single-sex schools, we can compute the gender gap within a school. The main advantage of our approach is that by analyzing gender gaps *within schools* we can control for all unobserved school characteristics, which may have biased the results of the previous literature.

To estimate the effect of attending a single-sex class, we use a sample of private, urban, Catholic schools in Chile. These schools are highly selective, and thus are not representative of Chilean schools overall. However, it is an interesting sample to study since one of the main critics of single-sex education is that it "increases gender stereotyping and legitimizes institutional sexism" (Halpern, Eliot, Bigler, Fabes, Hanish, Hyde, Liben, and Martin, 2011). This could be especially relevant for Catholic schools, since Catholicism has been found to reinforce sexist ideologies that legitimize gender inequality (Glick, Lameiras, and Castro, 2002).

Our results show that single-sex classes in coeducational schools can reduce gender gaps in math by more than half. We find that this effect is not driven by teacher quality or teacher-student gender matching. The effect is consistent with an increase in the math achievement of girls that is not driven by changes in the evaluation methods or by teacher characteristics.

The rest of the paper is organized as follows. Section 2 discusses the previous evidence on single-sex education, and some of the mechanisms through which single-sex education may affect student's achievement. Section 3 describes the Chilean educational system and data used in this study. Section 4 describes the identification strategy and presents an indirect test to asses the validity of the identification strategy. Section 5 presents the main results and discusses the possible alternative mechanisms. Section 6 concludes.

2 Gender Peer Effects

The previous literature has shown that the gender composition in the classroom can have an impact on student achievement (Lavy and Schlosser, 2011; Hoxby, 2000). On one hand, boys can be more disruptive than girls, which can have an impact on overall achievement. Also, the gender composition of schools may have an impact on how female students act and perceive themselves. Both Maccoby(1990, 1998) and Lee and Marks (1990) find that women in coed schools held more traditional views of gender roles than women in single-sex schools. Bertrand (2011) notes that teenage girls in mixed environments reinforce traditional gender identities to the extent that they compete with other women to capture the attention of their male peers. Moreover, Maccoby(1990, 1998) suggests that the pressure of women by being surrounded by men is greater than the pressure of men being surrounded by women, so minor or non significant effects are expected for men in single sex schools.

In the same line, some laboratory and field experiments also show that mixed-gender environments can decrease female achievement. Gneezy, Niederle, and Rustichini (2003) compares the performance of women and men in a piece-rate versus a tournament setup. They find that the performance of men substantially improves in the tournament setup. However, women's performance improved in the tournament setup only when their opponents were also women; in the mixed-group tournament, women's performance was not different from the piece-rate setup. This suggests that competition in mixed-sex settings can create a gender gap in performance. Booth and Yamamura (2017) found similar results for speedboat racing in Japan. Women's race time is longer in mixed-sex than single-sex races. Backus, Cubel, Guid, Sanchez-Pages, and Mañas (2016) found that women perform worse in chess tournaments when paired with a male opponent. It is important to notice that both speed boat races and expert chess tournaments are male dominated environments. Other studies that look at environments, tasks, or even societies that are not male dominated find opposite results (Gneezy and Rustichini, 2004; Gneezy, Leonard, and List, 2009; Iriberri and Rey-Biel, 2017).

In the educational literature, early studies that analyzed the effect of single-sex schooling on female student achievement found positive effects (Riordan, 1985; Jimenez and Lockheed, 1989; Bryk, Lee, and Holland, 1993). However, these early studies suffered from selection bias, since students who attend single-sex schools are generally different from those who attend coeducational schools. Recent studies have overcome this problem by studying settings where students are assigned randomly (Park, Behrman, and Choi, 2018; Sohn, 2016) or quasi-randomly (Jackson, 2012) to schools - however, the results of these recent studies are mixed. Park, Behrman, and Choi (2018) study the effect of single-sex schools on students' STEM outcomes for South Korea, and find that all-boy schools are positively related to STEM outcomes, but find no effect for girls-only schools.[1] Sohn (2016) also exploits the random assignment policy used in Korea, and finds a positive but small effect for female students and no effect for male students. Jackson (2012) studies the effect of single-sex schools in Trinidad and Tobago and finds no effect of single-sex schools on students' achievement but does find a negative effect on the probability of taking a science course for girls.

Even though the studies where students are randomly assigned to schools don't suffer from selection bias, the difference between single-sex schools and coeducational schools could be attributed to other school characteristics. For example, teacher quality may vary between coeducational and single-sex schools if teachers prefer to teach in single-sex environments. Sohn (2016) addresses this issue by focusing on public high schools, because the Korean Office of Education assigns new teachers to public schools, and rotates them every five years within the school district. Other studies have used year to year variation in the gender composition of the classroom within a school - that is a fixed effect approach- to identify how a higher proportion of female students can affect student achievement (Lavy and Schlosser, 2011). Lavy and Schlosser (2011) finds that a higher proportion of girls improves both girls' and boys' cognitive outcomes, which can be attributed to lower levels of classroom violence and disruption, improved student-teacher and student-student relations, and a decrease in teachers' fatigue. However, the within school standard deviation in the proportion of female students by school varies between 0.055 and 0.065, so it is not clear if we can extrapolate these results to single-sex schools. Eisenkopf, Hessami, Fischbacher, and Ursprung (2015) studies the case of a high school in Switzerland. Because of the school's focus on teaching pedagogies, it attracts more female than male students. However, the board of the school wanted to provide male students with more peers of their gender, so female students were randomly assigned to coeducational and single-sex classes.[2] The authors find that single-sex

[1] The STEM outcomes studied in Park, Behrman, and Choi (2018) are: math test scores, choice to take the science-math test, which is required to apply to a STEM college major, and choosing STEM college major

[2] In this study, coeducational classrooms had a rather low percentage of male students (only 22% of students in the coeducational classrooms are male)

classrooms improve the performance of female students in mathematics.

3 Institutional Context and Data

3.1 The Chilean Educational System

In 1981, Chile's military government implemented a major educational reform, where a national school voucher was implemented and the management of public schools was transferred from the national government to municipal councils. One important feature of the voucher policy is that it didn't discriminate between private and public schools. Therefore, three types of schools were established: public schools (owned and funded by the State); private, subsidized schools, that is, private school which receive state funding through vouchers; and private, non-subsidized schools. School funding in public and private subsidized schools was basically a function of school enrollment (and proportional to school attendance). In 1993, a new regulation (Law 19,247) allowed private subsidized schools to charge tuition, with progressive discounts over the subsidy, and to select students.[3]

The main goal of the voucher program was to induce competition between schools in order to attract more students, leading to higher quality education (Friedman, 1962). However, the evidence of the effect of the voucher program in school quality has been mixed (see Drago and Paredes (2011) for a review of this literature), and some literature suggests that it has exacerbated school stratification based on socioeconomic status (Elacqua, 2012; Hsieh and Urquiola, 2006). Indeed, 69 % of low socioeconomic status students attend municipal schools (Feigenberg, Rivkin, and Yan, 2017).

3.2 Data

We use data from the Sistema de Medición de la Calidad de la Educación (SIMCE) tests. The SIMCE battery of exams is the main instrument to measure educational quality in Chile (Paredes, 2014). In addition to standardized tests in math and language, the SIMCE collects data on household and teacher characteristics. We also use administrative data on school enrollment from the Ministry of Education (MINEDUC) to identify the gender composition of schools and classrooms. In 2012, we identify 2,547 mixed gender schools,

[3] The discount is proportional to the charged amount, with a maximum discount of 100% when the tuition exceeds three times the value of the voucher.

and only 32 of them had single-sex classrooms for 10th grade. Of these 32 schools, 1 was municipal, 13 were voucher schools, and 18 were private schools. Only one school was vocational, and only one school was rural. Also, 29 out of the 32 schools were Catholic schools (Table A1 in the Appendix).

Table 1 shows that coeducational schools with single sex classrooms are not a representative sample of schools in Chile. Even though we control for school fixed effects in our main specification, we would like schools with single-sex classrooms and coeducational classrooms to be similar. To make schools more comparable, we decided to consider only Catholic, urban, private or voucher schools (in what follows, we will refer to private non-subsidized schools and private subsidized schools simply as private schools). Therefore, we keep 27 schools with single-sex classrooms, and 585 schools with coeducational classrooms. In this restricted sample, students in single-sex classrooms correspond to 4.8% of total enrollment.

Table 1 compares schools with single-sex classrooms to those with only coeducational classrooms, both in the whole sample (Columns 1-3) and in the sample of Catholic, urban, private schools (Columns 4-6). Columns 1-3 in Table 1 show that schools with single-sex classrooms have students with higher parental schooling and income than schools with only coeducational classrooms. Even within our school subset, there is a difference in the socioeconomic characteristics of students who attend schools with only coeducational classrooms and schools with single-sex classrooms (Columns 4-6 in Table 1).

To make schools in our sample more comparable, in addition to restricting the sample to Catholic, private, urban schools, we use propensity score matching to select two restricted samples of schools. First, we calculate the propensity score matching and drop schools with extreme values. Second, we use the two closest neighbours to select schools in our control group. Columns 7-9 and 10-12 in Table 1 compare schools with and without single-sex classrooms in our restricted samples.

[INSERT TABLE 1]

In our preferred sample (Columns 10-12 in Table 1) we have 27 schools (and 2,141 students) with single-sex classrooms and 40 schools (and 2,260 students) with only coeducational classrooms. Schools in both groups have similar observable characteristics. In terms of student achievement, we find that while there is no significant difference in the average math score of male students, the average math score of female students in single-sex classrooms is higher than in coeducational classrooms.

3.3 Gender Gaps in SIMCE Test Scores

Before exploring the effect of single-sex classrooms on the gender gap, we estimate the gender gap for our different samples. First, we estimate the following equation

$$y_{is} = \alpha + \beta Female_{is} + \delta X_{is} + \varepsilon_{is}$$

Panel A in Table 2 shows that the average gender gap in math test scores is 8-10 point, or 0.12-0.17 SD.[4] The gender gap in math in our preferred matched sample closely resembles the overall gender gap, although the gender gap in language is smaller for our preferred sample than for the overall population. We also estimate the gender gap within schools by including school fixed effects (Panel B in Table 2). The gender gap within schools is roughly the same than the overall gender gap.

[INSERT TABLE 2]

4 Empirical Strategy

To measure the effect of being in a single-sex classroom on the math gender gap, we estimate the following regression:

$$y_{is} = \alpha_s + \beta Female_{is} + \gamma SingleSexClassroom \times Female_{is} + \delta X_{is} + \varepsilon_{is} \qquad (1)$$

where i denotes the student, and s denotes the school. The dependent variable, y_{is} is the math standardized test score, $Female$ takes the value 1 if the student is female, and $SingleSexClassroom$ takes the value 1 for students who attend schools with single-sex classrooms. The gender gap in coeducational schools with only coeducational classes is given by β, while the gender gap in coeducational schools with single-sex classrooms is given by $\beta + \gamma$.

The main identification problem when using equation 1 to identify the causal effect of single-sex classrooms on the math gender gap is that female students who attend schools with single-sex classrooms might differ from male students in these schools. To test if this is true, we replace the dependent variable in equation 1 with student observable characteristics. If the interaction coefficient is significant in these regressions, then female students

[4] The gap is nearly the same if we control for parental education and income.

in schools with single-sex classrooms differ from male students, and we won't be able to identify the effect of single-sex classrooms on the gender gap from equation 1. Results in Table 3 show that female and male students in single-sex classes don't differ in observable characteristics.[5]

[INSERT TABLE 3]

In addition, we test whether the main reason for their school choice differs for male and female students in coeducational schools with single-sex classrooms. The SIMCE survey for parents and guardians ask parents their main reason for their school choice. Table 4 shows the results of estimating equation 1 where we replace the dependent variable with a dummy variable that takes the value of 1 if the main reason for choosing the school was distance, values or academic performance. The results in Table 4 show that, in our restricted sample, the main reasons for choosing school don't differ for female and male students in both types of classrooms.

[INSERT TABLE 4]

5 Results

5.1 Effect of Single-Sex Classrooms in Coeducational Schools

Table 5 shows the results of estimating equation 1 using the sample of Catholic, private, urban schools and the two restricted samples. We also run our regressions with and without controls. Our results show that single-sex classrooms decrease the gender gap in SIMCE math scores by more than half. The gender gap in coeducational schools is around 8-10 points while - as shown in the previous subsection - coeducational schools with single-sex classrooms have a gender gap of 2-4 points that is no longer statistically significant.

[INSERT TABLE 5]

[5]Table 3 shows that in the sample of Catholic, private, urban schools, female and male students in coeducational classrooms differ in observable characteristics, but this difference between female and male students becomes insignificant in our preferred sample, matched sample 2. This is because we go from 585 schools to 41 schools with coeducational classrooms from one sample to the other. As we make the schools have more similar characteristics, the differences between female and male students decrease.

Interestingly, single-sex classrooms don't have a significant effect on language test scores (Panel B, Table 5). Therefore, single-sex classrooms seem to benefit female students by decreasing the gender gap in math but don't hurt male students by increasing the gender gap in language. This zero effect in the language gender gap is consistent with the experimental literature that found that a mixed-sex environment decreases female performance only when the task is male dominated. Since girls outperform boys in the language SIMCE, we shouldn't expect an effect in the language gender gap.

Because we are using a fixed effect approach, our methodology doesn't allow us to test whether the decrease in the gender gap is driven by an increase in the scores of female students or a decrease in the scores of male students. To see if the evidence is consistent with an increase of female students' scores or a decrease of male students' scores, we re-estimate equation 1 without the school fixed effect separately for male and female students. Before doing this, we test the robustness of the results to the exclusion of the school fixed effects. Table 6 shows that, although the gender gap in coeducational schools with single-sex classrooms is roughly the same in our three samples, the results for the gender gap in coeducational schools with only coeducational classrooms are only robust to the exclusion of school fixed effects in matched sample 2.[6] Only when using our preferred sample - matched sample 2 - the coefficient of female and the coefficient of the interaction of female and single-sex classroom is not significantly different in the model with and without school fixed effects. Therefore, we will use matched sample 2 to test whether the decrease in the gender gap is driven by an increase in female students' achievement or a decrease in male students' achievement.

[INSERT TABLE 6]

To test whether the results are consistent with an increase in female students' scores or a decrease in male students' scores, we estimate the following equation for female and male students separately using our restricted sample:

$$y_{is} = \alpha_g + \gamma_g SingleSexClass_i + \delta_g X_{is} + \varepsilon_{is} \tag{2}$$

[6] This happens because, while the sample of coeducational schools with single-sex classrooms is roughly the same between the 3 samples, the sample schools with only coeducational classrooms changes from more than 2,500 schools to 41 schools.

where $g \in \{Male, Female\}$. Results are shown in Table 7. The results are consistent with an increase in female students' test scores, and no effect for male students.

[INSERT TABLE 7]

5.2 Alternative mechanisms

Our main hypothesis is that the gender composition of the classroom has a direct effect on the mathematics gender gap. In line with the laboratory and field experiment literature, female students may decrease their performance in mixed-sex environments compared to single-sex environments, especially since if task - in this case math achievement- is considered to be male-dominated. However, there are alternative reasons why single-sex classrooms may decrease this gender gap. First, because female and male students are separated into different classes, with potentially different teachers, teacher characteristics may explain the decrease. For example, it could be the case that female students in single-sex classrooms are assigned to higher quality teachers. Second, even if teacher quality is the same for female and male students, schools with single-sex classrooms can assign students to teachers that match their gender. There is substantial evidence that teacher-student gender matching can improve test scores, especially for female students in math (Paredes, 2014; Nixon and Robinson, 1999; Carrell, Page, and West, 2010; Dee, 2007). Third, because female and male students are separated in different classrooms, if boys and girls learn in different ways, teachers can adapt their teaching to ways that enhance student learning for girls.

In addition to the parent/guardian survey, the SIMCE includes a teacher survey for both the language and math teachers. Teachers were asked about their gender, specialization, certification, experience, type of contract, teaching methods and curriculum coverage, their expectations for their students, and their thoughts about their schools and their principals. With the SIMCE teacher questionnaire we can test some of the hypothesis listed above. First, we test whether teacher quality differs between boys and girls in single-sex classrooms. We use teacher experience, certification, specialization and post-graduate studies as a proxy for teacher quality. Because the SIMCE collects teacher surveys at the classroom level, we estimate the following specifications using classroom level data:

$$y_{cs} = \alpha + \beta SingleSexClassroom_{cs} + \nu_{cs} \tag{3}$$

where c denote the classroom.[7] We also explore if, within schools with single-sex classrooms, only girls' classrooms are assigned teachers of different quality than only boys' classrooms. That is, we estimate the following:

$$y_{cs} = \alpha_s + \beta OnlyGirlsClassroom_{cs} + \nu_{cs} \tag{4}$$

Results are shown in Table 8. First, we see that schools with single-sex classrooms and schools with only coeducational classrooms have teachers of similar quality (Panel A). Second, when we consider only single-sex classrooms, we find that teachers in only-girls classrooms are similar to teachers in only-boys classrooms in terms of experience, specialization, certification, and post-graduate degrees (Panel B). The only characteristic in which teachers differ is teacher gender, i.e. only female classrooms are more likely to have female teachers. The same results hold after controlling for school fixed effects in Panel C.

[INSERT TABLE 8]

Table 9 reestimates equation 1 controlling for teacher observed characteristics. First, because only 85% of teachers answer the SIMCE teacher survey, we reestimate equation 1 for the sample of students for which we have information on their teachers' observable characteristics.[8] We find than in the smaller sample, the gender gap for both coeducational classes and single-sex classes is roughly the same. Next, we include controls for teacher observable characteristics. We find that most of the teachers characteristics included in the regressions are not statistically significant. However, using an F test we can reject the joint insignificance of the teacher controls. The two most important teacher characteristics are specialization and certification.

In terms of mechanisms, Table 9 shows that both the gender gap in coeducational classrooms and the gender gap in single-sex classrooms are not significantly different between the model that does and the one that doesn't control for teacher observed characteristics. Therefore, the effect of single-sex classrooms in the gender gap is not driven by teacher quality.

[7] This equation is estimated without the school fixed effect because we don't have variation of $SingleSexClassroom$ within schools.

[8] Table A2 in the Appendix analyzes whether we can assume that teacher characteristics are missing at random. We find that in models that include school fixed effects, the average math test score of classes of teachers with missing characteristics are not statistically different from those of classes with teachers who answered the survey. The same result holds for matched sample 2 without school fixed effects.

[INSERT TABLE 9]

Even though Panel B in Table 8 shows that teachers in only-girls classrooms are similar to teachers in only-boys classrooms in terms of experience, specialization, certification, and post-graduate degrees, it also shows that teachers differ in gender. Our data shows that in single-sex classrooms nearly 73% of students are assigned teachers of their same gender, while in coeducational classrooms only 51% of students are assigned teachers of their same gender (Table A3). Moreover, within schools with single-sex classrooms, female students are 4 percentage points more likely to by assigned to female teachers than male students are. To study if teacher-student gender matching explains the decrease in the gender gap, we control in equation 1 by $GenderMatch$, which takes the value of 1 when the teacher and student are the same gender. Results are shown in Table 10. As in Table 9, we first reestimate equation 1 to take into account that we lose some data when controlling by some teacher characteristics, in this case, teacher gender. With the restricted sample, the effect of single-sex classrooms is 1-2 points smaller, and in the whole sample and in matched sample 1 we lose significance. However, in terms of mechanisms, the results in Table 10 show that teacher-student gender matching doesn't explain the decrease in the mathematics gender gap. Both the gender gap in coeducational classrooms and the gender gap in single-sex classrooms are not significantly different between the model that does and the one that doesn't control for teacher-student gender match. Moreover, the results show that the effect of $GenderMatch$ is insignificant.

[INSERT TABLE 10]

Finally, we use information on the type of evaluation used to test whether teachers adapt their teaching to inprove student learning.[9] The type of evaluation is observed at the classroom level. Evaluation types are: diagnostic tests, self-evaluation, alternatives and/or true or false; writing and/or solving problems; and projects. For each evaluation type, teachers are asked if they always use them, use them the majority of the time, or sometimes or never use them. Teachers can use more than one type of evaluation. We code an evaluation type as used by the teacher is the teacher says it is used always or the majority of the time.

[9]Evaluations are, of course, only one way in which teachers can adapt their teaching to enhance student learning, so finding no effect doesn't mean that teachers didn?t adapt their teaching

There is some evidence that female students do worst on multiple choice tests and relatively better on essay tests (Ferber, Birnbaum, and Green, 1983; Lumsden and Scott, 1987). Moreover, as the SIMCE is a multiple-choice test, teachers who use multiple-choice tests as their usual form of evaluation may increase their students test scores. However, we don't find a significant difference between using this type of evaluations between schools with single-sex classrooms and those with only coeducational classrooms (Panel A in Table 11), or between only-girls classrooms and only-boys classrooms (Panel B and Panel C in Table 11). As expected, the results of estimating equation 1 don't change when we control for evaluation type (Table 12).

[INSERT TABLE 11]

[INSERT TABLE 12]

6 Conclusions

In this paper, we analyzed the effect of single-sex classrooms on the gender gap in mathematics test scores. Single-sex classrooms have both a statistically and economically significant effect on the gender gap, reducing it by more than half. This effect is not driven by teacher or school characteristics, but by the gender composition of the classroom itself.

Our results also show that the decrease in the gender gap in single-sex classrooms doesn't appear to be driven by a decrease in boys' achievement, but an increase in girls' achievement. Moreover, single-sex classrooms don't increase the language gender gap. Therefore, in addition to being a relatively cheap policy to implement, it does not have a trade-off in terms of negative effects on boys.

Our results suggest that teachers and schools should pay special attention to the gender composition inside the classroom. Teachers in Chile receive no formal training to handle issues around gender and other types of diversity. Even though an easy way to reduce mathematics gender gaps within a school is to separate boys and girls during said classes, preparing both teachers and students to handle gender diversity should not be neglected.

Finally, although single-sex classrooms are effective in reducing gender gaps in SIMCE scores, the SIMCE is a low stakes test. Previous literature has found that increasing stakes may lead to a decrease in performance, which is known as choking under pressure (Baumeister, 1984). In particular, Azmat, Calsamiglia, and Iriberri (2016) show that the grades of female students in relation to those of male students decrease as the stakes of tests increase. Indeed, the gender gap in the mathematics section of the university selection system test (PSU test), which is a high stake test, was 0.24 standard deviations in 2012, almost twice as large as the gender gap in the math SIMCE test. It is important to check is the results found in this study hold for high stake tests such as the PSU. Moreover, single-sex classrooms may also have an effect on the university major choice of boys and girls. By decreasing the math gender gap, single-sex classrooms may also decrease the gender gap in STEM majors. Future research is needed to see if this is the case.

References

Azmat, G., C. Calsamiglia, and N. Iriberri (2016): "Gender differences in response to big stakes," *Journal of the European Economic Association*, 14(6), 1372–1400.

Backus, P., M. Cubel, M. Guid, S. Sanchez-Pages, and E. Mañas (2016): *Gender, Competition and Performance: Evidence from Real Tournaments*. IEB Working Paper.

Baumeister, R. F. (1984): "Choking under pressure: self-consciousness and paradoxical effects of incentives on skillful performance.," *Journal of personality and social psychology*, 46(3), 610.

Bertrand, M. (2011): "New perspectives on gender," in *Handbook of labor economics*, vol. 4, pp. 1543–1590. Elsevier.

Booth, A., and E. Yamamura (2017): "Performance in mixed-sex and single-sex competitions: What we can learn from speedboat races in Japan," *Review of Economics and Statistics*, (0).

Bryk, A. S., V. E. Lee, and P. B. Holland (1993): *Catholic schools and the common good*. Harvard University Press.

Carrell, S. E., M. E. Page, and J. E. West (2010): "Sex and science: How professor gender perpetuates the gender gap," *The Quarterly Journal of Economics*, 125(3), 1101–1144.

Dee, T. S. (2007): "Teachers and the gender gaps in student achievement," *Journal of Human resources*, 42(3), 528–554.

Doris, A., D. O'Neill, and O. Sweetman (2013): "Gender, single-sex schooling and maths achievement," *Economics of Education Review*, 35, 104–119.

Drago, J. L., and R. D. Paredes (2011): "The quality gap in Chile's education system.," *Cepal Review*, (104).

Eisenkopf, G., Z. Hessami, U. Fischbacher, and H. W. Ursprung (2015): "Academic performance and single-sex schooling: Evidence from a natural experiment in Switzerland," *Journal of economic behavior & organization*, 115, 123–143.

Elacqua, G. (2012): "The impact of school choice and public policy on segregation: Evidence from Chile," *International Journal of Educational Development*, 32(3), 444–453.

Feigenberg, B., S. Rivkin, and R. Yan (2017): "Illusory Gains from Chile's Targeted School Voucher Experiment," Discussion paper, National Bureau of Economic Research.

Ferber, M. A., B. G. Birnbaum, and C. A. Green (1983): "Gender differences in economic knowledge: A reevaluation of the evidence," *The Journal of Economic Education*, 14(2), 24–37.

Friedman, M. (1962): *Capitalism and Freedom*. University of Chicago Press, Chicago.

Glick, P., M. Lameiras, and Y. R. Castro (2002): "Education and Catholic religiosity as predictors of hostile and benevolent sexism toward women and men," *Sex Roles*, 47(9-10), 433–441.

Gneezy, U., K. L. Leonard, and J. A. List (2009): "Gender differences in competition: Evidence from a matrilineal and a patriarchal society," *Econometrica*, 77(5), 1637–1664.

Gneezy, U., M. Niederle, and A. Rustichini (2003): "Performance in competitive environments: Gender differences," *The Quarterly Journal of Economics*, 118(3), 1049–1074.

Gneezy, U., and A. Rustichini (2004): "Gender and competition at a young age," *American Economic Review*, 94(2), 377–381.

Halpern, D. F., L. Eliot, R. S. Bigler, R. A. Fabes, L. D. Hanish, J. Hyde, L. S. Liben, and C. L. Martin (2011): "The pseudoscience of single-sex schooling," *Science*, 333(6050), 1706–1707.

Hoxby, C. M. (2000): "Does competition among public schools benefit students and taxpayers?," *American Economic Review*, 90(5), 1209–1238.

Hsieh, C.-T., and M. Urquiola (2006): "The effects of generalized school choice on achievement and stratification: Evidence from Chile's voucher program," *Journal of public Economics*, 90(8-9), 1477–1503.

Iriberri, N., and P. Rey-Biel (2017): "Stereotypes are only a threat when beliefs are reinforced: On the sensitivity of gender differences in performance under competition to information provision," *Journal of Economic Behavior & Organization*, 135, 99–111.

Jackson, C. K. (2012): "Single-sex schools, student achievement, and course selection: Evidence from rule-based student assignments in Trinidad and Tobago," *Journal of Public Economics*, 96(1-2), 173–187.

Jimenez, E., and M. E. Lockheed (1989): "Enhancing girls' learning through single-sex education: Evidence and a policy conundrum," *Educational Evaluation and Policy Analysis*, 11(2), 117–142.

Koedel, C., and E. Tyhurst (2012): "Math skills and labor-market outcomes: Evidence from a resume-based field experiment," *Economics of Education Review*, 31(1), 131–140.

Lavy, V., and A. Schlosser (2011): "Mechanisms and impacts of gender peer effects at school," *American Economic Journal: Applied Economics*, 3(2), 1–33.

Lee, V. E., and H. M. Marks (1990): "Sustained effects of the single-sex secondary school experience on attitudes, behaviors, and values in college.," *Journal of educational psychology*, 82(3), 578.

Lumsden, K. G., and A. Scott (1987): "The economics student reexamined: Male-female differences in comprehension," *The Journal of Economic Education*, 18(4), 365–375.

MACCOBY, E. E. (1990): "Gender and relationships: A developmental account.," *American psychologist*, 45(4), 513.

——— (1998): *The two sexes: Growing up apart, coming together*, vol. 4. Harvard University Press.

NIXON, L. A., AND M. D. ROBINSON (1999): "The educational attainment of young women: Role model effects of female high school faculty," *Demography*, 36(2), 185–194.

OECD (2013): *PISA 2012 results: ready to learn: students' engagement, drive and self-beliefs (volume III): preliminary version*. OECD, Paris, France.

PAREDES, V. (2014): "A teacher like me or a student like me? Role model versus teacher bias effect," *Economics of Education Review*, 39, 38–49.

PARK, H., J. R. BEHRMAN, AND J. CHOI (2018): "Do single-sex schools enhance students' STEM (science, technology, engineering, and mathematics) outcomes?," *Economics of Education Review*, 62, 35–47.

PEÑA-LÓPEZ, I., ET AL. (2016): "PISA 2015 Results (Volume I). Excellence and Equity in Education," .

RIORDAN, C. (1985): "Public and Catholic schooling: The effects of gender context policy," *American Journal of Education*, 93(4), 518–540.

SOHN, H. (2016): "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," *Economics of Education Review*, 52, 155–175.

STRAIN, M. R. (2013): "Single-sex classes & student outcomes: Evidence from North Carolina," *Economics of Education Review*, 36, 73–87.

Table 1: Descriptive Statistics - School level data

Sample:	Whole Sample			Catholic, private, urban schools			Matched Sample 1			Matched Sample 2		
	Single-sex (1)	coeducational (2)	Difference (3)	Single-sex (4)	coeducational (5)	Difference (6)	Single-sex (7)	coeducational (8)	Difference (9)	Single-sex (10)	coeducationl (11)	Difference (12)
Percentage female	0.486	0.509	0.023	0.490	0.520	0.030	0.498	0.521	0.023	0.490	0.510	0.020
	(0.083)	(0.187)	(0.033)	(0.086)	(0.111)	(0.022)	(0.077)	(0.107)	(0.022)	(0.086)	(0.095)	(0.023)
	[32]	[2,735]	[2,767]	[27]	[588]	[615]	[25]	[543]	[568]	[27]	[40]	[67]
Father education	14.657	11.920	-2.737	14.821	13.116	-1.705	14.821	13.104	-1.716	14.821	13.996	-0.825
	(2.747)	(2.737)	(0.503)	(2.754)	(2.288)	(0.472)	(2.754)	(2.304)	(0.476)	(2.754)	(2.767)	(0.715)
	[30]	[2,562]	[2,592]	[25]	[562]	[587]	[25]	[543]	[568]	[25]	[37]	[62]
Mother education	14.388	11.891	-2.497	14.433	13.109	-1.324	14.433	13.075	-1.357	14.433	13.835	-0.598
	(2.562)	(2.558)	(0.470)	(2.620)	(2.099)	(0.434)	(2.620)	(2.118)	(0.438)	(2.620)	(2.510)	(0.661)
	[30]	[2,563]	[2,593]	[25]	[562]	[587]	[25]	[543]	[568]	[25]	[37]	[62]
Income	1338.654	577.156	-761.497	1382.335	722.734	-659.601	1382.335	727.002	-655.333	1382.335	1113.961	-268.374
	(883.390)	(511.256)	(94.924)	(890.831)	(522.429)	(110.884)	(890.831)	(523.718)	(111.345)	(890.831)	(738.471)	(207.865)
	[30]	[2,563]	[2,593]	[25]	[562]	[587]	[25]	[543]	[568]	[25]	[37]	[62]
Municipal	0.031	0.272	0.241	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.177)	(0.445)	(0.079)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	[32]	[2,735]	[2,767]	[27]	[588]	[615]	[25]	[543]	[568]	[27]	[40]	[67]
Voucher	0.406	0.570	0.164	0.407	0.813	0.406	0.440	0.818	0.378	0.407	0.600	0.193
	(0.499)	(0.495)	(0.088)	(0.501)	(0.390)	(0.078)	(0.507)	(0.386)	(0.080)	(0.501)	(0.496)	(0.124)
	[32]	[2,735]	[2,767]	[27]	[588]	[615]	[25]	[543]	[568]	[27]	[40]	[67]
Private	0.563	0.132	-0.431	0.593	0.187	-0.406	0.560	0.182	-0.378	0.593	0.400	-0.193
	(0.504)	(0.339)	(0.061)	(0.501)	(0.390)	(0.078)	(0.507)	(0.386)	(0.080)	(0.501)	(0.496)	(0.124)
	[32]	[2,735]	[2,767]	[27]	[588]	[615]	[25]	[543]	[568]	[27]	[40]	[67]
Vocational	0.031	0.150	0.118	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.177)	(0.357)	(0.063)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	[32]	[2,735]	[2,767]	[27]	[588]	[615]	[25]	[543]	[568]	[27]	[40]	[67]
Catholic School	0.906	0.349	-0.557	1.000	1.000	0.000	1.000	1.000	0.000	1.000	1.000	0.000
	(0.296)	(0.477)	(0.084)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	[32]	[2,735]	[2,767]	[27]	[588]	[615]	[25]	[543]	[568]	[27]	[40]	[67]
Rural	0.031	0.064	0.032	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.177)	(0.244)	(0.043)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	[32]	[2,735]	[2,767]	[27]	[588]	[615]	[25]	[543]	[568]	[27]	[40]	[67]
Math Score	319.748	264.336	-55.412*	320.593	288.375	-32.218*	318.615	288.897	-29.717*	320.593	301.275	-19.318*
	(36.879)	(45.670)	(8.105)	(38.398)	(41.033)	(8.055)	(39.138)	(40.582)	(8.289)	(38.398)	(45.858)	(10.717)
	[32]	[2,733]	[2,765]	[27]	[587]	[614]	[25]	[542]	[567]	[27]	[40]	[67]
Math Score Boys	320.661	268.521	-52.140	320.553	294.165	-26.388	319.298	294.594	-24.704	320.553	309.125	-11.428
	(37.845)	(46.115)	(8.186)	(39.335)	(41.976)	(8.241)	(40.569)	(41.582)	(8.498)	(39.335)	(44.309)	(10.558)
	[32]	[2,581]	[2,613]	[27]	[586]	[613]	[25]	[541]	[566]	[27]	[40]	[67]
Math Score Girls	319.054	258.547	-60.508**	321.167	283.186	-37.982**	317.839	283.658	-34.181**	321.167	294.053	-27.115**
	(38.211)	(46.536)	(8.260)	(39.939)	(41.610)	(8.177)	(39.637)	(41.120)	(8.399)	(39.939)	(46.868)	(11.016)
	[32]	[2,661]	[2,693]	[27]	[585]	[612]	[25]	[541]	[566]	[27]	[40]	[67]

Notes: Standard errors are presented in parentheses, and number of schools are presented in square brackets. ***, ** and * indicate statistical significance at the 99%, 95% and 90%, respectively.

Table 2: Gender Gaps in SIMCE Test Scores

Panel A: Gender Gaps in Math and Language Test Scores								
Sample:	Whole Sample		Catholic, private, urban schools		Matched Sample 1		Matched Sample 2	
Dependent Variable:	Math Test Score	Lang Test Score	Math Test Score	Lang Test Score	Math Test Score	Lang Test Score	Math Test Score	Lang Test Score
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Female	-8.350***	10.300***	-10.697***	7.114***	-10.677***	7.232***	-8.751***	5.651***
	(1.236)	(1.003)	(0.543)	(0.524)	(0.557)	(0.539)	(1.943)	(1.799)
Constant	269.145***	253.837***	295.603***	273.603***	295.936***	273.639***	313.573***	284.916***
	(1.316)	(1.070)	(1.683)	(1.239)	(1.735)	(1.277)	(5.198)	(3.444)
School Fixed Effects	no	no	no	no	no	no	no	no
Observations	205,903	206,061	39,587	39,610	37,660	37,675	3,937	3,937
Panel B: Gender Gaps Within Schools in Math and Language Test Scores								
Sample:	Whole Sample		Catholic, private, urban schools		Matched Sample 1		Matched Sample 2	
Dependent Variable:	Math Test Score	Lang Test Score	Math Test Score	Lang Test Score	Math Test Score	Lang Test Score	Math Test Score	Lang Test Score
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Female	-11.222***	8.350***	-10.741***	7.040***	-10.711***	7.171***	-8.668***	5.763***
	(0.254)	(0.258)	(0.544)	(0.524)	(0.557)	(0.539)	(1.943)	(1.802)
School Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes
Observations	205,903	206,061	39,587	39,610	37,660	37,675	3,937	3,937

Notes: Standard errors, clustered at the school level, are presented in parentheses. ***, ** and * indicate statistical significance at the 99%, 95% and 90%, respectively.

Table 3: Validation Test: Differences in Sociodemographic variables

Sample:	Catholic, private, urban schools			Matched Sample 1			Matched Sample 2		
Dependent Variable:	Mother education	Father education	Income	Mother education	Father education	Income	Mother education	Father education	Income
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Female	-0.196***	-0.131***	-29.987***	-0.192***	-0.136***	-30.100***	-0.018	-0.215*	-20.142
	(0.033)	(0.034)	(4.744)	(0.034)	(0.034)	(4.801)	(0.120)	(0.116)	(18.465)
Single-sex classroom × Female	0.195*	0.017	3.313	0.190	0.023	3.426	0.016	0.101	-6.532
	(0.118)	(0.143)	(21.728)	(0.118)	(0.143)	(21.741)	(0.166)	(0.182)	(28.239)
Observations	32,388	31,378	32,419	31,851	30,863	31,882	3,067	3,002	3,057

Notes: Standard errors, clustered at the school level, are presented in parentheses. All columns include school fixed effects. ***, ** and * indicate statistical significance at the 99%, 95% and 90%, respectively.

Table 4: Validation Test: Differences in main reason for school choice

Dependent variable:	Distance		Values/ Religiosity		Academic Performance	
	(1)	(2)	(3)	(4)	(5)	(6)
Female	0.013	0.014	0.019	0.029	0.002	-0.003
	(0.010)	(0.016)	(0.016)	(0.024)	(0.014)	(0.017)
Single-sex classroom × Female	-0.009	-0.020	0.049	-0.021	0.029	0.032
	(0.015)	(0.020)	(0.031)	(0.034)	(0.019)	(0.025)
Father education		0.001		-0.002		-0.005
		(0.003)		(0.005)		(0.004)
Mother education		-0.004		0.006		0.003
		(0.004)		(0.004)		(0.002)
Income		-0.000		-0.000		-0.000
		(0.000)		(0.000)		(0.000)
Observations	4,381	2,915	4,381	2,915	4,381	2,915

Notes: Standard errors, clustered at the school level, are presented in parentheses. All columns include school fixed effects. ***, ** and * indicate statistical significance at the 99%, 95% and 90%, respectively.

Table 5: Effect of Single-Sex Classrooms in the Gender Gap

Panel A:
Dependent Variable: Math test score

Sample:	Catholic, private, urban schools		Matched Sample 1		Matched Sample 2	
	(1)	(2)	(3)	(4)	(5)	(6)
Female	-11.191***	-11.079***	-11.120***	-11.031***	-15.032***	-14.271***
	(0.542)	(0.562)	(0.557)	(0.570)	(1.620)	(1.844)
Single-sex classroom × Female	8.918***	6.715**	7.962**	6.670**	12.759***	9.872**
	(3.115)	(3.359)	(3.148)	(3.360)	(3.487)	(3.794)
Father's schooling		0.892***		0.891***		0.834**
		(0.102)		(0.102)		(0.381)
Mother's schooling		0.583***		0.570***		1.184**
		(0.112)		(0.113)		(0.462)
Income		0.003***		0.003***		0.003
		(0.001)		(0.001)		(0.002)
Gender gap in	-2.273	-4.363	-3.158	-4.361	-2.273	-4.399
Single-sex classroom	(3.067)	(3.310)	(3.098)	(3.311)	(3.088)	(3.315)
Observations	39,587	30,091	37,660	29,589	3,937	2,864

Panel B:
Dependent Variable: Language test score

Sample:	Catholic, private, urban schools		Matched Sample 1		Matched Sample 2	
	(1)	(2)	(3)	(4)	(5)	(6)
Female	6.969***	6.545***	7.110***	6.604***	3.154	2.390
	(0.530)	(0.559)	(0.544)	(0.565)	(1.957)	(1.977)
Single-sex classroom × Female	1.417	1.017	1.187	0.960	5.232	5.199
	(2.990)	(2.821)	(3.091)	(2.822)	(3.551)	(3.432)
Father's schooling		0.808***		0.822***		0.516
		(0.098)		(0.098)		(0.364)
Mother's schooling		0.650***		0.628***		0.417
		(0.105)		(0.106)		(0.427)
Income		0.001**		0.001**		0.003*
		(0.001)		(0.001)		(0.002)
Gender gap in	8.386	7.562	8.297	7.564	8.386	7.589
Single-sex classroom	(2.943)	(2.766)	(3.042)	(2.766)	(2.963)	(2.807)
Observations	39,610	30,102	37,675	29,599	3,937	2,865

Notes: Standard errors, clustered at the school level, are presented in parentheses. All columns include school fixed effects. The gender gap in single-sex classrooms is equal to the sum of the Female and Single-sex classroom × Female coefficients. ***, ** and * indicate statistical significance at the 99%, 95% and 90%, respectively.

Table 6: Effect of Single-Sex Classrooms with and without School Fixed Effects

Panel A: Dependent Variable: Math test score Sample:	Catholic, private, urban schools		Matched Sample 1		Matched Sample 2	
	(1)	(2)	(3)	(4)	(5)	(6)
Female	-8.607***	-11.079***	-8.522***	-11.031***	-15.392***	-14.271***
	(0.758)	(0.562)	(0.766)	(0.570)	(2.256)	(1.844)
Single-sex classroom × Female	4.529	6.715**	4.449	6.670**	11.424***	9.872**
	(3.233)	(3.359)	(3.236)	(3.360)	(3.915)	(3.794)
Single-sex classroom	6.961*		7.125*		3.692	
	(4.000)		(4.000)		(5.820)	
Father's schooling	2.147***	0.892***	2.141***	0.891***	1.640***	0.834**
	(0.147)	(0.102)	(0.148)	(0.102)	(0.423)	(0.381)
Mother's schooling	2.474***	0.583***	2.445***	0.570***	2.474***	1.184**
	(0.169)	(0.112)	(0.169)	(0.113)	(0.641)	(0.462)
Income	0.019***	0.003***	0.019***	0.003***	0.024***	0.003
	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.002)
School Fixed Effects	no	yes	no	yes	no	yes
Gender gap in	-4.078	-4.363	-4.072	-4.361	-3.968	-4.399
Single-sex classroom	(3.139)	(3.310)	(3.141)	(3.311)	(3.184)	(3.315)
Observations	30,091	30,091	29,589	29,589	2,864	2,864
p-value 1	0.000		0.000		0.374	
p-value 2	0.777		0.774		0.651	
Panel B: Dependent Variable: Language test score Sample:	Catholic, private, urban schools		Matched Sample 1		Matched Sample 2	
	(1)	(2)	(3)	(4)	(5)	(6)
Female	8.313***	6.545***	8.396***	6.604***	1.130	2.390
	(0.643)	(0.559)	(0.649)	(0.565)	(2.303)	(1.977)
Single-sex classroom × Female	-1.339	1.017	-1.415	0.960	5.907	5.199
	(2.824)	(2.821)	(2.826)	(2.822)	(3.599)	(3.432)
Single-sex classroom	5.460		5.597*		3.747	
	(3.378)		(3.380)		(4.753)	
Father's schooling	1.571***	0.808***	1.585***	0.822***	1.015***	0.516
	(0.121)	(0.098)	(0.122)	(0.098)	(0.352)	(0.364)
Mother's schooling	1.883***	0.650***	1.843***	0.628***	1.263***	0.417
	(0.137)	(0.105)	(0.137)	(0.106)	(0.428)	(0.427)
Income	0.010***	0.001**	0.010***	0.001**	0.013***	0.003*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
School Fixed Effects	no	yes	no	yes	no	yes
Gender gap in	6.974	7.562	6.981	7.564	7.038	7.589
Single-sex classroom	(2.752)	(2.766)	(2.753)	(2.766)	(2.801)	(2.807)
Observations	30,102	30,102	29,599	29,599	2,865	2,865
p-value 1	0.000		0.000		0.249	
p-value 2	0.401		0.405		0.446	

Notes: Standard errors, clustered at the school level, are presented in parentheses. P-value 1 refers to the null hypothesis of the equality of the Female coefficient between the model with and without school fixed effects. P-value 2 refers to the null hypothesis of the equality of the gender gap in single-sex classrooms between the model with and without school fixed effects. ***, ** and * indicate statistical significance at the 99%, 95% and 90%, respectively.

Table 7: Effect of Single-Sex Classrooms in Boys and Girls Math and Language Scores

Sample:	Male students		Female students	
Dependent Variable:	Math score (1)	Language score (2)	Math score (3)	Language score (4)
Single-sex classroom	4.033	3.261	14.754***	10.137***
	(5.877)	(4.784)	(5.398)	(3.800)
Father's schooling	2.278***	1.352**	1.145**	0.765
	(0.641)	(0.566)	(0.503)	(0.462)
Mother's schooling	1.736**	0.355	3.090***	2.017***
	(0.765)	(0.533)	(0.755)	(0.612)
Income	0.023***	0.016***	0.025***	0.011***
	(0.003)	(0.003)	(0.003)	(0.002)
Constant	230.544***	242.600***	210.534***	234.655***
	(14.442)	(8.537)	(12.483)	(9.171)
Observations	1,345	1,345	1,519	1,520

Notes: Standard errors, clustered at the school level, are presented in parentheses. ***, ** and * indicate statistical significance at the 99%, 95% and 90%, respectively.

Table 8: Differences in Teacher Characteristics between Coeducational and Single-sex classrooms and within Single-sex Classrooms

Panel A:					
Sample: Matched Sample 2					
Dependent Variable:	Certification	Specialization	Experience	Post-graduate studies	Female teacher
	(1)	(2)	(3)	(4)	(5)
Single-sex classroom	0.034	-0.170*	-0.162	0.163	0.006
	(0.036)	(0.086)	(2.630)	(0.109)	(0.107)
Constant	0.938***	0.841***	16.031***	0.323***	0.516***
	(0.031)	(0.047)	(2.104)	(0.072)	(0.080)
Observations	135	130	133	130	135
School FE	no	no	no	no	no
Panel B:					
Sample: Only single-sex classroom schools					
Dependent Variable:	Certification	Specialization	Experience	Post-graduate studies	Female teacher
	(1)	(2)	(3)	(4)	(5)
Only-girls classroom	0.001	0.110	1.366	-0.058	0.464***
	(0.040)	(0.116)	(2.550)	(0.123)	(0.107)
Constant	0.971***	0.618***	15.176***	0.515***	0.286***
	(0.028)	(0.081)	(1.816)	(0.088)	(0.076)
Observations	71	67	69	68	71
School FE	no	no	no	no	no
Panel C:					
Sample: Only single-sex classroom schools, within school estimation					
Dependent Variable:	Certification	Specialization	Experience	Post-graduate studies	Female teacher
	(1)	(2)	(3)	(4)	(5)
Only-girls classroom	0.000	0.024	3.066	-0.047	0.394***
	(0.047)	(0.105)	(2.217)	(0.101)	(0.090)
Observations	71	67	69	68	71
School FE	yes	yes	yes	yes	yes

Notes: Standard errors, clustered at the school level, are presented in parentheses. ***, ** and * indicate statistical significance at the 99%, 95% and 90%, respectively.

Table 9: Effect of Single-Sex Classrooms in the Gender Gap controlling by Teacher Quality

Dependent Variable: Math test score	Catholic, private, urban schools			Matched Sample 1			Matched Sample 2		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Female	-11.079***	-11.272***	-11.311***	-11.031***	-11.219***	-11.259***	-14.271***	-15.162***	-15.374***
	(0.562)	(0.619)	(0.616)	(0.570)	(0.629)	(0.626)	(1.844)	(2.073)	(2.027)
Single-sex classroom × Female	6.715**	6.855*	5.388	6.670**	6.805*	5.328	9.872**	10.700**	11.391**
	(3.359)	(4.126)	(4.316)	(3.360)	(4.129)	(4.314)	(3.794)	(4.548)	(5.271)
Father's schooling	0.892***	0.848***	0.850***	0.891***	0.848***	0.850***	0.834**	0.729*	0.727*
	(0.102)	(0.114)	(0.115)	(0.102)	(0.115)	(0.115)	(0.381)	(0.403)	(0.400)
Mother's schooling	0.583***	0.606***	0.598***	0.570***	0.588***	0.580***	1.184**	1.383**	1.345**
	(0.112)	(0.124)	(0.124)	(0.113)	(0.125)	(0.125)	(0.462)	(0.525)	(0.531)
Income	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***	0.003	0.002	0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Female Teacher			2.893			2.863			0.970
			(2.248)			(2.250)			(6.453)
Specialization			2.501			2.764			5.722*
			(2.780)			(2.789)			(3.352)
Experience			0.057			0.057			-0.038
			(0.114)			(0.114)			(0.218)
Post Graduate Studies			0.738			0.908			-6.349
			(2.384)			(2.394)			(4.391)
Certification			12.578***			12.506***			7.701
			(4.388)			(4.369)			(7.895)
Gender gap in	-4.363	-4.417	-5.923	-4.361	-4.414	-5.931	-4.399	-4.462	-3.983
Single-sex classroom	(3.310)	(4.078)	(4.276)	(3.311)	(4.079)	(4.273)	(3.315)	(4.039)	(4.855)
Observations	30,091	25,297	25,297	29,589	24,832	24,832	2,864	2,435	2,435
p-value 1		0.324			0.325			0.379	
p-value 2		0.167			0.166			0.869	

Notes: Standard errors, clustered at the school level, are presented in parentheses. All columns include school fixed effects. P-value 1 refers to the null hypothesis of the equality of the Female coefficient between the model with and without controlling for observed teacher characteristics. P-value 2 refers to the null hypothesis of the equality of the gender gap in single-sex classrooms between the model with and without controlling for observed teacher characteristics. ***, ** and * indicate statistical significance at the 99%, 95% and 90%, respectively.

Table 10: Effect of Single-Sex Classrooms in the Gender Gap controlling by Teacher-Student Gender Match

Dependent Variable: Math test score									
Sample:	Catholic, private, urban schools			Matched Sample 1			Matched Sample 2		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(8)
Female	-11.079***	-11.395***	-11.407***	-11.031***	-11.350***	-11.366***	-14.271***	-15.290***	-15.343***
	(0.562)	(0.585)	(0.583)	(0.570)	(0.593)	(0.591)	(1.844)	(2.048)	(2.021)
Single-sex classroom × Female	6.715**	4.857	4.843	6.670**	4.815	4.798	9.872**	8.709**	8.715**
	(3.359)	(3.504)	(3.525)	(3.360)	(3.507)	(3.533)	(3.794)	(4.009)	(4.034)
Father's schooling	0.892***	0.859***	0.859***	0.891***	0.860***	0.860***	0.834**	0.798**	0.800**
	(0.102)	(0.109)	(0.108)	(0.102)	(0.109)	(0.109)	(0.381)	(0.380)	(0.380)
Mother's schooling	0.583***	0.588***	0.588***	0.570***	0.570***	0.570***	1.184**	1.257**	1.253**
	(0.112)	(0.117)	(0.117)	(0.113)	(0.119)	(0.119)	(0.462)	(0.492)	(0.493)
Income	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***	0.003	0.003	0.003
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)	(0.003)
Gender Match			0.405			0.521			0.739
			(0.593)			(0.601)			(1.998)
Gender gap in	-4.363	-6.538	-6.564	-4.361	-6.535	-6.569	-4.399	-6.581	-6.628
Single-sex classroom	(3.310)	(3.454)	(3.476)	(3.311)	(3.455)	(3.483)	(3.315)	(3.455)	(3.519)
Observations	30,091	27,411	27,411	29,589	26,941	26,941	2,864	2,669	2,669
p-value 1		0.071			0.070			0.105	
p-value 2		0.169			0.169			0.175	

Notes: Standard errors, clustered at the school level, are presented in parentheses. All columns include school fixed effects. P-value 1 refers to the null hypothesis of the equality of the Female coefficient between the model with and without controlling for teacher-student gender match. P-value 2 refers to the null hypothesis of the equality of the gender gap in single-sex classrooms between the model with and without controlling for teacher-student gender match. ***, ** and * indicate statistical significance at the 99%, 95% and 90%, respectively.

Table 11: Differences in Type of evaluation between Coeducational and Single-sex classrooms and within Single-sex Classrooms

Panel A:					
Sample: Matched Sample 2					
Dependent Variable:	Diagnostic test	Auto-evaluation	Alternatives or T or F	Writing or solving problems	Projects
	(1)	(2)	(3)	(4)	(5)
Single-sex classroom	0.017	-0.153*	-0.010	0.009	-0.083
	(0.087)	(0.079)	(0.073)	(0.053)	(0.051)
Constant	1.469***	1.781***	1.781***	1.891***	1.141***
	(0.063)	(0.057)	(0.052)	(0.039)	(0.037)
Observations	134	134	134	134	134
School FE	no	no	no	no	no
Panel B:					
Sample: Only single-sex classroom schools					
Dependent Variable:	Diagnostic test	Auto-evaluation	Alternatives or T or F	Writing or solving problems	Projects
	(1)	(2)	(3)	(4)	(5)
Only-girls classroom	0.114	0.171	0.000	-0.086	-0.057
	(0.120)	(0.115)	(0.102)	(0.072)	(0.056)
Constant	1.429***	1.543***	1.771***	1.943***	1.086***
	(0.085)	(0.082)	(0.072)	(0.051)	(0.040)
Observations	70	70	70	70	70
School FE	no	no	no	no	no
Panel C:					
Sample: Only single-sex classroom schools, within school estimation					
Dependent Variable:	Diagnostic test	Auto-evaluation	Alternatives or T or F	Writing or solving problems	Projects
	(1)	(2)	(3)	(4)	(5)
Only-girls classroom	0.011	0.120	0.000	-0.087	-0.043
	(0.098)	(0.115)	(0.086)	(0.066)	(0.050)
Observations	70	70	70	70	70
School FE	yes	yes	yes	yes	yes

Notes: Standard errors, clustered at the school level, are presented in parentheses. ***, ** and * indicate statistical significance at the 99%, 95% and 90%, respectively.

Table 12: Effect of Single-Sex Classrooms in the Gender Gap controlling by Evaluation Type

Dependent Variable: Math test score									
Sample:	Catholic, private, urban schools			Matched Sample 1			Matched Sample 2		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Female	-11.079***	-11.320***	-11.318***	-11.031***	-11.281***	-11.279***	-14.271***	-15.285***	-15.256***
	(0.562)	(0.594)	(0.594)	(0.570)	(0.602)	(0.601)	(1.844)	(2.048)	(2.042)
Single-sex classroom × Female	6.715**	5.348	5.588	6.670**	5.313	5.557	9.872**	9.254**	9.547**
	(3.359)	(3.525)	(3.525)	(3.360)	(3.527)	(3.527)	(3.794)	(4.029)	(3.994)
Father's schooling	0.892***	0.847***	0.849***	0.891***	0.851***	0.853***	0.834**	0.813**	0.864**
	(0.102)	(0.109)	(0.109)	(0.102)	(0.110)	(0.110)	(0.381)	(0.387)	(0.375)
Mother's schooling	0.583***	0.613***	0.611***	0.570***	0.597***	0.596***	1.184**	1.228**	1.209**
	(0.112)	(0.117)	(0.117)	(0.113)	(0.118)	(0.118)	(0.462)	(0.509)	(0.518)
Income	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***	0.003	0.003	0.003
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)	(0.002)
Diagnostic test			-0.360			-0.261			6.743**
			(2.034)			(2.040)			(3.273)
Auto-evaluation			-0.566			-0.611			0.107
			(2.627)			(2.627)			(3.234)
Alternatives or T/F			2.156			2.022			-2.728
			(2.833)			(2.843)			(3.961)
Writing or solving problems			2.059			2.072			5.240
			(2.518)			(2.519)			(4.928)
Projects			-1.182			-1.177			-7.463
			(4.071)			(4.073)			(6.932)
Gender gap in	-4.363	-5.972	-5.730	-4.361	-5.968	-5.722	-4.399	-6.031	-5.708
Single-sex classroom	(3.310)	(3.473)	(3.467)	(3.311)	(3.474)	(3.468)	(3.315)	(3.474)	(3.458)
Observations	30,091	27,013	27,013	29,589	26,597	26,597	2,864	2,642	2,642
p-value 1		0.210			0.200			0.125	
p-value 2		0.428			0.429			0.492	

Notes: Standard errors, clustered at the school level, are presented in parentheses. All columns include school fixed effects. P-value 1 refers to the null hypothesis of the equality of the Female coefficient between the model with and without controlling for type of evaluation. of the gender gap in single-sex classrooms between the model with and without controlling for type of evaluation. ***, ** and * indicate statistical significance at the 99%, 95% and 90%, respectively.

Appendix

Table A1: Characteristics of Coeducational Schools with Single-Sex Classrooms

School ID	Private	Municipal	Voucher	Rural	Vocational	Catholic
1	0	0	1	0	0	1
2	0	1	0	0	0	0
3	1	0	0	0	0	1
4	1	0	0	0	0	1
5	1	0	0	0	0	1
6	1	0	0	0	0	1
7	1	0	0	0	0	1
8	0	0	1	0	1	1
9	1	0	0	0	0	1
10	1	0	0	0	0	1
11	0	0	1	0	0	1
12	0	0	1	0	0	1
13	1	0	0	0	0	1
14	1	0	0	1	0	1
15	0	0	1	0	0	1
16	0	0	1	0	0	1
17	0	0	1	0	0	1
18	0	0	1	0	0	1
19	0	0	1	0	0	1
20	0	0	1	0	0	1
21	1	0	0	0	0	1
22	0	0	1	0	0	1
23	1	0	0	0	0	1
24	1	0	0	0	0	1
25	1	0	0	0	0	0
26	0	0	1	0	0	1
27	1	0	0	0	0	1
28	1	0	0	0	0	1
29	1	0	0	0	0	1
30	1	0	0	0	0	1
31	0	0	1	0	0	0
32	1	0	0	0	0	1
Total	18	1	13	1	1	29
Percentage	0.563	0.031	0.406	0.031	0.031	0.906

Table A2: Difference in Students Achievement of Teachers with and without missing characteristics

Dependent Variable:	Classroom Average Math Test Score					
Sample:	Catholic, private, urban schools		Matched sample 1		Matched sample 2	
	(1)	(2)	(3)	(4)	(5)	(6)
Missing Teacher Characteristics	-11.959***	-2.041	-10.593***	-1.891	2.427	1.223
	(2.928)	(1.830)	(3.133)	(1.855)	(9.361)	(3.387)
Constant	294.446***	292.525***	294.207***	292.702***	316.603***	316.813***
	(1.288)	(0.542)	(1.303)	(0.532)	(3.910)	(1.104)
Observations	1,286	1,286	1,214	1,214	149	149
School FE	no	yes	no	yes	no	yes

Notes: Standard errors, clustered at the school level, are presented in parentheses. ***, ** and * indicate statistical significance at the 99%, 95% and 90%, respectively.

Table A3: Percentage of students with teachers of their own gender

	All students		Female students		Male students	
	Single-sex	Coeducational	Single-sex	Coeducational	Single-sex	Coeducational
Whole Sample	0.728	0.512	0.716	0.470	0.739	0.556
Matched Sample 1	0.730	0.512	0.707	0.481	0.753	0.545
Matched Sample 2	0.728	0.530	0.716	0.519	0.739	0.542