Female empowerment and female competitiveness

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Abstract

We study competitiveness among 600,000 students representative of 79 countries or regions. We find an overall significant gender gap in competitiveness, a gap that increases as countries are more gender egalitarian. This effect is largely driven by girls being less competitive in more gender-egalitarian countries. We document a role of culture in determining competitiveness and that competitiveness is universally a strong predictor of math achievement and interest in high-paying occupations. Within countries, the gender gap in competitiveness increases with socioeconomic status, though, contrary to cross-country results, this is largely driven by high socioeconomic-status boys being more competitive.

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1 Introduction

A growing literature in economics documents gender differences in preferences and their role in accounting for education and labor market outcomes and the gender gaps therein (e.g., Bertrand, 2011 and Niederle, 2016 for overviews). More recently, there is an interest in documenting and understanding cross-cultural variations in the gender gap in preferences and especially in the gender-equality paradox, namely that for some preferences more gender-equal countries display a larger gender gap (Stoet and Geary, 2018; Falk and Hermle, 2018). In this paper we focus on a specific trait, competitiveness (Gneezy et al., 2003; Niederle and Vesterlund, 2007). In western (or WEIRD, see Henrich et al., 2010) countries there is evidence of not only a large gender gap in competitiveness, but competitiveness also predicts education and labor market outcomes and gender gaps therein (Buser et al., 2014, 2021; Flory et al., 2015; Ålmas et al., 2016; Buser et al., 2017; Reuben et al., 2017; Kamas and Preston, 2018; Samek, 2019). However, little is known about the global variation in competitiveness or whether competitiveness is a relevant trait in most societies.[1]

To close this gap we use the 2018 Programme for International Student Assessment (PISA 2018), an international standardized assessment of scholastic achievement of approximately 600,000 high school students representative of 30 million students in 79 countries or regions (OECD, 2020a). The assessment includes a survey measure of competitiveness akin to those recently developed in the literature.

We find that boys are significantly more competitive than girls in 74% of countries. Furthermore, the gender gap in competitiveness increases the more gender-egalitarian a country is, indicating a gender-equality paradox for competitiveness. We document the role of culture on competitiveness by analyzing second-generation immigrant students who share the same country of upbringing and test-taking but vary in their cultural ancestry.

[1] In a meta-analysis of non-representative studies with varying methods to elicit competitiveness, Markowsky and Beblo (2022) find suggestive evidence of larger gender gaps in tournament entry in studies ran in more gender-egalitarian countries. One such study, Gneezy et al. (2009), finds that men are more competitive than women among the Maasai (a patriarchal society) but the opposite is true among the Khasi (a matrilineal and matrilocal society). Lowes (2021), however, finds no change in the gender gap in competitiveness across ethnic groups in Central Africa that vary in their kinship structure.

Finally, in virtually all countries, competitiveness strongly predicts math achievement and interest in a high-paying occupation even conditional on math achievement.

We then go two steps further than is common in this literature. First, we study competitiveness across countries separately for boys and girls. We find that more gender-equal countries have a larger gender gap in competitiveness because girls become less competitive as countries become wealthier and more gender-equal. Boys' competitiveness is largely constant across countries. That is, the gender-equality paradox in competitiveness is driven by changes in the girls' preferences. Furthermore, for girls, competitiveness predicts math achievement and interest in high-paying jobs more strongly the more gender-equal the country is.

Second, we study patterns of competitiveness within countries. We find that the competitiveness of boys exhibits larger variance and increases more with socioeconomic status (SES) than that of girls.

To summarize, the gender gap in competitiveness increases both within countries as a function of SES and across countries as countries become more gender-equal (and more wealthy). However, the drivers of those two results are very different. Within countries, boys' competitiveness shows higher variance and increases more with SES, while across countries girls' competitiveness shows higher variance and decreases more with gender equality and wealth. Future models of changes in the gender gap in preferences should aim to reconcile the patterns within and across societies.

2 Data

We use data from PISA 2018, an international standardized assessment of 15-year-old school students' achievement in reading, mathematics, and science coordinated by the Organisation for Economic Co-operation and Development (OECD, 2019). A total of 79 countries or regions participated in PISA 2018, each with a sample ranging from 3,294 to 35,943 students that is nationally or regionally representative of the population of students aged between 15 years and 3 months and 16 years and 2 months at the beginning of the assessment period and who are enrolled in an educational institution at grade 7 or higher.[2] A total of more than 600,000 students participated in PISA 2018, representing approximately 30 million students (OECD, 2020a).

PISA 2018 included a questionnaire that elicited students' socioeconomic background, personality traits, and various preferences and attitudes and other information. As part of the questionnaire students indicated whether they "strongly disagree", "disagree", "agree", or "strongly agree" with each of the following three items intended to measure preferences for competition: (i) *I enjoy working in situations involving competition with others*, (ii) *It is important for me to perform better than other people on a task*, and (iii) *I try harder when I'm in competition with other people*. [3] PISA then constructs an index of the student's competitiveness by averaging his or her answers to the three items and rescaling the average to have mean of zero and standard deviation of one in the OECD student population (OECD, 2020b). We use this standardized index as our competitiveness measure. The Appendix contains robustness tests using the raw answers to each of the three items as alternative competitiveness measures with very similar results.[4]

Most of the economics literature on competitiveness elicits preferences for competition with an incentivized tournament entry decision (e.g., Niederle and Vesterlund, 2007). Recent studies have shown that unincentivized survey measures of competitiveness similar to those in PISA 2018 predict tournament entry (Bönte et al., 2017; Fallucchi et al., 2020; Buser et al., 2021; Hauge et al., 2023).[5] The correspondence reported in the literature between survey and incentivized measures suggests that the PISA 2018 competitiveness measure would likely also correlate with tournament entry. In the last section we show that the relation between competitiveness and education and labor market outcomes is in line with previous results from the literature.

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[2] Table S1 lists all participating countries and regions.

[3] While item (i) evokes a preference for entering a competition (see Niederle and Vesterlund, 2007), item (iii) is closer to capturing the intensive margin of performance in a competition (see Gneezy et al., 2003).

[4] Napp and Breda (2022) look at responses by PISA 2018 participants to the competitiveness item (i). They report that the gender gap in competitiveness for item (i) is larger in more gender-egalitarian countries.

[5] Survey measures of competitiveness elicit participants' agreement with, or answers to, statements such as "*I enjoy competing against others*", "*Competition brings the best out of me*", "*When I try to reach a goal I prefer to compete against others instead of trying to reach the goal on my own*", and "*How competitive do you consider yourself to be?*".

3 Gender differences in competitiveness

We begin by measuring the gender gap in competitiveness in each country. To do so, we estimate

$$Compete_{ic} = \beta_c Male_i + \epsilon_{ic} \quad (1)$$

separately for each country using ordinary least squares (OLS). $Compete_{ic}$ is the level of competitiveness of student i in country c and $Male_i$ is an indicator for the student being male. The coefficient β_c captures the mean gender gap in competitiveness in country c, where a positive value indicates that boys are more competitive than girls are.

Figure 1a plots the $\hat{\beta}_c$ estimate from equation (1) for each country and the overall (i.e., grand) mean gender gap in competitiveness obtained from a random-effects meta-regression of $\hat{\beta}_c$ without covariates. In this meta-regression, each country's $\hat{\beta}_c$ estimate from equation (1) is a distinct observation with its associated standard error and sample size (the sample size being the number of students in the PISA sample in country c with nonmissing competitiveness). The gender gap in competitiveness is positive and significant at p<0.05 in 74% of countries. The overall mean gender gap in competitiveness is 0.167 SD (p<0.001, Table S2). This result is consistent with robust evidence that women are less competitive than men.

While not generally studied when considering gender gaps, we ask whether the change in the gender gap in competitiveness across countries is driven by one specific gender or both genders. The large cross-country heterogeneity from Figure 1a is driven primarily by variation in girls' competitiveness. Figure 1b plots the mean competitiveness of boys and girls against the gender gap in competitiveness in each country. Girls' cross-country variance is more than twice as large as boys' (0.067 vs. 0.031, p<0.001, Table S3). While for boys the correlation between the mean competitiveness and the gender gap in competitiveness in a country is -0.175 (p=0.129), for girls this correlation is -0.745 (p<0.001). This result shows that boys are similarly competitive across societies, while girls vary significantly and their variation is responsible for the differences in the gender gap in competitiveness across countries.

These results hold for each competitiveness item separately (Table S3, Figure S1). The findings are unlikely to stem from differential selection of boys and girls into schooling across countries, since all countries in the sample have a male-female secondary school enrollment ratio close to 1 (more precisely, between 0.88 and 1.09, Table S4). Furthermore, the results hold separately for students below and above the median SES in their country (Figure S2), the latter being particularly noteworthy because students above median SES in a country are arguably less prone to gender differentials in selection into schooling.[6] The results are also unlikely to stem from differential survey nonresponse. In PISA, students may leave questionnaire items unanswered, including the competitiveness items, and boys are more likely than girls to leave at least one competitiveness item unanswered (9.7% vs. 7.0% globally, respectively). However, the rate of nonresponse of competitiveness items does not vary systematically across countries (Figure S3). It is also not likely that the reason girls' competitiveness varies more than boys' across countries is that girls answer the questionnaire more randomly than boys do. In fact, in all countries without exception, boys' competitiveness is more variable than girls' *within* countries (Figure S4).[7]

4 Female empowerment and female competitiveness

A recent literature documents that societies in which women have more economic, educational, and political empowerment display larger gender gaps in various traits and preferences, including larger gender gaps in fields of study (Charles and Bradley, 2009; Geary and Stoet, 2018), economic preferences concerning risk, time, and social interactions (Falk and Hermle, 2018), and personality traits (Costa et al., 2001; Schmitt et al., 2008; Mac Giolla and Kajonius, 2019). This phenomenon has been called the gender-equality paradox, the

[6] SES is a student-level index constructed by PISA to be comparable across countries, based on the student's home possessions and the parents' highest level of education and occupational status (OECD, 2020b).

[7] In the Appendix, we also examine attitudes to competition in the World Values Survey (WVS), an international survey of beliefs and values that includes a question on competition. We find significant cross-country heterogeneity in the gender gap in views about competition, driven primarily by women's cross-country variation, especially in earlier waves of the WVS (Figure S5, Table S5). Note, though, that the WVS elicits value judgements about competition, not competitiveness per se, as respondents indicate agreement with "competition is good/harmful".

paradox being that men and women become more, rather than less, differentiated as women's socioeconomic opportunities improve.

In this section, we examine how the gender gap in competitiveness varies as a function of the level of gender equality in a country. We also take a step further than the typical analysis in the literature by examining which gender drives changes in the gender gap across countries.

Figure 2a plots the $\hat{\beta}_c$ estimate from equation (1) for each country against the country's level of gender equality as measured by the 2018 Global Gender Gap Index (GGGI). The GGGI is an index produced by the World Economic Forum to benchmark progress toward gender parity across four dimensions: economic opportunities, educational attainment, health and survival, and political participation (World Economic Forum, 2022). The GGGI takes a value from 0 to 1, where 0 indicates complete inequality disadvantaging women and 1 indicates gender parity (outcomes for which women outperform men do not receive values greater than 1). Consistent with the gender-equality paradox, we find that more gender-equal societies exhibit larger gender gaps in competitiveness. The linear correlation between the gender gap in competitiveness and the GGGI is 0.593 (p<0.001). We formalize this relation by estimating the random-effects meta-regression

$$y_c = \alpha GGGI_c + v_c + \epsilon_c \tag{2}$$

where y_c is an outcome of interest observed for country c, $GGGI_c$ is the GGGI of country c, $v_c \sim \mathcal{N}(0, \tau^2)$ is the random effect capturing the country-specific deviation from the mean of the distribution of the outcome, and $\epsilon_c \sim \mathcal{N}(0, {\sigma_c}^2)$ is the within-country sampling error. The outcome of interest y_c in this case is the $\hat{\beta}_c$ estimate from equation (1). Then, α in equation (2) captures the effect of GGGI on the gender gap in competitiveness. The $\hat{\alpha}$ estimate is 1.803 (p<0.001, Table S6 column 1), indicating that more gender-equal societies exhibit larger gender gaps in competitiveness.

To show which gender drives the gender-equality paradox in competitiveness, Figure 2b plots the mean competitiveness of boys and girls in a country against the country's GGGI. While for boys the linear correlation between competitiveness and GGGI is weak and insignificant (-0.184, p=0.119), for girls it is substantially larger and highly significant (-0.497, p<0.001). Table S6 columns 2-3 show the effect of GGGI on the competitiveness of boys and girls, estimated from equation (2) separately for boys and girls, where the outcome of interest y_c is the mean competitiveness of boys or girls in country c. The $\hat{\alpha}$ estimate is -0.607 for boys (p=0.117, Table S6 column 2) and -2.417 for girls (p<0.001, Table S6 column 3). In these meta-regressions, GGGI captures 3.4% of the cross-country variation in boys' competitiveness and 24.7% of the cross-country variation in girls' competitiveness (Table S6 columns 2-3). To test for the differential effect of GGGI on boys' and girls' competitiveness, we estimate the meta-regression

$$y_{cg} = \alpha_1 GGGI_c + \alpha_2 Female_{cg} + \alpha_3 GGGI_c \times Female_{cg} + v_{cg} + \epsilon_{cg} \quad (3)$$

where y_{cg} is an outcome of interest observed for country c and gender g, $Female_{cg}$ is an indicator for the outcome being an observation concerning girls, $GGGI_c$ is the GGGI of country c, and v_{cg} and ϵ_{cg} are the country-gender-specific random effects and error terms. The outcome of interest y_{cg} in this case is the mean competitiveness of boys or girls in country c. The $\hat{\alpha}_3$ estimate is -1.809 (p=0.004, Table S6 column 4), indicating a highly significant difference between the effect of GGGI on boys' and girls' competitiveness.

In sum, more gender-equal societies exhibit larger gender gaps in competitiveness, primarily because girls' competitiveness decreases with the gender equality in the society while boys' competitiveness remains unchanged. This result holds for each competitiveness item separately (Figure S6) and for alternative measures of gender equality (Figure S7). It also holds if we exclude students from single-sex schools or countries with more than 20% of students in single-sex schools (Table S7, Figures S8-S9). This alleviates concerns that students compare themselves only to their classmates when answering questions on competitiveness and hence that differential shares of single-sex schooling across countries could be the driver of cross-country differences in the gender gap in competitiveness.

5 A direct test of cultural transmission

To provide evidence that girls' competitiveness is shaped not only by institutions or opportunities in a country but also culture, we use the "epidemiological approach" (Fernandez, 2011).[8] Specifically, we examine whether the competitiveness of second-generation immigrant students taking the test in a given country is predicted by the level of gender equality in their parents' country of origin.[9] Such relation would suggest that competitiveness is at least partly culturally transmitted, since students can conceivably acquire the culture of their country of ancestry that might influence competitiveness—for example, through socialization within the family—but cannot acquire the institutions and economic conditions of their country of ancestry that might influence competitiveness. Previous work has similarly studied second-generation immigrants to identify the impact of culture on variables such as gender norms and female labor supply (Fernandez and Fogli, 2009; Alesina et al., 2013), long-term orientation and academic attainment (Figlio et al., 2019), and gender gaps in performance in PISA (Nollenberger et al., 2016; Rodriguez-Planas and Nollenberger, 2018).[10]

Accordingly, we estimate

$$Compete_{icp} = \beta GGGI_p + \boldsymbol{\gamma}'\boldsymbol{X}_i + \theta_c + \epsilon_{icp} \qquad (4)$$

using OLS. $Compete_{icp}$ is the level of competitiveness of second-generation immigrant student i in the country of test-taking c and whose parent was born in country $p \neq c$, $GGGI_p$ is the GGGI of the parent's country of birth, and $\boldsymbol{X}_i$ is a vector of student characteristics consisting of student i's SES and the highest parental occupational status, which intend to control for systematic differences in economic conditions across country of ancestry that

[8] By culture we mean customary beliefs and attitudes of a society that are transmitted intergenerationally (Guiso et al., 2006). For a review of the economics literature on gender and culture, see e.g. Giuliano (2020).
[9] Second-generation immigrants are students born in the country of test-taking and whose parents were both born elsewhere. For any given country, these students are an apt sample to study the role of culture, since they are born into a similar economic and institutional environment but vary in their cultural ancestry.
[10] Relatedly, Farre and Vella (2012) find that mothers' gender attitudes are transmitted to their children and explain their education and labor decisions. Dohmen et al. (2012) give evidence of transmission of risk and trust attitudes from parents to children in a representative German sample. Dossi et al. (2021) find that socialization of gender attitudes within the family explains part of the math gender gap in the US. Hauge et al. (2023) find that for second-generation Norwegians in their study sample the gender gap in competitiveness (measured experimentally) decreases in the level of gender equality of their country of ancestry. This is the opposite of what we would expect from the results in the previous section and what we report in this section.

might affect a student's competitiveness purely for economic reasons. We include country of test-taking fixed effects θ_c so that we only compare students born in the same country. Then, the coefficient β captures the effect of the level of gender equality in the parent's country of origin on the student's competitiveness. We estimate equation (4) separately for boys and girls and for mothers and fathers as the parent of interest, and cluster standard errors at the level of the parent's country of origin. There are 9,775 second-generation immigrant students in the sample whose fathers come from 95 different countries with nonmissing GGGI, and 9,924 second-generation immigrant students whose mothers come from 95 different countries with nonmissing GGGI.

Given that boys' competitiveness is not significantly changing with GGGI or with the countries' gender gap in competitiveness, we do not expect either parent's country of origin to have a strong impact on boys' competitiveness. Table 1 shows that indeed neither the GGGI of the father's country of origin ($\hat{\beta}$=0.123, p=0.622, Table 1 column 1) nor the mother's country of origin ($\hat{\beta}$=0.005, p=0.988, Table 1 column 4) predicts the son's competitiveness. In contrast, parental origin predicts the daughter's competitiveness, directionally so for the GGGI of the father's country of origin ($\hat{\beta}$=-0.476, p=0.133, Table 1 column 2) and significantly so for the GGGI of the mother's country of origin ($\hat{\beta}$=-0.717, p=0.049, Table 1 column 5). The negative sign on $\hat{\beta}$ indicates that girls whose parents were born in more gender-equal countries are less competitive, consistent with our findings in the previous section that girls' competitiveness is inversely related to gender equality. Interacted models show that, for both fathers and mothers, the effect of paternal ancestry on the child's competitiveness is significantly larger for daughters than for sons (Table 1, p=0.005 for column 3 and p=0.003 for column 6).[11]

Thus, the competitiveness of second-generation immigrant girls is related to the gender equality of their country of ancestry, especially maternal ancestry. These results give evidence that culture influences girls' competitiveness. The fact that immigrant boys show no such effect strongly suggests that the effect observed for girls is not driven by economic conditions of their country of ancestry, since one would expect those conditions

[11] In line with this result, Boneva et al. (2021) find among German adolescents a positive relation between the competitiveness of mothers and daughters but not between mothers and sons.

to also affect boys. Indeed, we show in the next section that socioeconomic conditions have a larger effect on boys' than on girls' competitiveness conditional on the gender equality in the country.

6 Socioeconomic status and competitiveness

In the previous section, we interpreted the relation between the competitiveness of second-generation immigrant girls (but not boys) and the level of gender equality in their country of ancestry as evidence that culture influences girls' competitiveness. An alternative interpretation is that ancestry predicts girls' competitiveness purely due to economic factors, while it does not predict boys' competitiveness because boys' competitiveness is unresponsive in general.[12] In this section, we show that this alternative explanation is unlikely to be correct. We show that SES in fact predicts individual competitiveness more strongly for boys than for girls holding fixed the level of gender equality in the society.

To show this, we regress for boys and girls and for each country separately the student's competitiveness against their SES, including school fixed effects so that we only compare students in the same school. Figure S10 plots the estimated SES coefficient for each country. The coefficient is positive for both boys and girls in virtually all countries, indicating that wealthier students are more competitive (Figures S10a,c). However, in most countries the effect is stronger for boys, as shown by country-specific regressions that pool together boys and girls and include a female indicator and its interaction with SES. In these regressions, the interaction term is negative for most countries, indicating a stronger effect of SES on boys' competitiveness (Figure S10e). These results are confirmed in an OLS regression that pools together students from all countries and estimates the student's competitiveness on their SES, a female indicator, and the interaction of the two, including school fixed effects. The interaction effect is negative and significant ($p<0.001$, Table S8 column 3). This implies that the gender gap in competitiveness increases in the SES of students.

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[12] Recall, however, that equation (4) in the previous section includes student-level socioeconomic controls and country of test-taking fixed effects in an effort to control for these potential economic confounds.

Thus, conditional on gender egalitarianism, wealthier students are more competitive in virtually all countries. Moreover, boys' competitiveness tends to be more strongly affected by socioeconomic conditions than girls' competitiveness. These results in themselves contribute to a nascent literature that investigates whether SES influences competitiveness (Ålmas et al., 2016; Boneva et al., 2021), and in the Appendix we compare our results to this literature in greater detail. More broadly, these results speak to our findings in the previous sections with two points. First, competitiveness increases with SES. Second, within societies, boys' competitiveness varies more than girls', and is more strongly predicted by SES than girls'. In contrast, in the previous sections we found that competitiveness decreases with gender equality (largely correlated with wealth, apart from oil countries), an effect driven almost exclusively by changes among girls. Wealth differences are thus unlikely to explain why girls are less competitive in more gender-equal societies. Rather, factors other than wealth that affect women in particular are likely driving the decline in female competitiveness in more gender-equal countries.

7 Returns to competitiveness

In this last section we show how PISA measures of competitiveness relate to labor market outcomes. The literature studying the role of competitiveness on labor market outcomes pays particular attention to math test scores and occupational interests, since math skills are a good predictor of earnings (e.g., Hanushek et al., 2015) and occupational sorting explains a sizeable fraction of the gender wage gap (Blau and Kahn, 2017). There is growing evidence that competitiveness accounts for part of the observed gender differences in career and job choice, earnings expectations, and realized earnings (Buser et al., 2014, 2021; Flory et al., 2015; Ålmas et al., 2016; Buser et al., 2017; Reuben et al., 2017; Kamas and Preston, 2018; Samek, 2019).

As our final analysis, we examine whether competitiveness predicts math achievement and occupational interests of boys and girls conditional on student-level covariates and school fixed effects, and how this relation varies across societies.

7.1 Explaining math achievement

In most countries, boys outperform girls by a small amount in the PISA 2018 math test, with an overall mean gender gap of 0.059 standard deviations (SD) ($p<0.001$, Figure S11, Table S9). Boys' math advantage grows to an overall mean gender gap of 0.279 SD ($p<0.001$, Figure S12, Table S10) if one controls for student reading test score, SES, and school fixed effects, with boys outperforming girls in all countries. Boys and girls have higher math test scores in more gender-equal countries. However, the math gender gap does not vary systematically as a function of gender equality (Figures S13-S14).[13]

To examine whether a student's competitiveness predicts his or her math test score, we estimate

$$MathScore_{isc} = \beta_c Compete_i + \boldsymbol{\gamma}_c' \boldsymbol{X}_i + \theta_s + \epsilon_{isc} \qquad (5)$$

separately for each country with OLS. $MathScore_{isc}$ is the math test score of student i in school s and country c, $Compete_i$ is student i's level of competitiveness, and $\boldsymbol{X}_i$ is a vector of student-level controls consisting of student i 's verbal test score and SES. We include school fixed effects θ_s so that we only compare students in the same school. The coefficient of interest in equation (5) is β_c, which captures the mean effect of competitiveness on math test scores in country c conditional on covariates. Note that the covariates include reading test scores, thus we are estimating the contribution of competitiveness to math achievement on top of the contribution it may have through its effect on reading achievement.

Figure S15a plots the $\hat{\beta}_c$ estimate from equation (5) for each country. $\hat{\beta}_c$ is positive and significant at $p<0.05$ in 77% of countries. The overall mean $\hat{\beta}_c$ is 0.041 ($p<0.001$), meaning that a 1 SD increase in the student's competitiveness is associated with a 0.041 SD increase in the student's math performance conditional on covariates (Table S12 column 1).[14] Note that by controlling for reading achievement, SES, and school fixed

[13] In their influential paper, Guiso et al. (2008) document that the math gender gap in PISA 2003 shrinks (i.e., girls perform relatively better) in more gender-equal countries, hence the opposite of the gender-equality paradox. We replicate this finding in PISA 2003 and PISA 2018 if we use Guiso et al.'s regression specification and remove from the sample, as they do, all students below the median SES in each country (Table S11).

[14] To put this value in perspective, the average student learning in a year of schooling corresponds to gains of roughly 0.25-0.33 SD in PISA scores (Woessmann, 2016).

effects we capture a large fraction of the within-country variation in math test scores, as the average R^2 for the country-specific regressions is 0.6776 (Table S12 column 1).

The effect of competitiveness on math performance is larger for girls than for boys. Figures S15c,e show results from estimating equation (5) separately by gender. $\hat{\beta}_c$ is positive and significant at p<0.05 in 36% of countries for boys and 47% of countries for girls. The overall mean $\hat{\beta}_c$ is 0.023 (p<0.001) for boys and 0.031 (p<0.001) for girls (Table S12 columns 2-3); the difference is significant (p=0.013, Table S12 column 4).

Interestingly, $\hat{\beta}_c$ is larger in more gender-equal societies for girls but not for boys. The correlation between $\hat{\beta}_c$ and GGGI is 0.095 (p=0.424) for boys and 0.283 (p=0.015) for girls (Figure S15). If we estimate equation (2) separately by gender using as the outcome of interest y_c the $\hat{\beta}_c$ estimate from equation (5), we find that the effect of GGGI on $\hat{\beta}_c$ (the α coefficient in equation (2)) is 0.058 for boys (p=0.184, Table S13 column 2) and 0.114 for girls (p=0.005, Table S13 column 3). While the difference between these two values is not significant (p=0.154, Table S13 column 4), the effect of GGGI on $\hat{\beta}_c$ does become significantly larger for girls than boys, and the effect of competitiveness on math performance is even stronger for girls relative to boys, when math achievement is measured as the probability that the student scores among the top 50, 25, or 10 percent in their school (Tables S14-S19, Figures S16-S18).

Finally, we examine whether competitiveness helps to explain the gender gap in math test scores conditional on covariates. For this, we estimate

$$MathScore_{isc} = \alpha_c^{exc} Female_i + \boldsymbol{\gamma}_c' \boldsymbol{X}_i + \theta_s + \epsilon_{isc} \quad (6)$$

$$MathScore_{isc} = \alpha_c^{inc} Female_i + \beta_c Compete_i + \boldsymbol{\gamma}_c' \boldsymbol{X}_i + \theta_s + \epsilon_{isc} \quad (7)$$

separately for each country with OLS. $MathScore_{isc}$ is the math score of student i in school s and country c, $Female_i$ is an indicator for student i being female, $Compete_i$ is student i's level of competitiveness, $\boldsymbol{X}_i$ is a vector of student-level controls consisting of student i's verbal test score and SES, and θ_s is a school fixed effect. Then, the ratio $\frac{\hat{\alpha}_c^{exc} - \hat{\alpha}_c^{inc}}{\hat{\alpha}_c^{exc}}$ is the estimated fraction of the math gender gap in country c explained by competitiveness.

Figure 3a plots the ratio $\frac{\hat{\alpha}_c^{exc}-\hat{\alpha}_c^{inc}}{\hat{\alpha}_c^{exc}}$ in percentage terms for each country. A positive value indicates that the math gender gap in the country shrinks after controlling for competitiveness (i.e., competitiveness accounts for part of the math gender gap). The ratio is positive for 84% of countries and ranges from -2.5% for Saudi Arabia to 8.8% for Iceland.

Figure 3b plots the ratio $\frac{\hat{\alpha}_c^{exc}-\hat{\alpha}_c^{inc}}{\hat{\alpha}_c^{exc}}$ for each country against the country's GGGI. The correlation between the two variables is 0.508 (p<0.001). In a simple country-level univariate regression, GGGI captures 25.8% of the cross-country variation in the ratio $\frac{\hat{\alpha}_c^{exc}-\hat{\alpha}_c^{inc}}{\hat{\alpha}_c^{exc}}$.

In sum, competitiveness significantly predicts math achievement in most countries. This relation is stronger for girls than for boys, and stronger in more gender-equal countries for girls but not for boys. Competitiveness explains a larger fraction of the math gender gap in more gender-equal countries.

7.2 Explaining occupational interests

Finally, we examine the relation between competitiveness and occupational interests and its variation across societies. For this, we look at students' responses to the question *"What kind of job do you expect to have when you are about 30 years old?"* contained in the PISA student questionnaire.[15] Students give an open-ended answer to this question, and PISA then classifies each answer into one of more than 400 occupations listed in the International Standard Classification of Occupations (ISCO-08). We classify as "high-paying occupations" managerial and professional occupations in fields that tend to be relatively high paying. Examples are engineers, computer programmers, physicians and surgeons, nurses, dentists, financial managers, lawyers, and judges (see Table S20 for a full list).

[15] While students' answers to this question may differ from later actual career choices, previous findings indicate that occupational interests in early high school years strongly predict subsequent college field of study (Morgan et al., 2013; Cimpian et al., 2020).

The share of students interested in a high-paying occupation ranges from 12% in Belgium to 56% in Qatar. On average across countries, 32.3% of boys and 34.5% of girls are interested in a high-paying occupation (p=0.007 for the gender difference, Table S21). The share of boys and girls interested in a high-paying occupation declines in more gender-equal countries, and the rate of this decline is not significantly different between boys and girls (Table S22). Thus, the gender gap in interest in a high-paying occupation does not vary systematically with the level of gender egalitarianism (Figures S19, S20).

To examine whether a student's competitiveness helps to explain his or her interest in a high-paying occupation, we estimate

$$HighPayOccupation_{isc} = \beta_c Compete_i + \delta_c MathScore_i + \boldsymbol{\gamma}_c' \boldsymbol{X}_i + \theta_s + \epsilon_{isc} \quad (8)$$

separately for each country using OLS. $HighPayOccupation_{isc}$ is an indicator for student i in school s in country c being interested in a high-paying occupation. All other variables are as previously defined. The coefficient of interest β_c captures the mean effect of competitiveness on the interest in a high-paying occupation in country c conditional on covariates. Note that the covariates include math performance, thus we are estimating the contribution of competitiveness to occupational interests on top of the contribution it may have through its effect on math achievement. We express $\hat{\beta}_c$ as a fraction of the share of students interested in a high-paying occupation in country c (or the share of boys or girls when we estimate gender-specific regressions) to allow for cross-country comparisons.

Figure 4a plots each country's $\hat{\beta}_c$ estimate from equation (8). The overall mean $\hat{\beta}_c$ is 0.078 (p<0.001, Table S23 column 1), indicating that a 1 SD increase in competitiveness is associated with a 7.8% increase in the probability of being interested in a high-paying occupation conditional on math and verbal test scores, SES, and school fixed effects. The effect is positive and significant at p<0.10 in 86% of countries. Similarly, Figures 4c,e plot $\hat{\beta}_c$ when estimated from equation (8) for boys and girls separately. For boys, $\hat{\beta}_c$ is positive and significant at p<0.10 in 43% of countries and the overall mean $\hat{\beta}_c$ is 0.052 (p<0.001, Table S23 column 2), while for girls $\hat{\beta}_c$ is positive and significant at p<0.10 in 86% of countries and the overall mean $\hat{\beta}_c$ is 0.105 (p<0.001, Table S23 column 3). The difference in $\hat{\beta}_c$ for boys and girls is significant (p<0.001, Table S23 column 4), indicating that competitiveness is associated with a larger increase in interest in a high-paying occupation for girls.

As with math achievement, $\hat{\beta}_c$ is larger in more gender-equal societies for girls but not for boys. The correlation between $\hat{\beta}_c$ and GGGI is 0.125 (p=0.294) for boys and 0.236 (p=0.045) for girls (Figure 4). If we estimate equation (2) separately by gender using as the outcome of interest y_c the $\hat{\beta}_c$ estimate from equation (8), we find that the effect of GGGI on $\hat{\beta}_c$ (the α coefficient in equation (2)) is 0.091 for boys (p=0.350, Table S24 column 2) and 0.317 for girls (p=0.019, Table S24 column 3). The difference between boys and girls is significant (p=0.028, Table S24 column 4).

In sum, even conditional on math achievement, more competitive students are significantly more likely to be interested in a high-paying occupation in most countries. The relation is stronger for girls than for boys, and stronger in more gender-equal countries for girls but not for boys.

8 Conclusion

We study competitiveness among 600,000 students which are a representative sample of 79 countries or regions, including all OECD countries. Most countries exhibit a gender gap in competitiveness, with boys being more competitive. As countries become more gender-equal, average competitiveness decreases and the gender gap in competitiveness increases. The latter phenomenon is known as the gender-equality paradox.

We go two steps further than is common in the literature by, first, describing that changes in girls' competitiveness drive the gender-equality paradox, with girls in more gender-equal countries being less competitive. Culture likely plays a role in this result, as we show that girls' competitiveness is culturally transmitted. Finally, we show that competitiveness predicts math achievement and interest in high-paying jobs in most countries, and more so for girls the more gender-equal the country is. Second, we use the same competitiveness measure to study variation within a country. We find that, similar to cross-country results, the gender gap in competitiveness increases for higher socioeconomic-status children. However, within countries, it is boys whose competitiveness exhibits more variance and increases more with socioeconomic status.

Future research needs to establish which traits exhibit the gender-equality paradox and which do not (e.g., math achievement does not; Guiso et al., 2008), and which other traits exhibit cross-country patterns that are almost the reverse of within-country patterns, in terms of which gender is more variable in the trait and which gender drives the change in the gender gap as a function of wealth and gender equality. Such work complements research on the role of institutions for cross-country differences and provides much needed data to formulate models of variation in gender differences. For example, a resource hypothesis positing that increased resources allow women and men to express their gender-specific preferences more freely will have to address why resources are important for boys largely only within a country and for girls more strongly across countries.

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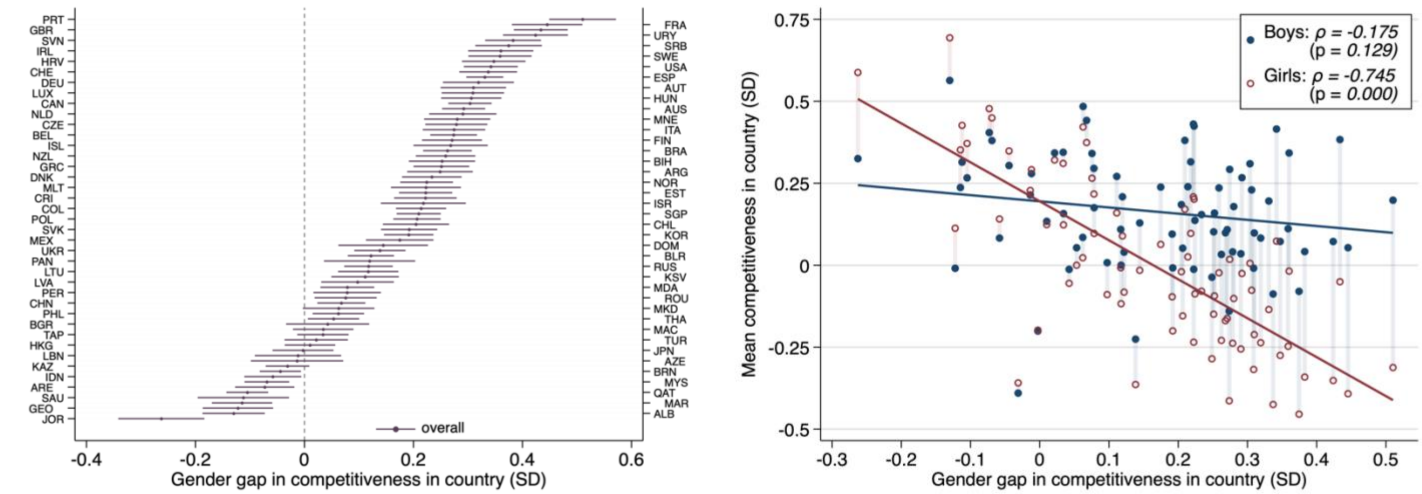
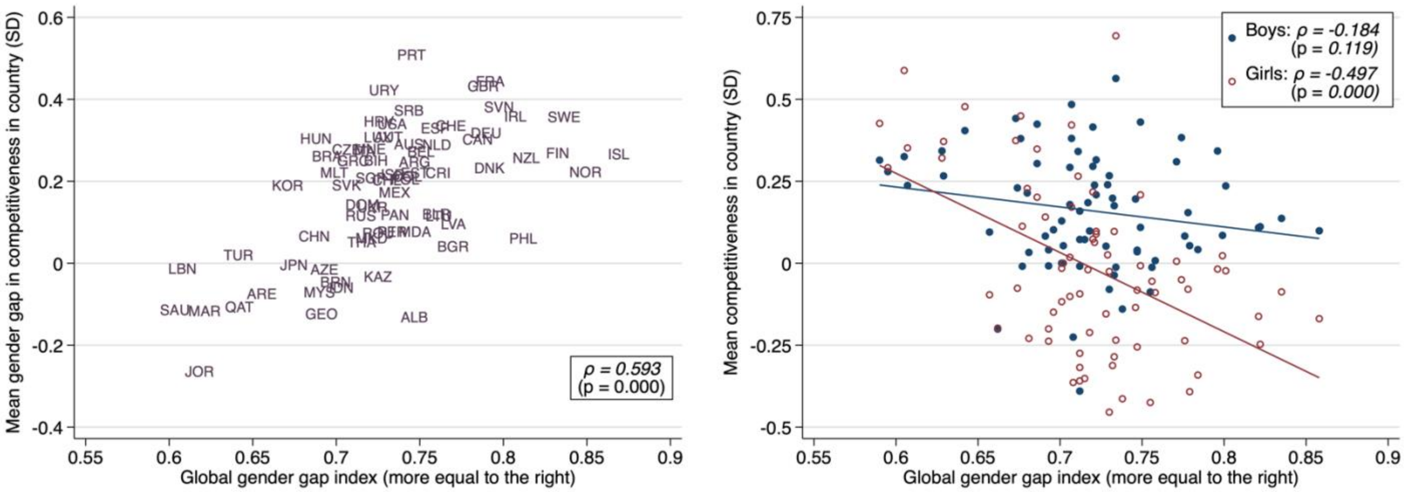


a. Mean gender gap in competitiveness in the country

b. Mean competitiveness of boys and girls in the country

Figure 1 Competitiveness of boys and girls

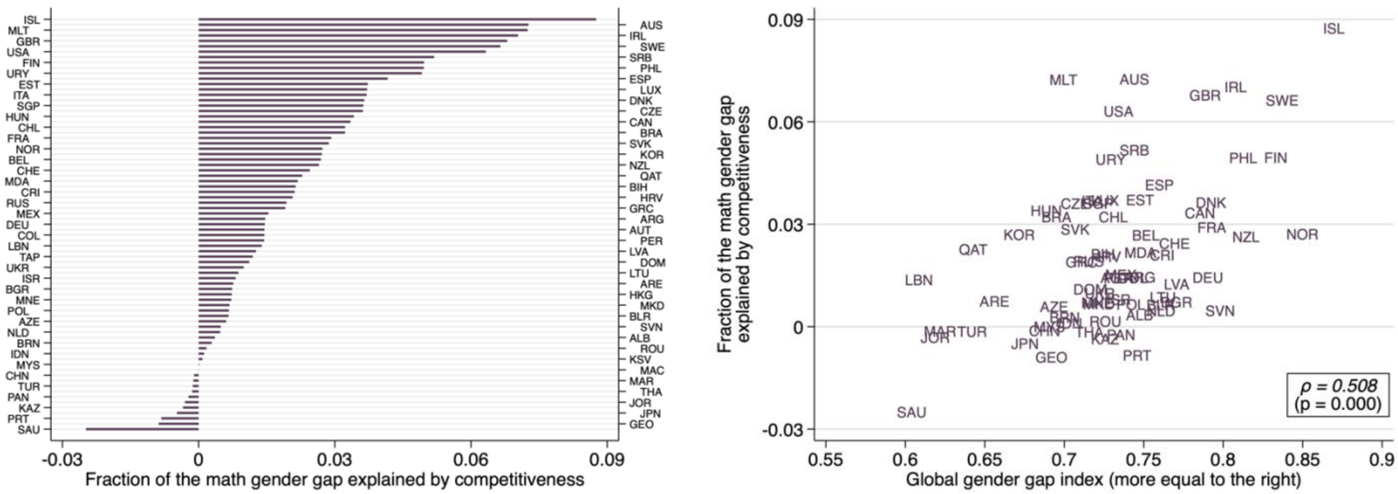
Notes: A positive gender gap indicates that boys are more competitive than girls. In panel a, whiskers are 95% confidence intervals.



a. Gender gap in competitiveness in country

b. Mean competitiveness of boys and girls in country

Figure 2 Competitiveness vs. gender egalitarianism in the country



a. Fraction explained

b. Fraction explained vs GGGI in the country

Figure 3 Fraction of the gender gap in math test scores explained by competitiveness

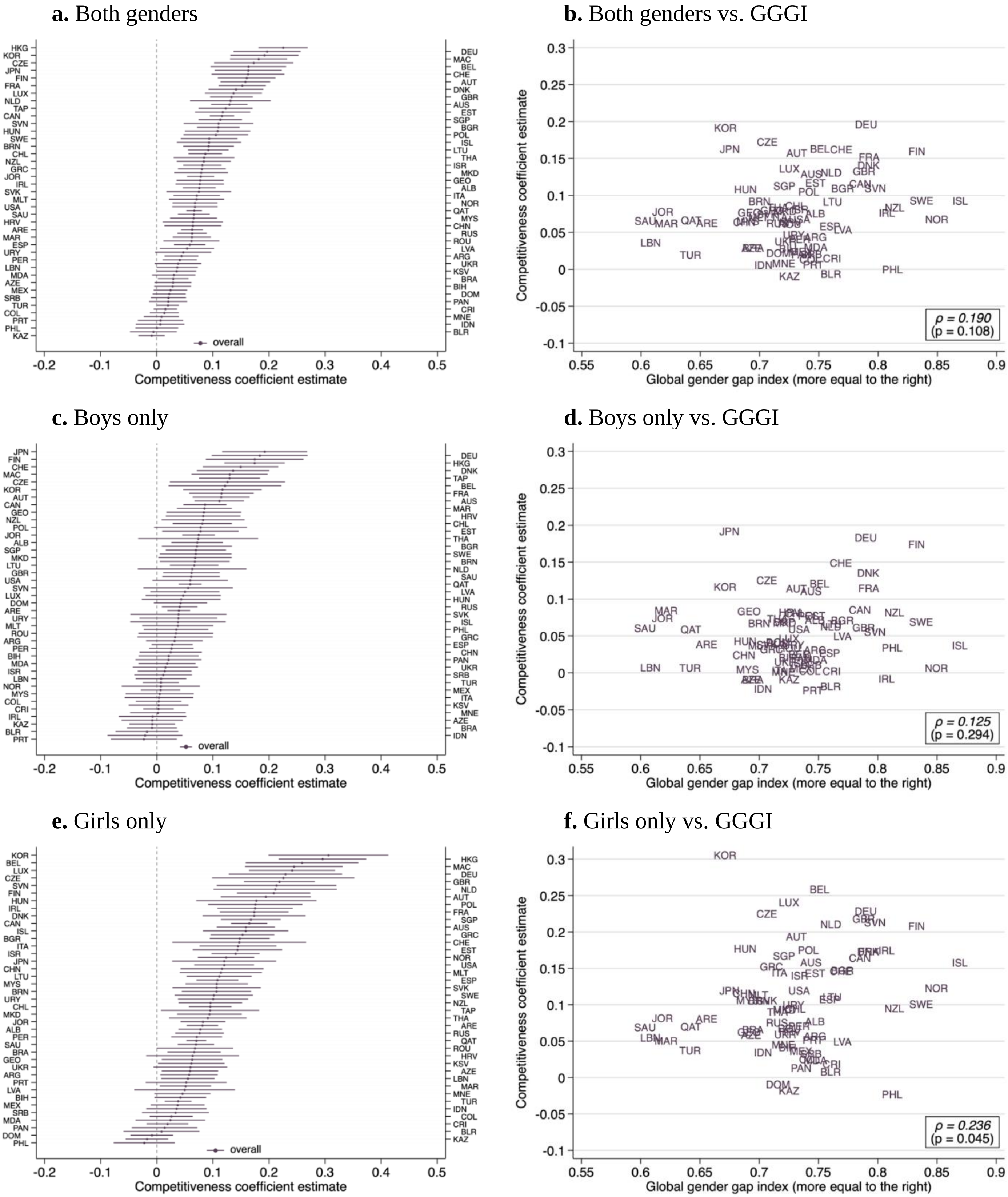


Figure 4 Effect of competitiveness on the students' interest in pursuing a high-paying occupation

Table 1 Competitiveness of second-generation immigrant students by GGGI of the parent's country of origin

	Parent: Father			Parent: Mother		
	Boys	Girls	Both	Boys	Girls	Both
	(1)	(2)	(3)	(4)	(5)	(6)
GGGI of parent	0.123	-0.476	0.393	0.005	-0.717**	0.330
	(0.249)	(0.314)	(0.302)	(0.326)	(0.359)	(0.298)
Female			0.587*			0.687**
			(0.299)			(0.312)
Female x GGGI of parent			-1.191***			-1.333***
			(0.407)			(0.433)
SES controls	Y	Y	Y	Y	Y	Y
Country of test taking FE	Y	Y	Y	Y	Y	Y
R^2	0.0482	0.0825	0.0680	0.0452	0.0853	0.0681
N students	4,792	4,983	9,775	4,841	5,083	9,924

Notes: OLS regressions estimating the student's competitiveness on the GGGI of the parent's country of origin. SES controls are the student's SES and the highest parental occupational status index level. Standard errors clustered at the parent's country of origin in parentheses. *p<0.1, **p<0.05, ***p<0.01, ****p<0.001.

Appendix to

Female empowerment and female competitiveness

David Klinowski and Muriel Niederle

(For online publication)

Table of Contents

Appendix A. Data

A.1 Working sample and variables in PISA 2018

The Programme for International Student Assessment (PISA) is a standardized assessment of math, reading, and science achievement conducted every three years under the coordination of the Organisation for Economic Co-operation and Development (OECD). In each wave, each participating country or region collects a sample that is nationally or regionally representative of students aged between 15 years and 3 months and 16 years and 2 months at the beginning of the assessment period and who are enrolled in an educational institution at grade 7 or higher. To obtain this sample, each country or region uses a two-stage sampling procedure whereby a representative sample of at least 150 school is first selected and then roughly 42 students of the target age are randomly selected from each school to participate in the assessment (OECD, 2020a).

We use data from PISA 2018, the latest dataset available. A total of 79 countries or regions participated in PISA 2018, each with a sample size ranging from 3,294 to 35,943 students. A list of participating countries or regions is in Table S1.[18] To this list we make three modifications. We change Baku (Azerbaijan)'s code from QAZ to AZE to match the code given to Azerbaijan in the Global Gender Gap Index dataset. Similarly, we change B-S-J-Z (China)'s code from QCI to CHN to match the code given to China in the Global Gender Gap Index dataset. Finally, we pool together observations from Moscow Region, Tatarstan, and Russian Federation and assign them code RUS, which matches the code given to Russia in the Global Gender Gap Index dataset.

<u>Competitiveness measure</u>

PISA 2018 included a questionnaire that elicited students' socioeconomic background, personality traits, and various preferences and attitudes and other information. As part of the questionnaire, students indicated whether they "strongly disagree", "disagree", "agree", or "strongly agree" with each of the following three items intended to measure their preferences for competition.

Item 1: *I enjoy working in situations involving competition with others*. (code ST181Q02HA.)

Item 2: *It is important for me to perform better than other people on a task*. (code ST181Q03HA.)

Item 3: *I try harder when I'm in competition with other people*. (code ST181Q04HA.)

[18] In addition to the countries or regions listed in Table S1, the original PISA 2018 dataset contains information from Vietnam. However, the OECD "cannot currently assure full international comparability of the results" for Vietnam due to data quality violations and technical issues (OECD, 2019). Thus, we do not use data from Vietnam in our analysis.

PISA then constructs an index of the student's competitiveness by averaging his or her answers to the three items and rescaling the average to have mean of zero and standard deviation of one across students in the OECD countries (OECD, 2020b). We use this standardized index as our competitiveness measure.

Socioeconomic status

PISA constructs a student index of economic, social, and cultural status derived from three variables elicited in the student questionnaire: parents' highest level of education, parents' highest occupational status, and home possessions. PISA standardizes the index to have mean of zero and standard deviation of one across students in all participating countries and regions (OECD, 2020b). We use this standardized index as our measure of students' socioeconomic status.

Achievement scores and imputation of plausible values

PISA achievement scores are values scaled to have mean of approximately 500 points and standard deviation of approximately 100 points for students across OECD countries (OECD, 2019). The precise empirical means in the OECD sample are 489 for math and 487 for reading, and the standard deviations are 91 for math and 99 for reading (see also Schleicher, 2019). We subtract students' math and reading achievement scores by their empirical mean and divide by the empirical standard deviation to express scores as fractions of a standard deviation.

Because participating students sit in only a subset of the material assessed by PISA, achievement scores in each domain are estimated by PISA as plausible values drawn randomly from the distribution of potential scores the student is reasonably expected to receive given his or her characteristics and responses in the material assessed. PISA assigns ten plausible values for each student's achievement score in each domain.

Sampling weights for population estimates and standard errors

PISA provides a sampling weight for each student, denoted *final weight*, that allows for unbiased estimation of population parameters. Moreover, PISA provides 80 different replicate weights that allow for computing standard errors of the parameter estimates that account for sampling error in PISA.[19]

Throughout the paper, we follow the PISA methodological recommendations and estimate population parameters using student final weights and standard errors using the replicate weights, as well as computing

[19] See OECD's *How to prepare and analyse the PISA database* (https://www.oecd.org/pisa/data/httpoecdorgpisa database-instructions.htm).

average estimates across plausible values whenever plausible values of achievement scores are used. We use the "Repest" Stata package developed by the OECD to conduct this analysis (Avvisati and Keslair, 2020).

A.2 Country-level variables not in PISA 2018

Global Gender Gap Index

We use the Global Gender Gap Index (GGGI) of the World Economic Forum (WEF) as our measure of gender egalitarianism in a country. The GGGI is an index produced by the WEF to benchmark progress towards gender parity and compare countries' gender gaps across four dimensions: economic participation and opportunities, educational attainment, health and survival, and political empowerment (World Economic Forum, 2022). The GGGI takes a value from 0 to 1, where values closer to 1 indicate outcomes closer to gender parity (outcomes for which women outperform men do not translate into values greater than 1). The index is designed to measure gender-based gaps in access to resources and opportunities, rather than actual levels of available resources and opportunities in the countries, in order to disassociate the index from the countries' levels of development (World Economic Forum, 2022). Unless otherwise specified, we use values for the 2018 GGGI. Countries or regions in our working PISA sample with no GGGI value are Hong Kong (HKG), Kosovo (KSV), Macao (MAC), and Chinese Taipei (TAP). Data from https://tcdata360.worldbank.org

Gender Equality Composite Index

In robustness tests, we use an alternative measure of gender egalitarianism in a country that follows the work by Falk and Hermle (2018) and that we refer to as the Gender Equality Composite Index. This index equals the first predicted component from principal component analysis of the following four country-level variables: years since women were granted the right to vote, the 2018 GGGI, the 2018 United Nations Gender Inequality Index (reverse-coded), and the 2009-2018 average female-male labor force participation ratio based on World Bank statistics. The sources for these data are:

- *Years since women were granted the right to vote*: From Inter-parliamentary Union at http://archive.ipu.org/wmn-e/suffrage.htm#Note1
- *United Nations Gender Inequality Index*: From United Nations Human Development Reports at https://hdr.undp.org/data-center/thematic-composite-indices/gender-inequality-index#/indicies/GII
- *Female-male labor force participation ratio*: From the World Bank World Development Indicators, based on data from the International Labor Organization at https://data.worldbank.org/indicator/SL.TLF.CACT.FM.ZS

Male-Female Ration in Secondary School Enrollment

Male-female ratio in secondary school enrollment in the country, computed from World Bank data of secondary school enrollment (% gross) in 2018 at https://data.worldbank.org/indicator/SE.SEC.ENRR

Attitudes toward Competition, World Values Survey

Attitude to competition measured as the individual's agreement from 1-10 with the statement "1=Competition is good, 10=Competition is harmful". From https://www.worldvaluessurvey.org/wvs.jsp

GDP per capita

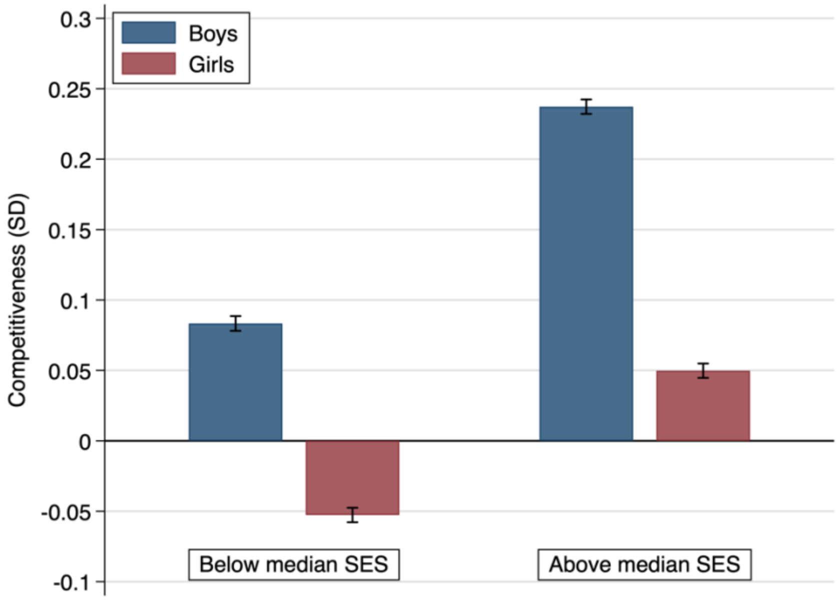
2018 Gross Domestic Product per capita, from World Bank at https://data.worldbank.org/indicator/NY.GDP.PCAP.CD

Appendix B. Additional results on socioeconomic status and competitiveness

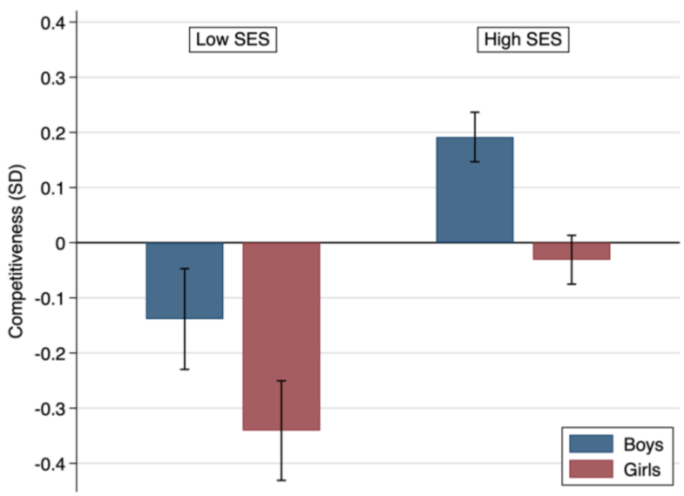
A small literature examines the relation between the gender gap in competitiveness and socioeconomic status (SES). In a representative sample of adolescents in Norway, Ålmas et al. (2016) find that the gender gap in competitiveness (measured experimentally) grows with SES. In our data from Norway, we replicate this result, as the gender gap in competitiveness is 10% larger among high SES students low SES students (Figure B1b). For this analysis we define low SES students as the bottom 20% of the distribution of SES in our Norway sample and high SES otherwise, to follow as close as possible the definition in Ålmas et al. (2016).

More recently, Boneva et al. (2021) find in a selected sample of children from Bonn and Cologne that the gender gap in competitiveness (measured in a survey) is larger among low SES children. In our data from Germany, we do not replicate this result, as the gender gap in competitiveness is 37% larger among high SES students low SES students (Figure B1c). In this analysis, we define low SES students as the bottom 30% of the distribution of SES in our Germany sample and high SES otherwise, to follow as close as possible the definition in Boneva et al. (2021). We can only speculate as to why our results differ from those of Boneva et al. (2021), but one notable possibility is the difference in samples, as our sample is representative of 15-year-old students in all of Germany.

a. Full PISA 2018 sample



b. Norway PISA 2018



c. Germany PISA 2018

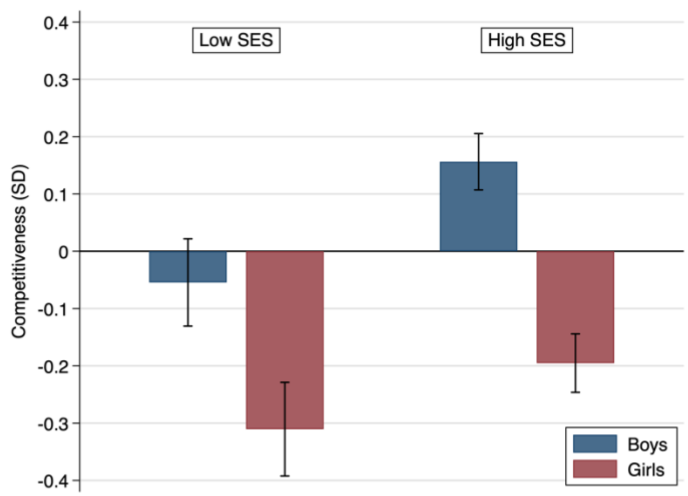


Figure B1 Mean competitiveness of boys and girls by socioeconomic status (SES) in country

Notes: For Norway (Germany), Low SES is defined as students in the bottom 20% (30%) of SES in the country and High SES are all other students. Whiskers are 95% confidence intervals.

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Appendix C. Supplementary tables

Table S1 PISA 2018 participating countries and regions

Code	Country	Code	Country	Code	Country
ALB	Albania	HKG	Hong Kong	NZL	New Zealand
ARE	United Arab Emirates	HRV	Croatia	PAN	Panama
ARG	Argentina	HUN	Hungary	PER	Peru
AUS	Australia	IDN	Indonesia	PHL	Philippines
AUT	Austria	IRL	Ireland	POL	Poland
BEL	Belgium	ISL	Iceland	PRT	Portugal
BGR	Bulgaria	ISR	Israel	QAT	Qatar
BIH	Bosnia and Herzegovina	ITA	Italy	QAZ	Baku (Azerbaijan)
BLR	Belarus	JOR	Jordan	QCI	B-S-J-Z (China)
BRA	Brazil	JPN	Japan	QMR	Moscow Region (RUS)
BRN	Brunei Darussalam	KAZ	Kazakhstan	QRT	Tatarstan (RUS)
CAN	Canada	KOR	Korea	ROU	Romania
CHE	Switzerland	KSV	Kosovo	RUS	Russian Federation
CHL	Chile	LBN	Lebanon	SAU	Saudi Arabia
COL	Colombia	LTU	Lithuania	SGP	Singapore
CRI	Costa Rica	LUX	Luxembourg	SRB	Serbia
CZE	Czech Republic	LVA	Latvia	SVK	Slovak Republic
DEU	Germany	MAC	Macao	SVN	Slovenia
DNK	Denmark	MAR	Morocco	SWE	Sweden
DOM	Dominican Republic	MDA	Moldova	TAP	Chinese Taipei
ESP	Spain	MEX	Mexico	THA	Thailand
EST	Estonia	MKD	North Macedonia	TUR	Turkey
FIN	Finland	MLT	Malta	UKR	Ukraine
FRA	France	MNE	Montenegro	URY	Uruguay
GBR	United Kingdom	MYS	Malaysia	USA	United States
GEO	Georgia	NLD	Netherlands		
GRC	Greece	NOR	Norway		

Notes: As noted in this Appendix, we make three changes to this list of participating countries and regions. We change Baku (Azerbaijan)'s code from QAZ to AZE to match the code given to Azerbaijan in the Global Gender Gap Index dataset. We change B-S-J-Z (China)'s code from QCI to CHN to match the code given to China in the Global Gender Gap Index dataset. And we pool observations from Moscow Region, Tatarstan, and Russian Federation and assign them code RUS, which matches the code given to Russia in the Global Gender Gap Index dataset. B-S-J-Z refers to the Chinese provinces of Beijing, Shanghai, Jiangsu, and Zhejiang.

Table S2 Overall gender gap in competitiveness

	Estimate	Standard error	95% confidence interval	
			Lower	Upper
Boys - Girls	0.167****	0.018	0.131	0.204
I^2 (%)	97.21			
Avg within-country R^2	0.0142			
N countries	77			
N students	556,249			

Notes: Results from a random-effects meta-regression without covariates, where each observation is a country's mean gender gap in competitiveness. I^2 is the percentage of the observed cross-country variation in the gender gap in competitiveness that is due to country heterogeneity rather than randomness. The Avg within-country R^2 is the average R^2 of the within-country regressions of the gender gap in competitiveness without covariates, weighted by the country's sample size. *p<0.1, **p<0.05, ***p<0.01, ****p<0.001.

Table S3 Cross-country variation in boys' and girls' competitiveness

	Variance		Median absolute deviation		F test	Levene's test
	Boys	Girls	Boys	Girls	p-value	p-value
Competitiveness index	0.0306	0.0668	0.1176	0.1827	0.0008	0.0016
Competitiveness Q1	0.0242	0.0450	0.1068	0.1638	0.0074	0.0070
Competitiveness Q2	0.0199	0.0460	0.0997	0.1688	0.0003	0.0001
Competitiveness Q3	0.0205	0.0480	0.0944	0.1417	0.0003	0.0014

Notes: Cross-country variance and median absolute deviation in boys' and girls' competitiveness, computed by taking each country's mean level of competitiveness for boys and girls as an observation.

Table S4 Male-female ratio in secondary school enrollment

Country	M-F ratio	Country	M-F ratio	Country	M-F ratio	Country	M-F ratio
JOR	0.9679	**MKD**	1.0218	**ISR**	0.9829	**HUN**	1.0045
ALB	0.9946	**CHN**	.	**CRI**	0.9300	**LUX**	0.9804
GEO	0.9859	**ROU**	0.9975	**EST**	0.9721	**AUT**	1.0373
MAR	1.0929	**PER**	1.0543	**MLT**	0.9983	**DEU**	1.0621
SAU	1.0600	**MDA**	1.0071	**NOR**	1.0467	**ESP**	0.9816
QAT	.	**LVA**	1.0103	**DNK**	1.0006	**CHE**	1.0514
ARE	.	**KSV**	.	**ARG**	0.9588	**USA**	1.0095
MYS	0.9223	**LTU**	1.0376	**GRC**	1.0542	**HRV**	0.9548
IDN	0.9756	**RUS**	1.0305	**BIH**	.	**SWE**	0.9383
BRN	0.9771	**PAN**	.	**NZL**	0.9417	**IRL**	0.8768
AZE	0.9919	**BLR**	1.0143	**BRA**	0.9696	**SRB**	0.9903
LBN	.	**UKR**	.	**ISL**	1.0107	**SVN**	0.9763
JPN	0.9955	**DOM**	0.9275	**FIN**	0.9061	**URY**	0.9003
HKG	1.0310	**MEX**	0.9194	**BEL**	0.8899	**GBR**	0.9749
TUR	1.0247	**KOR**	1.0072	**ITA**	1.0139	**FRA**	0.9944
TAP	.	**SVK**	0.9883	**CZE**	0.9958	**PRT**	1.0042
MAC	1.0026	**CHL**	0.9996	**MNE**	0.9863		
BGR	1.0333	**POL**	1.0292	**NLD**	0.9895		
THA	1.0205	**SGP**	1.0097	**AUS**	1.0628		
PHL	0.8997	**COL**	0.9494	**CAN**	0.9894		

Notes: *M-F ratio* is the male-female ratio in secondary school enrollment in the country. Values computed from World Bank data of secondary school enrollment (% gross) in 2018. Countries sorted by their gender gap in competitiveness.

Table S5 Variability in men's and women's attitudes to competition across country, World Values Survey

	Variance		Median absolute deviation		F test p-value	Levene's test p-value
	Male	Female	Male	Female		
Wave 2	0.5058	0.6414	0.5916	0.5529	0.6406	0.5345
Wave 3	0.2886	0.3805	0.2969	0.3513	0.3218	0.4410
Wave 4	0.4074	0.4469	0.4488	0.5279	0.8047	0.7056
Wave 5	0.3203	0.4320	0.3233	0.3806	0.2661	0.2727
Wave 6	0.5367	0.5702	0.4514	0.4530	0.8168	0.8428
Wave 7	0.7758	0.7569	0.6066	0.5411	0.9253	0.6120

Notes: First four columns show cross-country variance and median absolute deviation of men's and women's attitude to competition, with observations at the country level (the mean attitude to competition in the country). The last two columns show p-values of tests of differences in cross-country variability between men and women and girls. Attitude to competition measured as the individual's agreement from 1-10 with the statement "1=Competition is good, 10=Competition is harmful". Sample restricted to individuals 29 years old or younger.

Table S6 Competitiveness as a function of GGGI in the country

	Gender gap (1)	Boys (2)	Girls (3)	Interaction (4)
GGGI	1.803**** (0.292)	-0.607 (0.388)	-2.417**** (0.501)	
Female x GGGI				-1.809*** (0.634)
I^2 (%)	95.84	98.60	99.33	99.07
Across-country R^2	0.3518	0.0338	0.2472	0.2885
Avg within-country R^2	0.0147	-	-	-
N countries	73	73	73	73
N students	535,005	264,289	270,716	535,005

Notes: Results from a random-effects meta-regression estimating the mean gender gap in competitiveness in the country in column 1, and the mean competitiveness of boys in the country in the country in columns 2-4. The Avg within-country R^2 is the average R^2 of the country-specific regressions, weighted by the country's sample size. The Across-country R^2 is the R^2 from a country-level OLS regression. *p<0.1, **p<0.05, ***p<0.01, ****p<0.001.

Table S7 Share of students in single-sex schools in PISA 2018 sample

Code	Country	Code	Country	Code	Country
ALB	0.0566	GEO	0.0154	NLD	0.0042
ARE	0.7326	GRC	0.0069	NOR	0.0031
ARG	0.0198	HKG	0.1704	NZL	0.3276
AUS	0.1631	HRV	0.0461	PAN	0.0110
AUT	0.0809	HUN	0.0429	PER	0.1076
AZE	0.0000	IDN	0.0185	PHL	0.0050
BEL	0.0487	IRL	0.3733	POL	0.0034
BGR	0.0110	ISL	0.0124	PRT	0.0089
BIH	0.0008	ISR	0.2518	QAT	0.6078
BLR	0.0272	ITA	0.0341	ROU	0.0118
BRA	0.0077	JOR	0.9340	RUS	0.0077
BRN	0.1718	JPN	0.0943	SAU	1.0000
CAN	0.0225	KAZ	0.0094	SGP	0.1893
CHE	0.0192	KOR	0.4206	SRB	0.0067
CHL	0.0911	KSV	0.0065	SVK	0.0441
CHN	0.0001	LBN	0.1058	SVN	0.1617
COL	0.0447	LTU	0.0112	SWE	0.0018
CRI	0.0123	LUX	0.0434	TAP	0.0377
CZE	0.0376	LVA	0.0051	THA	0.0363
DEU	0.0090	MAC	0.2093	TUR	0.1765
DNK	0.0029	MAR	0.0000	UKR	0.0200
DOM	0.0097	MDA	0.0121	URY	0.0010
ESP	0.0117	MEX	0.0147	USA	0.0252
EST	0.0043	MKD	0.0038		
FIN	0.0032	MLT	0.5263		
FRA	0.0070	MNE	0.0018		
GBR	0.1144	MYS	0.0648		

Notes: We classify a school as single-sex if all students in the sample from that school are of the same sex.

Table S8 Effect of socioeconomic status on competitiveness

	Boys (1)	Girls (2)	Both genders (3)	Both genders (4)
SES	0.082**** (0.003)	0.078**** (0.002)	0.102**** (0.002)	
Female			-0.202**** (0.003)	
SES x Female			-0.046**** (0.003)	
SES x Female x GGGI				0.022 (0.051)
School FE	Y	Y	Y	Y
R^2	0.1354	0.1668	0.1193	0.1214
N students	273,187	280,381	553,568	532,386

Notes: Results from student-level OLS regressions pooling all countries and estimating the student's competitiveness on the student's socioeconomic status (SES) for columns 1-2. Column 3 includes a female indicator, and the SES x Female interaction. All regressions include school fixed effects. Robust standard errors in parentheses. *p<0.1, **p<0.05, ***p<0.01, ****p<0.001.

Table S9 Overall mean gender gap in unadjusted math test scores

	Estimate	Standard error	95% confidence interval	
			Lower	Upper
Boys - Girls	0.059****	0.010	0.040	0.078
I^2 (%)	83.06			
Avg within-country R^2	0.0032			
N countries	77			
N students	556,249			

Notes: Results from a random-effects meta-regression without moderating covariates, where each observation is a country's mean gender gap in math test scores. Math test score is estimated from country-specific regressions of a student's math test score on a male indicator. Sample restricted to students with nonmissing competitiveness. I^2 is the percentage of the observed cross-country variation in the gender gap in math test scores that is due to country heterogeneity rather than randomness. The Avg within-country R^2 is the average R^2 of the country-specific regressions of the gender gap in math test scores without covariates, weighted by the country's sample size. *p<0.1, **p<0.05, ***p<0.01, ****p<0.001.

Table S10 Overall mean gender gap in adjusted math test scores

	Estimate	Standard error	95% confidence interval	
			Lower	Upper
Boys - Girls	0.279****	0.006	0.267	0.291
I^2 (%)	78.15			
Avg within-country R^2	0.6928			
N countries	77			
N students	553,568			

Notes: Results from a random-effects meta-regression without moderating covariates, where each observation is a country's mean gender gap in math test scores. Math test score is estimated from country-specific regressions of a student's math test score on a male indicator, the student's verbal test score and socioeconomic level, and school fixed effects. Sample restricted to students with nonmissing competitiveness. I^2 is the percentage of the observed cross-country variation in the gender gap in math test scores that is due to country heterogeneity rather than randomness. The Avg within-country R^2 is the average R^2 of the country-specific regressions of the gender gap in math test scores, weighted by the country's sample size. *p<0.1, **p<0.05, ***p<0.01, ****p<0.001.

Table S11 Gender gap in math performance and GGGI

	PISA 2003	PISA 2018			
	(1)	(2)	(3)	(4)	(5)
Female	-45.602**	42.634***	13.142	43.828***	15.423
	(20.902)	(15.200)	(9.065)	(15.135)	(10.054)
GGGI	2158.448****	-2924.286****	-1104.227****	525.622	951.704****
	(129.060)	(65.735)	(39.441)	(345.632)	(222.246)
Female x GGGI	89.286**	31.695*	23.755**	51.930*	41.090**
	(36.182)	(16.354)	(11.946)	(27.801)	(19.119)
Country FE	Y	Y	Y	Y	Y
Additional controls	Y	Y	Y	Y	Y
Verbal score control	N	N	Y	N	Y
R^2	0.4031	0.4008	0.7802	0.3366	0.7599
N	128,273	270,752	270,752	139,840	139,840

Notes: Student-level OLS regressions estimating math test scores on a female indicator, GGGI of the country, the interaction of the two, and country fixed effects. Additional controls are the log GDP per capita in the country and its interaction with the female indicator, socioeconomic status of the student, and an indicator for the student being in a grade other than the modal grade in the country. Column 1 runs the regression on the PISA 2003 dataset, and columns 2-5 on the PISA 2018 dataset. The sample in columns 2-3 includes all countries that participated in PISA 2018, and the sample in columns 4-5 includes only the countries that participated in PISA 2003. All regressions remove from the sample students below the median socioeconomic status in the country. Columns 2-5 also remove from the sample observations with missing value for competitiveness. *p<0.1, **p<0.05, ***p<0.01, ****p<0.001.

Table S12 Returns to competitiveness on math test scores

	Both genders (1)	Boys (2)	Girls (3)	Gender diff (4)
$\hat{\beta}_c$	0.041****	0.023****	0.031****	
	(0.002)	(0.002)	(0.002)	
$\hat{\beta}_{c,girls} - \hat{\beta}_{c,boys}$				0.006**
				(0.003)
I^2 (%)	67.30	40.31	31.22	0.03
Avg within-country R^2	0.6776	0.7149	0.6942	0.7044
N countries	77	77	77	77
N students	553,568	273,187	280,381	553,568

Notes: Results from random-effects meta-regressions where each observation is a country's estimated effect of competitiveness on math test scores conditional on the student's verbal test scores, SES, and school fixed effects. In column 1, $\hat{\beta}_c$ is estimated pooling boys and girls. In columns 2 and 3, $\hat{\beta}_c$ is estimated for boys and girls separately. Column 4 estimates the difference between the results in columns 3 and 2 by pooling estimates from columns 2 and 3 and estimating the meta-regression $\hat{\beta}_{cg} = \alpha Female_{cg} + \theta_c + v_{cg} + \epsilon_{cg}$, where $Female_{gc}$ is an indicator that the estimate $\hat{\beta}_{gc}$ corresponds to an estimate for girls and θ_c is a country fixed-effect. Then, $\alpha = \hat{\beta}_{c,girls} - \hat{\beta}_{c,boys}$ is the estimate presented in column 4. The Avg within-country R^2 is the average R^2 of the country-specific regressions, weighted by the country's sample size. *p<0.1, **p<0.05, ***p<0.01, ****p<0.001.

Table S13 Returns to competitiveness on math test scores vs. GGGI

	Both genders (1)	Boys (2)	Girls (3)	Interaction (4)
GGGI	0.162**** (0.043)	0.058 (0.044)	0.114*** (0.040)	
Female x GGGI				0.069 (0.049)
I^2 (%)	61.03	37.43	24.21	0.01
Across-country R^2	0.1534	0.0090	0.0800	0.0749
Avg within-country R^2	0.6777	0.7151	0.6946	0.7047
N countries	73	73	73	73
N students	532,386	262,555	269,831	532,386

Notes: Results from random-effects meta-regressions where each observation is a country's estimated effect $\hat{\beta}_c$ of competitiveness on math test scores conditional on the student's verbal test scores, SES, and school fixed effects. Columns 1-3 regress $\hat{\beta}_c$ on the country's GGGI, where $\hat{\beta}_c$ is estimated pooling boys and girls together (column 1), for boys separately (column 2), or for girls separately (column 3). Column 4 pools estimates from columns 2 and 3 and regresses $\hat{\beta}_c$ on the country's GGGI, an indicator for the observation for girls, and the interaction of the two. The Avg within-country R^2 is the average R^2 of the country-specific regressions, weighted by the country's sample size. The Across-country R^2 is the R^2 from a country-level OLS regression. $^{*}p<0.1$, $^{**}p<0.05$, $^{***}p<0.01$, $^{****}p<0.001$.

Table S14 Returns to competitiveness on the prob. of being in the top 50% of math test scores in the school

	Both genders (1)	Boys (2)	Girls (3)	Gender diff (4)
$\hat{\beta}_c$	0.021****	0.012****	0.016****	
	(0.001)	(0.001)	(0.001)	
$\hat{\beta}_{c,girls} - \hat{\beta}_{c,boys}$				0.005**
				(0.002)
I^2 (%)	32.45	0.01	0.00	0.02
Avg within-country R^2	0.3240	0.3718	0.3555	0.3635
N countries	77	77	77	77
N students	553,344	273,071	280,273	553,344

Notes: Results from random-effects meta-regressions where each observation is a country's estimated effect of competitiveness on the probability that the student's math test score is among the top 50% of scores in their school conditional on the student's verbal test scores, SES, and school fixed effects. In column 1, $\hat{\beta}_c$ is estimated pooling boys and girls. In columns 2 and 3, $\hat{\beta}_c$ is estimated for boys and girls separately. Column 4 estimates the difference between the results in columns 3 and 2 by pooling estimates from columns 2 and 3 and estimating the meta-regression $\hat{\beta}_{cg} = \alpha Female_{cg} + \theta_c + v_{cg} + \epsilon_{cg}$, where $Female_{gc}$ is an indicator that the estimate $\hat{\beta}_{gc}$ corresponds to an estimate for girls and θ_c is a country fixed-effect. Then, $\alpha = \hat{\beta}_{c,girls} - \hat{\beta}_{c,boys}$ is the estimate presented in column 4. The Avg within-country R^2 is the average R^2 of the country-specific regressions, weighted by the country's sample size. Sample restricted to students in schools with at least 2 observations. *p<0.1, **p<0.05, ***p<0.01, ****p<0.001.

Table S15 Returns to competitiveness on the prob. of being in the top 50% of math test scores in the school vs. GGGI

	Both genders (1)	Boys (2)	Girls (3)	Interaction (4)
GGGI	0.068***	-0.002	0.062**	
	(0.021)	(0.024)	(0.026)	
Female x GGGI				0.069*
				(0.035)
I^2 (%)	24.51	0.02	0.01	0.00
Across-country R^2	0.1142	0.0024	0.0842	0.1004
Avg within-country R^2	0.3239	0.3716	0.3563	0.3638
N countries	73	73	73	73
N students	532,166	262,440	269,726	532,166

Notes: Results from random-effects meta-regressions where each observation is a country's estimated effect $\hat{\beta}_c$ of competitiveness on the probability that the student's math test score is among the top 50% of scores in their school conditional on the student's verbal test scores, SES, and school fixed effects. Columns 1-3 regress $\hat{\beta}_c$ on the country's GGGI, where $\hat{\beta}_c$ is estimated pooling boys and girls together (column 1), for boys separately (column 2), or for girls separately (column 3). Column 4 pools estimates from columns 2 and 3 and regresses $\hat{\beta}_c$ on the country's GGGI, an indicator for the observation for girls, and the interaction of the two. The Avg within-country R^2 is the average R^2 of the country-specific regressions, weighted by the country's sample size. The Across-country R^2 is the R^2 from a country-level OLS regression. Sample restricted to students in schools with at least 2 observations. *p<0.1, **p<0.05, ***p<0.01, ****p<0.001.

Table S16 Returns to competitiveness on the prob. of being in the top 25% of math test scores in the school

	Both genders (1)	Boys (2)	Girls (3)	Gender diff (4)
$\hat{\beta}_c$	0.017**** (0.001)	0.008**** (0.001)	0.013**** (0.001)	
$\hat{\beta}_{c,girls} - \hat{\beta}_{c,boys}$				0.005*** (0.002)
I^2 (%)	49.14	0.01	0.01	0.01
Avg within-country R^2	0.2779	0.3350	0.3003	0.3174
N countries	77	77	77	77
N students	551,910	272,267	279,643	551,910

Notes: Results from random-effects meta-regressions where each observation is a country's estimated effect of competitiveness on the probability that the student's math test score is among the top 50% of scores in their school conditional on the student's verbal test scores, SES, and school fixed effects. In column 1, $\hat{\beta}_c$ is estimated pooling boys and girls. In columns 2 and 3, $\hat{\beta}_c$ is estimated for boys and girls separately. Column 4 estimates the difference between the results in columns 3 and 2 by pooling estimates from columns 2 and 3 and estimating the meta-regression $\hat{\beta}_{cg} = \alpha Female_{cg} + \theta_c + v_{cg} + \epsilon_{cg}$, where $Female_{gc}$ is an indicator that the estimate $\hat{\beta}_{gc}$ corresponds to an estimate for girls and θ_c is a country fixed-effect. Then, $\alpha = \hat{\beta}_{c,girls} - \hat{\beta}_{c,boys}$ is the estimate presented in column 4. The Avg within-country R^2 is the average R^2 of the country-specific regressions, weighted by the country's sample size. Sample restricted to students in schools with at least 4 observations. *p<0.1, **p<0.05, ***p<0.01, ****p<0.001.

Table S17 Returns to competitiveness on the prob. of being in the top 25% of math test scores in the school vs. GGGI

	Both genders (1)	Boys (2)	Girls (3)	Interaction (4)
GGGI	0.072*** (0.022)	0.011 (0.021)	0.072*** (0.023)	
Female x GGGI				0.064** (0.032)
I^2 (%)	42.83	0.01	0.00	0.01
Across-country R^2	0.1224	0.0002	0.1286	0.1233
Avg within-country R^2	0.2782	0.3355	0.3014	0.3182
N countries	73	73	73	73
N students	530,770	261,653	269,117	530,770

Notes: Results from random-effects meta-regressions where each observation is a country's estimated effect $\hat{\beta}_c$ of competitiveness on the probability that the student's math test score is among the top 25% of scores in their school conditional on the student's verbal test scores, SES, and school fixed effects. Columns 1-3 regress $\hat{\beta}_c$ on the country's GGGI, where $\hat{\beta}_c$ is estimated pooling boys and girls together (column 1), for boys separately (column 2), or for girls separately (column 3). Column 4 pools estimates from columns 2 and 3 and regresses $\hat{\beta}_c$ on the country's GGGI, an indicator for the observation for girls, and the interaction of the two. The Avg within-country R^2 is the average R^2 of the country-specific regressions, weighted by the country's sample size. The Across-country R^2 is the R^2 from a country-level OLS regression. Sample restricted to students in schools with at least 4 observations. *p<0.1, **p<0.05, ***p<0.01, ****p<0.001.

Table S18 Returns to competitiveness on the prob. of being in the top 10% of math test scores in the school

	Both genders (1)	Boys (2)	Girls (3)	Gender diff (4)
$\hat{\beta}_c$	0.010****	0.004****	0.007****	
	(0.001)	(0.001)	(0.001)	
$\hat{\beta}_{c,girls} - \hat{\beta}_{c,boys}$				0.003**
				(0.001)
I^2 (%)	43.82	0.00	0.02	0.00
Avg within-country R^2	0.1807	0.2352	0.1987	0.2167
N countries	77	77	77	77
N students	541,666	266,789	274,877	541,666

Notes: Results from random-effects meta-regressions where each observation is a country's estimated effect of competitiveness on the probability that the student's math test score is among the top 50% of scores in their school conditional on the student's verbal test scores, SES, and school fixed effects. In column 1, $\hat{\beta}_c$ is estimated pooling boys and girls. In columns 2 and 3, $\hat{\beta}_c$ is estimated for boys and girls separately. Column 4 estimates the difference between the results in columns 3 and 2 by pooling estimates from columns 2 and 3 and estimating the meta-regression $\hat{\beta}_{cg} = \alpha Female_{cg} + \theta_c + v_{cg} + \epsilon_{cg}$, where $Female_{gc}$ is an indicator that the estimate $\hat{\beta}_{gc}$ corresponds to an estimate for girls and θ_c is a country fixed-effect. Then, $\alpha = \hat{\beta}_{c,girls} - \hat{\beta}_{c,boys}$ is the estimate presented in column 4. The Avg within-country R^2 is the average R^2 of the country-specific regressions, weighted by the country's sample size. Sample restricted to students in schools with at least 10 observations. *p<0.1, **p<0.05, ***p<0.01, ****p<0.001.

Table S19 Returns to competitiveness on the prob. of being in the top 10% of math test scores in the school vs. GGGI

	Both genders (1)	Boys (2)	Girls (3)	Interaction (4)
GGGI	0.051****	0.013	0.044**	
	(0.015)	(0.016)	(0.017)	
Female x GGGI				0.034
				(0.024)
I^2 (%)	35.65	0.02	0.02	0.00
Across-country R^2	0.1038	0.0039	0.0969	0.0900
Avg within-country R^2	0.1813	0.2360	0.1997	0.2176
N countries	73	73	73	73
N students	520,813	256,312	264,501	520,813

Notes: Results from random-effects meta-regressions where each observation is a country's estimated effect $\hat{\beta}_c$ of competitiveness on the probability that the student's math test score is among the top 10% of scores in their school conditional on the student's verbal test scores, SES, and school fixed effects. Columns 1-3 regress $\hat{\beta}_c$ on the country's GGGI, where $\hat{\beta}_c$ is estimated pooling boys and girls together (column 1), for boys separately (column 2), or for girls separately (column 3). Column 4 pools estimates from columns 2 and 3 and regresses $\hat{\beta}_c$ on the country's GGGI, an indicator for the observation for girls, and the interaction of the two. The Avg within-country R^2 is the average R^2 of the country-specific regressions, weighted by the country's sample size. The Across-country R^2 is the R^2 from a country-level OLS regression. Sample restricted to students in schools with at least 10 observations. *p<0.1, **p<0.05, ***p<0.01, ****p<0.001.

Table S20 Managerial and professional occupations in PISA (high-paying occupation starred)

	Code	Occupation		Code	Occupation
*	1000	Managers		1420	Retail and wholesale trade managers
*	1100	Chief executives, senior officials and legislators		1430	Other services managers
*	1110	Legislators and senior officials		1431	Sports, recreation and cultural centre managers
*	1111	Legislators		1439	Services managers not elsewhere classified
*	1112	Senior government officials		2000	Professionals
	1113	Traditional chiefs and heads of village	*	2100	Science and engineering professionals
*	1114	Senior officials of special-interest organizations	*	2110	Physical and earth science professionals
*	1120	Managing directors and chief executives	*	2111	Physicists and astronomers
*	1200	Administrative and commercial managers	*	2112	Meteorologists
*	1210	Business services and administration managers	*	2113	Chemists
*	1211	Finance managers	*	2114	Geologists and geophysicists
*	1212	Human resource managers	*	2120	Mathematicians, actuaries and statisticians
*	1213	Policy and planning managers		2130	Life science professionals
*	1219	Business services and administration managers not elsewhere classd		2131	Biologists, botanists, zoologists and related professionals
*	1220	Sales, marketing and development managers		2132	Farming, forestry and fisheries advisers
*	1221	Sales and marketing managers		2133	Environmental protection professionals
*	1222	Advertising and public relations managers	*	2140	Engineering professionals (excluding electrotechnology)
*	1223	Research and development managers	*	2141	Industrial and production engineers
*	1300	Production and specialised services managers	*	2142	Civil engineers
*	1310	Production managers in agriculture, forestry and fisheries	*	2143	Environmental engineers
*	1311	Agricultural and forestry production managers	*	2144	Mechanical engineers
*	1312	Aquaculture and fisheries production managers	*	2145	Chemical engineers
*	1320	Manufacturing, mining, construction, and distribution managers	*	2146	Mining engineers, metallurgists and related professionals
*	1321	Manufacturing managers	*	2149	Engineering professionals not elsewhere classified
*	1322	Mining managers	*	2150	Electrotechnology engineers
*	1323	Construction managers	*	2151	Electrical engineers
*	1324	Supply, distribution and related managers	*	2152	Electronics engineers
*	1330	Information and communications technology service managers	*	2153	Telecommunications engineers
	1340	Professional services managers	*	2160	Architects, planners, surveyors and designers
	1341	Child care services managers	*	2161	Building architects
*	1342	Health services managers		2162	Landscape architects
	1343	Aged care services managers		2163	Product and garment designers
	1344	Social welfare managers		2164	Town and traffic planners
	1345	Education managers		2165	Cartographers and surveyors
*	1346	Financial and insurance services branch managers		2166	Graphic and multimedia designers
	1349	Professional services managers not elsewhere classified	*	2200	Health professionals
	1400	Hospitality, retail and other services managers	*	2210	Medical doctors
	1410	Hotel and restaurant managers	*	2211	Generalist medical practitioners
	1411	Hotel managers	*	2212	Specialist medical practitioners
	1412	Restaurant managers	*	2220	Nursing and midwifery professionals

Table S20 continued Managerial and professional occupations in PISA (high-paying occupations starred)

	Code	Occupation		Code	Occupation
*	2221	Nursing professionals		2433	Technical and medical sales professionals (excluding ICT)
	2222	Midwifery professionals		2434	Information and communications technology sales professionals
	2230	Traditional and complementary medicine professionals		2500	Information and communications technology professionals
	2240	Paramedical practitioners	*	2510	Software and applications developers and analysts
	2250	Veterinarians	*	2511	Systems analysts
	2260	Other health professionals	*	2512	Software developers
*	2261	Dentists	*	2513	Web and multimedia developers
*	2262	Pharmacists	*	2514	Applications programmers
	2263	Environmental and occupational health and hygiene professionals	*	2519	Software and apps developers and analysts not elsewhere classd
	2264	Physiotherapists	*	2520	Database and network professionals
	2265	Dieticians and nutritionists	*	2521	Database designers and administrators
	2266	Audiologists and speech therapists	*	2522	Systems administrators
	2267	Optometrists and ophthalmic opticians	*	2523	Computer network professionals
	2269	Health professionals not elsewhere classified	*	2529	Database and network professionals not elsewhere classified
	2300	Teaching professionals		2600	Legal, social and cultural professionals
	2310	University and higher education teachers		2610	Legal professionals
	2320	Vocational education teachers	*	2611	Lawyers
	2330	Secondary education teachers	*	2612	Judges
	2340	Primary school and early childhood teachers		2619	Legal professionals not elsewhere classified
	2341	Primary school teachers		2620	Librarians, archivists and curators
	2342	Early childhood educators		2621	Archivists and curators
	2351	Education methods specialists		2622	Librarians and related information professionals
	2352	Special needs teachers		2630	Social and religious professionals
	2353	Other language teachers	*	2631	Economists
	2354	Other music teachers		2632	Sociologists, anthropologists and related professionals
	2355	Other arts teachers		2633	Philosophers, historians and political scientists
	2356	Information technology trainers		2634	Psychologists
	2359	Teaching professionals not elsewhere classified		2635	Social work and counselling professionals
*	2400	Business and administration professionals		2636	Religious professionals
*	2410	Finance professionals		2640	Authors, journalists and linguists
*	2411	Accountants		2641	Authors and related writers
*	2412	Financial and investment advisers		2642	Journalists
*	2413	Financial analysts		2643	Translators, interpreters and other linguists
*	2420	Administration professionals		2650	Creative and performing artists
*	2421	Management and organization analysts		2651	Visual artists
	2422	Policy administration professionals		2652	Musicians, singers and composers
	2423	Personnel and careers professionals		2653	Dancers and choreographers
	2424	Training and staff development professionals		2654	Film, stage and related directors and producers
*	2430	Sales, marketing and public relations professionals		2655	Actors
*	2431	Advertising and marketing professionals		2656	Announcers on radio, television and other media
	2432	Public relations professionals		2659	Creative and performing artists not elsewhere classified

Table S21 Overall mean gender gap in interest in a high-paying occupation

	Estimate	Standard error	95% confidence interval	
			Lower	Upper
Boys - Girls	-0.018***	0.007	-0.031	-0.006
I^2 (%)	95.04			
Avg within-country R^2	0.0041			
N countries	77			
N students	556,249			

Notes: Results from a random-effects meta-regression without moderating covariates, where each observation is a country's mean gender gap in the probability that the student is interested in a high-paying occupation, estimated from country-specific regressions of an indicator that the student expects a high-paying occupation on a male indicator. Sample restricted to students with nonmissing competitiveness. I^2 is the percentage of the observed cross-country variation in the gender gap in interest in a high-paying occupation that is due to country heterogeneity rather than randomness. Avg within-country R^2 is the average R^2 of the country-specific regressions, weighted by the country's sample size. $^{*}p<0.1$, $^{**}p<0.05$, $^{***}p<0.01$, $^{****}p<0.001$.

Table S22 Interest in a high-paying occupation and GGGI

	Both genders (1)	Boys (2)	Girls (3)	Interaction (4)
GGGI	-0.783****	-0.785****	-0.781****	
	(0.206)	(0.211)	(0.215)	
Female x GGGI				0.007
				(0.107)
I^2 (%)	99.38	98.88	98.93	90.93
Across-country R^2	0.1697	0.1647	0.1578	0.1621
Avg within-country R^2	-	-	-	-
N countries	73	73	73	73
N students	532,386	262,555	269,831	532,386

Notes: Results from random-effects meta-regressions where each observation is a country's mean share of students interested in a high-paying occupation. Columns 1-3 regress the estimated mean on the country's GGGI, where the mean is estimated pooling boys and girls together (column 1), for boys separately (column 2), or for girls separately (column 3). Column 4 pools estimates from columns 2 and 3 and regresses the estimated mean on the country's GGGI, an indicator for the observation for girls, and the interaction of the two. The Avg within-country R^2 is the average R^2 of the country-specific regressions, weighted by the country's sample size. The Across-country R^2 is the R^2 from a country-level OLS regression. *p<0.1, **p<0.05, ***p<0.01, ****p<0.001.

Table S23 Return to competitiveness on the student's interest in a high-paying occupation

	Both genders (1)	Boys (2)	Girls (3)	Gender diff (4)
$\hat{\beta}_c$	0.078****	0.052****	0.105****	
	(0.006)	(0.006)	(0.008)	
$\hat{\beta}_{c,girls} - \hat{\beta}_{c,boys}$				0.048****
				(0.006)
I^2 (%)	87.41	69.40	84.47	40.40
Avg within-country R^2	0.1219	0.1712	0.1437	0.1573
N countries	77	77	77	77
N students	553,568	273,187	280,381	553,568

Notes: Results from random-effects meta-regressions where each observation is a country's estimated effect of competitiveness on the probability that the student is interested in a high-paying occupation conditional on the student's math test scores, verbal test scores, SES, and school fixed effects. The effect is scaled by share of students interested in in a high-paying occupation the country. In column 1, $\hat{\beta}_c$ is estimated pooling boys and girls. In columns 2 and 3, $\hat{\beta}_c$ is estimated for boys and girls separately. Column 4 estimates the difference between the results in columns 3 and 2 by pooling estimates from columns 2 and 3 and estimating the meta-regression $\hat{\beta}_{cg} = \alpha Female_{cg} + \theta_c + v_{cg} + \epsilon_{cg}$, where $Female_{gc}$ is an indicator that the estimate $\hat{\beta}_{gc}$ corresponds to an estimate for girls and θ_c is a country fixed-effect. Then, $\alpha = \hat{\beta}_{c,girls} - \hat{\beta}_{c,boys}$ is the estimate presented in column 4. The Avg within-country R^2 is the average R^2 of the country-specific regressions, weighted by the country's sample size. Sample restricted to students in schools with at least 10 observations. *p<0.1, **p<0.05, ***p<0.01, ****p<0.001.

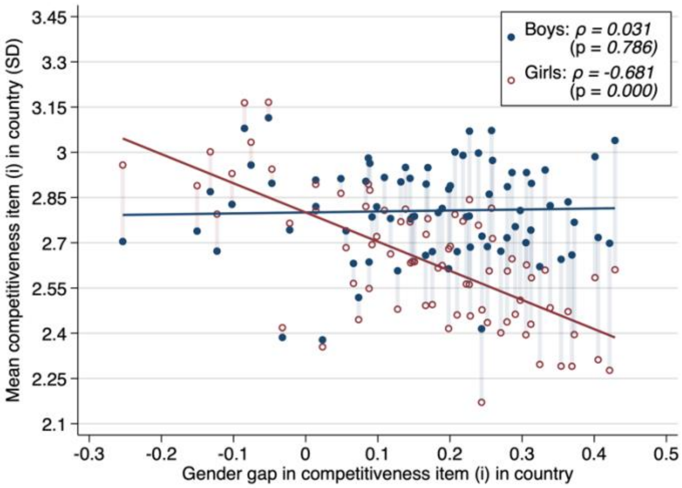
Table S24 Returns to competitiveness on the student's interest in a high-paying occupation vs. GGGI

	Both genders (1)	Boys (2)	Girls (3)	Interaction (4)
GGGI	0.177*	0.091	0.317**	
	(0.103)	(0.097)	(0.135)	
Female x GGGI				0.225**
				(0.103)
I^2 (%)	84.84	63.55	81.30	34.44
Across-country R^2	0.0360	0.0157	0.0553	0.2072
Avg within-country R^2	0.1225	0.1732	0.1437	0.1583
N countries	73	73	73	73
N students	532,386	262,555	269,831	532,386

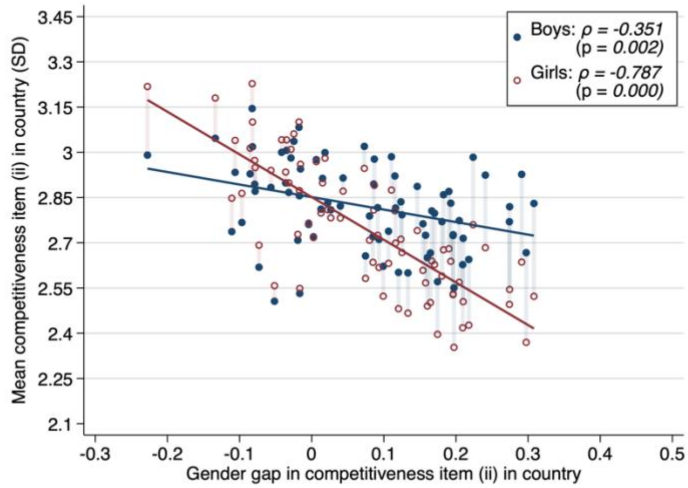
Notes: Results from random-effects meta-regressions where each observation is a country's estimated effect $\hat{\beta}_c$ of competitiveness on the probability that the student is interested in a high-paying occupation conditional on the student's math test scores, verbal test scores, SES, and school fixed effects. The effect is scaled by share of students interested in in a high-paying occupation the country. Columns 1-3 regress $\hat{\beta}_c$ on the country's GGGI, where $\hat{\beta}_c$ is estimated pooling boys and girls together (column 1), for boys separately (column 2), or for girls separately (column 3). Column 4 pools estimates from columns 2 and 3 and regresses $\hat{\beta}_c$ on the country's GGGI, an indicator for the observation for girls, and the interaction of the two. The Avg within-country R^2 is the average R^2 of the country-specific regressions, weighted by the country's sample size. The Across-country R^2 is the R^2 from a country-level OLS regression. Sample restricted to students in schools with at least 10 observations. *p<0.1, **p<0.05, ***p<0.01, ****p<0.001.

Appendix D. Supplementary figures

a. Competitiveness item i



b. Competitiveness item ii



c. Competitiveness item iii

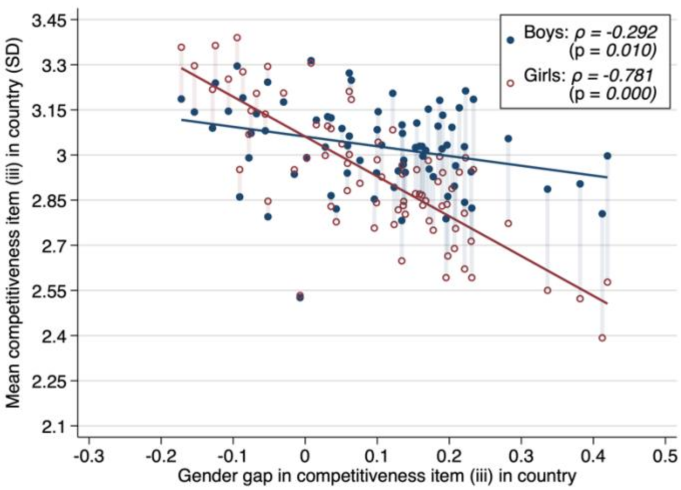
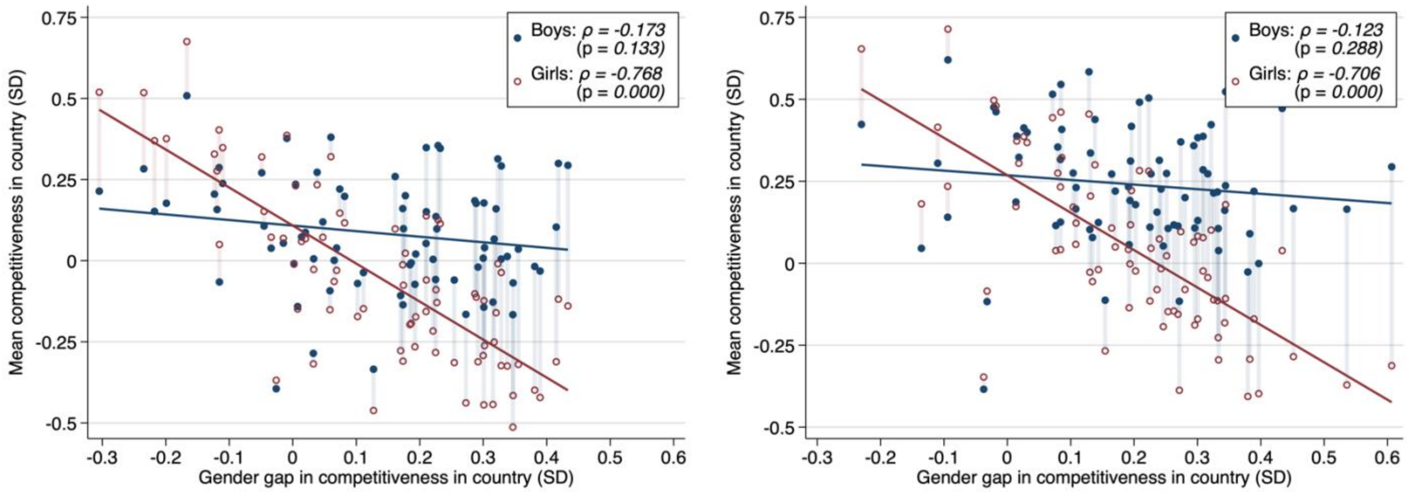


Figure S1 Mean competitiveness of boys and girls in the country

Notes: Item i: *"I enjoy working in situations involving competition with others"*. Item ii: *"It is important for me to perform better than other people on a task"*. Item iii: *"I try harder when I'm in competition with other people."*



a. Students below median SES in their country **b.** Students above median SES in their country

Figure S2 Mean competitiveness of boys and girls in the country

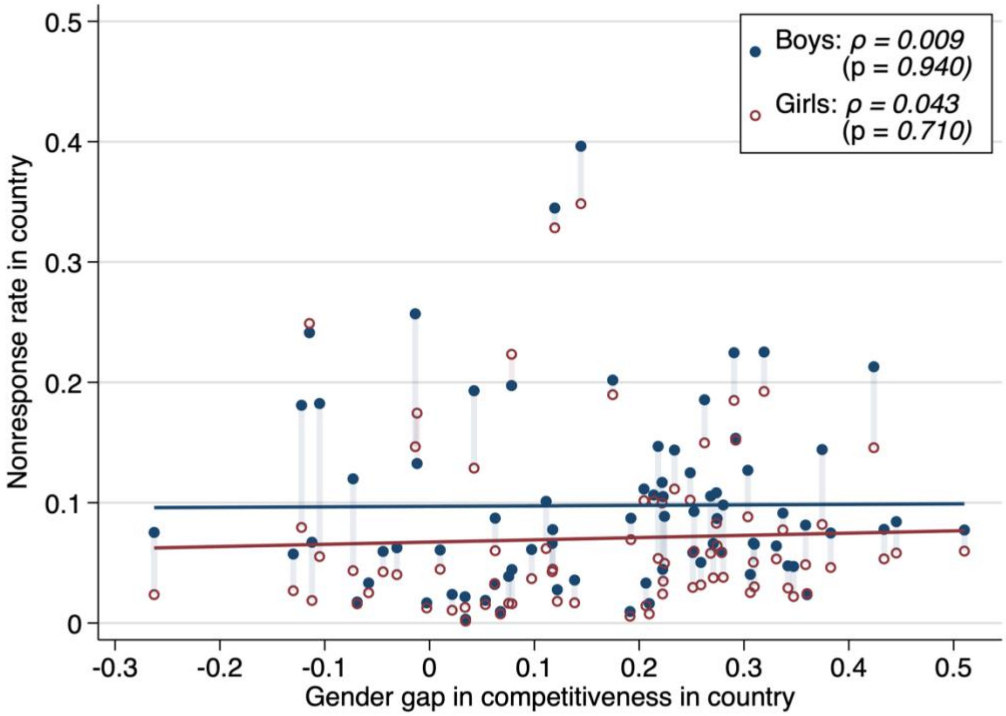


Figure S3 Nonresponse rate of boys and girls

Notes: Nonresponse rate is the fraction of students in the country that leave at least one competitiveness item unanswered.

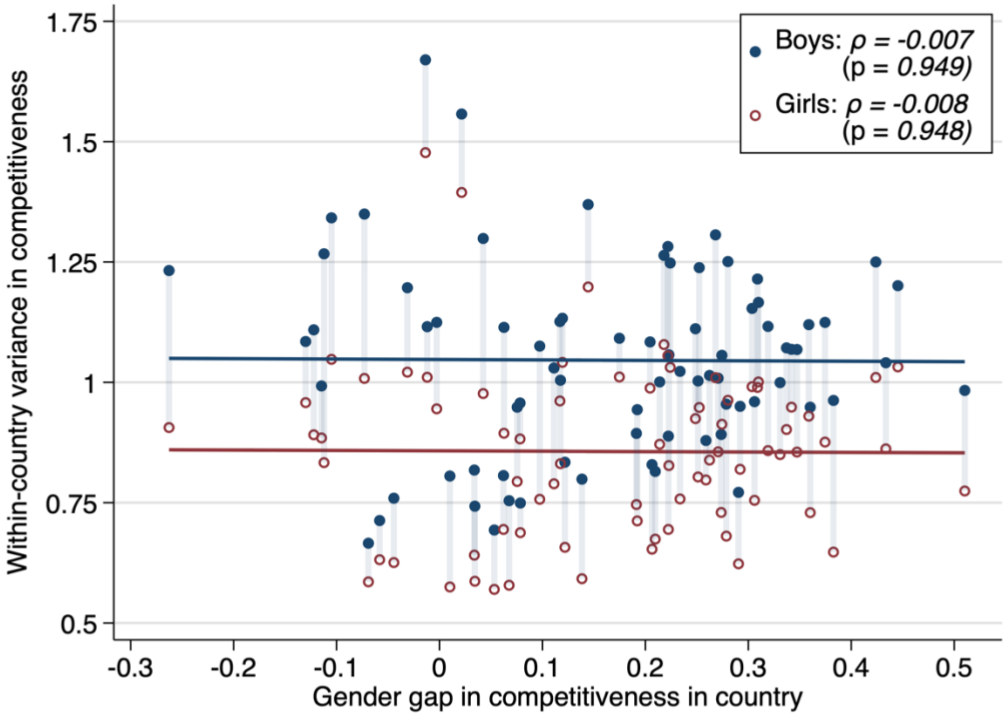


Figure S4 Within-country variance in competitiveness of boys and girls

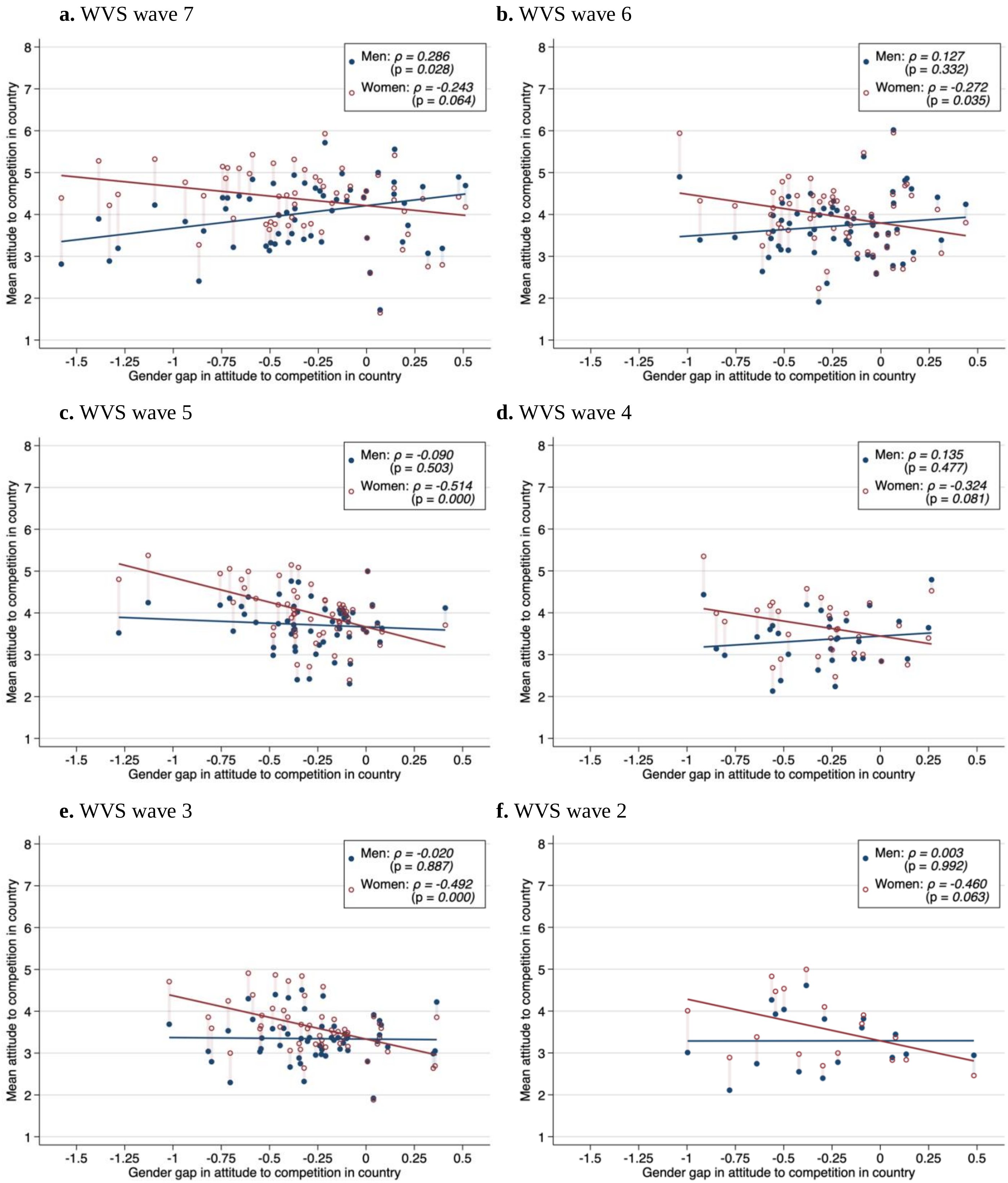
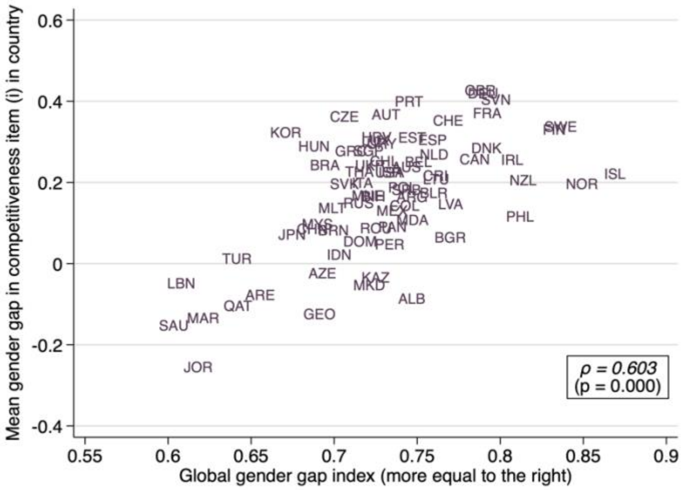


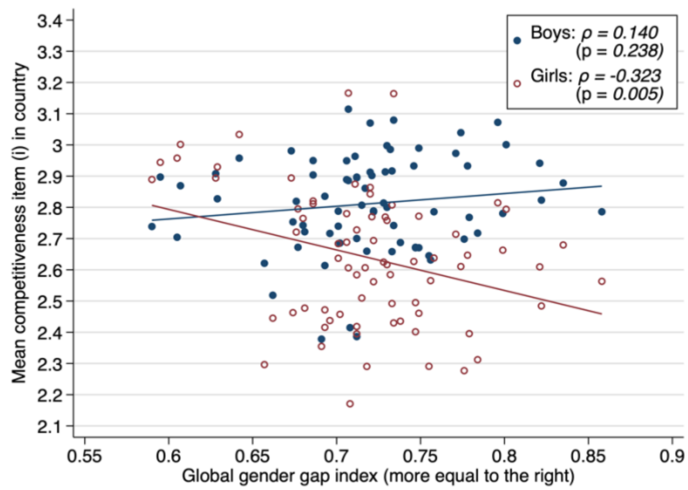
Figure S5 Mean attitude to competition of men and women across country, World Values Survey

Notes: Sample in each wave restricted to individuals 29 years old or younger.

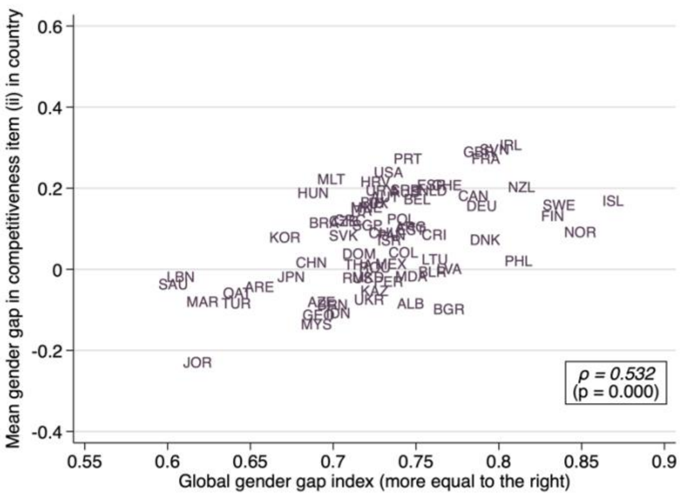
a. Competitiveness item i, gender gap



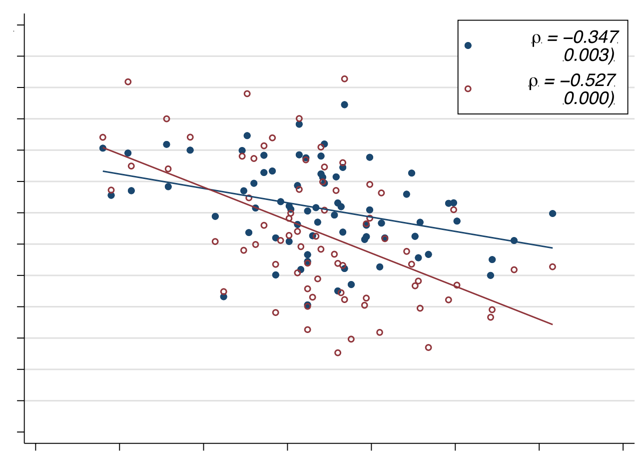
b. Competitiveness item i, boys and girls



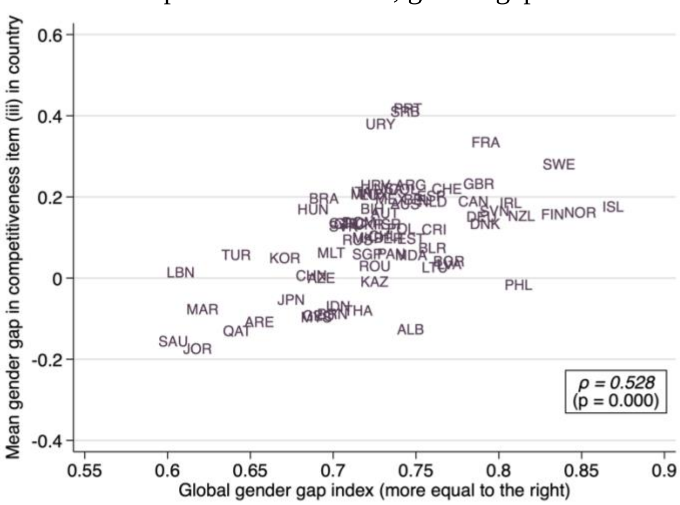
c. Competitiveness item ii, gender gap



d. Competitiveness item ii, boys and girls



e. Competitiveness item iii, gender gap



f. Competitiveness item iii, boys and girls

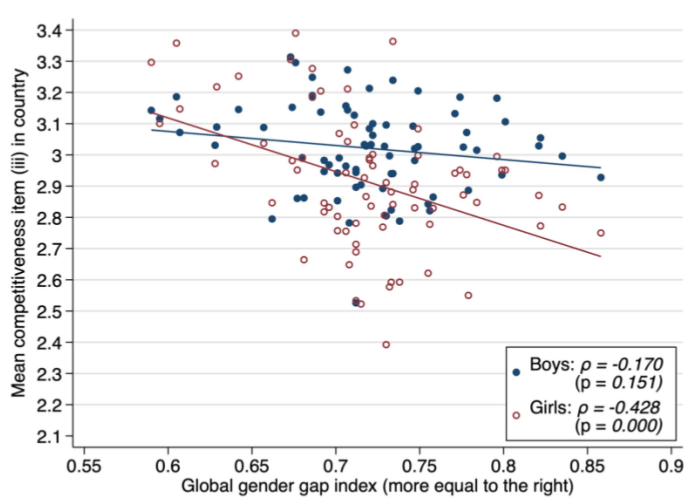
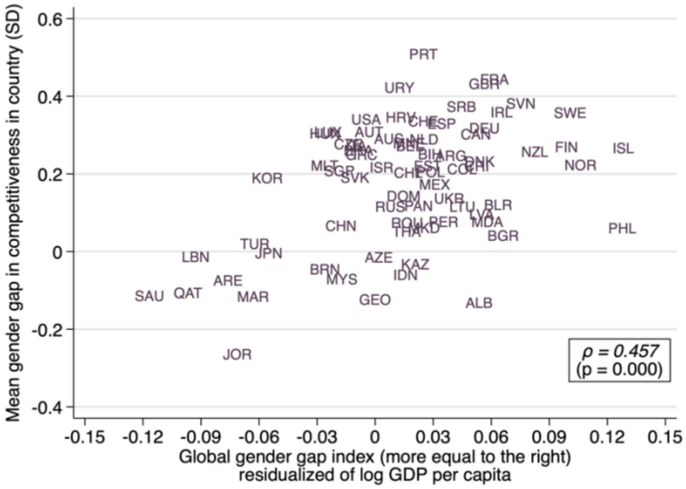


Figure S6 Competitiveness vs. gender egalitarianism in the country

a-b. Against the WEF Global Gender Equality Index residualized of the log GDP per capita



c-d. Against the Gender Equality Composite Index

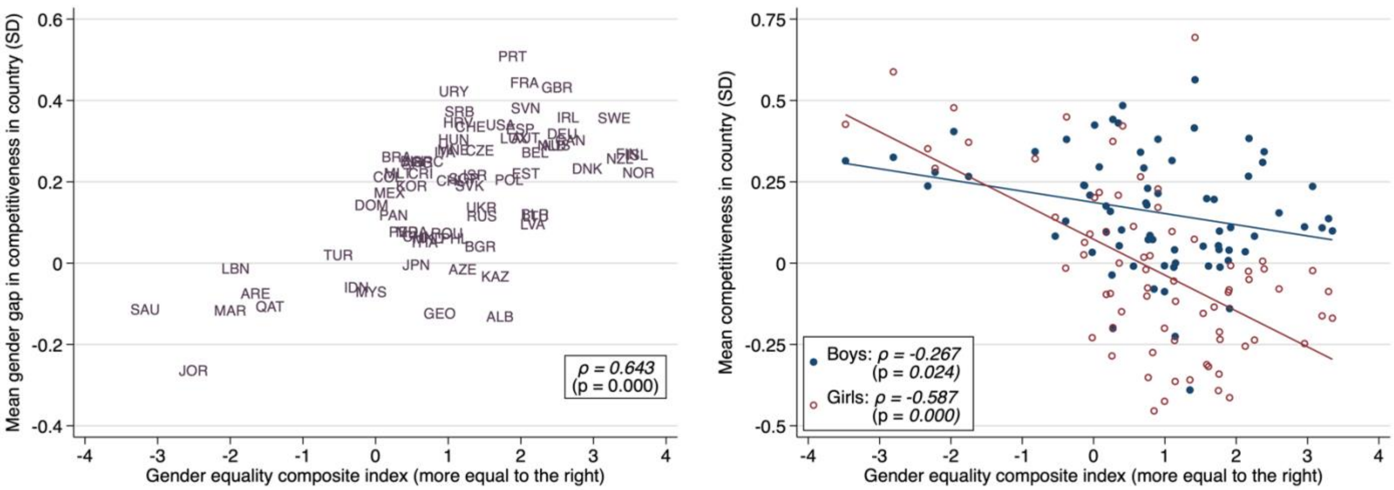
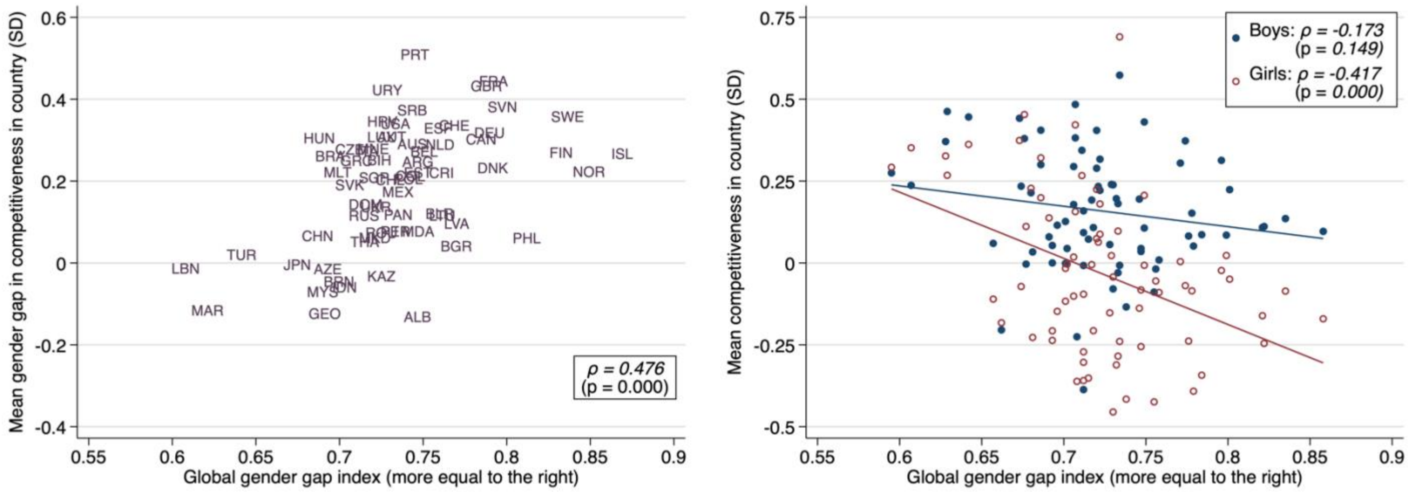


Figure S7 Competitiveness vs. alternative measures of gender egalitarianism in the country

Notes: In Panels a-b, the horizontal axis is the WEF Global Gender Gap Index in the country residualized of the 2018 log GDP per capita in the country. In Panels c-d, the horizontal axis is the Gender Equality Composite Index, which is the first predicted component from principal component analysis of the following four country-level variables: years since women were granted the right to vote, the 2018 WEF Gender Gap Index, the 2018 UN Gender Inequality Index (reverse-coded), and the 2009-2018 average female-male labor force participation ratio based on World Bank statistics. In Panels c-d, BRN (Brunei Darussalam) drops from the sample due to missing Gender Equality Composite Index.

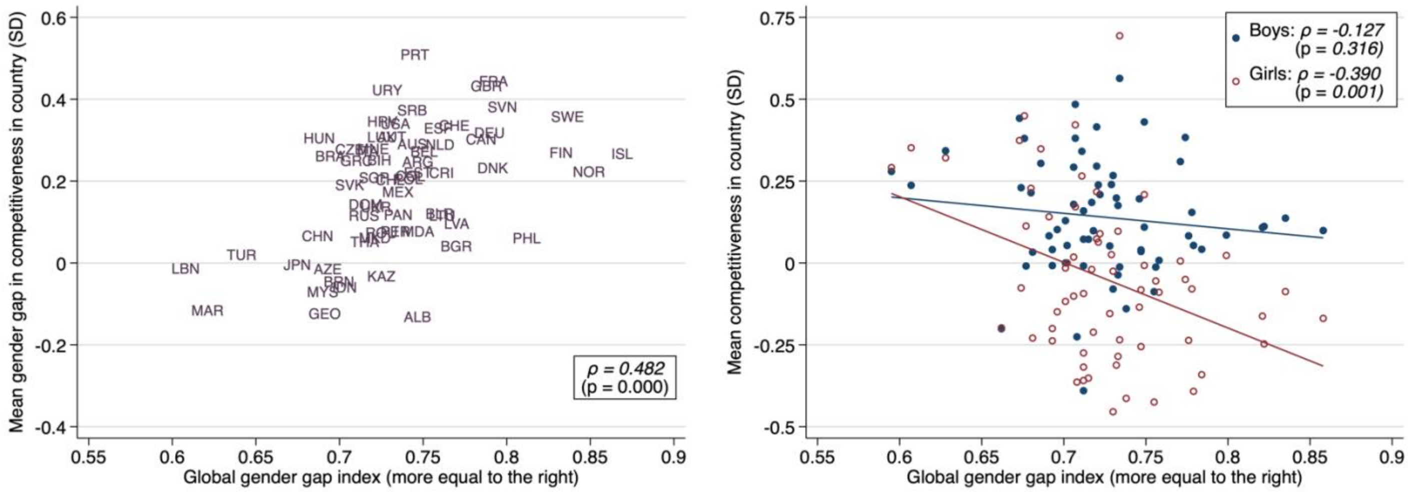


a. Gender gap in competitiveness in country

b. Mean competitiveness of boys and girls in country

Figure S8 Competitiveness vs. gender egalitarianism in the country

Notes: We exclude observations from Jordan, Saudi Arabia, and single-sex schools in all other countries.



a. Gender gap in competitiveness in country

b. Mean competitiveness of boys and girls in country

Figure S9 Competitiveness vs. gender egalitarianism in the country

Notes: We exclude all observations from countries or regions with more than 20% of their sample in single-sex schools; i.e., Azerbaijan, Ireland, Israel, Jordan, Korea, Macao, Malta, New Zealand, Qatar, and Saudi Arabia.

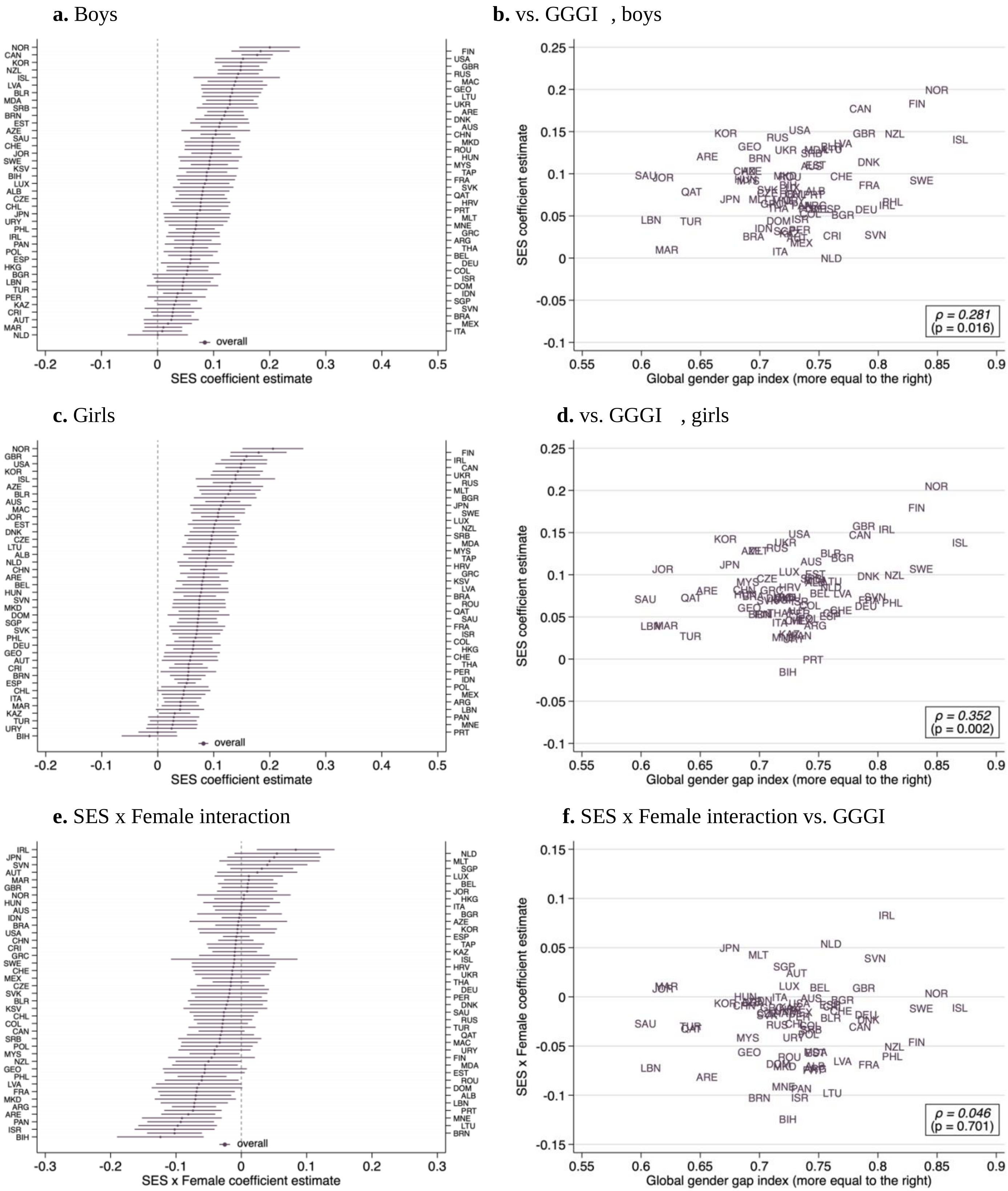
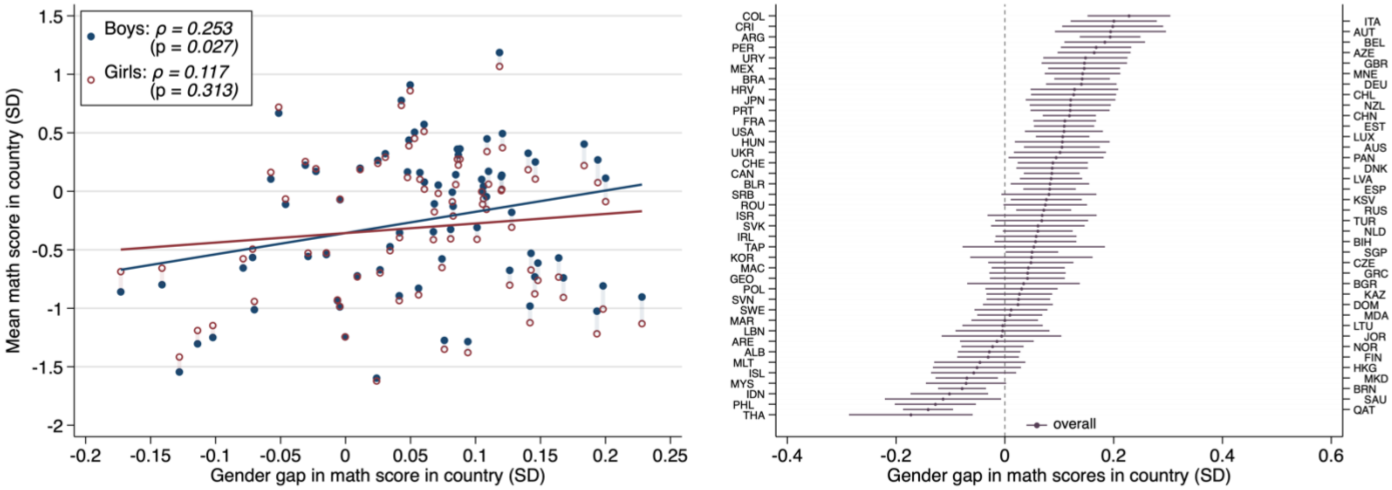


Figure S10 Effect of socioeconomic status on competitiveness

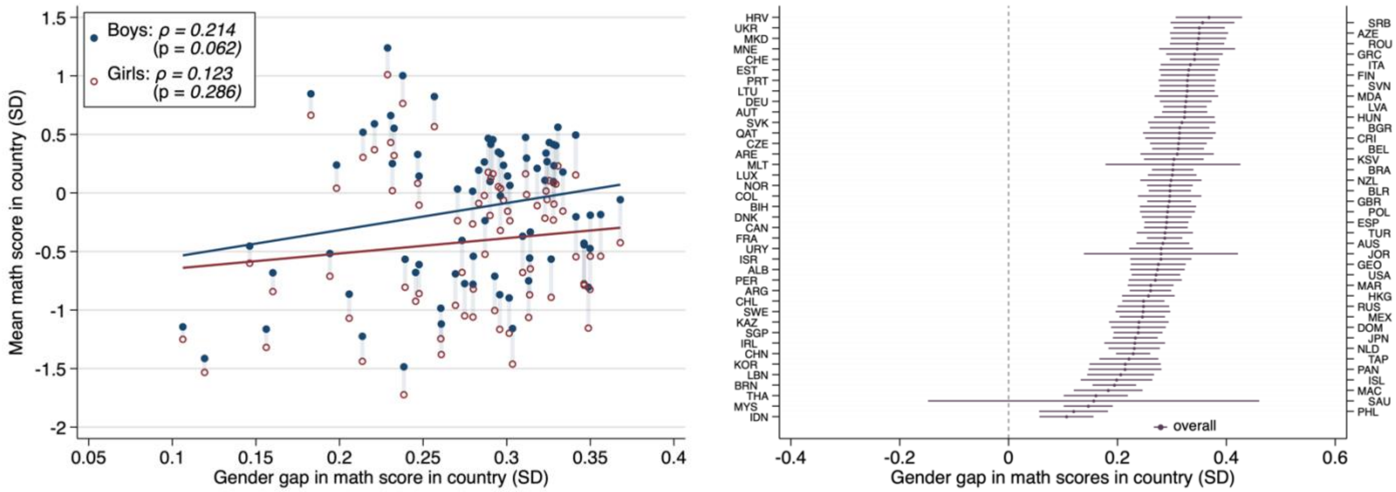


a. Mean math test scores of boys and girls in the country

b. Mean gender gap in math test scores in the country

Figure S11 Unadjusted math test scores of boys and girls

Notes: Sample restricted to students with nonmissing competitiveness. Whiskers in panel b are 95% confidence intervals obtained from a regression of math test scores on male indicator and no additional controls.

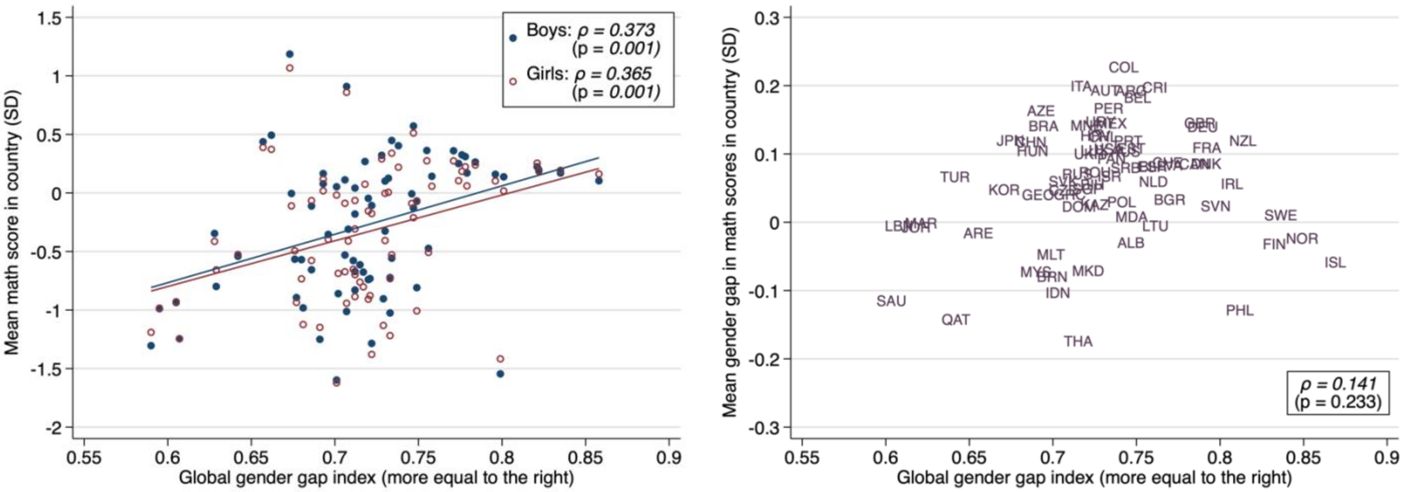


a. Mean math test scores of boys and girls in the country

b. Mean gender gap in math test scores in the country

Figure S12 Adjusted math test scores of boys and girls

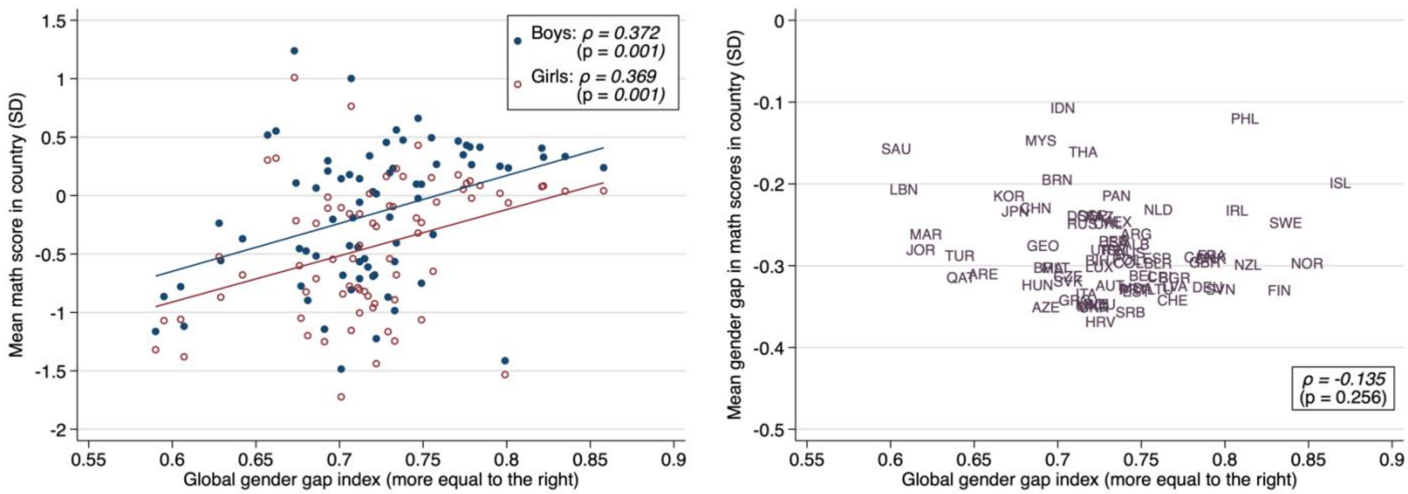
Notes: Math test scores estimated from within-country regressions controlling for student's verbal test score, socioeconomic status, gender, and school fixed effects. Sample restricted to students with nonmissing competitiveness. Whiskers in panel b are 95% confidence intervals.



a. Mean math test scores of boys and girls in the country **b.** Mean gender gap in math test scores in the country

Figure S13 Unadjusted math test scores of boys and girls vs. gender egalitarianism in the country

Notes: Sample restricted to students with nonmissing competitiveness.



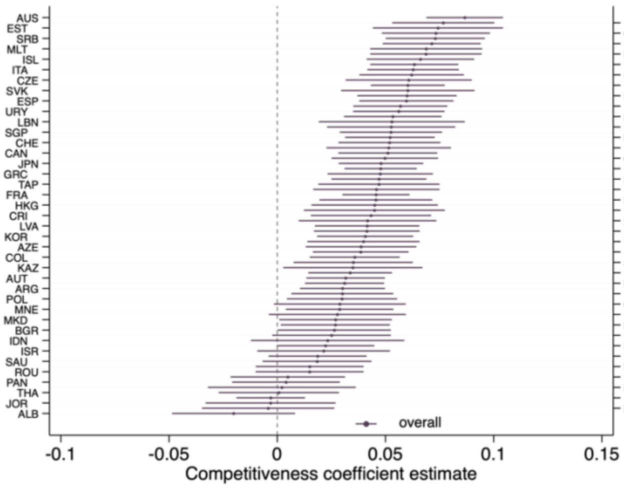
a. Mean math test scores of boys and girls in the country

b. Mean gender gap in math test scores in the country

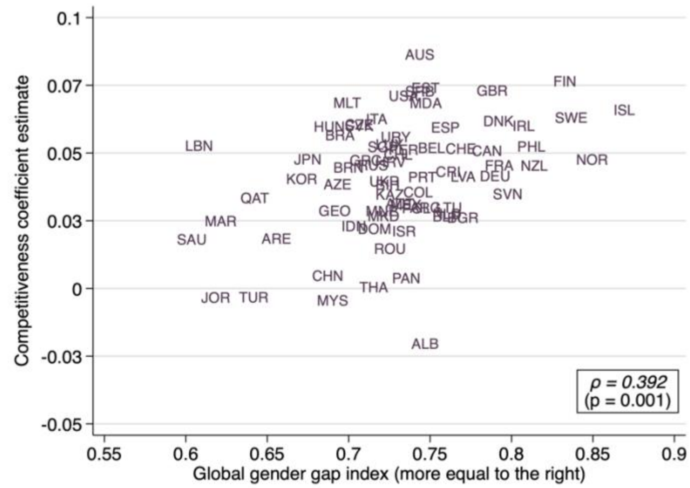
Figure S14 Adjusted math test scores of boys and girls vs. gender egalitarianism in the country

Notes: Math test scores estimated from within-country regressions controlling for student's verbal test score, socioeconomic status, gender, and school fixed effects. Sample restricted to students with nonmissing competitiveness.

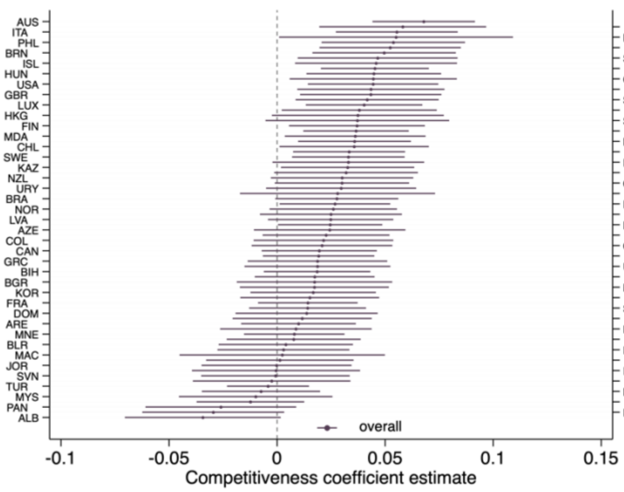
a. Both genders



b. Both genders vs. GGGI

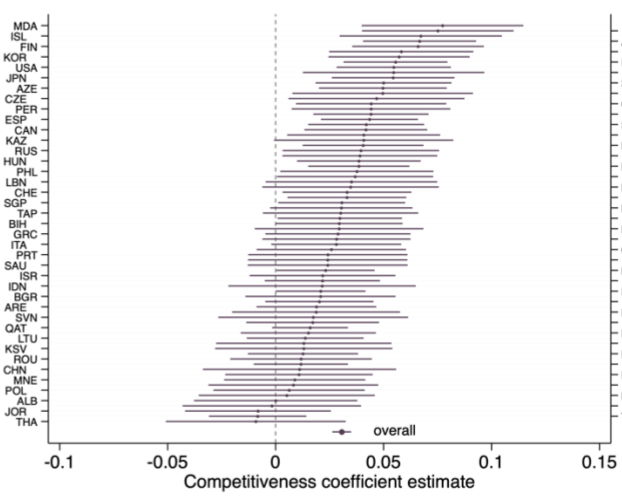


c. Boys



d. Boys vs. GGGI

e. Girls



f. Girls vs. GGGI

Figure S15 Effect of competitiveness on math test scores

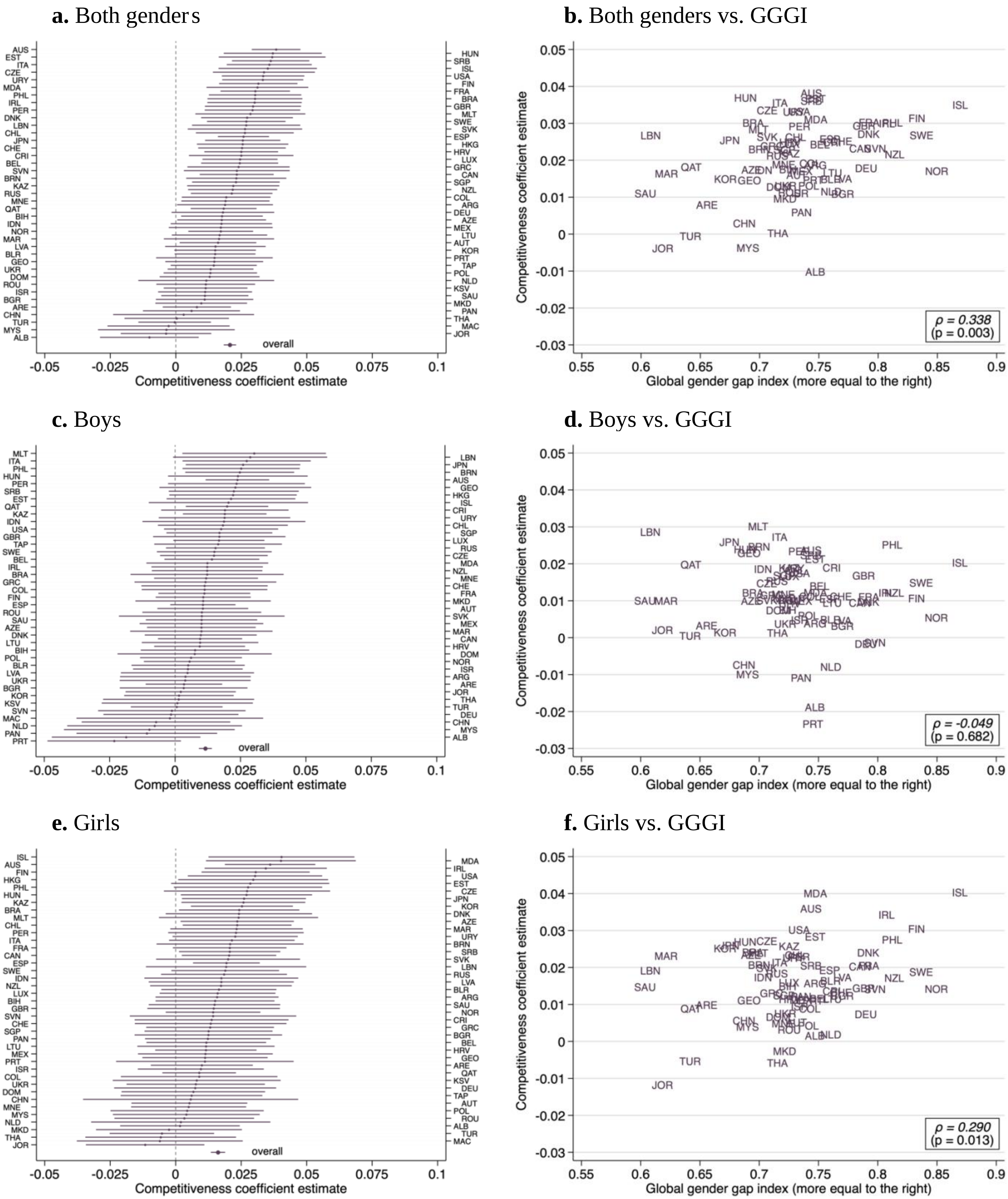
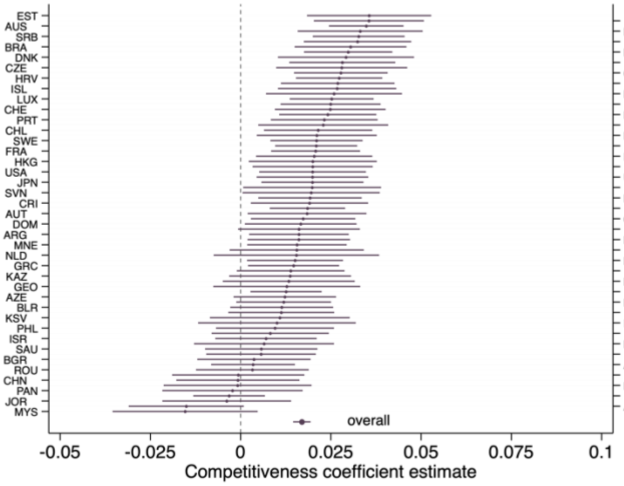
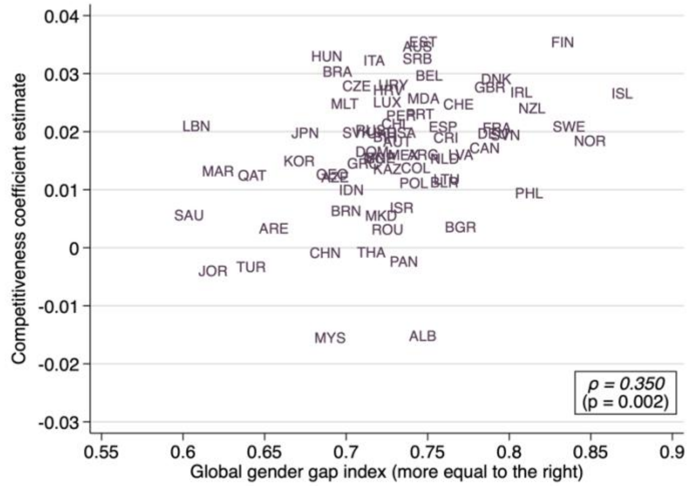


Figure S16 Effect of competitiveness on the probability that math test score is in top 50% in the school

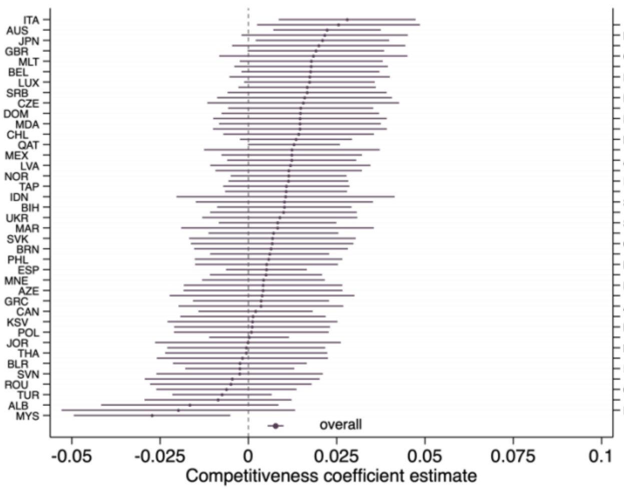
a. Both genders



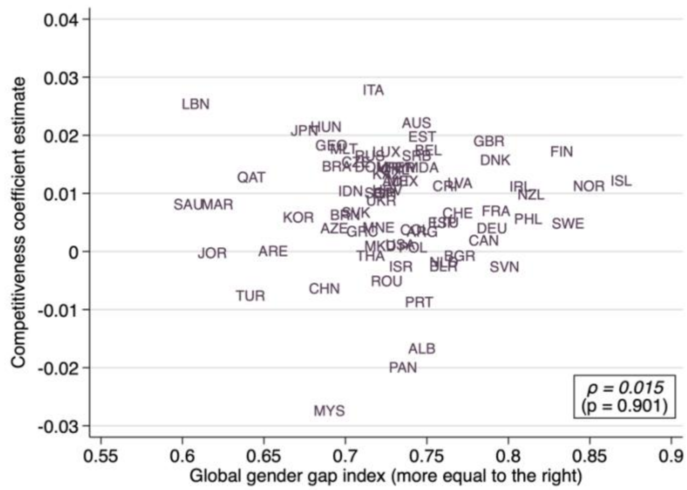
b. Both genders vs. GGGI



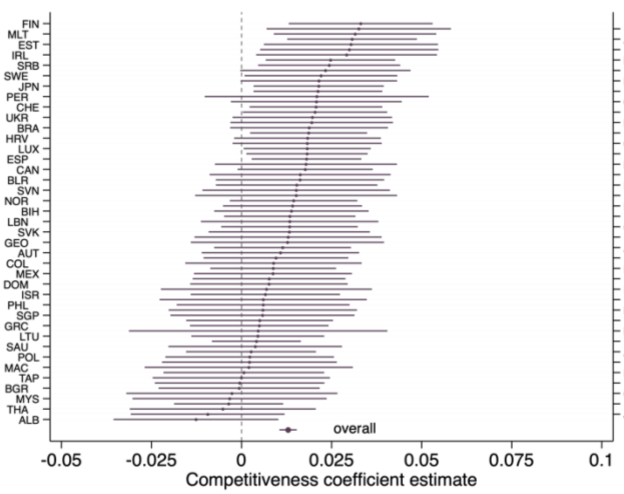
c. Boys



d. Boys vs. GGGI



e. Girls



f. Girls vs. GGGI

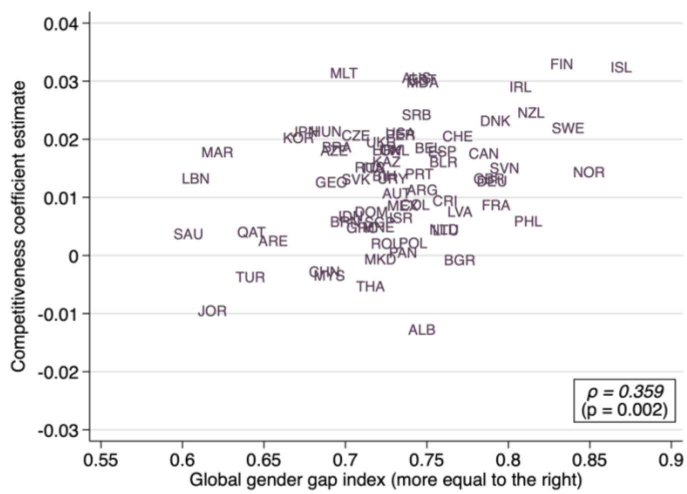
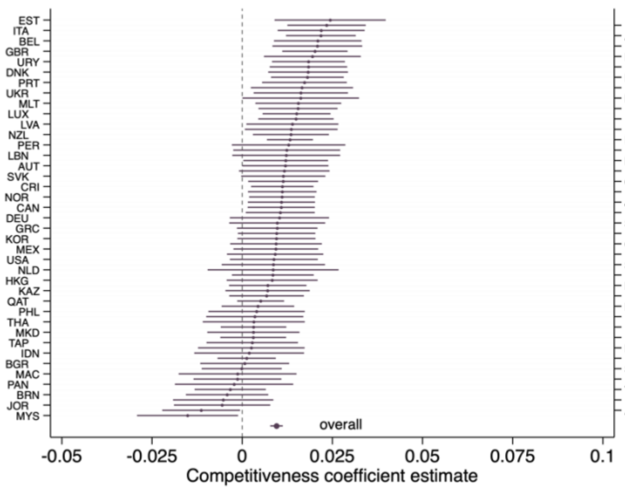
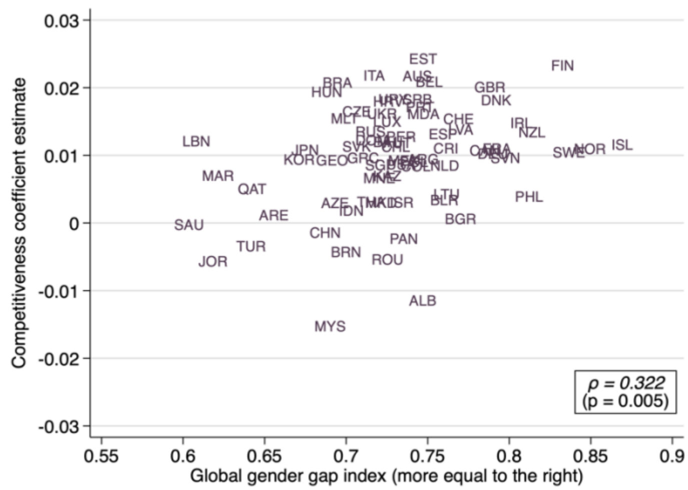


Figure S17 Effect of competitiveness on the probability that math test score is in top 25% in the school

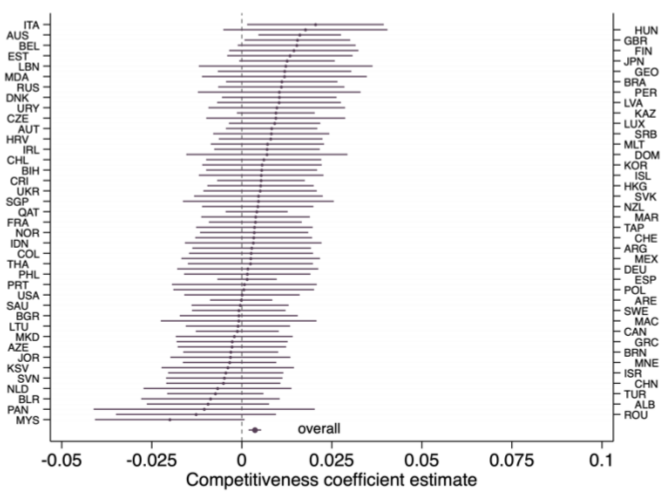
a. Both genders



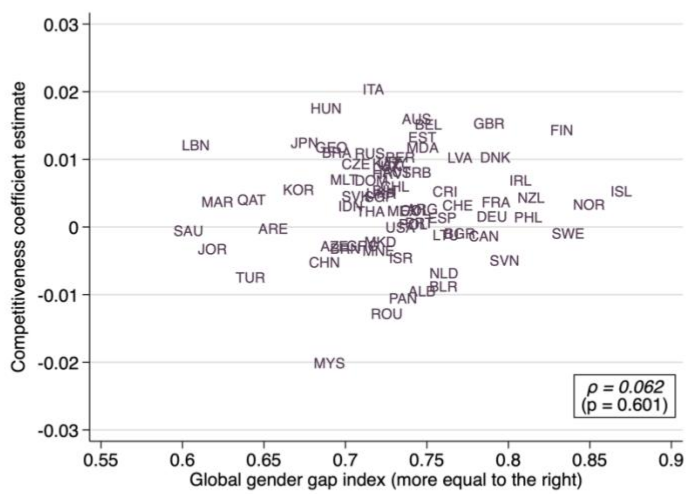
b. Both genders vs. GGGI



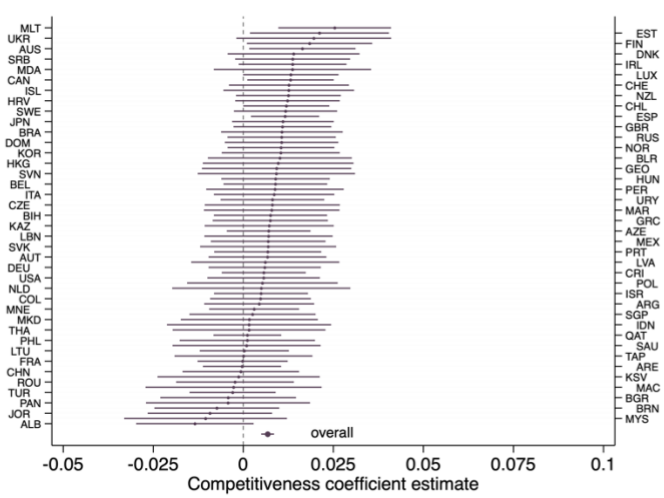
c. Boys



d. Boys vs. GGGI



e. Girls



f. Girls vs. GGGI

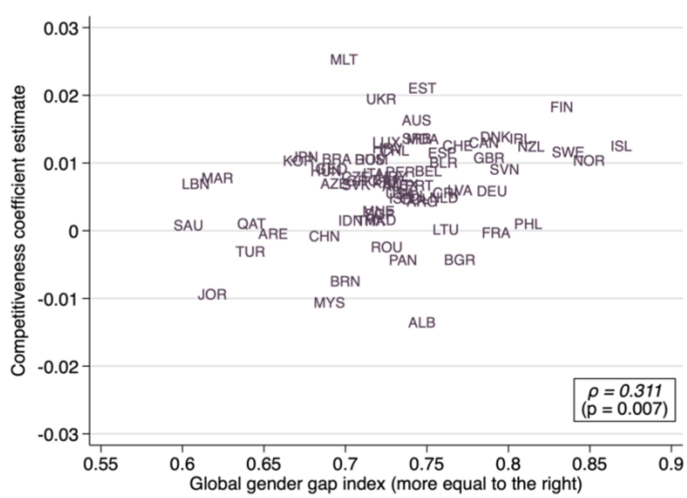
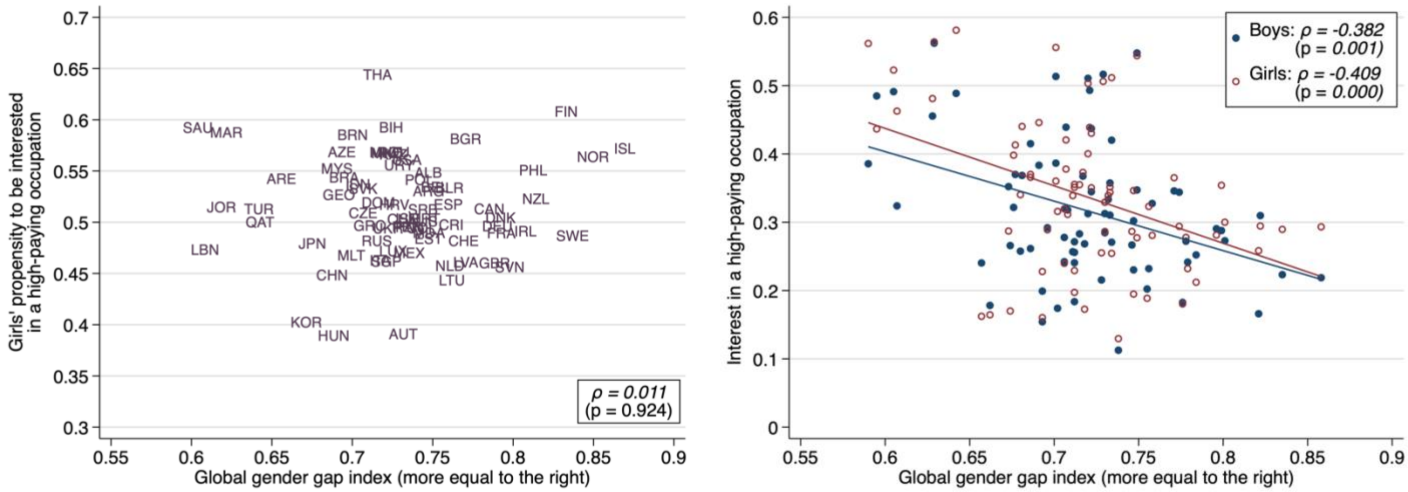


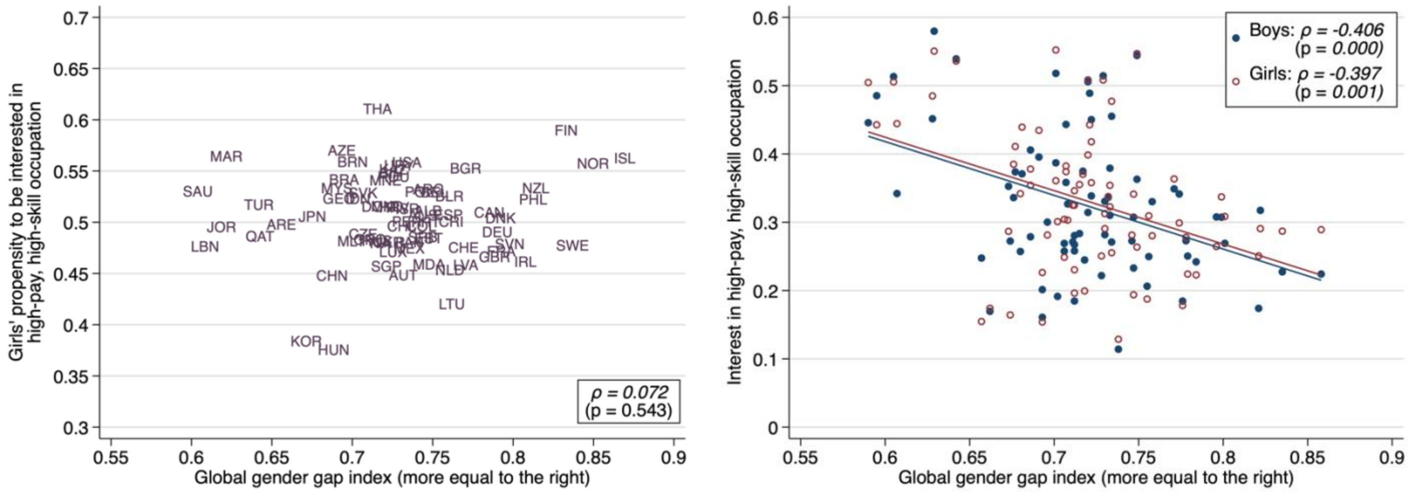
Figure S18 Effect of competitiveness on the probability that math test score is in top 10% in the school



a. Girls' propensity to be interested in a high-paying occupation **b.** Mean interest in a high-paying occupation

Figure S19 Unadjusted interest in a high-paying occupation

Notes: In panel a, girls' propensity to be interested in a high-paying occupation is computed as the ratio $a/(a+b)$, where a is the share of girls interested in a high-paying occupation and b is the share of boys interested in a high-paying occupation. Panel b plots the values for a and b.



a. Girls' propensity to be interested in a high-paying occupation **b.** Mean interest in a high-paying occupation

Figure S20 Adjusted interest in a high-paying occupation

Notes: In panel a, girls' propensity to be interested in a high-paying occupation is computed as the ratio $a/(a+b)$, where a is the share of girls interested in a high-paying occupation and b is the share of boys interested in a high-paying occupation. Panel b plots the values for a and b. In both panels, a and b are estimated from within-country regressions controlling for student's math test score, verbal test score, socioeconomic status, gender, and school fixed effects.