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# UNDERSTANDING THE MATH GENDER GAP IN LATIN AMERICAN COUNTRIES

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DEVELOPMENT BANK OF LATIN AMERICA

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**ABSTRACT**

This paper documents that the math gender gap in Latin America is larger than in other developing or developed countries and that such gap do not decrease after controlling for individual, family and school characteristics. Using individual variation across eight Latin American countries for which PISA collected a very rich set of questions related to mathematics in 2012, we then analyze the role played by alternative (yet potentially complementary) socialization theories in explaining the math gender gap. We only find evidence that differential parents' expectations on math for girls' and boys' career and differential girls' and boys' own perception of math self-efficiency, self-concept, and anxiety matter, as they are associated with between 8 and 30 percent of the math gender gap. Second, pooling 2006 to 2012 PISA waves and exploiting time and cross-country variation, we explore the influence of societal factors on the math gender gap in eleven Latin American countries, finding that those Latin American countries with greater gender-equality in both the labor market and tertiary education, as well as higher economic development in the country, have a smaller math gender gap.

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# ENTENDIENDO LA BRECHA DE GÉNERO MATEMÁTICA EN PAÍSES DE AMÉRICA LATINA

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**RESUMEN**

El presente trabajo documenta que la brecha de género en matemática en América Latina es más grande que en otras regiones y no disminuye luego de controlar por características individuales, familiares y del centro educativo. Usando datos individuales en ocho países de América Latina en 2012 para los que el programa PISA recogió un conjunto de preguntas relacionadas con las matemáticas, se testea el papel desempeñado por diferentes teorías de socialización (alternativas o potencialmente complementarias) en la explicación de esa brecha. Se encuentra evidencia de que diferentes expectativas de los padres acerca de si chicas y chicos seguirán una carrera en matemática y diferencias en la propia percepción de autoeficacia, auto-concepto, y ansiedad al hacer matemáticas entre chicas y chicos, podrían explicar entre 8 y 30 por ciento de la brecha de género en matemáticas. En segundo lugar, uniendo las olas de PISA 2006 a 2012, se explota la variación temporal y entre países para evaluar la influencia de factores sociales en la brecha de género de matemáticas en once países de América Latina. Encontramos que en aquellos países latinoamericanos con mayor igualdad de género tanto en el acceso al mercado de trabajo como a la educación superior, y un mayor desarrollo económico, la brecha de género en matemáticas es menor.

# Understanding the Math Gender Gap in Latin American Countries

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**Abstract**

This paper documents that the math gender gap in Latin America is larger than in other developing or developed countries and that such gap do not decrease after controlling for individual, family and school characteristics. Using individual variation across eight Latin American countries for which PISA collected a very rich set of questions related to mathematics in 2012, we then analyze the role played by alternative (yet potentially complementary) socialization theories in explaining the math gender gap. We *only* find evidence that differential parents' expectations on math for girls' and boys' career and differential girls' and boys' own perception of math *self-efficiency*, *self-concept*, and *anxiety* matter, as they are associated with between 8 and 30 percent of the math gender gap. Second, pooling 2006 to 2012 PISA waves and exploiting time and cross-country variation, we explore the influence of societal factors on the math gender gap in eleven Latin American countries, finding that those Latin American countries with greater gender-equality in both the labor market and tertiary education, as well as higher economic development in the country, have a smaller math gender gap.

## 1. Introduction

Despite the gains that females have made in terms of general schooling in Latin America, many gender disparities in both education and the labor market remain. Women in Latin America earn about 30 percent less than men (conditional on age, education, family composition, type of employment, and hours worked), tend to concentrate in health, education, and sociology majors (as opposed to engineering, manufacturing and construction), and are underrepresented in high-powered careers as CEOs, and more generally in finance, business and STEM fields, such as science, technology, engineering, and mathematics (Ñopo 2012). Given the evidence that mathematical ability determines field choice for college graduates (Paglin and Rufolo 1990 and Turner and Bowen 1999), and that a significant part (between 8 and 20 percent) of the gender wage gap can be explained by choice of major (Machin and Puhani 2003, and Black et al. 2008), improving girl's math performance is a first step towards reducing the previously mentioned gender disparities. Attracting more women to STEM careers is also considered key for the improvement of productivity, innovation, economic growth, and development of a country (Joensen and Nielsen 2015).

While the math gender gap has been widely documented in both developing and developed countries, its size is dramatically large in Latin America.[1] According to 2012 data from the Program for International Student Assessment (PISA hereafter), girls' math scores average 17 lower score points than those of boys, which is equivalent to 5 fewer months of schooling. This difference is three times higher than that of other developing countries and between one fifth to one half that of developed countries (see Figure 1).

Although some scholars claim that the math gender gap is innate and rooted in biology, there is a growing consensus, based on new evidence, that societal factors play an important role, making room for policy interventions (Fryer and Levitt 2010; Guiso et al. 2008; Bharadwaj et al. (2012), Nollenberger, Rodríguez-Planas, and Sevilla 2014). Hence, understanding the reasons behind the math gender gap in Latin America is a first step towards designing policies that aim to reduce the

[1] The gender gap is calculated as the girls' average score minus the boys' average score, whereby a negative gap means that boys over perform girls while a positive gap means that girls over perform

underrepresentation of women in STEM fields and improve the conditions of female workers in the region.

The aim of this paper is to test alternative (yet potentially complementary) socialization theories behind that math gender gap in Latin America. To do so, we first exploit individual variation in tests scores between boys and girls (a total of 90,799 students, 52% of which are girls) *within* 8 Latin American countries, for which PISA collected thorough information on mathematics in 2012. While this analysis is in the spirit of Fryer and Levitt (2010) for the US and Bharadwaj et al. (2012) for Chile, we are able to test a wide array of socialization theories as the 2012 PISA contains a rich set of math-related questions asked to students, schools' heads and parents. In contrast with earlier studies who found no support for any socialization theory, we find evidence that differential parents' expectations on math for girls' and boys' career and differential girls' and boys' own perception of math *self-efficiency*, *self-concept*, and *anxiety* matter, as they are associated with 8 and 30 percent of the math gender gap, respectively.[2]

Second, pooling 2006 to 2012 PISA waves and exploiting time and cross-country variation, we explore the influence of societal factors on the math gender gap in 11 Latin American countries. As in Guiso et al. (2008), we find that more gender-equal countries have smaller math gender gaps. However, while Guiso's analysis, which focuses on 39 medium- to high-income countries participating in 2003 PISA, finds that both women's economic opportunities and political empowerment matter, we find that gender-equality in either the labor market or tertiary education are most relevant for Latin America. Perhaps more importantly, we also find that higher economic development in Latin American countries is associated with a smaller math gender gap, a result that is reversed in developed countries.[3]

The contribution of this paper is threefold. First, we are the first to document the existence and persistence across time of a sizeable average math gender gap in Latin America, as well as the existence of large differences in the gap across countries

[2] According to PISA, *self-efficiency* measures whether the student feels confident when doing math; *self-concept* as the student's views about his or her abilities doing math; and *anxiety* as the extent to which the student feels worried, nervous, tense, helpless when doing math.

[3] At the end of their paper, Fryer and Levitt (2010) also conduct a similar analysis with TIMMS data. They find that more gender-equal countries are associated with a smaller math gender gap if Muslim countries or those with single-sex education are dropped from the sample. In Fryer and Levitt's sample, GDP has no effect on the math gender gap (the coefficient is zero and not statistically significant).

also within this region. Second, exploiting the wealth of math information in 2012 PISA, we find evidence that parents' differential expectations regarding the usefulness of math for their daughters' and sons' professional career, as well as girls' and boys' differential own perception of math *self-efficiency*, *self-concept*, and *anxiety* are associated with the math gender gap. While experimental evidence has been supportive of some of these findings (see for example Ho et al. 2000; Tobias and Weissbrod 1980 for evidence on math anxiety), to the best of our knowledge, this is the first paper providing such evidence with nationally representative survey data. Third, we corroborate findings from others on the relevance of environmental factors in explaining the math gender gap, and find evidence that relevant factors may vary with the region's level of development.

The paper is organized as follows. First, we document the math gender gap in Latin American countries. Second, we use PISA 2012 and student-level data to test alternative socialization hypotheses in explaining the math gender gap in Section 3. In Section 4, we use country-level data merged with measures of gender equality to explore the relevance of societal factors. Section 5 concludes.

## 2. The Math Gender Gap in Latin America

### *PISA Data*

We use 2003, 2006, 2009 and 2012 student-level data from the *Programme of International Student Assessment* (PISA), an internationally standardized assessment conducted by the Organization for Economic Cooperation and Development (OECD) and administered to 15-year olds in schools every three years since 2000. PISA assesses a range of relevant skills and competencies in three main domains: mathematics, reading and science, but our analysis focuses on mathematics. In addition, students, school principals, and, in some countries, also parents, answer questionnaires to provide information about the students' background, as well as the broader school system and learning environment.

We standardized the test scores to have mean zero and standard deviation equal to one by country and PISA wave, and define the math gender gap as the girls' minus the boy's PISA math test score. So that, a negative gap means that boys outperform girls, while a positive gap means that girls outperform boys in math test scores. PISA uses imputation methods, denoted as plausible values (PV), to report student performance. In all of our analysis, we follow the OECD recommendations that involve estimating one regression for each set of PV and subsequently report the arithmetic average of these estimates.

***The Math Gender Gap***

Tables 1 and 2 document the raw math gender gap for our sample of 11 Latin American countries, by country and year (Table 1) and by country and quantile (Table 2). Table 1 shows that there are important cross-country differences in girls' performance in math tests relative to boys within the region. While Uruguayan girls scored 0.13 standard deviations lower than boys in 2012 (which is equivalent to around 3.5 fewer months of schooling), Colombian and Costa Rican girls underperform boys by 0.30 standard deviations or the equivalent to 8.5 months of schooling. In addition, the time-series information available for those countries participating in PISA from 2003 onwards suggests that the size of the gap persist over time.

Table 2 shows that gender differences in math scores increase along the distribution, reaching 0.34 of a standard deviation at the top 5 percentile. This pattern is present in all countries in our sample and is consistent with what others have documented for developed countries (Ellison and Swanson 2010; Fryer and Levitt 2010; and Hyde and Mertz 2009). While our estimates rely on linear probability models estimated using the whole sample, our results are robust to estimating quantile regressions at the top of the distribution, instead.

## 3. Testing Alternative Socialization Theories

While there is a wide literature documenting the math gender gap, evidence, using nationally representative samples of math test scores, on which socialization theories explain this math gender gap is scarce.[4] Using the Early Childhood Longitudinal

[4] Much of the research documenting gender gap in math scores has been based upon US data. The size of the gap reported depends on the test and time-period. Some recent studies suggest that the average gender gap in math scores among teenagers has been narrowing (Hyde and Mertz 2009), while others document persisting large differences in the average performance of girls relative to boys (Fryer and Levitt 2010). There is a wide consensus that substantial differences persist at the top of the distribution (Ellison and Swanson 2010; Hyde and Mertz 2009) and that the fraction of males to females who score in the top 5 percent of the distribution in high-school math has remained constant at two to one over the past 20 years (Xie and Shauman 2003). Ellison and Swanson (2010) document that the gender gap in secondary-school math at high-achievement levels is present in every US high school, although the size

Study Kindergarten (ECLS-K), Fryer and Levitt (2010) explore several socialization theories that could explain the math gender gap in the US, including gender differences in human capital investment, differential parental expectations, and biased testing, but they fail to find support for any of them. Similarly, using administrative Chilean data, Bharadwaj et al. (2012) test the following socialization theories: teacher's gender, gender composition of the classroom, class size, parental investment, and students' perceptions of their own math abilities. They find no compelling support for any of these theories driving the Chilean math gender gap.

As explained earlier, in 2012 PISA collected thorough information on mathematics from the students', principals', and parents' questionnaires.[5] In this section, we analyze this rich data to test alternative socializing theories. Because the parental questionnaire is not mandatory for participating countries, and hence was only implemented in Chile and México, estimates on parents' differential expectations on math for their sons and daughters are restricted to these two countries.

Table 3 displays the summary statistics by gender for the variables used in this section. Panel A in Table 3 shows that boys are more likely than girls to fall behind a grade and less likely immigrate. Panel B reveals that some family characteristics are significantly different across gender, suggesting that 15-year-old boys and girls are not randomly assigned across families in our sample. Indeed, boys have more educated parents who work in better occupations, and are more likely to live in wealthier households. It is possible that boys and girls are more likely to be present in specific households because gender-selective fertility and abortion. An alternative and complementary explanation is that gender differences in drop-out rates at secondary school are behind this imbalance.[6] Consistent with this, Panel C shows that boys tend to go to smaller schools with a lower student-teacher ratio than girls. However, boys are also more likely to be present in smaller schools with lower quality of materials and a tad poorer peers.

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of the gap varies between schools. Bedard and Cho (2010) review the existing evidence documenting gender gap in math scores in OECD countries. Guiso et al. (2008) document that "*girls' math scores average 10.5 (or 2 percent) lower score points than those of boys",* using PISA data as in this paper.

[5] Appendix Tables A.1 and A.2 show a list of definitions and details on the construction of all the variables used in this section.

[6] According to UNESCO statistics, the enrollment rate at secondary school is higher for girls at lower-secondary schools for all countries in our sample. This difference increases at the upper-secondary level.

Panels D to I in Table 3 display summary statistics by gender for variables used to test alternative socialization theories. The figures show that girls are less likely to have a positive perception of math teacher's support (panel D) and a positive self-evaluation of their own performance in math (panel I), or agree that mathematics are important for their future than boys (panel I). Girls are also more likely to experiment anxiety when doing math than boys (panel I). Panel H indicate that parents are less likely to expect a math career (job) for their daughter, or support their daughter with math tasks at home.

### 3.1. Controlling for Individual characteristics

We first estimate the following equation using pooled 2012 PISA data:

$$E_{ik}=\alpha_1 female_i + X'_{ik}\beta_1 + \lambda_k + \varepsilon_{ik} \qquad (1)$$

where $i$ is the individual who lives in country $k$. $E_{ik}$ indicates an individual's educational attainment in math test scores. To identify the differences in educational attainment between sexes, the variable $female_i$ is a dummy variable equal to one if the individual is a girl and zero otherwise. We include country fixed effects ($\lambda_k$) in our specification to account for the country-specific characteristics that may be related to educational attainment. The vector $X_{ik}$ includes a set of individual characteristics that may affect educational attainment for reasons unrelated to gender equality. In our baseline specification, we only include the age of the child at the time of the exam, a dummy indicating whether the individual is in a different grade from the modal one in the country, and a dummy indicating whether the individual is immigrant. The fully parametrized model (equation 2 below) include a full set of family and school characteristics.

As can be seen in column (1) of Table 4, after controlling for these individual characteristics, the math gender gap increases in 0.05 of a standard deviation (from 0.22 to 0.27), suggesting that, in Latin American countries the raw math gender gap is underestimated due to the omitted variable bias generated by the fact that boys are more likely to fall behind a grade than girls.

### 3.2. Controlling for Family and School Characteristics

As discussed earlier, boys and girls do not seem to be randomly distributed across families and schools. To control for these differences, we then estimate the following model:

$$E_{ik}=\alpha_1 female_i + X'_{ik}\beta_1 + Z'_{ik}\beta_2 + \lambda_k + \varepsilon_{ik} \qquad (2)$$

where vector $X_{ik}$ now also includes mother and father's highest education level, index of cultural possessions, an index of educational resources, and an index of home possessions. The vector $Z_{ik}$ includes school characteristics, such as, school size, type of school (public versus private), whether the school is located in a metropolitan area, teachers' quality, among others.

The results are presented in columns 2 to 15 in Table 4. After controlling for family characteristics, the math gender gap decreases in 0.05 of a standard deviation (from 0.27 in column 1 to 0.22 in column 9). Parental education, the level of wealth in the household, and the presence of brothers and sisters at home are the variables driving this variation. Most of school characteristics, however, do not affect the relative performance of boys and girls in math, with the exception of whether the school is private or not (column 10), whether it is in a metropolitan area or not (column 11) or the average socio-economic and cultural level of students at the school (column 17), which increase the math gender gap by 0.02 of a standard deviation.

### 3.3. Testing Socialization Theories

We conclude this section by testing alternative socialization theories. For this purpose, we estimate the following specification:

$$E_{ikt}=\alpha_1 female_i + X'_{ikt}\beta_1 + Z'_{ikt}\beta_2 + \beta_3 S_{ikt} + \lambda_k + \varepsilon_{ikt} \qquad (3)$$

The variable $S_{ikt}$ depends on the socializations theories being tested.[7] For expositional clarity, let's assume that we are testing whether school-gender peer effects are behind the math gender gap in Latin American countries. In this case, $S_{ikt}$ would be the proportion of girls in the school (as recorded by the school's principal). If girls

[7] When possible, we will use alternative variables to test the same socialization hypothesis in order to check the sensitivity of our results to the variable used in the analysis.

perform worse than boys in math when placed in competition with male peers (Niederle and Vesterlund 2010), we should observe a reduction in the math gender gap (the coefficient of the female dummy) after controlling by the proportion of girls in the school. Note that the variables used to test the different hypothesis are not associated to random events so we are not able to identify causal relationships.

### *3.3.1. Differential treatment by teachers*

We first explore whether the math gender gap could be explained by different treatment by teachers. In particular, teacher's gender may influence the gender gap in students' achievement, either through a passive effect (role model, stereotype threat) or through an active effect (discrimination) (Dee 2005, 2007). Unfortunately, PISA does not contain information about the gender of the math teachers. To explore potential differential treatment by math teachers, we use students' answers to several questions about teachers' behavior, more specifically whether the math teacher shows interest in every student, or whether he or she gives extra help when needed, among others. While descriptive statistics show that a slightly higher proportion of girls tend to have a negative perception of math teacher support (panel D in Table 3), we do not find support that girls' and boys' perceptions of their teachers' differential treatment by gender affects the math gender gap. Indeed, when we control for these perceptions in equation (3), the coefficient of the female dummy variable does not change (see Table 5).

While students' perceptions could be reasonably influenced by their own performance in the subject, we do not find that this is the only story. Indeed, when we regress each of these variables reflecting student's perceptions regarding their math teacher on a female dummy variable conditional on the math score, we continue to find that girls are more likely to have a negative view of their math teacher's support, *even* when they perform as well as boys (shown in Appendix Table A.3)

### *3.3.2. School environment*

Even though we have already controlled for a set of school characteristics, we further explore whether the math gender gap could be influenced by school characteristics that are specific to math, such as the proportion of math teachers with a math major, whether students are grouped by ability within math classes, or whether the school offers math competitions or math clubs. None of these variables change the math gender gap (shown in Table 6), even though they generally affect the math performance of students in the expected way.

#### *3.3.3. Peer effects*

Another possible explanation behind the math gender gap is related to peer-pressure. There is evidence that girls and boys tend to respond differently in competitive environments (Booth 2009; Booth and Nolen 2008; Niederle and Vesterlund 2010). In particular, girls exposed to the competition of boys tend to perform worse than those in same-sex environments. We explore whether the math gender gap is lower when school gender-peer pressure is low, by controlling for either the proportion of girls at the school or a variable indicating whether the school is a single-sex school or not. Although both variables have a positive effect on math tests scores, their inclusion in the regression has no effect on the coefficient of the math gap (shown in Table 7).

If girls are more sensitive to peer pressure than boys, peers' performance may affect differently boys and girls. We explore this hypothesis using objective measures of peer performance (average tests scores in math, reading and science at the school level) and measures of students' perceptions of their peers' performance. In this case, when we look at the peer performance by gender we restrict our sample to co-education environments. Again, we find little evidence that peer's performance is behind the math gender gap (as shown in Tables 8 and 9).

#### *3.3.4. Parents: role model, expectations and time investment*

***Role model.*** Parents may influence the relative performance of boys and girls in many ways. We first explore the role model hypothesis by controlling for the mother's educational level, using an indicator variable on whether the mother has a higher educational level than the father, mother's labor status, and an indicator variable of whether she has a STEM field occupation or not. None of these variables alter the math gender gap (shown in Table 10).

***Parents' expectations and time investment.*** Descriptive statistics show that parents are less likely to expect a math career for their daughters (see Panel H of Table 3) and these lower parental expectations for their daughters could potentially drive the math gender gap. Hence, we explore how much of the math gender gap is driven by parents' differential expectations regarding math performance of daughters and sons. For this purpose, we use the parental questionnaire available in the 2012 PISA for Mexico and Chile. We use direct questions about whether they expect their child follow a math career, which are summarized in a PISA index about parents' expectations, and also a more general set of questions about whether they think mathematics is important to get a job, or improve future income, among others. Alternatively, it may be not a story of expectations but of differential time investment doing math with children. We explore this hypothesis by controlling for a set of parents' questions about how frequently they spend time doing math-related activities with their children, which is summarized in a PISA index labeled "Parents support child at home" (see Appendix Table A.2 for details on all these variables).

Results are shown in Table 11. Parents' expectations have a positive effect on math scores and it seems they play a role in explaining the math gender gap, although the effect is small. Column 2 in Table 11 shows that, after controlling for parents' expectations, the math gender gap decreases by 0.02 of a standard deviation, from 0.24 to 0.22 (the equivalent to an 8% reduction in the math gender gap).

Parents' attitudes toward mathematics, which measures parents' general attitude on the relevance of math in the job market but not directly related to his or her own child, also increase the math scores generally, but only reduce the math gender gap in 0.01 of a standard deviation (shown in column 3). Interestingly, parental time investment on their children's math activities is negatively correlated with children's math scores, suggesting that parents provide more support to those children who may need it the most (column 4). Columns 6 and 7 of Table 11, use students' perception of parental attitudes toward math. The results are similar to those found above.

We also check to what extent parental differential expectations and attitudes are driven by the differential child's performance by regressing the parental variables on a female dummy variable conditional to the children math test score. As shown in columns 1 to 3 of Appendix Table A.4, parents are less likely to expect a math career for girls and invest less time doing math activities with their daughters even when girls perform as well as boys. Another concern is whether these differential expectations and attitudes are math-specific or parents tend to have lower expectations and invest less time with their daughters in general. We examine this using a set of questions to parents not related to mathematics. As can be seen in columns 4 to 8 of Appendix Table A.4, parents are more likely to expect a higher educational level for their daughters (column 4), and tend to spend more time doing some no math-specific activities with their daughters (columns 6 and 7), even after controlling for math or reading skills.

### *3.3.5. Children differential expectations and perceptions of self-ability*

Finally, we explore the extent to which girls' lower performance in math may be the result of differential interests or motivations, differential perceptions of self-ability, or differential levels of confidence or anxiety when doing math between boys and girls. This could be because girls have internalized what constitutes being a girl and behaving according to a girl's gender identity (Akerlof and Kranton 2000).

For this purpose, we use alternative questions included in 2012 PISA, which are summarized in several indices. Specifically, we evaluate the effect of students': (1) interest or *intrinsic motivation* to learn mathematics; (2) *instrumental motivation* to do it because they think that mathematics are important to get a job in the future; (3) confidence when doing math (*self-efficiency*), (4) views about their abilities doing math (*self-concept*), (5) feelings of wariness, nervousness, tension, helplessness when doing math (*anxiety*), and the extent to which they perceive self-responsibility for falling in mathematics.

As discussed earlier, Panel I in Table 3 indicates that girls are less interested and motivated in math, feel less confident and have a lower perception of their math abilities, and feel more anxiety when doing mathematics than boys. These perceptions could be logically influenced by their own performance in the subject. However, when we regress each of these variables on a female dummy conditional to the math score, we find that such differences persists, even when girls perform as well as boys (shown in Appendix Table A.5).

We then explore to what extent these factors explain the math gender gap by including each of these indices in equation 3. The results are shown in Table 12. All the indices affect the math scores in the expected way. While differential interest and instrumental motivation do not affect the math gender gap, the lower confidence (*self-efficiency*) of girls when doing math, the lower perception of self-ability (*self-concept*), and the higher *anxiety* they report seem to all play a role. Taking all of these indices together, the math gender gap decreases by 0.07 of a standard deviation or 30% of the math gender gap. Given that we cannot rule out that part of the differential perceptions are explained by the math scores (and not vice-versa), this analysis is largely suggestive and should be interpreted with caution.

### 3.4. Sensitivity Analysis

To test the sensitivity of our results we run the same regressions for different groups of students and countries. First, given that the math gender gap increases at the top of the math score distribution, we estimate quantile regressions for the top 10 percentile of the distribution, and find similar results. Second, we follow Guiso et al. (2008) and keep only those students with an index of socioeconomic and cultural status (variable "ESCS") above the median of each country. Again, the main conclusions remain. Finally, we estimate the same regression for two sub-samples of countries: 1) those with the lowest math gender gap (Argentina and Uruguay), 2) those with the highest math gender gap (Chile, Colombia and Costa Rica). We do not find differences on the influence of the variables analyzed between these two groups. All these results are available from authors upon request.

## 4. Cross-Country Variation and the Role of Social Environment

In the previous section, we tested many socialization theories and only found that parents' differential expectations regarding the usefulness of math for their daughters' and sons' professional career, as well as girls' and boys' differential own perception of math *self-efficiency*, *self-concept*, and *anxiety* are associated with the math gender gap. In this section we follow the influential 2008 *Science* article by Guiso and coauthors and analyze whether there is evidence that the math gender gap decreases in more gender-equal Latin American countries. Compelling support for this would reinforce the earlier findings that gender-related institutions or beliefs are behind the math gender gap.

### 4.1. Methodological Approach and Data

To this end, we merge 2006, 2009 and 2012 PISA waves to different measures of gender equality that capture the relative position of women to men in different social aspects, such as health, education, labor market, or political empowerment, as well as beliefs regarding gender roles in the society.[8] Table 1 displays a list of countries included in each PISA wave and used in the country-level analysis in this section. We then exploit *both* time and cross-country variation and estimate the following specification:[9]

$$Math\ Gender\ Gap_{tk} = \alpha_1 + \alpha_2 ENV_{tk} + \alpha_3 logGPDpc + \lambda_t + \varepsilon_{kt} \qquad (4)$$

The left-hand-side (LHS) variable, *Math Gender Gap,* is the average girls' minus the average boy's PISA math test score for the country $k$ at the time (PISA wave) $t$.[10] The variable $ENV_{kt}$ is a measure of gender-equality in country $k$ at time $t$. Generally, the different measures of gender equality are indices ranging from 0 to 1, with a larger value being associated with a more gender-equal environment. For the sake of expositional clarity, let's assume that $ENV_{kt}$ is a measure of gender equality in the labor market. In such case, our coefficient of interest, $\alpha_2$, would capture the role of gender equality in the labor market in explaining gender differences in math test scores of girls relative to boys. A positive and significant $\alpha_2$ would suggest that more gender-equal conditions in the labor market are associated with a higher relative performance of girls over boys, and thus a smaller gender gap in children's math test scores. Thus, the gender gap in math scores between boys and girls from a country with more gender-equal labor market conditions (higher $ENV_k$) would be smaller than the gender gap between boys and girls from a country with less gender-equal conditions (lower $ENV_k$).

To measure gender equality in a country, we follow Guiso et al. (2008) and use the Gender Gap Index (GGI) from the World Economic Forum (Hausmann, Tyson, and Zahidi 2009). The GGI measures the relative position of women in a society taking into account the gap between men and women in economic opportunities, economic participation, educational attainment, political achievements, health and well-being. It ranges from 0 to 1 and larger values point to a better

[8] When possible, we use alternative variables to test the same socialization hypothesis in order to check the sensitivity of our results to the variable used in the analysis.

[9] This differs from Guiso et al. 2008 and Fryer and Levitt 2010, which do not exploit time variation in their analysis.

[10] It is obtained from estimating a linear regression for each country and PISA wave using the plausible values provided by the PISA data sets as LHS variable and a female dummy as RHS variable. We estimated one regression for each PV for each country and present the average of the 5 coefficients estimated.

position of women in society. Information of the GGI is available beginning from 2006. To explore which environmental factors matter, we also use other measures of gender equality from the World Economic Forum, namely an index of economic participation and opportunity (which include inequality in salaries, labor force participation levels and access to high-skilled employment), an index on educational attainment, an index on political empowerment, and an index of health and survival. These indexes range from 0 to 1 and larger values point to a better position of women in society. In addition, we construct an index of cultural attitudes towards women using the answers to some questions included in the *Latinbarómetro*.[11] Appendix Table A.6 presents a detailed description of all the gender equality measures used in the analysis and the Panel A of Table A.7 present the mean values by country, cross-country standard deviation and correlations.

Cross-country differences in the math gender gap could be related to differences in the economic development rather than differences in the role of women in society. For example, it could be that all individuals have the same biased-gender attitudes independently of the country but that, according to how credit constrained they are, they invest more or less in their girls. To take this into account, we control for the GDP per capita (in logarithms) for each country. In addition, PISA wave fixed effects ($\lambda_t$) account for cohort differences and shocks affecting to all countries. To facilitate the interpretation of the coefficients, in our regression analysis we standardize both the math gender gap and the gender-equality measures to have mean equal to zero and standard deviation equal to one over the sample.

### 4.2. Cross-country analysis for Latin American countries

The results are reported in Table 13. Column 1 suggests that higher values of the GGI (more gender-equal countries) are associated with a better math test performance of girls relative to boys, but the coefficient is not statically significant. Indeed, the only statistically significant factor is the one related to gender equality in the labor market presented in column 2. This suggests that more gender equality in economic participation and opportunities (implying more equality in salaries, labor force participation, and access to high-powered positions) is associated with a relatively better performance of girls in math. According to our estimation, an increase in one

[11] The *Latinobarómetro* is an annual public opinion survey that involves some 20,000 interviews in 18 Latin American countries.

standard deviation in this index reduces the math gender gap in 0.46 standard deviations. Another way to see this is: if Chile (Eco_Opp index = 0.53), which is one of the Latin American countries with the lower index of gender equality in the labor market in our sample, had the level of gender equality of Uruguay (Eco_Opp index = 0.64), one of the more gender-equal countries in our sample, the Chilean math gender gap (currently -24.61) would be reduced in 7.2 score points (or 30%), from -24.6 to -17.4.[12] Our results in Table 13 suggests that gender differences in educational institutions, health access and political empowerment cannot account for the variation in the math gender gap across Latin American countries as the sign of the coefficients is always negative, the coefficients for political empowerment and educational system are close to zero, and none of the coefficients are statistically significant.

In addition, we find strong evidence that differences in the GDP per capita appear to be important in explaining the differences in the math gender gap across LA countries: an increase of one standard deviation in the (logarithm of the) GDP per capita is associated with a reduction of the math gender gap across countries of more than 0.5 standard deviations. While this positive and statistically significant correlation between the GDP and girls' relative performance in math is also found by Dickerson, McIntosh, and Valente (2015) for a sample of sub-Saharan countries, it is of opposite sign in medium- to high-developed countries (see Table 14 for OECD countries and Guiso et al. 2008).[13]

### 4.3. Cross-country analysis for developed countries

Table 14 displays the results from estimating the same specification over a sample of developed countries, including all the OECD countries with the exception of Chile and México (see Appendix Table A.8 for a list of the countries included). As Guiso et al. (2008), we find that the higher the degree of gender equality in an OECD country, the higher the math performance of girls relative to boys. Specifically, one standard deviation increase in the GGI is associated with a reduction in the math gender gap of 0.66 standard deviations, which is slightly larger and more precisely

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[12] To calculate this, we first recover the non-standardized coefficient using the standard deviations of each variable ($\frac{MathGap_{St.Dev}(=8.26)\times 0.46}{GGI\ Ec.Opp_{St.Dev}(=0.06)} = 63.51$). Then, we apply the following formula:

$$\frac{(GGI\ Ec.Opp_{Chile}=0.53 - GGI\ Ec.Opp_{Uruguay}=0.64)=0.11 \times 63.5=7.2}{MathGap_{Chile}=-24.6} = -0.29$$

[13] The coefficient of the GDP per capita is negative and mostly not statistically significant in Guiso et al. (2008) estimations using 2003 PISA data, which include mainly (but not only) OECD countries.

estimated than the effect found among Latin American countries. As in the Latin American sample, gender discrimination in the labor market also matters in explaining the variation in the math gender gap across OECD countries. In addition, in OECD countries, women's political empowerment is also relevant. We find that an increase of one standard deviation in women's economic participation and political empowerment is associated with a decrease the cross-country variation in the math gender gap by 0.39 and 0.60 standard deviation, respectively. We also find that the WVS index is associated with a decrease in the math gender gap of 0.38 standard deviations. Note that WVS is not directly comparable with the earlier indexes as they cover different sample sizes.[14]

Table 15 explores the role of different social factors in explaining the cross-country and across-time variation of the math gender gap using alternative measures of gender equality. As can be seen, the main conclusions remain. Interestingly, we find that the proportion of females enrolled in tertiary education are associated with a decrease in math gender gap in both Latin American countries and OECD countries.

### 4.4. Robustness checks

One concern with the country-level approach is that it may be capturing spurious correlations between unobserved factors and our measures of environment. To explore whether this is the case, we estimate the same equation at the student level, including country fixed effects and individual controls to better account for unobserved heterogeneity. To do so, we estimate the following equation:

$$E_{ikt}=\alpha_1 female_i + \alpha_2(female_i ENV_{kt}) + \alpha_3(female_i GDPpc_{kt}) + \lambda_k + \lambda_t + X'_{ikt}\beta_1 + Z'_{ik}\beta_2 + \varepsilon_{ikt} \quad (5)$$

where $E_{ikt}$ is the test score for the individual *i*, living in the country *k* and assessed in the PISA wave *t*. In this case, our coefficient of interest, $\alpha_2$, is the interaction between $ENV_{kt}$ and the female dummy variable, which captures the role of gender equality in explaining the gender differences in the math educational achievement of boys and girls. $\lambda_k$ are country fixed effects and vectors $X_{ikt}$ and $Z_{ik}$ are the set of individual and

[14] As not all the OECD countries participate in the World Value Survey or in all the waves we use in our analysis, the sample is smaller when using WVS index of attitudes towards women.

family, and school characteristics respectively, described in Sections 4.1 and 4.2.[15] As can be seen in Appendix Table A.9, the main conclusions from the country-level analysis remain.[16]

Our main results also hold at both the country- and student-level when restricting the sample to those students in the upper tail of the distribution or those who live in households with an index of socio-economic and cultural level above the median (results are available from authors upon request).

## 5. Conclusions

According to PISA data, Latin American countries are among those with the highest math gender gap. Exploiting rich information on mathematics from 90,799 students, their parents and their school principals collected in PISA 2012, we test a wide array of socialization theories behind the math gender gap. In contrast with earlier findings unable to uncover compelling support for these theories, we find evidence that differential parents' expectations on math for their sons' and daughters' career and students' own perception of math *self-efficiency*, *self-concept*, and *anxiety* are associated with 8 and 30 percent of the math gender gap, respectively.

We then explore whether broader societal forces regarding women's position in society explain the sizable math gender gap in Latin America. Using 2006, 2009, and 2012 PISA data and exploiting cross-country and time variation, we find evidence that growing up in more gender-equal countries in Latin America reduces the math gender gap, consistent with findings from 45 countries all over the world (Guiso et al., 2008). Interestingly, we find that an important part of the variation in the math gender gap across Latin American countries is associated with gender differences in the labor market and access to tertiary education, as well as the level of the country's economic development (measured by the GDP per capita). Our country-level findings also provide a useful point of comparison with previous literature, which has focused mainly in high- and medium-income countries. In contrast with what we find for Latin American countries, we find that in OECD countries, factors like women's

[15] We were unable to control in this specification for the variables related to family structure, as this question was not included in all PISA waves.

[16] To facilitate the comparison with the estimations at country level, we first present the results of the estimations at the country level not standardized.

political empowerment and attitudes towards women, more generally, seem to be more relevant. Using a sample of 19 African countries, Dickerson, McIntosh, and Valente (2015) present some evidence that cross-country differences in the math gender gap in Africa are correlated with the regional share of adult women with no education, the share of Muslim in the population and the regional fertility rate rather than economic opportunities. One possible interpretation of these results is that depending on the level of development and, most importantly, on the stage in the gender revolution of the region analyzed (Esping-Andersen 2009), the environmental factors influencing girls relative performance in math would be different. In any case, given that even among OECD countries differences in the math performance between girls and boys still persist, it is unlikely that gender differences in math scores in Latin American countries will disappear with economic growth alone.

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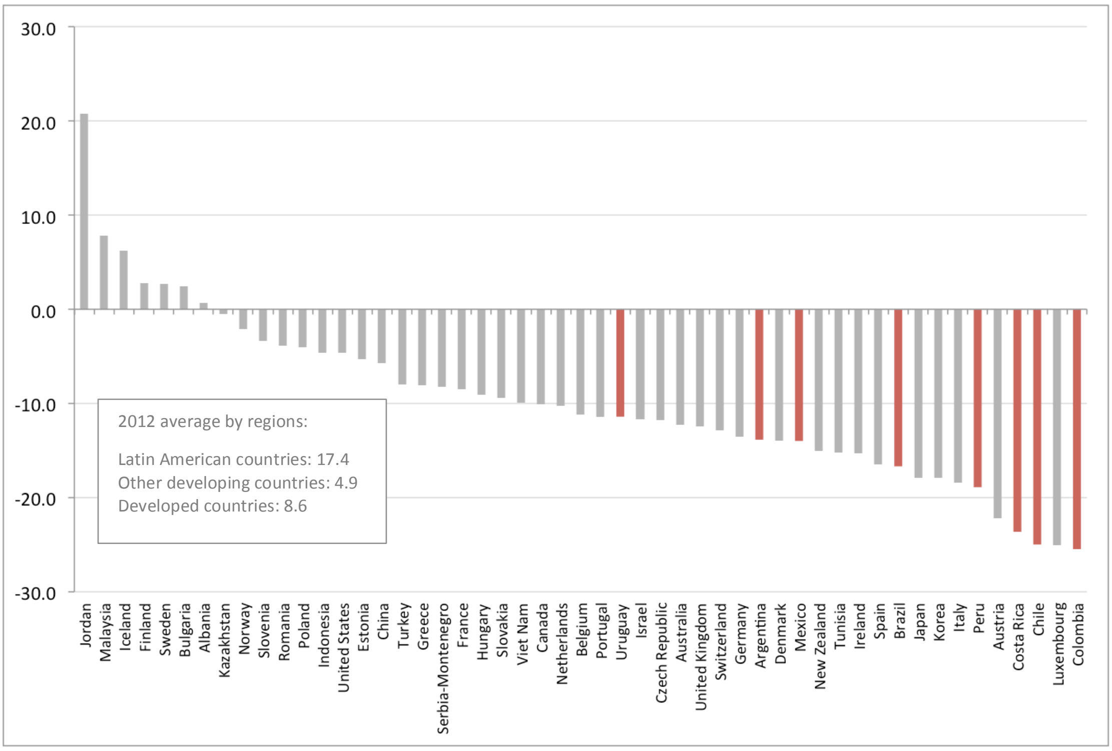
# Figures and Tables

## Figure 1. The Math Gender Gap - 2012 PISA




*Notes:* Girls' PISA math score minus boys' PISA math score by country. Source: elaborated by the authors based on 2012 PISA data.

## Table 1. The Math Gender Gap in Latin American Countries

| | 2003 | 2006 | 2009 | 2012 |
|---|---|---|---|---|
| Argentina | | -0.13 | -0.12 | -0.17 |
| Brazil | -0.17 | -0.20 | -0.20 | -0.22 |
| Chile | | -0.32 | -0.26 | -0.29 |
| Colombia | | -0.25 | -0.42 | -0.34 |
| Costa Rica | | | -0.36 | -0.36 |
| Mexico | -0.14 | -0.12 | -0.18 | -0.19 |
| Panama | | | -0.06 | |
| Peru | | | -0.20 | -0.23 |
| Trinidad y Tobago | | | 0.08 | |
| Uruguay | -0.12 | -0.13 | -0.13 | -0.13 |
| Venezuela | | | -0.20 | |

*Notes:* Girls' PISA math score minus boys' PISA math score. PISA tests scores are normalized to have mean zero and standard deviation one by country and PISA wave. A negative value means that boys perform relatively better than girls while a positive value means that girls perform better than boys.

**Table 2: The Math Gender Gap by Quantiles – 2012 PISA**

| | Mean | Q50 | Q75 | Q90 | Q95 |
|---|---|---|---|---|---|
| All LA countries | -0.22*** | -0.21*** | -0.25*** | -0.31*** | -0.34*** |
| | [0.01] | [0.01] | [0.02] | [0.02] | [0.03] |
| Argentina | -0.17*** | -0.18*** | -0.18*** | -0.18*** | -0.25*** |
| | [0.03] | [0.04] | [0.05] | [0.05] | [0.06] |
| Brazil | -0.22*** | -0.20*** | -0.25*** | -0.32*** | -0.35*** |
| | [0.02] | [0.03] | [0.03] | [0.05] | [0.06] |
| Chile | -0.29*** | -0.29*** | -0.34*** | -0.33*** | -0.33*** |
| | [0.03] | [0.04] | [0.04] | [0.05] | [0.06] |
| Colombia | -0.34*** | -0.31*** | -0.39*** | -0.49*** | -0.55*** |
| | [0.02] | [0.05] | [0.05] | [0.07] | [0.08] |
| Costa Rica | -0.36*** | -0.34*** | -0.43*** | -0.47*** | -0.52*** |
| | [0.03] | [0.04] | [0.05] | [0.10] | [0.09] |
| México | -0.19*** | -0.19*** | -0.23*** | -0.29*** | -0.32*** |
| | [0.01] | [0.02] | [0.02] | [0.03] | [0.04] |
| Perú | -0.23*** | -0.21*** | -0.20*** | -0.26*** | -0.29*** |
| | [0.03] | [0.04] | [0.05] | [0.07] | [0.10] |
| Uruguay | -0.13*** | -0.14*** | -0.22*** | -0.24*** | -0.29*** |
| | [0.03] | [0.04] | [0.05] | [0.07] | [0.06] |

*Notes:* The gender gap is defined as the girls' score minus the boys' score. It was obtained from estimating quantile regressions using the plausible values provided by the 2012 PISA data sets as LHS variable and a female dummy as RHS.
* p<0.1, ** p<0.05, *** p<0.01

## Table 3: Summary Statistics by Gender

| | Males | Females | Difference |
|---|---|---|---|
| **A. Individual characteristics:** | | | |
| Age in months | 15.80 | 15.80 | -0.001 |
| | (0.295) | (0.298) | |
| Diff. grade | 0.550 | 0.473 | 0.077*** |
| | (0.498) | (0.499) | |
| Immigrant | 0.010 | 0.013 | -0.003*** |
| | (0.100) | (0.113) | |
| **B. Family characteristics:** | | | |
| Father education | 3.052 | 2.903 | 0.149*** |
| | (1.953) | (1.950) | |
| Mother education | 3.065 | 2.881 | 0.184*** |
| | (1.964) | (1.966) | |
| Highest parental occupational status | 41.13 | 40.10 | 1.030*** |
| | (21.04) | (20.89) | |
| Cultural possessions | -0.286 | -0.135 | -0.151*** |
| | (0.940) | (0.923) | |
| Home educational resources | -0.789 | -0.778 | -0.001 |
| | (1.046) | (1.039) | |
| Wealth | -1.141 | -1.287 | 0.146*** |
| | (1.177) | (1.166) | |
| Family Structure | | | |
| Two parents at home | 0.609 | 0.615 | -0.006 |
| | (0.488) | (0.487) | |
| Sisters | 0.546 | 0.567 | -0.021*** |
| | (0.438) | (0.431) | |
| Brothers | 0.640 | 0.651 | -0.011*** |
| | (0.432) | (0.424) | |
| **C. School characteristics:** | | | |
| Private school | 0.200 | 0.203 | -0.003 |
| | (0.397) | (0.399) | |
| Location (Village omitted) | | | |
| Metropolis | 0.133 | 0.132 | 0.001 |
| | (0.337) | (0.335) | |
| City | 0.249 | 0.250 | -0.001* |
| | (0.429) | (0.429) | |
| Town | 0.281 | 0.280 | 0.001* |
| | (0.446) | (0.445) | |
| Total school enrolment | 760.8 | 781.5 | -20.7*** |
| | (672.0) | (711.3) | |
| Student-Teacher ratio | 16.52 | 16.83 | -0.310*** |
| | (14.11) | (16.46) | |
| Proportion of certified teachers | 0.753 | 0.755 | -0.002 |
| | (0.325) | (0.326) | |
| Quality of school educational resources | -0.203 | -0.182 | -0.021** |
| | (1.119) | (1.109) | |
| School apply selection rules | 0.421 | 0.429 | -0.008 |
| | (0.486) | (0.488) | |
| Average students' socio-economic and cultural index | -1.126 | -1.107 | -0.019** |
| | (0.817) | (0.811) | |

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ *Continued*

**Table 3 (cont.) Summary Statistics by Gender**

| | Males | Females | Difference |
|---|---|---|---|
| **D. Teachers differential treatment** | | | |
| Math teacher shows interest in every student | 0.849 | 0.843 | 0.006*** |
| | (0.285) | (0.293) | |
| Math teacher gives extra help when needed | 0.765 | 0.746 | 0.019*** |
| | (0.337) | (0.352) | |
| Math teachers helps with learning | 0.852 | 0.847 | 0.005*** |
| | (0.281) | (0.288) | |
| Math teacher teaches until all understand | 0.780 | 0.772 | 0.008*** |
| | (0.328) | (0.336) | |
| Math teacher gives students time to ask | 0.801 | 0.794 | 0.007*** |
| | (0.319) | (0.326) | |
| **E. School Environment** | | | |
| Proportion of math teachers with major | 0.435 | 0.436 | -0.001 |
| | (0.355) | (0.357) | |
| Streaming math within class by ability | 0.0931 | 0.0906 | 0.003 |
| | (0.278) | (0.277) | |
| School offers mathematic competitions | 0.769 | 0.770 | -0.001 |
| | (0.405) | (0.409) | |
| School offers math club | 0.231 | 0.226 | 0.005 |
| | (0.403) | (0.403) | |
| **F. Peers' gender and performance** | | | |
| Proportion of girls at school | 0.489 | 0.507 | -0.047*** |
| | (0.0991) | (0.0914) | |
| Single sex school | 0.0137 | 0.0135 | 0.000*** |
| | (0.116) | (0.115) | |
| *Objective measures of peers' performance* | | | |
| Average school math score | -0.029 | -0.0034 | -0.026*** |
| | (0.672) | (0.659) | |
| Average school reading score | -0.046 | 0.012 | -0.058*** |
| | (0.682) | (0.660) | |
| Average school science score | -0.029 | 0.008 | -0.037*** |
| | (0.674) | (0.653) | |
| *Child's perception of peers* | | | |
| Friends do well in math | 0.545 | 0.538 | 0.007 |
| | (0.399) | (0.403) | |
| Friends work hard in math | 0.505 | 0.500 | 0.005 |
| | (0.400) | (0.403) | |
| Friends enjoy math | 0.284 | 0.245 | 0.039*** |
| | (0.367) | (0.343) | |

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ *Continued*

**Table 3 (cont.) Summary Statistics by Gender**

| | Males | Females | Differences |
|---|---|---|---|
| **G. Parents: Role Model** | | | |
| Mother more educated than father | 0.291 | 0.285 | 0.006 |
| | (0.454) | (0.452) | |
| Mother work | 0.520 | 0.502 | 0.018*** |
| | (0.488) | (0.490) | |
| Mother in STEM occupation | 0.006 | 0.006 | 0.000 |
| | (0.078) | (0.075) | |
| **H. Parents expectations, attitudes and time investment (1)** | | | |
| *Parents' answers* | | | |
| Parents' expectations of Math. Career | 0.419 | 0.264 | 0.155*** |
| | (0.906) | (0.923) | |
| Parent attitudes toward mathematics | 0.425 | 0.414 | 0.011* |
| | (0.876) | (0.884) | |
| Parents support child in math at home | 0.005 | -0.033 | 0.038*** |
| | (1.064) | (1.124) | |
| *Child's answers* | | | |
| Parents believe math is important | 0.941 | 0.941 | 0.001 |
| | (0.185) | (0.187) | |
| Parents believe math is important for career | 0.906 | 0.890 | 0.016*** |
| | (0.226) | (0.255) | |
| **I. Children's beliefs** | | | |
| Mathematics Interest | 0.557 | 0.452 | 0.105*** |
| | (0.719) | (0.722) | |
| Instrumental Motivation for Mathematics | 0.428 | 0.378 | 0.050*** |
| | (0.704) | (0.715) | |
| Mathematics Self-Efficacy | -0.247 | -0.389 | 0.142*** |
| | (0.712) | (0.678) | |
| Mathematics Self-Concept | 0.0971 | -0.0831 | 0.180*** |
| | (0.682) | (0.693) | |
| Mathematics Anxiety | 0.397 | 0.512 | -0.115*** |
| | (0.638) | (0.624) | |
| Attributions to Failure in Mathematics | -0.0193 | -0.0158 | -0.003 |
| | (0.837) | (0.771) | |

*Notes:* The Table displays means and standard deviations of student-level 2012 PISA data by gender. Definitions and detailed information of the variables are provided in Appendix Tables A.1 and A.2. Sample weights applied.
(1) Variable from Parents' Questionnaire, only available for Chile and México.
$^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

**Table 4: The Math Gender Gap and Individual, Family and School Characteristics**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| Female | -0.27*** | -0.25*** | -0.24*** | -0.24*** | -0.25*** | -0.24*** | -0.23*** | -0.23*** | -0.22*** |
| | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] |
| Age of student | 0.01 | 0.03 | 0.03* | 0.04** | 0.04** | 0.03** | 0.04** | 0.04** | 0.04** |
| | [0.02] | [0.02] | [0.02] | [0.02] | [0.02] | [0.02] | [0.02] | [0.02] | [0.02] |
| Diff. Grade | -0.65*** | -0.60*** | -0.57*** | -0.55*** | -0.53*** | -0.52*** | -0.50*** | -0.48*** | -0.47*** |
| | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] |
| Immigrant | -0.54*** | -0.54*** | -0.50*** | -0.48*** | -0.46*** | -0.46*** | -0.45*** | -0.44*** | -0.43*** |
| | [0.05] | [0.05] | [0.05] | [0.05] | [0.05] | [0.05] | [0.05] | [0.05] | [0.05] |
| Father education | | 0.12*** | 0.07*** | 0.05*** | 0.04*** | 0.04*** | 0.03*** | 0.03*** | 0.03*** |
| | | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] |
| Mother education | | | 0.09*** | 0.06*** | 0.05*** | 0.04*** | 0.03*** | 0.04*** | 0.04*** |
| | | | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] |
| Highest parental occupational status | | | | 0.01*** | 0.01*** | 0.01*** | 0.01*** | 0.01*** | 0.01*** |
| | | | | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] |
| Cultural possess. | | | | | 0.03*** | -0.01* | -0.01*** | -0.01** | -0.01** |
| | | | | | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] |
| Home educational resources | | | | | | 0.12*** | 0.07*** | 0.06*** | 0.06*** |
| | | | | | | [0.01] | [0.01] | [0.01] | [0.01] |
| Wealth | | | | | | | 0.12*** | 0.11*** | 0.11*** |
| | | | | | | | [0.01] | [0.01] | [0.01] |
| Two parents at home | | | | | | | | 0.22*** | 0.18*** |
| | | | | | | | | [0.01] | [0.01] |
| Sisters | | | | | | | | | 0.04*** |
| | | | | | | | | | [0.01] |
| Brothers | | | | | | | | | -0.07*** |
| | | | | | | | | | [0.01] |
| Constant | 0.15 | -0.48* | -0.73*** | -0.96*** | -0.93*** | -0.77*** | -0.59** | -0.82*** | -0.74*** |
| | [0.29] | [0.28] | [0.27] | [0.27] | [0.27] | [0.26] | [0.26] | [0.26] | [0.26] |
| Country FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 90799 | 90799 | 90799 | 90799 | 90799 | 90799 | 90799 | 90799 | 90799 |
| $R^2$ | 0.13 | 0.19 | 0.21 | 0.24 | 0.25 | 0.26 | 0.28 | 0.29 | 0.30 |

*Continued*

**Table 4 (cont.): The Math Gender Gap and Individual, Family and School Charact.**

| | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) |
|---|---|---|---|---|---|---|---|---|
| Female | -0.23*** | -0.24*** | -0.24*** | -0.24*** | -0.24*** | -0.24*** | -0.24*** | -0.25*** |
| | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] |
| Age of student | 0.04** | 0.04** | 0.03** | 0.03** | 0.03** | 0.03** | 0.03** | 0.03** |
| | [0.02] | [0.02] | [0.02] | [0.02] | [0.02] | [0.02] | [0.02] | [0.02] |
| Diff. grade | -0.45*** | -0.45*** | -0.43*** | -0.43*** | -0.44*** | -0.43*** | -0.43*** | -0.40*** |
| | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] |
| Immigrant | -0.44*** | -0.45*** | -0.45*** | -0.45*** | -0.45*** | -0.45*** | -0.44*** | -0.44*** |
| | [0.06] | [0.06] | [0.05] | [0.05] | [0.05] | [0.06] | [0.06] | [0.06] |
| Father education | 0.02*** | 0.02*** | 0.02*** | 0.02*** | 0.02*** | 0.02*** | 0.02*** | 0.00 |
| | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] |
| Mother education | 0.03*** | 0.03*** | 0.03*** | 0.03*** | 0.03*** | 0.03*** | 0.02*** | 0.01*** |
| | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] |
| Highest parental occup. status | 0.01*** | 0.01*** | 0.01*** | 0.01*** | 0.01*** | 0.01*** | 0.01*** | 0.00*** |
| | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] |
| Cultural possessions | -0.02*** | -0.02*** | -0.02*** | -0.02*** | -0.02*** | -0.01*** | -0.01*** | -0.02*** |
| | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] |
| Home educational resources | 0.07*** | 0.07*** | 0.07*** | 0.07*** | 0.06*** | 0.06*** | 0.06*** | 0.06*** |
| | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] |
| Wealth | 0.08*** | 0.07*** | 0.07*** | 0.07*** | 0.07*** | 0.06*** | 0.06*** | -0.00 |
| | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] |
| Two parents at home | 0.17*** | 0.17*** | 0.17*** | 0.17*** | 0.17*** | 0.17*** | 0.17*** | 0.16*** |
| | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] |
| Sisters | 0.05*** | 0.05*** | 0.04*** | 0.05*** | 0.05*** | 0.05*** | 0.04*** | 0.05*** |
| | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] |
| Brothers | -0.06*** | -0.06*** | -0.06*** | -0.06*** | -0.06*** | -0.06*** | -0.06*** | -0.05*** |
| | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] |
| Private school | 0.45*** | 0.43*** | 0.48*** | 0.48*** | 0.48*** | 0.43*** | 0.42*** | 0.14*** |
| | [0.02] | [0.02] | [0.02] | [0.02] | [0.02] | [0.02] | [0.02] | [0.02] |
| Metropolis | | 0.20*** | 0.13*** | 0.13*** | 0.13*** | 0.10*** | 0.10*** | -0.12*** |
| | | [0.02] | [0.02] | [0.02] | [0.02] | [0.02] | [0.02] | [0.02] |
| City | | 0.12*** | 0.06*** | 0.06*** | 0.06*** | 0.04*** | 0.04*** | -0.15*** |
| | | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] |
| Town | | 0.11*** | 0.06*** | 0.06*** | 0.06*** | 0.05*** | 0.05*** | -0.07*** |
| | | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] |
| School size | | | 0.00*** | 0.00*** | 0.00*** | 0.00*** | 0.00*** | 0.00*** |
| | | | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] |
| Student-Teacher ratio | | | | -0.00*** | -0.00*** | -0.00*** | -0.00*** | -0.00*** |
| | | | | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] |
| Proportion of certified teachers | | | | | 0.03 | 0.04** | 0.04** | 0.02 |
| | | | | | [0.02] | [0.02] | [0.02] | [0.02] |
| Quality of educational resources | | | | | | 0.06*** | 0.06*** | 0.02*** |
| | | | | | | [0.00] | [0.00] | [0.00] |
| School applies selection | | | | | | | 0.04*** | 0.01 |
| | | | | | | | [0.01] | [0.01] |
| Av. Socio-Economic status of students at school | | | | | | | | 0.43*** |
| | | | | | | | | [0.01] |
| Constant | -0.79*** | -0.83*** | -0.80*** | -0.80*** | -0.83*** | -0.74*** | -0.73*** | -0.09 |
| | [0.25] | [0.25] | [0.25] | [0.25] | [0.25] | [0.25] | [0.25] | [0.25] |
| Country FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 90799 | 90799 | 90799 | 90799 | 90799 | 90799 | 90799 | 90799 |
| $R^2$ | 0.32 | 0.32 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.37 |

*Notes:* Results from estimating equations (1) and (2) using 2012 PISA data at student level. In all cases we use the five plausible values of math test scores provided by PISA datasets and report the average coeficient (Stata command *pv*). * p<0.1, ** p<0.05, *** p<0.01.

**Table 5: The Math Gender Gap and Differential Treatment by Teachers**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Female | -0.25*** | -0.25*** | -0.25*** | -0.25*** | -0.25*** | -0.26*** | -0.26*** |
| | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] |
| Math teacher shows interest in every student | | 0.00 | | | | | -0.01 |
| | | [0.02] | | | | | [0.02] |
| Math teacher gives extra help when needed | | | -0.01 | | | | -0.02 |
| | | | [0.01] | | | | [0.02] |
| Math teachers helps with learning | | | | 0.06*** | | | 0.09*** |
| | | | | [0.02] | | | [0.02] |
| Math teacher teaches until all understand | | | | | 0.00 | | -0.01 |
| | | | | | [0.01] | | [0.02] |
| Math teacher gives students time to ask | | | | | | -0.02 | -0.04** |
| | | | | | | [0.01] | [0.02] |
| Constant | -0.09 | -0.09 | -0.08 | -0.14 | -0.09 | -0.07 | -0.10 |
| | [0.25] | [0.25] | [0.25] | [0.25] | [0.25] | [0.25] | [0.25] |
| Country FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 90799 | 90799 | 90799 | 90799 | 90799 | 90799 | 90799 |

*Notes:* Results from estimating equation 3, using 2012 PISA data at student level. Variables $S_{itk}$ are those in Panel D of Table 3 (see definitions in Appendix Table A.2). In all cases we use the five plausible values of math test scores provided by PISA datasets and report the average coefficient (Stata command *pv*). * p<0.1, ** p<0.05, *** p<0.01.

**Table 6: The Math Gender Gap and School Environment**

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Female | -0.25*** | -0.25*** | -0.26*** | -0.26*** | -0.26*** | -0.25*** |
| | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] |
| Proportion of maths teachers with maths major | | 0.06*** | | | | 0.03** |
| | | [0.02] | | | | [0.02] |
| Streaming math within class according to ability | | | -0.08*** | | | -0.07*** |
| | | | [0.02] | | | [0.02] |
| School offers math club | | | | 0.02* | | 0.02 |
| | | | | [0.01] | | [0.01] |
| School offers mathematic competitions | | | | | 0.08*** | 0.08*** |
| | | | | | [0.01] | [0.01] |
| Constant | -0.09 | -0.11 | -0.03 | -0.07 | -0.07 | 0.20 |
| | [0.25] | [0.25] | [0.25] | [0.25] | [0.25] | [0.24] |
| Country FE | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 90799 | 90799 | 90799 | 90799 | 90799 | 90799 |

*Notes:* Results from estimating equation 3, using 2012 PISA data at student level. Variables $S_{itk}$ are those in Panel E of Table 3 (see definitions in Appendix Table A.2). In all cases we use the five plausible values of math test scores provided by PISA datasets and report the average coefficient (Stata command *pv*). * p<0.1, ** p<0.05, *** p<0.01.

## Table 7: The Math Gender Gap and Peers' Gender and Performance

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| Female | -0.25*** | -0.26*** | -0.26*** | -0.26*** | -0.28*** | -0.26*** | -0.26*** | -0.25*** |
| | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] |
| Proportion of girls at school | | 0.14*** | | | | | 0.22*** | |
| | | [0.04] | | | | | [0.04] | |
| Single sex school | | | 0.10*** | | | | | 0.03 |
| | | | [0.02] | | | | | [0.02] |
| Av. Math score of peers | | | | 0.89*** | | | 0.94*** | 0.92*** |
| | | | | [0.01] | | | [0.02] | [0.02] |
| Av. Read score of peers | | | | | 0.68*** | | -0.04** | -0.03 |
| | | | | | [0.01] | | [0.02] | [0.02] |
| Av. Science score of peers | | | | | | 0.70*** | -0.01 | -0.02 |
| | | | | | | [0.01] | [0.02] | [0.02] |
| Constant | -0.09 | -0.17 | -0.10 | -0.15 | 0.10 | -0.13 | -0.27 | -0.16 |
| | [0.25] | [0.25] | [0.25] | [0.22] | [0.23] | [0.23] | [0.22] | [0.22] |
| Country FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 90799 | 90799 | 90799 | 90799 | 90799 | 90799 | 90799 | 90799 |

*Notes:* Results from estimating equation 3, using 2012 PISA data at student level. Variables $S_{itk}$ are those in rows 1 to 5 of Panel F of Table 3 (see definitions in Appendix Table A.2). In all cases we use the five plausible values of math test scores provided by PISA datasets and report the average coefficient (Stata command *pv*). * p<0.1, ** p<0.05, *** p<0.01.

## Table 8: The Math Gender Gap and Peers' Performance by Gender in Co-educational schools

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| Female | -0.26*** | -0.27*** | -0.27*** | -0.27*** | -0.27*** | -0.27*** | -0.27*** | -0.27*** |
| | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] |
| Av. Math score of male peers | | 0.76*** | | | | | | 0.44*** |
| | | [0.01] | | | | | | [0.03] |
| Av. Math score of female peers | | | 0.78*** | | | | | 0.50*** |
| | | | [0.01] | | | | | [0.03] |
| Av. Reading score of male peers | | | | 0.60*** | | | | -0.00 |
| | | | | [0.01] | | | | [0.02] |
| Av. Reading score of female peers | | | | | 0.60*** | | | -0.06*** |
| | | | | | [0.01] | | | [0.02] |
| Av. Science score of male peers | | | | | | 0.60*** | | -0.01 |
| | | | | | | [0.01] | | [0.02] |
| Av. Science score of female peers | | | | | | | 0.61*** | -0.02 |
| | | | | | | | [0.01] | [0.02] |
| Constant | 0.05 | -0.08 | 0.05 | 0.25 | 0.11 | 0.02 | -0.02 | -0.04 |
| | [0.17] | [0.16] | [0.16] | [0.16] | [0.16] | [0.17] | [0.16] | [0.16] |
| Country FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 86569 | 86265 | 86300 | 86265 | 86300 | 86265 | 86300 | 85996 |

*Notes:* Results from estimating equation 3, using 2012 PISA data at student level. Variables $S_{itk}$ are those in rows 3-5 of

Panel F of Table 3 by gender. In all cases we use the five plausible values of math test scores provided by PISA datasets and report the average coefficient (Stata command *pv*). * p<0.1, ** p<0.05, *** p<0.01.

**Table 9: The Math Gender Gap and Perception of Peers' Performance**

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | b/se | b/se | b/se | b/se | b/se |
| Female | -0.25*** | -0.26*** | -0.26*** | -0.27*** | -0.26*** |
| | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] |
| Friends do well in maths | | -0.21*** | | | -0.12*** |
| | | [0.01] | | | [0.01] |
| Friends work hard in maths | | | -0.21*** | | -0.10*** |
| | | | [0.01] | | [0.01] |
| Friends enjoy maths | | | | -0.26*** | -0.16*** |
| | | | | [0.01] | [0.01] |
| Constant | -0.09 | 0.05 | 0.04 | 0.01 | 0.11 |
| | [0.25] | [0.25] | [0.25] | [0.25] | [0.25] |
| Country FE | Yes | Yes | Yes | Yes | Yes |
| N | 90799 | 90799 | 90799 | 90799 | 90799 |

*Notes:* Results from estimating equation 3, using 2012 PISA data at student level. Variables $S_{itk}$ are those in rows 6 to 8 of Panel F of Table 3 (see definitions in Appendix Table A.2). In all cases we use the five plausible values of math test scores provided by PISA datasets and report the average coeficient (Stata command *pv*). * p<0.1, ** p<0.05, *** p<0.01.

**Table 10: The Math Gender Gap and Mother's Role Model**

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Female | -0.25*** | -0.25*** | -0.26*** | -0.26*** | -0.26*** |
| | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] |
| Mother more educated than father | | -0.02 | | | -0.02 |
| | | [0.01] | | | [0.01] |
| Mother work | | | -0.04*** | | -0.04*** |
| | | | [0.01] | | [0.01] |
| Mother in a STEM occupation | | | | 0.21*** | 0.21*** |
| | | | | [0.07] | [0.07] |
| Constant | -0.09 | -0.09 | -0.08 | -0.09 | -0.07 |
| | [0.25] | [0.25] | [0.25] | [0.25] | [0.25] |
| Country FE | Yes | Yes | Yes | Yes | Yes |
| N | 90799 | 90799 | 90799 | 90799 | 90799 |

*Notes:* Results from estimating equation 3, using 2012 PISA data at student level. Variables $S_{itk}$ are those in Panel G of Table 3 (see definitions in Appendix Table A.2). In all cases we use the five plausible values of math test scores provided by PISA datasets and report the average coefficient (Stata command *pv*). * p<0.1, ** p<0.05, *** p<0.01.

**Table 11: The Math Gender Gap and Parental Expectations, Attitudes and Time investment**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Female | -0.24*** | -0.22*** | -0.24*** | -0.25*** | -0.22*** | -0.24*** | -0.24*** |
| | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] |
| *Parents questionnaire* | | | | | | | |
| Parents' expectations of Math. Career | | 0.15*** | | | 0.16*** | | |
| | | [0.01] | | | [0.01] | | |
| Parent attitudes toward mathematics | | | 0.05*** | | 0.03*** | | |
| | | | [0.01] | | [0.01] | | |
| Parents support child in math at home | | | | -0.07*** | -0.09*** | | |
| | | | | [0.01] | [0.01] | | |
| *Children questionnaire* | | | | | | | |
| Parents believe math is important | | | | | | 0.08** | |
| | | | | | | [0.03] | |
| Parents believe math is important for career | | | | | | | 0.03 |
| | | | | | | | [0.03] |
| Constant | 1.59*** | 1.48*** | 1.53*** | 1.59*** | 1.49*** | 1.50*** | 1.56*** |
| | [0.28] | [0.37] | [0.37] | [0.37] | [0.37] | [0.38] | [0.37] |
| Country FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 40662 | 40662 | 40662 | 40662 | 40662 | 40662 | 40662 |

*Notes:* Results from estimating equation 3, using 2012 PISA data at student level. Variables $S_{itk}$ are those in Panel H of Table 3 (see definitions in Appendix Table A.2). In all cases we use the five plausible values of math test scores provided by PISA datasets and report the average coefficient (Stata command *pv*). * p<0.1, ** p<0.05, *** p<0.01.

**Table 12: The Math Gender Gap and Children's Beliefs**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| Female | -0.25*** | -0.25*** | -0.25*** | -0.22*** | -0.21*** | -0.22*** | -0.25*** | -0.18*** |
| | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] |
| Mathematics Interest | | 0.06*** | | | | | | -0.10*** |
| | | [0.01] | | | | | | [0.01] |
| Instrumental Motivation for Mathematics | | | 0.05*** | | | | | 0.01 |
| | | | [0.01] | | | | | [0.01] |
| Mathematics Self-Efficacy | | | | 0.21*** | | | | 0.21*** |
| | | | | [0.01] | | | | [0.01] |
| Mathematics Self-Concept | | | | | 0.24*** | | | 0.13*** |
| | | | | | [0.01] | | | [0.01] |
| Mathematics Anxiety | | | | | | -0.30*** | | -0.23*** |
| | | | | | | [0.01] | | [0.01] |
| Attributions to Failure in Mathematics | | | | | | | -0.11*** | -0.06*** |
| | | | | | | | [0.01] | [0.01] |
| Constant | -0.09 | -0.10 | -0.10 | -0.02 | -0.07 | 0.08 | -0.04 | 0.18 |
| | [0.25] | [0.25] | [0.25] | [0.24] | [0.25] | [0.24] | [0.25] | [0.24] |
| Country FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 90799 | 90799 | 90799 | 90799 | 90799 | 90799 | 90799 | 90799 |

*Notes:* Results from estimating equation 3, using 2012 PISA data at student level. Variables $S_{itk}$ are those in Panel I of Table 3 (see definitions in Appendix Table A.2). In all cases we use the five plausible values of math test scores provided by PISA datasets and report the average coefficient (Stata command *pv*). * p<0.1, ** p<0.05, *** p<0.01.

**Table 13: The Math Gender Gap and Environmental factors**
**Panel of countries analysis – Latin American countries**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| GGI | 0.20 | | | | | | |
| | [0.21] | | | | | | |
| Ec Participation and Opportunities | | 0.46** | | | | | |
| | | [0.19] | | | | | |
| Education | | | -0.05 | | | | |
| | | | [0.19] | | | | |
| Political Empowerment | | | | -0.02 | | | |
| | | | | [0.20] | | | |
| Health and Survival | | | | | -0.24 | | |
| | | | | | [0.22] | | |
| Attitudes towards women (*Latinbarómetro* index) | | | | | | 0.20 | |
| | | | | | | [0.22] | |
| GDPpc | 0.55*** | 0.71*** | 0.53*** | 0.53** | 0.64*** | 0.29 | 0.53*** |
| | [0.18] | [0.18] | [0.19] | [0.19] | [0.21] | [0.20] | [0.18] |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 25 | 25 | 25 | 25 | 25 | 24 | 25 |
| $R^2$ | 0.35 | 0.47 | 0.33 | 0.32 | 0.36 | 0.15 | 0.32 |

*Notes:* Results from estimating equation 4, using 2006, 2009 and 2012 PISA data, over a sample of Latin American countries. See Table 1 for a list of countries included in each PISA wave and Appendix Table A.6 for a definition of the alternative environmental factors used. * p<0.1, ** p<0.05, *** p<0.01.

## Table 14: The Math Gender Gap and Environmental factors

**Panel of countries analysis - OECD (no Latin American) countries**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| GGI | 0.66*** | | | | | | |
| | [0.13] | | | | | | |
| Ec Participation and Opportunities | | 0.39*** | | | | | |
| | | [0.12] | | | | | |
| Education | | | 0.04 | | | | |
| | | | [0.11] | | | | |
| Political Empowerment | | | | 0.60*** | | | |
| | | | | [0.11] | | | |
| Health and Survival | | | | | -0.18* | | |
| | | | | | [0.11] | | |
| Attitudes toward women (WVS index) | | | | | | 0.35 | |
| | | | | | | [0.24] | |
| GDPpc | -0.63*** | -0.39*** | -0.21* | -0.55*** | -0.23** | -0.48* | -0.19* |
| | [0.12] | [0.12] | [0.11] | [0.11] | [0.11] | [0.24] | [0.11] |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 91 | 91 | 91 | 91 | 91 | 32 | 91 |
| $R^2$ | 0.27 | 0.15 | 0.04 | 0.28 | 0.07 | 0.13 | 0.04 |

*Notes:* Results from estimating equation 4, using 2006, 2009 and 2012 PISA data, over the sample of OECD countries, excluding Chile and México. See Appendix Table 1 for a list of countries included in each PISA wave and Appendix Table A.6 for a definition of the alternative environmental factors used.
* p<0.1, ** p<0.05, *** p<0.01.

## Table 15: The Math Gender Gap and alternative environmental factors

**Panel of countries analysis – Latin American and OECD (no Latin American) countries**

| | A. LA countries | | | B. OECD (no LA) countries | | |
|---|---|---|---|---|---|---|
| | b/se | N | $R^2$ | b/se | N | $R^2$ |
| ***A. Labor Market institutions*** | | | | | | |
| FLFP | 0.67*** | 25 | 0.57 | 0.45*** | 91 | 0.17 |
| | [0.20] | | | [0.12] | | |
| Female Empl no agro. | 0.26 | 25 | 0.39 | 0.21* | 91 | 0.07 |
| | [0.18] | | | [0.12] | | |
| ***B. Educational institutions*** | | | | | | |
| Enrollment gender gap at primary school | 0.14 | 25 | 0.34 | 0.13 | 88 | 0.05 |
| | [0.22] | | | [0.12] | | |
| Enrollment gender gap at lower secondary level | 0.22 | 25 | 0.37 | 0.08 | 88 | 0.04 |
| | [0.18] | | | [0.11] | | |
| Enrollment gender gap at tertiary level | 0.38** | 25 | 0.47 | 0.40*** | 82 | 0.18 |
| | [0.16] | | | [0.11] | | |
| ***C. Political Empowerment*** | | | | | | |
| Prop. of parliament seats held by women | 0.08 | 25 | 0.33 | 0.38*** | 91 | 0.14 |
| | [0.19] | | | [0.12] | | |
| ***D. Health and Survival*** | | | | | | |
| Life Expectancy Gap | 0.30 | 25 | 0.40 | -0.14 | 91 | 0.05 |
| | [0.19] | | | [0.16] | | |
| Adolescent fertility rate | 0.12 | 25 | 0.34 | -0.07 | 91 | 0.04 |
| | [0.19] | | | [0.12] | | |
| ***E. Attitudes toward women*** | | | | | | |
| WVS index | 0.20 | 20 | 0.34 | -.- | | |
| | [0.46] | | | | | |

*Notes:* Each row display the results from estimating equation 4, using 2006, 2009 and 2012 PISA data and alternative measures of gender-equality, over a sample of Latin American countries (panel A) or OECD countries excluding Chile and Mexico (panel B). See Table 1 for a list of countries included in each PISA wave and Appendix Table A.6 for a definition of the alternative environmental factors used. All variables were standardized to have mean zero and standard deviation equal to one over the sample. * $p<0.1$, ** $p<0.05$, *** $p<0.01$.

# Appendix:

## Table A.1. Control Variables

| Variable | Definition |
|---|---|
| ***Individual Characteristics*** | |
| Female | Dummy variable equal to 1 if the individual is a girl |
| Age | In months |
| Different grade | Dummy equal to 1 if the current individual's grade is different from the modal grade at the children age in the host country and 0 otherwise. |
| Immigrant status | Dummy equal to 1 if the individual is an immigrant (either second or first generation) and 0 if the individual is a native. |
| ***Family characteristics*** | |
| Father highest level of education | Index constructed by the PISA program based upon the highest education level of the mother |
| Mother highest level of education | Index constructed by the PISA program based upon the highest education level of the mother |
| Index of cultural possessions (cultposs) | PISA index based upon the students' responses to whether they had the following at home: classic literature, books of poetry and works of art. |
| Index of home educational resources (hedres) | PISA index based upon the items measuring the existence of educational resources at home including a desk and a quiet place to study, a computer that students can use for schoolwork, educational software, books to help with students' school work, technical reference books and a dictionary. |
| Wealth | PISA index based upon the items measuring the existence of DVD players and other country-specific items at home and the amount of the following items: cellular phones, televisions, computers, cars, rooms with a bath or shower. |
| Two parents at home | Dummy variable equal to 1 if both parents live at home |
| Sisters | Dummy variable equal to 1 if the child have at least one sister living at home |
| Brothers | Dummy variable equal to 1 if the child have at least one brother living at home |
| ***School characteristics*** | |
| School size | Total number of students |
| School type | Dummy equal to 1 if school is private and 0 otherwise. |
| School location (Metropolis, City, Town) | Indicator variables of whether the school is in a Metropolis, in a City, in a Town or in a Village (omitted). |
| Teacher-Students ratio | Average number of students by teacher |
| Teachers quality | Proportion of fully certified teachers |
| Material resources quality | PISA index of resources quality based on availability of books, internet, laboratory, among others |
| School selectivity | An indicator on whether the school select students based on any criteria or not |
| Socio-economic and cultural environment | An indicator of the school's socio-economic environment based on the average PISA index of economic, social and cultural status (ESC) at school level. |

*Note:* all this variables are available for all countries and PISA waves, with the exception of family structure variables (two parents at home, sisters and brothers), which are not consistently reported across PISA waves (we only consider these variables when using 2012 data).

## Table A.2 Variables for testing socialization theories

| Variable | Definition |
|---|---|
| ***Teachers differential treatment*** | |
| Math teacher shows interest in every student | Indicator variable equal to one if the student agrees or strongly agrees with the sentence, and zero otherwise. |
| Math teacher gives extra help when needed | Indicator variable equal to one if the student agrees or strongly agrees with the sentence, and zero otherwise. |
| Math teachers helps with learning | Indicator variable equal to one if the student agrees or strongly agrees with the sentence, and zero otherwise. |
| Math teacher teaches until all understand | Indicator variable equal to one if the student agrees or strongly agrees with the sentence, and zero otherwise. |
| Math teacher gives students time to ask | Indicator variable equal to one if the student agrees or strongly agrees with the sentence, and zero otherwise. |
| ***School environment*** | |
| Proportion of math teachers with major | Ratio of math teachers with a major in math over total math teachers provided by the school's principal |
| Streaming math within class by ability | Indicator variable equal to one if the school's principal says that the school applies streaming by ability within math class and zero otherwise. |
| School offers mathematic competitions | Indicator variable equal to one if the school's principal says that the school offer mathematic competitions and zero otherwise |
| School offers math club | Indicator variable equal to one if the school's principal says that the school offer math club and zero otherwise |
| ***Peers' gender and peers' performance*** | |
| Proportion of girls | PISA variable based on school's principal reply on total enrollment of girls and boys at the school. |
| Single sex school | Indicator variable equal to one if the proportion of girls is lower than 1% or higher than 99%, and zero otherwise. |
| Av. peers' performance on math, reading or science. | Own calculation of weighted average students' performance at the school. For each student we calculate the average performance of the school excluding him/her. |
| Friends do well in math | Indicator variable equal to one if the student agrees or strongly agrees with the sentence, and zero otherwise. |
| Friends work hard in math | Indicator variable equal to one if the student agrees or strongly agrees with the sentence, and zero otherwise. |
| Friends enjoy math | Indicator variable equal to one if the student agrees or strongly agrees with the sentence, and zero otherwise. |
| ***Role model*** | |
| Mother is more educated than father | Indicator variable equal to one if mother highest level of education is higher than the father one and zero otherwise. |
| Mother labor status | Dummy equal to one if the mother works, and zero if she is unemployed or inactive. |
| Mother occupation in STEM fields | Indicator variable equal to one if mother is employed in a STEM occupation and zero otherwise. It was constructed based on student responses over their parents' occupation. The variable takes the value 1 if the mother works in the following ISCO-08 occupations codes: 2100 to 2166, 2510 to 2529, 3100 to 3155, 2631, 3314 or 2413. |
| ***Parents' differential expectations, attitudes and time invested*** | |
| Parents' expectations of child on math career | PISA index based on parents' answers to the following questions: a) Does anybody in your family (including you) work in a mathematics-related career? b) Does your child show an interest in working in a mathematics-related career? c) Do you expect your child will go into a mathematics-related career? d) Do you expect your child will study mathematics after completing secondary school? |

**Table A.2 (Cont.) Variables for testing socialization theories**

| VARIABLE | DEFINITION |
|---|---|
| ***Parents' differential expectations, attitudes and time invested (cont.)*** | |
| Parent attitudes toward mathematics | PISA index based on the following answers: a) It is important to have good mathematics knowledge and skills in order to get any good job in today's world; b) Employers generally appreciate strong mathematics knowledge and skills among their employees; c) Most jobs today require some mathematics knowledge and skills; d) It is an advantage in the job market to have good mathematics knowledge and skills. |
| Parents' support in homework | PISA index based on the following answers to the question: How often do you or someone else in your home do the following things with your child? a) Help my child with his/her mathematics homework, b) Discuss how my child is performing in mathematics class, c) Discuss with my child how mathematics can be applied in everyday life. |
| ***Beliefs*** | |
| Intrinsic motivation to learn mathematics | PISA index constructed using student responses to the statements asked in question, when asked to think about their views on mathematics: I enjoy reading about mathematics; I look forward to my mathematics; I do mathematics because I enjoy it; I am interested in the things I learn in mathematics. |
| Instrumental motivation to learn mathematics | PISA index constructed using student responses to a series of statements in question when asked to think about their views on mathematics: Making an effort in mathematics is worth because it will help me in the work that I want to do later on; learning mathematics is worthwhile for me because it will improve my career <prospects, chances>; Mathematics is an important subject for me because I need it for what I want to study later on; I will learn many things in mathematics that will help me get a job. |
| Self-efficiency | PISA index constructed using student responses over the extent they reported feeling very confident, confident, not very confident, not at confident about having to do a number of mathematics tasks. |
| Mathematics self-concept | PISA index constructed using student responses when asked to think about studying mathematics: I am just not good at mathematics; I get good <grades> in mathematics; I learn mathematics quickly; I have always believed that mathematics is one of my best subjects; in my mathematics class, I understand even the most difficult work. |
| Mathematics anxiety | PISA index constructed using student responses to question over the extent they strongly agreed, agreed, disagreed or strongly disagreed with the following statements when asked to think about studying mathematics: I often worry that it will be difficult for me in mathematics classes; I get very tense when I have to do mathematics homework; I get very nervous doing mathematics problems; I feel helpless when doing a mathematics problem; I worry that I will get poor <grades> in mathematics. |

*Note:* all this variables are available for all countries, with the exception of the indexes of parental expectations, attitudes and support in homework, which are only available for those countries applying the parents' questionnaire (Chile and México).

**Table A3: Student perceptions of teachers support conditional to math test score**

| | (1) Math teacher shows interest in every student | (2) Math teacher gives extra help when needed | (3) Math teachers helps with learning | (4) Math teacher teaches until all understand | (5) Math teacher gives students time to ask |
|---|---|---|---|---|---|
| Female | -0.01** | -0.02*** | -0.00 | -0.01** | -0.01** |
| | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] |
| Average score in math | -0.00* | -0.00* | 0.01*** | -0.00 | -0.01*** |
| | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] |
| Country FE | Yes | Yes | Yes | Yes | Yes |
| N | 90799 | 90799 | 90799 | 90799 | 90799 |

*Notes:* Results from regressing the variables in columns 1 to 5 using 2012 PISA data at student level, on a female dummy, controlling for the student's score in math test.

**Table A4: Parents expectations, attitudes and time investment conditional to test score**

| | Math-specific | | | No Math-specific | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) Parents' expectation s of Math. Career | (2) Parent attitudes toward maths | (3) Parents support child at home | (4) Parents' expectations of ISEI of student | (5) Parental involvement in school-related activities | (6) Spend time just talking to my child | (7) Do the main meal with my child around a table | (8) Discus how w my chi is doin at scho |
| Female | -0.12*** | -0.00 | -0.05*** | 1.33*** | -0.22*** | 0.04*** | 0.00 | 0.03** |
| | [0.01] | [0.01] | [0.02] | [0.17] | [0.01] | [0.01] | [0.01] | [0.01] |
| Av. score in math | 0.18*** | 0.05*** | -0.04*** | 2.04*** | -0.27*** | 0.06*** | 0.03*** | 0.10** |
| | [0.01] | [0.01] | [0.01] | [0.09] | [0.01] | [0.01] | [0.01] | [0.01] |
| Female | -.- | -.- | -.- | 0.86*** | -0.08*** | 0.00 | 0.00 | -0.02* |
| | | | | [0.18] | [0.01] | [0.02] | [0.01] | [0.01] |
| Av. score in reading | -.- | -.- | -.- | 0.98*** | -0.29*** | 0.07*** | 0.00 | 0.11** |
| | | | | [0.19] | [0.01] | [0.02] | [0.01] | [0.01] |
| Country FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 40662 | 40662 | 40662 | 40662 | 40662 | 40662 | 40662 | 40662 |

*Notes:* Results from regressing the variables in columns 1 to 8 using 2012 PISA data at student level, on a female dummy, controlling either for the student's score in math test or reading test. As parental questionnaire was only applied in Chile and México, we have to restrict the sample to only these countries.

**Table A5: Student interests and perceptions conditional to math test score**

| | (1) Mathematics Interest | (2) Instrumental Motivation for Mathematics | (3) Mathematics Self-Efficacy | (4) Mathemati cs Self-Concept | (5) Mathemati cs Anxiety | (6) Attributions to Failure in Mathematics |
|---|---|---|---|---|---|---|
| Female | -0.11*** | -0.05*** | -0.10*** | -0.15*** | 0.08*** | -0.02** |
| | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] | [0.01] |
| Average score in math | -0.03*** | -0.01** | 0.16*** | 0.13*** | -0.18*** | -0.09*** |
| | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] |
| Country FE | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 90799 | 90799 | 90799 | 90799 | 90799 | 90799 |

*Notes:* Results from regressing the variables in columns 1 to 6 using 2012 PISA data at student level, on a female dummy, controlling for the student's score in math test.

## Table A6: Variables for the cross-country analysis

| Variable | Definition and Source |
|---|---|
| ***General Gender Inequality*** | |
| Gender Gap Index (GGI) | Synthesizes the position of women by considering economic opportunities, economic participation, educational attainment, political achievements, health and well-being. The index range between 0 and 1. Larger values point to a better position of women in society. Source: World Economic Forum. |
| ***Labor Market Institutions*** | |
| Economic Participation and Opportunity Index | Index based upon: (1) female labour force participation over male, (2) Wage equality between women and men to similar work, (3) female earned income over male, (4) female legislators, senior officials and managers over male, (5) female professional and technical workers over male. Source: World Economic Forum. |
| Female Labor Force Participation (FLFP) | Female Labor Force Participation, from 15 years old. Source: ILO. |
| Share of women employed in the non-agricultural sector | Share of female workers in the nonagricultural sector (industry and services), expressed as a percentage of total employment in the nonagricultural sector. Source: World Bank Statistics. |
| ***Political Empowerment*** | |
| Political Empowerment Index | Index of women's political participation based upon: (1) the ratio women to men with seats in parliament; (2) the ratio of women to men in ministerial level and (3) the ratio of the number of years with a woman as head of state to the years with a man. Source: World Economic Forum. |
| Seats in Parliament | Proportion of seats held by women in the national parliaments. Source: World Bank Statistics. |
| ***Educational Institutions*** | |
| Educational Attainment Index | Index based upon: (1) female literacy rate over male, (2) female net primary level enrolment over male value, (3) female net secondary level enrolment over male, (4) female gross tertiary level enrolment over male. Source: World Economic Forum. |
| Enrolment gender gap at primary, secondary and tertiary education level. | Female primary, secondary or tertiary enrolment rate over male. Source: UNESCO and World Economic Forum for Brazil. |
| ***Health and Survival*** | |
| Health and Survival Index | Index based upon: (1) female healthy life expectancy over male, (2) sex ratio at birth (converted to female over male ratio). Source: World Economic Forum. |
| Gap in life expectancy at birth | Difference between females and males life expectancy at birth |
| Adolescent fertility rate | Number of births per 1,000 women ages 15-19. |
| ***Attitudes Towards Women*** | |
| *Latinbarómetro* Index (only to Latin American countries) | Index elaborated from the subjective survey *Latinbarómetro,* based upon the following questions: (1)"On the whole, men make better political leaders than women do", (2)"If a woman earns more money than her husband, it is almost certain to cause problems", (3) "It is better if man works and woman stays at home". The answers are 1=strongly agree, 2=agree, 3=disagree, 4=strongly disagree, so that higher values indicate more liberal views about the role of women in society. The index is an average by country and wave, so it ranges from 1 to 4. These questions were only included in the 2000, 2004 and 2009 waves, so we use the index of these waves in 2006, 2009 and 2012 respectively. Source: Latinbarómetro. |
| WVS index | Index elaborated from data of the subjective World Value Survey based upon the following questions: (1)"When jobs are scarce, men should have more right to a job than women", (2)"Being a housewife is just as fulfilling as working for pay", (3)"On the whole, men make better political leaders than women do", and (4)"A university education is more important for a boy than for a girl". The answers are 1=strongly agree, 2=agree, 3=disagree, 4=strongly disagree, so that higher values indicate a more liberal view about the role of women in society. The final index is the average by country and wave. We use the 1994-1998, 1999-2004, 2005-2009 and 2010-2014 waves and assign to 2006 the average index of the 1999-2004 and 1994-1998 waves (because some countries asked these questions in the first one, others in the second one and others in both), to 2009 the answers of 2005-2009 wave and to 2012 the answers of the 2010-2014 wave. Source: World Value Survey. |

## Table A7: Descriptive Statistics and correlations of main variables used for the cross-country analysis

| A. LA countries | Math Gender Gap | GGI | Ec. Opp. | Educ. | Pol. Emp. | Health | Att. towards women WVS | Att. towards women Latinb | GDP pc |
|---|---|---|---|---|---|---|---|---|---|
| Argentina | -12.39 | 0.71 | 0.59 | 1.00 | 0.27 | 0.98 | 2.73 | 2.76 | 6,782 |
| Brazil | -16.97 | 0.68 | 0.63 | 0.99 | 0.09 | 0.98 | 2.80 | 2.98 | 5,298 |
| Chile | -24.61 | 0.66 | 0.53 | 0.99 | 0.17 | 0.98 | 2.66 | 2.79 | 8,584 |
| Colombia | -26.57 | 0.70 | 0.66 | 1.00 | 0.15 | 0.98 | 2.72 | 2.72 | 3,923 |
| Costa Rica | -24.46 | 0.72 | 0.61 | 1.00 | 0.30 | 0.98 | . | 2.69 | 5,610 |
| Mexico | -12.21 | 0.66 | 0.51 | 0.99 | 0.15 | 0.98 | 2.62 | 2.77 | 8,126 |
| Panama | -5.18 | 0.71 | 0.68 | 0.99 | 0.15 | 0.98 | . | 2.58 | 5,999 |
| Peru | -18.25 | 0.67 | 0.62 | 0.98 | 0.18 | 0.97 | 2.77 | 2.71 | 3,619 |
| Trinidad y Tobago | 8.07 | 0.71 | 0.69 | 0.99 | 0.25 | 0.98 | 2.68 | . | 14,243 |
| Uruguay | -12.21 | 0.67 | 0.64 | 1.00 | 0.08 | 0.98 | 2.71 | 2.94 | 6,414 |
| Venezuela | -16.63 | 0.71 | 0.62 | 1.00 | 0.14 | 0.98 | . | 2.62 | 6,204 |
| Average | -16.56 | 0.69 | 0.60 | 0.99 | 0.17 | 0.98 | 2.71 | 2.79 | 6,492 |
| Cross-country SD | 8.26 | 0.02 | 0.06 | 0.01 | 0.08 | 0.00 | 0.15 | 0.17 | 2,325 |
| Math Gender Gap | 1 | | | | | | | | |
| GGI | 0.14 | 1 | | | | | | | |
| Ec. Opp. | 0.16 | 0.54* | 1 | | | | | | |
| Educ. | 0.01 | 0.52* | 0.33 | 1 | | | | | |
| Pol. Emp. | 0.08 | 0.66* | -0.05 | 0.22 | 1 | | | | |
| Health | 0.12 | 0.04 | -0.07 | 0.41* | -0.13 | 1 | | | |
| ATW - WVS | -0.12 | 0.25 | 0.34 | 0.22 | -0.08 | -0.19 | 1 | | |
| ATW - latinbar. | 0.15 | -0.39* | -0.06 | -0.27 | -0.38* | 0.11 | -0.16 | 1 | |
| GDP pc | 0.57* | -0.03 | -0.25 | 0.10 | 0.21 | 0.36* | -0.04 | 0.02 | 1 |
| **B. OECD countries** | | | | | | | | | |
| Average | -10.94 | 0.72 | 0.67 | 0.99 | 0.25 | 0.98 | 2.75 | -.- | 34,612 |
| Cross-country SD | 6.43 | 0.06 | 0.09 | 0.02 | 0.16 | 0.00 | 0.23 | -.- | 17,183 |
| Math Gender Gap | 1 | | | | | | | | |
| GGI | 0.23* | 1 | | | | | | | |
| Ec. Opp. | 0.18* | 0.80* | 1 | | | | | | |
| Educ. | -0.03 | 0.52* | 0.61* | 1 | | | | | |
| Pol. Emp. | 0.28* | 0.91* | 0.56* | 0.33* | 1 | | | | |
| Health | -0.14 | -0.13 | -0.03 | 0.19* | -0.21* | 1 | | | |
| ATW - WVS | 0.03 | 0.81* | 0.70* | 0.60* | 0.76* | -0.03 | 1 | | |
| ATW - latinbar. | -.- | -.- | -.- | -.- | -.- | -.- | -.- | -.- | |
| GDP pc | -0.15 | 0.61* | 0.44* | 0.29* | 0.55* | -0.21* | 0.63* | -.- | 1 |

## Table A.8. List of OECD countries included in the panel-country analysis

| | 2006 | 2009 | 2012 |
|---|---|---|---|
| Australia | ✓ | ✓ | ✓ |
| Austria | ✓ | ✓ | ✓ |
| Belgium | ✓ | ✓ | ✓ |
| Canada | ✓ | ✓ | ✓ |
| Czech Republic | ✓ | ✓ | ✓ |
| Denmark | ✓ | ✓ | ✓ |
| Estonia | | ✓ | ✓ |
| Finland | ✓ | ✓ | ✓ |
| France | ✓ | ✓ | ✓ |
| Germany | ✓ | ✓ | ✓ |
| Greece | ✓ | ✓ | ✓ |
| Hungary | ✓ | ✓ | ✓ |
| Iceland | ✓ | ✓ | ✓ |
| Ireland | ✓ | ✓ | ✓ |
| Israel | | ✓ | ✓ |
| Italy | ✓ | ✓ | ✓ |
| Japan | ✓ | ✓ | ✓ |
| Korea | ✓ | ✓ | ✓ |
| Luxembourg | ✓ | ✓ | ✓ |
| Netherlands | ✓ | ✓ | ✓ |
| New Zealand | ✓ | ✓ | ✓ |
| Norway | ✓ | ✓ | ✓ |
| Poland | ✓ | ✓ | ✓ |
| Portugal | ✓ | ✓ | ✓ |
| Slovakia | | ✓ | ✓ |
| Slovenia | | ✓ | ✓ |
| Spain | ✓ | ✓ | ✓ |
| Sweden | ✓ | ✓ | ✓ |
| Switzerland | ✓ | ✓ | ✓ |
| Turkey | ✓ | ✓ | ✓ |
| United Kingdom | ✓ | ✓ | ✓ |
| United States | ✓ | ✓ | ✓ |

## Table A.9 The role of environmental factors

### Robustness check using student level data

| | Estimations at country level (no standardized) Coef. Displayed: $\alpha_2$ (Eq. 4) | | | Estimations at student level (no standardized) Coef. Displayed: $\alpha_2$ (Eq. 5) | | |
|---|---|---|---|---|---|---|
| | b/se | N | $R^2$ | b/se | N | $R^2$ |
| ***A. Gender Gap Index*** | | | | | | |
| GGI | 68.96 | 25 | 0.35 | 18.39 | 254,863 | 0.36 |
| | [71.35] | | | [27.86] | | |
| ***B. Labor Market institutions*** | | | | | | |
| Ec. Participation and Opp. | 63.51** | 25 | 0.47 | -7.38 | 254,863 | 0.36 |
| | [26.63] | | | [11.57] | | |
| FLFP | 74.29*** | 25 | 0.57 | 27.18*** | 254,863 | 0.36 |
| | [22.17] | | | [10.02] | | |
| Female Empl no agro | 52.97 | 25 | 0.39 | 38.10*** | 254,863 | 0.36 |
| | [35.64] | | | [12.19] | | |
| ***C. Educational institutions*** | | | | | | |
| Education | -52.96 | 25 | 0.33 | -26.78 | 254,863 | 0.36 |
| | [195.10] | | | [49.20] | | |
| Enrollment gender gap at primary school | 67.85 | 25 | 0.34 | 32.62 | 254,863 | 0.36 |
| | [108.54] | | | [25.00] | | |
| Enrollment gender gap at lower secondary level | 44.43 | 25 | 0.37 | -15.56 | 254,863 | 0.36 |
| | [36.39] | | | [12.22] | | |
| Enrollment gender gap at tertiary level | 10.74** | 25 | 0.37 | 7.92*** | 254,863 | 0.36 |
| | [4.57] | | | [2.55] | | |
| ***D. Political Empowerment*** | | | | | | |
| Political Emp | -1.74 | 25 | 0.32 | -23.44*** | 254,863 | 0.36 |
| | [20.18] | | | [7.91] | | |
| Prop. of parliament seats held by women | 5.69 | 25 | 0.33 | -9.92** | 254,863 | 0.36 |
| | [13.97] | | | [4.78] | | |
| ***E. Health and Survival*** | | | | | | |
| Health and Survival | -602.20 | 25 | 0.36 | 85.94 | 254,863 | 0.36 |
| | [549.30] | | | [178.17] | | |
| Life Expectancy Gap | 143.04 | 25 | 0.40 | 80.76** | 254,863 | 0.36 |
| | [88.84] | | | [35.98] | | |
| Adolescent fertility rate | 0.10 | 25 | 0.34 | 0.37*** | 254,863 | 0.36 |
| | [0.16] | | | [0.08] | | |
| ***F. Attitudes toward women*** | | | | | | |
| Latinbar. index | 9.64 | 24 | 0.15 | 6.53** | 250,085 | 0.36 |
| | [10.65] | | | [3.32] | | |
| WVS index | 10.81 | 20 | 0.34 | 11.34 | 241,714 | 0.36 |
| | [25.08] | | | [12.67] | | |

*Notes*: Each row display the results from estimating equation 4 (Panel A) or equation 5 (Panel B), using 2006, 2009 and 2012 PISA data and alternative measures of gender-equality, over a sample of Latin American countries. In both cases, the coefficient displayed is $\alpha_2$. See Table 1 for a list of countries included in each PISA wave and Appendix Table A.6 for a definition of the alternative environmental factors used. Estimations at student level control for individual, family and school characteristics. * p<0.1, ** p<0.05, *** p<0.01.