Gender-equality paradox in competitiveness: Evidence and explanations

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May 2024

Abstract

Recent cross-cultural work documents that for some traits and economic preferences, gender differences increase with economic development and gender equality. Two main explanations have been given in the literature for this paradoxical finding: one, that increased availability of material resources allows individuals to express more freely their gender-specific interests, and another, that gender stereotypes are amplified by culture in postmaterialist societies. In this paper we study this paradoxical phenomenon and disentangle its explanations for the trait of competitiveness. Using a sample of over 500,000 students representative of 77 countries, we show that the gender-equality paradox is the result of a cultural process that reduces the competitiveness of girls as societies become more developed and gender equal and has no effect on the competitiveness of boys.

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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 gender gaps therein (e.g., Bertrand, 2011, Niederle, 2016 for overviews). More recent work has focused on exploring cross-cultural variations in the gender gap in preferences, with some papers documenting what has come to be called the *gender-equality paradox*—namely, that more economically advanced and gender-equal countries display larger gender gaps in some traits and preferences, including occupational interests, risk taking, patience, and social preferences (Charles and Bradley, 2009; Stoet and Geary, 2018; Falk and Hermle, 2018).

In this paper we focus on the specific trait of competitiveness (Gneezy et al., 2003; Niederle and Vesterlund, 2007). Significant evidence has accumulated now that males are on average more competitive than females, and that competitiveness helps to account for education and labor market outcomes and gender gaps in those outcomes (Buser et al., 2014, 2021; Flory et al., 2015; Ålmas et al., 2016a; Buser et al., 2017; Reuben et al., 2017; Kamas and Preston, 2018; Samek, 2019). However, most of this evidence comes from western, or WEIRD (Henrich et al., 2010), samples, and little is known about the global variation in competitiveness or whether competitiveness is a relevant trait in most societies.[1] Most recently, however, two studies give evidence that a gender-equality paradox exists with respect to competitiveness. Markowsky and Beblo (2022) conduct a meta-analysis of studies of competitiveness elicited using various methods and non-representative

[1] In notable exceptions, Gneezy et al. (2009) find that men are more competitive than women among the Maasai (a patriarchal society) and that the reverse is true among the Khasi (a matrilineal and matrilocal society); Andersen et al. (2013) study kids and adolescents in a patriarchal and a matrilineal society and find a gender gap in competitiveness (favoring males) only among adolescents in the patriarchal society; and Lowes (2021) finds a stable gender gap in competitiveness (favoring males) across ethnic groups in Central Africa with varying kinship structure.

samples from 30 countries and find directionally larger gender gaps favoring males in studies ran in more gender equal countries. Napp and Breda (2022) look at the 2018 Programme for International Student Assessment (PISA 2018), an international standardized assessment of scholastic achievement of over 500,000 adolescents representative of 25 million students in 77 countries that includes a survey measure of competitiveness (OECD, 2020a). Napp and Breda (2022) document larger gender gaps favoring males in more developed and gender-equal countries.

Building on this important work, we seek to unpack and understand the reasons for this paradox. Using the PISA 2018 dataset, we start by replicating the gender-equality paradox finding. Figure 1a shows that boys are significantly more competitive than girls in 74% of countries, and significantly less competitive in 13% of countries. Consistent with the gender-equality paradox, Figure 1b shows that the gender gap in competitiveness is larger in favor of boys in more gender equal countries as measured by the UN Gender Equality Index (more details on this index below).

The literature has given two main explanations for the gender-equality paradox in preferences in general, that also apply to competitiveness.[2] One explanation argues that greater access to material and social resources enables individuals to pursue their gender-specific attitudes and desires more freely, and thus more economically developed countries and countries with higher levels of female empowerment in economic, political, and social domains will exhibit larger gender gaps in preferences (e.g., Stoet and Geary, 2018; Falk and Hermle, 2018). This explanation is referred to in the literature as the *resource hypothesis*. The second explanation argues for a role of cultural beliefs about gender differences in shaping a person's preferences. Following postmaterialist theory (Inglehart, 2018), it posits that industrialized societies place greater cultural

[2] See Balducci (2023) for an review of this literature, and Costa et al. (2001), Schmitt et al. (2008), and Mac Giolla and Kajonius (2019) for evidence of a gender-equality paradox in personality traits.

value on individual self-expression and self-realization. Since gender is generally so central to a person's identity, individuals in these societies are encouraged by culture to develop and enact gendered preferences, leading to the formation and amplification of gender stereotypes. Thus, more advanced societies will display larger gender gaps in preferences (Charles and Bradley, 2009). We refer to this hypothesis as the *gender identity hypothesis*.

It has been a challenge in the literature to assess the merits of these two explanations, as they both account for the same empirical observation. We propose to distinguish between the two explanations by examining their implications for the behavior of each gender separately, and by taking these implications to the data both across *and* within countries. In particular, we argue that whatever prediction a hypothesis makes with respect to the behavior of a given gender as a function of the relevant variable—access to resources or cultural identity—, that prediction must be the same whether the variable is (exogenously) varied within or across countries. For example, if the resource hypothesis proposes that access to resources increases the competitiveness of boys more so than that of girls, then that prediction must hold both when access to resources is varied across and within countries. Similarly, if the gender identity hypothesis proposes that cultural beliefs and values held by certain societies discourage girls in particular from being competitive, then that prediction must hold both when cultural identity is varied across and within countries.

What the resource hypothesis and the gender identity hypothesis predict for each gender separately is typically not formally described or even articulated in the literature. To help frame the discussion, in Section 2 we formalize the resource hypothesis and the gender identity hypothesis in a model of tournament entry. Individuals with heterogenous ability and intrinsic taste for competition select between performing a task under a competitive (tournament) and a noncompetitive (piece rate) payment scheme. We model the resource hypothesis by assuming gender differences in the intrinsic taste for competition, with girls having lower taste for competition than boys on average. Greater access to resources allows individuals to select into their preferred payment scheme more freely. While in the model selection into the tournament increases with resources for both boys and girls, boys' greater intrinsic taste for competition implies that their tournament entry is more sensitive to resources than that of girls is, and thus the gender-equality paradox results from boys increasing their tournament entry more pronouncedly than girls do as resources increase. On the other hand, we model the gender identity hypothesis following the identity model of Akerlof and Kranton (2000), by assuming that individuals belong to social categories—boy or girl in this case—and that deviating from the behavior that is stereotypical for one's category decreases utility. A stereotype that "girls do not compete"—which we show is consistent with the Bordalo et al.'s (2016) model of stereotype formation given the empirical data—leads girls to reduce their tournament entry relative to boys of equal ability and taste for competition. Thus, the gender-equality paradox results from girls decreasing their tournament entry in cultures that place stronger emphasis on gender identity, while boys are unaffected by cultural variation.

We describe the empirical data and the PISA 2018 framework in Section 3. In Section 4 we examine how the competitiveness of boys and girls varies across countries. Boys are equally competitive everywhere while girls are less competitive in more advanced and gender equal countries. That is, the gender-equality paradox in competitiveness is driven by variation in the girls across countries. This finding is robust to a number of checks, including using alternative measures of gender equality, decomposing gender equality into subindices of economic, social, and political female empowerment, removing single-sex schools from the sample to deal with reference-group effects (i.e., that students in these schools compare themselves to others of their own gender, driving the results for some countries), and dealing with potential gender differential selection into schooling and survey non-response. We also conduct placebo tests in which we replicate the analysis using different outcome variables for which we expect, and find, no gender-equality paradox. And we show that even though the PISA 2018 competitiveness measure is self-reported, it is akin to those recently developed and validated in the economics literature, and replicates main findings in the experimental literature, particularly that it predicts math performance and interest in high-paying occupations.

In Section 5 we test more directly that access to resources and gender identity produce the observed cross-country patterns by examining how these variables affect the competitiveness of boys and girls within countries. Within countries, greater access to resources (measured by student-level socioeconomic status) is associated with higher competitiveness for both boys and girls, with boys being generally more responsive. This gives evidence against the resource hypothesis as a mechanism driving the gender-equality paradox in competitiveness, since, rather inconsistently, increased resources is associated with a decrease in competitiveness exclusively for girls in the cross-country analysis, but with an increase in competitiveness and more strongly so for boys in the within-country analysis. On the other hand, the gender identity hypothesis is supported in the data. We vary gender identity within countries using the epidemiological approach (Fernandez, 2011), by estimating the competitiveness of second-generation immigrant students in a country of test-taking on the level of gender equality of their parents' countries of origin, conditional on student socioeconomic status. Since second-generation immigrant students in a given country of test-taking are all born and raised in the same economic and institutional environment but vary in their cultural ancestry, this approach gives causal evidence for a role of culture in shaping competitive preferences. Consistent with the cross-country results, immigrant girls whose parents were born in more gender-equal countries are less competitive, while immigrant boys are not affected by the level of gender equality in their parents' countries of origin. Thus, culture influences competitiveness precisely in the direction that explains the gender-equality paradox and that is in line with the gender identity hypothesis. We close the paper by discussing implications of our results for policy and future work.

2 Model

We formalize the resource hypothesis and the gender identity hypothesis in a model of tournament entry and show how they both predict a gender-equality paradox in competitiveness. We start with a basic setup in which individuals with heterogenous ability and taste for competition choose between performing a task under a piece rate and a tournament payment scheme. We introduce the resource hypothesis into the basic setup by assuming that individuals are drawn from a population of either boys or girls, where girls have lower taste for competition on average. Girls are thus less likely to enter the tournament than boys of equal ability. Greater access to resources allows individuals to express their taste for competition more freely, and thus groups with greater resources display larger gender gaps in tournament entry. On the other hand, we introduce gender identity into the basic setup following the identity model of Akerlof and Kranton (2000), by assuming that individuals belong to social categories—boy or girl in this case—and that deviating from the behavior that is stereotypical for one's category decreases utility. A stereotype that "girls do not compete" leads girls to reduce their tournament entry relative to boys of equal ability and taste for competition. Cultures that place stronger emphasis on gender identity for decision making exhibit larger gender gaps in tournament entry.

2.1 Basic setup

Consider an individual i who performs a task for pay. The individual has ability a_i, which is private information and is randomly drawn from a distribution with density $f(a)$ with support over positive values only. Performance on the task increases with ability. For simplicity, ability maps to performance linearly without noise at the rate of 1, so that performance is simply a_i.

Individual i must select one of the following two compensation schemes:

Piece rate: Individual i receives y per unit of her output, normalized to $y = 1$. The monetary utility to i under this payment scheme is therefore a_i.

Tournament: Individual i competes with another individual j whose ability is also randomly drawn from the same distribution $f(a)$. If i outperforms j, which occurs with probability $F(a_i)$, then individual i receives r per unit of her output, where $r > 1$. If i fails to outperform j, which occurs with probability $1 - F(a_i)$, then individual i receives no payment. To eliminate social preferences concerns, individual j's payment is independent of the tournament outcome. The monetary utility to i under this payment scheme is therefore $ra_iF(a_i)$.

Under the setup so far, a risk-neutral individual who cares only about her monetary utility enters the tournament if $ra_iF(a_i) > a_i$. That is, she enters the tournament if her expected payoff in the tournament is larger than her guaranteed payoff in the piece rate. In addition, allow now for individual i to have intrinsic preferences for competition, by letting b_i be individual i's taste for competition, which is private to i and unobservable to the analyst, and is randomly drawn from a distribution with density $g(b)$, where g is independent of f and has support possibly over both positive and negative values. Individual i derives direct utility from competing equal to γb_i, where

$\gamma > 0$ captures how much she cares about competing per se relative to how much she cares about money.[3] Therefore, individual i's utility from participating in the tournament is

$$r a_i F(a_i) + \gamma b_i \tag{1}$$

Given these preferences, individual i chooses her payment scheme by solving

$$\max_{d \in \{0,1\}} \{(1-d) a_i + d[r a_i F(a_i) + \gamma b_i]\} \tag{2}$$

where $d = 0$ and $d = 1$ indicate selection into the piece rate and the tournament, respectively. d is a measure of i's competitiveness observable to the analyst.

Individual i selects into the tournament if $r a_i F(a_i) + \gamma b_i > a_i$. Intuitively, for any given level of ability a_i, the individual is more likely to enter the tournament the greater her taste for competition b_i is.

2.2 Resource hypothesis

We now capture the resource hypothesis in the model. While there is no single formulation of the resource hypothesis in the literature, we take as reference the one in Falk and Hermle (2018):

> "[...] g*reater availability of material and social resources removes the gender-neutral goal of subsistence, which creates the scope for gender-specific ambitions and desires. In addition, more gender-equal access to those resources may allow women and men to express preferences independently from each other. As a consequence, one would expect gender differences in preferences to be positively associated with higher levels of economic development and gender equality (resource hypothesis)."*

[3] Here we focus only on a preference for competition and ignore the possibility that competition affects performance (as documented e.g. by Gneezy et al., 2003).

There are two elements to this hypothesis as applied to competitiveness. One is the existence of gender differences in the taste for competition. The other is that the expression of these differences is enabled by increased access to resources, as individuals with more resources can devote themselves to pursuits other than subsistence. We capture these elements by modifying the basic setup as follows. Recall that individual i obtains utility a_i from the piece-rate scheme and $ra_iF(a_i) + \gamma b_i$ from the tournament scheme, where b_i is the taste for competition and γ is how much she cares about competing per se relative to how much she cares about money. The first element of the resource hypothesis can be captured by assuming that the population individual i comes from consists of boys (B) and girls (G), and that b_i is randomly drawn from a distribution with density $g_B(b)$ with mean $\bar{b}_B$ if the individual is a boy and $g_G(b)$ with mean $\bar{b}_G$ if the individual is a girl, where $\bar{b}_B > \bar{b}_G$. That is, boys have on average a greater taste for competition. The second element can be captured by reinterpreting γ as a constraint parameter: γ is the degree to which the individual can devote herself to the pursuit of her taste for competition rather than to the pursuit of money only (i.e., subsistence). A greater γ indicates greater access to resources, and thus greater freedom from the pursuit of subsistence.

In our model, individuals express their taste for competition via their compensation choice. The resource hypothesis posits that gender differences in tournament entry are magnified for individuals with greater γ. This is indeed what our model predicts. Individual i enters the tournament if $ra_iF(a_i) + \gamma b_i > a_i$. As γ goes to zero, gender differences in tournament entry disappear, since there are no gender differences in ability. As γ increases, tournament entry increases for boys and girls, but it does so more pronouncedly for boys on average, and thus the average gender gap in tournament entry widens.

An obvious question regarding the resource hypothesis is what gives rise to the gender difference in the taste for competition. The model is agnostic about this point. Some proponents of the resource hypothesis argue that trait differences are at least partly innate, while others allow for the possibility of socialization. For instance, Falk and Hermle (2018) write: "One may be agnostic about the ultimate determinants of gender-specific preferences. They may be acquired through cross-culturally universal gender roles, or they may be due to biological and evolutionary differences between women and men."

2.3 Gender identity hypothesis

Charles and Bradley (2009) document greater sex segregation in field of study in more developed countries. In explaining their finding, Charles and Bradley (2009) write:

> "*The segregative effect of gender-essentialist beliefs is intensified [...] by a strong Western cultural emphasis on individual self-expression and self-realization that [...] is today most clearly evident in affluent late-modern societies. [...] Because gender remains so central an axis of human identity, we argue that self-expressive value systems tend to encourage the development and enactment of culturally masculine or feminine affinities. Girls may, for example, be more likely to express an aversion to mathematics and avoid related programs where self-expression is a legitimate, and even normative, criterion for curricular choice.*"

To model how gender identity influences tournament entry, we add gender identity to the basic setup of Section 2.1 following Akerlof and Kranton's (2000) identity model. Recall that the basic setup assumes no gender differences in ability a_i or taste for competition b_i. Let individual i's identity be $I_i \in \{B, G\}$; i.e., either boy or girl. The individual cannot choose her identity; rather, it is exogenously assigned. The individual belongs to a culture that may hold stereotypes regarding the behavior of boys and girls. Deviating from the behavior that is stereotypical for one's gender causes the individual to suffer a loss in identity utility.

Individual i's monetary-plus-identity utility U_i is

$$U_i = u_i + p \cdot v_i \tag{3}$$

where u_i is monetary utility, v_i is identity utility, and $p > 0$ is the weight placed on identity relative to the weight placed on money. As in Akerlof and Kranton (2000), we assume p is culture specific and captures the extent to which members of the culture are concerned with their gender identity when making economic choices. For instance, a culture that values self-realization and self-expression and endorses a gender essentialist ideology is a culture with a relatively large p.

We consider a stereotype according to which "girls do not compete".[4] Violating this stereotype—i.e., competing—leads girls to experience identity disutility. Accordingly, girls, but not boys, incur in a loss in identity utility equal to c if they enter the tournament. Individual i's total utility from participating in the tournament is thus

$$ra_iF(a_i) + \gamma b_i + p \cdot I_{I_i=G}\{-c\} \tag{4}$$

Given these preferences, the individual chooses her payment scheme by solving

$$\max_{d \in \{0,1\}} \left\{(1-d)a_i + d\left[ra_iF(a_i) + \gamma b_i + p \cdot I_{I_i=G}\{-c\}\right]\right\} \tag{5}$$

The individual selects into the tournament if

$$\begin{aligned} ra_iF(a_i) + \gamma b_i \quad\quad &> a_i \quad \text{for boys} \\ ra_iF(a_i) + \gamma b_i - pc &> a_i \quad \text{for girls} \end{aligned} \tag{6}$$

[4] In Section 5 we show that the emergence of this stereotype is consistent with the data if individuals overweight a group's most representative type, as in Bordalo et al.'s (2016) model. To preview, just as in Bordalo et al.'s model (2016) the stereotype "women are bad at math" can arise from men being overrepresented at the top of the math ability distribution, we find that boys are overrepresented at the highest level of competitiveness in most countries (Figure 8).

For any given level of ability a_i and taste for competition b_i, girls are less likely to enter the tournament than boys in cultures that hold the stereotypical view that girls do not compete. The gender gap in tournament entry widens across cultures as p increases, since girls reduce their tournament entry while boys are not affected by changes in p.

As with the resource hypothesis, one question that naturally arises regarding the gender identity hypothesis is what gives rise to the stereotype that girls are not competitive. The model is agnostic about this question. While it does not assume intrinsic gender differences in the taste for competition, it does not rule them out either. Stereotypes may or may not be accurate and can be self-sustaining once they emerge. We also note that while we treat the taste for competition as exogenous and assume girls suffer identity disutility only from entering the tournament, it is also possible to treat the taste for competition itself as endogenous to the stereotype, which would correspond to a situation in which girls internalize the stereotype and suffer identity disutility from *being* competitive even without acting out on it.

3 Empirical data

3.1 PISA 2018 background and sampling design

The Programme for International Student Assessment (PISA) is 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). The assessment was launched in 2000 and is conducted every three years. In each wave, participating countries include all the OECD members at the time of the assessment plus a set of non-OECD countries that has varied over time.[5]

We use student-level data from the PISA 2018 wave. A total of 79 countries participated in this wave, 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. To obtain this sample, each country used a two-stage sampling procedure whereby a representative sample of at least 150 schools was first selected and then roughly 42 students of the target age were randomly selected from each school to participate in the assessment (OECD, 2020a). Participating students were given approximately two hours to solve questions on mathematics, reading, and/or science, and then spent approximately 30 minutes completing a background questionnaire on their socioeconomic status, personality traits, and various preferences and attitudes and other information. A total of more than 600,000 students participated in PISA 2018, representing approximately 30 million students (OECD, 2020a). Figure 2 shows the coverage of PISA 2018 across the globe, and Table S1 in the Appendix lists all participating countries. PISA presents data separately for Moscow, Tatarstan, and the Russian Federation; we combine these into a single country (Russia, RUS), thus our effective sample consists of 77 countries.[6]

3.2 Population estimates and standard errors

[5] PISA refers to participating territories as "countries or regions" to acknowledge disputes over the sovereignty of certain territories. We refer to all territories as countries for simplicity.
[6] In addition to the countries listed in Table S1, Vietnam participated in PISA 2018. However, we drop Vietnam from the sample because the OECD reports that it "cannot currently assure full international comparability of the results" for Vietnam due to data quality issues (OECD, 2019).

Our results throughout the paper are unbiased estimates of country population parameters or global parameters with standard errors that account for PISA's complex survey design, unless noted otherwise. To obtain these estimates, we follow the PISA methodological recommendations.[7] We estimate parameters weighting observations by the sampling weights provided by PISA for each student (denoted by PISA as *final student weights*), which rescale the sample to the size of the student population in each country. This implies that whenever we present global estimates, the contribution of each country depends on its student population size. We estimate standard errors using the 80 balance repeated replicate (BRR) weights provided by PISA with Fay correction coefficient equal to 0.5. Similarly, in the part of the analysis that uses PISA test scores, we compute estimates by replicating the analysis 10 times, one for each plausible value of test scores provided by PISA, and average the results to obtain the final estimate. This averaging is required because in PISA students sit in only a subset of the material assessed, and thus test 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 then assigns ten plausible values for each student's test score in each domain.

3.3 Competitiveness measure

PISA 2018 included in the background questionnaire three items that measure the student's preferences for competition by eliciting his or her agreement from 1 to 4 ("strongly disagree", "disagree", "agree", or "strongly agree") with each of the following statements:

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[7] For the PISA methodological recommendations, see OECD's *How to prepare and analyse the PISA database* (https://www.oecd.org/pisa/data/httpoecdorgpisadatabase-instr uctions.htm).

Item 1: *I enjoy working in situations involving competition with others*.

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

Item 3: *I try harder when I'm in competition with other people*.[8]

PISA computes 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. We also conduct robustness tests using the raw answers to each of the three items, with very similar results.

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, however, show 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).[9] 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 Section 4, we show that the PISA 2018 competitiveness measure predicts math performance and occupational interests, in line with the literature.

3.4 Student-level socioeconomic status

[8] While Item 1 evokes a preference for entering a competition (see Niederle and Vesterlund, 2007), Item 3 is closer to capturing the intensive margin of performance in a competition (see Gneezy et al., 2003).

[9] Survey measures of competitiveness in the economics literature 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?*".

Another variable in our analysis that comes from the PISA background questionnaire is the student's socioeconomic status (SES). PISA constructs a student-level SES index that is intended to be comparable across countries and "measure the student's access to family resources (financial capital, social capital, cultural capital, and human capital) which determine the social position of the student's family and household" (Avvisati, 2020). PISA computes the SES index as the equal-weighted average of the student's parental educational attainment, parental occupational status, and household possessions (OECD, 2020b). Parental educational attainment is measured as the highest value for either parent of the estimated years of schooling. Parental occupational status is measured as the highest value for either parent of the occupational status score based on the International Socio-Economic Index scale (Ganzenboom, 2010). Household possessions is measured as a summary index based on the availability at home of items such as cars, rooms with a bath or shower, books, various consumer electronics, and country-specific items seen as appropriate measures of family wealth. PISA then transforms the final SES measure to have mean of zero and standard deviation of one in the OECD student population. We use this standardized index as our measure of student SES.

3.5 Gender equality index

Part of our analysis examines the relationship between competitiveness and the level of gender equality in the country. Gender equality refers to the relative position of men and women in their society in terms of education, health, politics, and the economy (Duflo, 2012; Blau and Winkler, 2022). A useful and common way in the literature to summarize the multidimensional landscape of gender equality is to aggregate the different dimensions into a single index. We follow this approach and measure gender equality across countries with the UN Gender Inequality Index, constructed by the United Nations Development Program and intended to capture the loss in human development due to inequality between female and male outcomes in education, health, politics, and the labor market (UNDP, 2022). The UN Gender Inequality Index aggregates the following country-level indicators:[10]

Maternal mortality ratio: data from World Health Organization, UNICEF, UNFPA, World Bank, and UN Population Division.

Adolescent birth rate: data from UNDESA.

Share of parliamentary seats held by each sex: data from Inter-Parliamentary Union.

Share of males and females with at least some secondary education: data from UNESCO Institute for Statistics, and Barro and Lee Dataset for Educational Attainment.

Labor force participation rate of each sex: data from International Labour Organization.

The UN Gender Inequality Index ranges from 0 to 1, where smaller values indicate greater gender equality. We use values of the index for the year 2018, reverse-coded, so that larger values indicate greater gender equality. We refer to this reversed index as the UN Gender Equality Index (GEI). For a similar, recent use of this index, see Bursztyn et al. (2024). In our PISA sample, the GEI ranges from 0.547 for Indonesia to 0.982 for Norway. The median is 0.845. Figure 3 shows the GEI values for the PISA sample, excluding Kosovo (KSV), Macao (MAC), and Taipei (TAP), for which GEI data are missing. Countries in Latin America and Muslim-majority countries rank among the least gender equal in the sample, while Nordic countries rank among the most gender equal.

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[10] For details on the aggregation method, see (https://hdr.undp.org/sites/default/files/2021-22_HDR/hdr2021-22_technical_notes.pdf).

3.6 Other country-level variables

In addition to the GEI and its subindices, we use the following country-level variables in the analysis:

Male-Female Ratio in Secondary School Enrollment: computed from World Bank data of secondary school enrollment (% gross) in 2018 at https://data.worldbank.org/indicator/SE.SEC.ENRR

Hofstede's (2001) Individualism Index: data from https://geerthofstede.com/research-and-vsm/dimension-data-matrix/

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

4 Evidence for the gender-equality paradox

We begin the analysis by replicating the gender-equality paradox in competitiveness; namely, that the gender gap in competitiveness is larger in more gender equal countries. To do so, we estimate

$$Compete_{ic} = \beta_c Male_i + \epsilon_{ic} \tag{7}$$

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.

Figure 1a plots the $\hat{\beta}_c$ estimate from equation (7) for each country as well as the global mean gender gap in competitiveness estimated from a regression pooling all students in the sample. The gender gap in competitiveness is positive and significant at p<0.05 in 57 countries (74% of countries), negative and significant at $p<0.05$ in 10 countries (13% of countries), and non-significant in 10 countries. The global mean gender gap in competitiveness is 0.157 SD ($p<0.001$, Table 1). This result is consistent with robust evidence that women tend to be less competitive than men. Figure 4 shows in the world map the mean gender gap in competitiveness for each country in the sample.

Figure 1b plots the $\hat{\beta}_c$ estimate from equation (7) for each country against the country's GEI. Consistent with the gender-equality paradox, more gender-equal countries exhibit larger gender gaps in competitiveness. The linear correlation between the gender gap in competitiveness and the GGGI is 0.546 ($p<0.001$). We formalize this relation with a country-level regression of the mean gender gap in competitiveness in the country against the country's GEI. The estimated coefficient is 0.692 ($p<0.001$, Table 2 column 1), indicating that more gender-equal countries exhibit larger gender gaps in competitiveness.

4.1 The competitiveness of boys and girls across countries

To begin exploring mechanisms underlying the gender-equality paradox in competitiveness, we examine whether the gender-equality paradox finding is driven by variation across countries in the boys' or girls' competitiveness, or both. Figure 5a 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 S2). While for boys the cross-country correlation between the mean competitiveness and the gender gap in competitiveness is -0.175 ($p=0.129$), for girls the correlation is -0.745 ($p<0.001$). We see similar results for each competitiveness item separately (Table S2), indicating that the cross-country heterogeneity in the gender gap in competitiveness is driven by variation in the competitiveness of girls.

Figure 5b plots the mean competitiveness of boys and girls in the country against the country's GEI. While for boys the linear correlation between competitiveness and GEI is weak and insignificant (-0.128, $p=0.281$), for girls it is larger and highly significant (-0.429, $p<0.001$). We formalize these relations with a country-level regression of the mean competitiveness on the GEI, estimated separately for boys and girls (Table 2 columns 2-3). The estimated GEI coefficient is -0.176 ($p=0.281$) for boys and -0.868 ($p<0.001$) for girls, and the difference between the two is significant, as indicated by the interaction term coefficient of -0.692 ($p=0.012$) in Table 2 column 4. Thus, the gender-equality paradox in competitiveness is driven by a decline in the competitiveness of girls with gender equality and a lack of response by boys to gender equality.

4.2 Robustness and sensitivity

4.2.1 Robustness of the gender-equality paradox

The results above are robust to measuring gender equality with the World Economic Forum's Global Gender Gap Index (WEF, 2022) (Figure S1), an alternative index of gender equality commonly used in the literature (e.g., Guiso et al., 2008; Stoet and Geary, 2018), and to measuring competitiveness with each raw item separately (Figure S2). The results are also robust to excluding from the sample students from single-sex schools or excluding countries with more than 20% of their students in single-sex schools; i.e., United Arab Emirates, Ireland, Israel, Jordan, Korea, Macao, Malta, New Zealand, Qatar, and Saudi Arabia (Table S3, Figure S3). This alleviates concerns that students compare themselves to their classmates when reporting their competitiveness and thus differential shares of single-sex schooling across countries drive the cross-country differences in the gender gap in competitiveness.

The results are unlikely to be an artifact of 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, ranging from 0.88 to 1.09, Table S4). Moreover, the results hold separately for students below and above the median SES in their country (Figure S4), the latter group being particularly noteworthy because relatively wealthy students are less prone to gender differentials in selection into schooling. The results are also unlikely to be an artifact of 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). But the rate of nonresponse for competitiveness items does not vary systematically across countries (Figure S5). It is also unlikely that the reason girls' competitiveness varies more than boys' across countries is that girls answer questions more randomly than boys do. In fact, in all countries without exception, boys' competitiveness is more variable than girls' *within* country (Figure S6).

Additionally, we run placebo tests in which we replicate our analysis using different outcome variables that also come from the background questionnaire but for which we have no reason to expect a gender-equality paradox. These placebo tests intend to rule out that boys and girls answer questions in general in a way that produces the patterns we observe for competitiveness (perhaps due to inattention). The first placebo variable is month of birth, which we recode as the four quarters of the year to bring it to a 1-4 range as in the competitiveness items. Table S5 shows that there is no gender gap in quarter of birth and no relation between the gender gap in quarter of birth and GEI (there is a negative relation between quarter of year and GEI for boys, but this relation is not statistically different than that of girls). The second placebo variable is the student's agreement from 1 to 4 ("strongly disagree", "disagree", "agree", or "strongly agree") with the statement "*Thinking of the past two language lessons, I felt that my teacher understood me"*, which is arguably less likely to be influenced by a student's traits or preferences than the competitiveness items might be. Agreement with this statement is negatively correlated with GEI for both boys and girls, but there is no difference in this relation across gender, and thus no relation between the gender gap and GEI (Table S6).

4.2.2 Decomposing gender equality

While convenient, the use of a single index to summarize gender equality has its limitations, one of which is that an index aggregates many dimensions which may not all rise and fall together. Here, we examine the association between the gender gap in competitiveness and each GEI component separately, to explore whether the cross-country results are driven by one dimension in particular (health, education, politics, or the labor market). Moreover, research shows that economic development and gender equality are generally, but not always, positively associated, and the two are likely causally intertwined (Duflo, 2012; Jayachandran, 2015; Doepke and Tertilt, 2019). Thus, we also examine how the gender gap in competitiveness varies with economic development, proxied by the log GDP per capita (from 2018 World Bank data), and with each dimension of gender equality residualized of the log GDP per capita.

Table S7 summarizes the distribution of each GEI component for our sample of countries. There is substantial heterogeneity in each component, but the indicators of women's reproductive health (maternal mortality and adolescent fertility) are particularly compressed at the top of the distribution, as many countries perform well on these indicators, which implies that we may be less able to detect how the gender gap in competitiveness varies with these two indicators.

Table 3 panel A shows how the country-level gender gap in competitiveness and the competitiveness of boys and girls vary with each GEI component—maternal mortality (reverse coded), adolescent fertility (reverse coded), the female-male ratio in secondary schooling, the share of parliamentary seats held by women, and the female-male ratio in labor force participation. The gender gap in competitiveness widens significantly with improved women's status across all indicators. This is largely driven by girls, whose competitiveness declines significantly with every indicator (except only directionally so with adolescent fertility, p=0.167), while the competitiveness of boys either does not change or declines less pronouncedly than girls'.

One interpretation of these results is that the relative status of women in health, education, politics, and the labor market all contribute their part toward the reduction in girls' competitiveness. Another possibility is that an omitted variable, e.g., economic development, drives the results. Table 3 panel B shows that indeed the gender gap in competitiveness widens significantly with GDP per capita, again because the competitiveness of girls declines while that of boys does not vary (see also Figure S7). If we residualize each GEI subindex of the log GDP per capita, the gender gap in competitiveness no longer varies significantly with the health and education indicators, and continues to widen significantly with the politics and labor market indicators.

Thus, the gender gap competitiveness widens with economic development in the country. After accounting for this relation, gender equality, particularly in politics and the labor market, is also associated with larger gender gaps in competitiveness. These results are largely driven by a decline in girls' competitiveness with these variables.

4.2.3 Relevance to math performance and occupational choice

Previous work shows that competitiveness predicts education and labor market outcomes and gender gaps therein (Buser et al., 2014, 2021; Flory et al., 2015; Ålmas et al., 2016a; Buser et al., 2017; Reuben et al., 2017; Kamas and Preston, 2018; Samek, 2019). The outcomes this literature pays particular attention to are 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). We find that competitiveness predicts these outcomes also in our data: Competitiveness predicts math test scores conditional on verbal test scores and socioeconomic status, positively and significantly so at $p<0.1$ in 79% of countries, while negatively and significantly so in only 3% of countries (Figure S8a). Globally, a 1SD increase in the student's competitiveness is associated with a 0.04SD increase in the student's math test scores conditional on covariates.[11] Competitiveness also predicts interest in high-paying occupations conditional on the same covariates *in addition to* conditioning on math test scores, positively and significantly so at $p<0.1$ in 82% of countries (Figure S8b).[12] Globally, a 1SD increase in the student's competitiveness is associated with an increase by 10.7% in the likelihood that the student is interested in a high-paying occupation relative to the mean interest in high-paying occupations globally, conditional on covariates.

[11] 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).

[12] Occupational interest is derived from 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. We classify as high-paying occupations a subset of managerial and professional occupations shown in Table S8. These results are similar if we change the outcome variable to the occupational status of the student's occupation of interest, as measured by the international socioeconomic index of occupational status (ISEI) (Ganzeboom, 2010) (Figure S9). Note that while the students' occupational interests reported in the survey may differ from their later actual career choices, previous work finds that occupational interests in early high school years strongly predict subsequent college field of study (Morgan et al., 2013; Cimpian et al., 2020).

5 Analysis of mechanisms

5.1 Resource hypothesis

If access to resources drives the gender-equality paradox in competitiveness, it does so by decreasing the competitiveness of girls while having little or no effect on the competitiveness of boys, based on the cross-country finings documented in the previous section. We now test for these relationships directly by examining how the competitiveness of boys and girls vary within countries as a function of student SES. Since the SES variable in the PISA data is specifically intended to measure the student's access to material and social resources, and the within country analysis controls for cross-country cultural heterogeneity, the within-country analysis provides a cleaner test of the relation between access to resources and competitiveness than the cross-country analysis does.[13]

We regress the student's competitiveness on the student's SES separately for each country and gender. That is, we estimate

$$Compete_{icg} = \beta_{cg} SES_i + \epsilon_{icg} \tag{8}$$

separately for each country c and gender g (boys or girls) using OLS. Figure 6 plots the $\hat{\beta}_{cg}$ estimate from equation (8) for each country and gender, as well as the global estimate obtained from a regression pooling all students in the sample. In most countries, competitiveness increases with SES for both boys and girls. For boys, $\hat{\beta}_{cg}$ is positive and significant at $p<0.1$ in 95% of countries and nonsignificant in 5% of countries, while for girls $\hat{\beta}_{cg}$ is positive and significant at

[13] Recall that SES is constructed by PISA to "measure the student's access to family resources (financial capital, social capital, cultural capital, and human capital) which determine the social position of the student's family and household" (Avvisati, 2020).

$p<0.1$ in 82% of countries and nonsignificant in 18% of countries. The coefficient is significantly larger for boys than for girls at $p<0.1$ in 32% of countries, and significantly larger at $p<0.1$ for girls than for boys in 3% of countries (Figure S10).

The global coefficient estimate of the effect of SES on competitiveness is 0.083 ($p<0.001$) for boys and 0.021 ($p<0.001$) for girls (Table 4 columns 1-2). The difference between the two coefficients is highly significant, as indicated by a highly significant interaction term of -0.062 ($p<0.001$) in a global regression of the student competitiveness on a female indicator, the student SES, and the interaction of the two (Table 4 column 3). Thus, globally, the competitiveness of boys is more responsive than that of girls to socioeconomic resources. This is illustrated in Figure 7a, which plots the competitiveness of boys and girls as a function of SES estimated from the global regression in Table 4 column 3. Boys' greater sensitivity to SES implies that most countries exhibit larger gender gaps in competitiveness (in favor of boys) among higher-SES students than lower-SES students, regardless of the overall size of the gender gap in competitiveness in the country. To show this, Figure 7b plots for each country the gender gap in competitiveness among students below the median SES of their country on the x-axis versus the gender gap in competitiveness among students above the median SES of their country on the y-axis. 75% of countries are above the diagonal, indicating that their gender gap in competitiveness is larger for above-median SES students. The gender gap in competitiveness is significantly larger for above-median SES students in 29% of countries.

These results give evidence against the resource hypothesis as the explanation for the gender-equality paradox. The robust evidence within most counties indicates that access to resources is associated with an increase in the competitiveness of both boys and girls, with boys being generally more responsive. It is difficult to see then how greater access to resources would lead to a decrease in competitiveness of girls and no change in the competitiveness of boys across countries to produce the gender-equality paradox.

In closing, we note that the results in this section contribute to a nascent literature on the relationship between SES and competitiveness, by documenting this relationship in representative samples of a large set of countries. Ålmas et al. (2016b) study competitiveness (measured experimentally) in a representative sample of adolescents in Norway and find that high-SES adolescents are more competitive than low-SES adolescents and that the gender gap in competitiveness is larger among the high-SES group. We replicate these findings in our Norway sample using Ålmas et al.'s high- and low-SES classification (Figure S11a). More recently, Boneva et al. (2021) study competitiveness (measured in a survey) in a selected sample of children from Bonn and Cologne and find that high-SES girls are more competitive than low-SES girls, while boys' competitiveness is unchanged across SES levels, leading to a larger gender gap in competitiveness among low-SES children. In our Germany sample we replicate the finding regarding girls, but not those regarding boys or the gender gap in general. We find that high-SES boys are more competitive than low-SES boys and that the gender gap in competitiveness is larger among high-SES students (Figure S11b). We can only speculate as to why our results differ from those of Boneva et al. (2021), but one possibility is sample differences, as our sample is representative of 15-year-old students in all of Germany.

5.2 Gender identity hypothesis

If cultural beliefs and values regarding gender identity drive the gender-equality paradox in competitiveness, they do so by reducing the competitiveness of girls while having little or no effect on the competitiveness of boys, based on the cross-country findings documented in Section 4. The results in this section find support for this mechanism and the gender identity hypothesis.

The gender identity hypothesis posits that the gender gap in competitiveness will be larger in societies that place greater cultural value on individual self-expression and self-realization. We confirm this pattern in the data. We measure a society's cultural value on individual self-expression and self-realization using Hofstede's individualism index (Hofstede, 2001), a common measure of individualism in cross-cultural work. Figure S12 shows that countries that score higher on the individualism index have larger gender gaps in competitiveness (ρ=0.463, p<0.001), due to a decrease in the competitiveness of girls with the individualism index (ρ=-0.337, p=0.010) and a lack of response in the competitiveness of boys to the individualism index (ρ=-0.062, p=0.647).

Next, we examine how competitiveness responds to variation in cultural identity within countries, and find causal evidence that culture influences competitiveness precisely in the direction predicted by the gender identity hypothesis and observed across countries in Section 4 for boys and girls to produce the gender-equality paradox.[14] Following the epidemiological approach (Fernandez, 2011), we examine whether the competitiveness of second-generation immigrant students in a given country of test-taking is predicted by the level of gender equality of their parents' countries of origin.[15] Such a relation would give causal evidence of a process of cultural transmission shaping these students' competitiveness, since second-generation immigrants do not inherit the institutions or economic environment of their parents' country of origin but can

[14] 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).
[15] Second-generation immigrants are students born in the country of test-taking and whose parents were both born elsewhere. For a given country of test-taking, these students are an apt sample to study the role of culture, since they are born into a similar economic and institutional environment but differ in their cultural ancestry.

certainly inherit its customary beliefs and attitudes, for example through socialization within the family. 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).[16]

Accordingly, we estimate

$$Compete_{icfm} = \beta\overline{GEI}_{fm} + \boldsymbol{\gamma}'\boldsymbol{X}_i + \theta_c + \epsilon_{icfm} \quad (9)$$

using OLS. $Compete_{icfm}$ is the level of competitiveness of second-generation immigrant student i in the country of test-taking c and whose father and mother were born in countries $f \neq c$ and $m \neq c$ respectively, $\overline{GEI}_{fm}$ is the average GEI of the father's and the mother's countries of birth, and $\boldsymbol{X}_i$ is a vector of student i's characteristics which in this case consists only of the student's SES, which intends to control for differences in socioeconomic position across students that might affect their competitiveness for reasons unrelated to cultural ancestry. We include country of test-taking fixed effects θ_c so that we only compare second-generation immigrant students within a country of test-taking. Then, the coefficient β captures the effect of the average gender equality of the parents' countries of origin on the student's competitiveness. We estimate equation (9) for the sample, rather than population estimates, separately for boys and girls. There are 5729 boys and

[16] Relatedly, Farre and Vella (2013), Morrill and Morrill (2013), and Olivetti et al. (2020) find a correlation between mothers' gender attitudes and labor market participation and their daughters' 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; i.e., the opposite of a gender-equality paradox.

5797 girls in the sample, whose parents come from 95 different countries with nonmissing GEI. Of these students, 76% have parents who both come from the same country. Among students whose parents come from different countries, the correlation between the GEI of parents' countries of origin is 0.499 (p<0.0001).

Table 5 presents the results. The competitiveness of second-generation immigrant boys is unrelated to their parents' GEI ($\hat{\beta} = -0.075, p = 0.614$, column 1), while the competitiveness of second-generation immigrant girls is highly negatively correlated with their parents' GEI ($\hat{\beta} = -0.308, p = 0.017$, column 2). That is, second-generation immigrant girls whose parents were born in more gender-equal countries are less competitive. In column 3, we pool observations from boys and girls and add to equation (9) an indicator that the student is a girl and its interaction with $\overline{GEI}_{fm}$, and find that the difference in the effects between boys and girls is highly significant ($\hat{\beta} = -0.350, p = 0.004$). These results are robust to looking at the GEI of the country of origin of each parent separately (Table S9).

Thus, in line with the results in Section 4, gender equality in one's culture of ancestry has no effect on the competitiveness of immigrant boys and a negative effect on the competitiveness of immigrant girls. Notably, unlike the cross-country analysis in Section 4, the analysis of immigrants relies entirely on student variation within country of test-taking, for which we already saw in Sections 4.3 and 5.1 that the competitiveness of boys is more variable and generally more sensitive to SES than the competitiveness of girls, and that SES has a positive effect on competitiveness. Given this, it is telling that we estimate no effect of parental GEI on the competitiveness of boys and a negative effect on the competitiveness of girls. This strongly suggests that these estimates are not driven by economic confounds.[17] Rather, they indicate that culture influences competitiveness in the direction that matches the gender-equality paradox and that is in line with the gender identity explanation.

Finally, we give evidence of the plausibility that a stereotype "girls are not competitive" emerges given the data. In Bordalo et al.'s (2016) model, stereotypes arise from individuals overweighting representative types when assessing groups, where a type is representative of a group if it is relatively more frequent in that group than in the comparison group. For example, Bordalo et al. (2016) argue that the overrepresentation of men at the highest level of math ability can lead to beliefs that "women are bad at math". Figure 8a plots the distribution of competitiveness for boys and girls across all countries, constructed by first standardizing competitiveness within each country pooling both genders and then averaging the share of boys and girls separately in each bin, giving countries equal weight. Boys are overrepresented in the highest bin (competitiveness greater than or equal to 1 SD), with a boy-girl ratio of 1.4. Figure 8b plots the boy-girl ratio in this bin for each country separately. Boys are overrepresented in this bin in 90% of countries, and this bin has the most uneven gender ratio relative to other bins in 44% of countries. Thus, it is plausible that a representativeness-based mechanism gives rise to stereotypes against girls competing given the data.

6 Discussion

We have sought to understand why gender gaps in competitiveness are larger in more developed and gender equal countries. We formalize the two main explanations in the literature—

[17] Recall, moreover, that equation (9) includes a student-level SES control and country of test-taking fixed effects in an effort to control for these potential economic confounds.

the resource hypothesis and the gender identity hypothesis—in a model of tournament entry, and propose to distinguish between the two explanations by testing their implications for the behavior of boys and girls separately both across and within countries. The evidence consistently favors the gender identity hypothesis and indicates that the gender-equality paradox is driven by a cultural process that reduces the competitiveness of girls as countries become more developed and gender equal and has no effect on the competitiveness of boys.

While the resource hypothesis cannot explain the gender-equality paradox in competitiveness in our data, the resource hypothesis is not entirely without merit. Within countries, we do see larger gender gaps in competitiveness for students with greater availability of resources, as proposed by the resource hypothesis. This finding is driven by boys' greater responsiveness to SES and is consistent with previous evidence that boys' behavioral and educational outcomes are disproportionately sensitive to family resources (Bertrand and Pan, 2013; Autor et al., 2019, 2022). Yet this mechanism is not the driver of the gender-equality paradox across countries. Future work that investigates why resources are linked to an increase in competitiveness, and why more pronouncedly for boys, may shed further light on our understanding of the formation of preferences.

Our results indicate that we cannot expect gender gaps in competitiveness to be readily closed with improvements in gender equality, economic development, or even family resources. The fact that the competitiveness of girls is culturally determined is not necessarily good news for the prospect of closing gender gaps either, as gender norms can be sticky and survive the passage of time and the flow of people across geography to continue to affect female labor market outcomes (e.g., Fernandez, Fogli, and Olivetti, 2004; Fortin, 2005, 2015; Almond and Edlund, 2008; Abrevaya, 2009; Alesina et al., 2013). Change might require direct policy intervention, including the design of education and labor market institutions so that opportunities are not dependent on behavior for which women might be culturally penalized.

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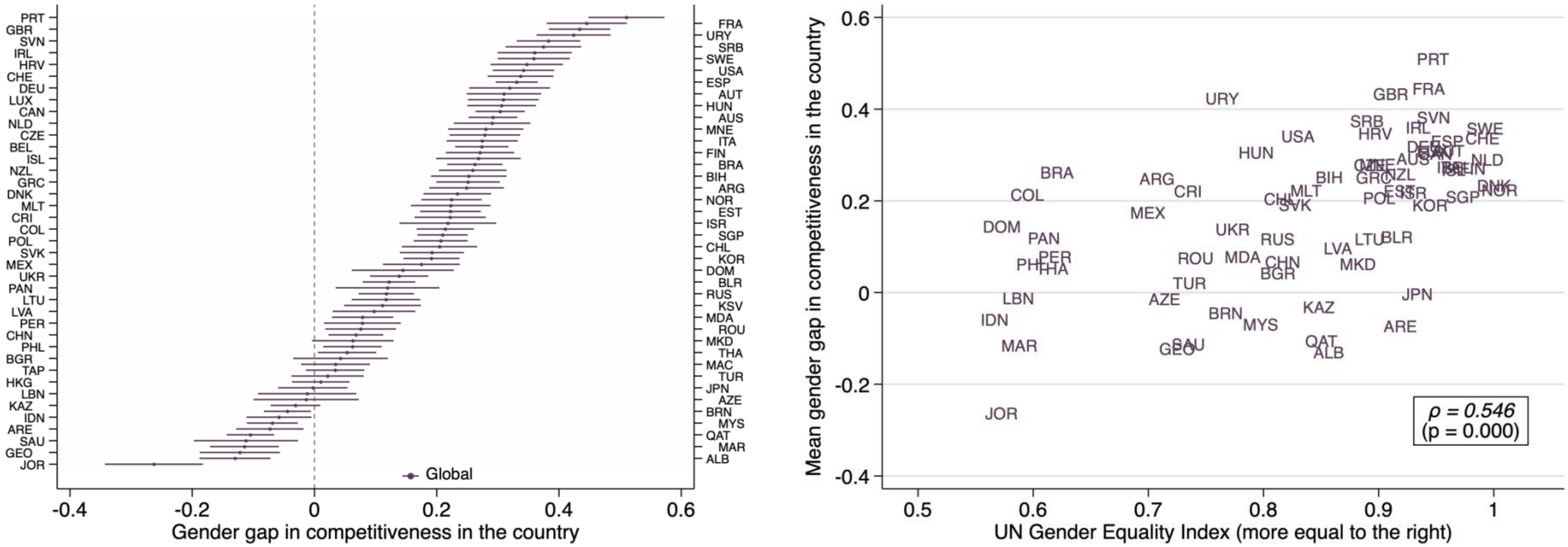


a. Mean gender gap in competitiveness

b. Mean gender gap in competitiveness by gender equality

Figure 1 Gender gap in competitiveness by country

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

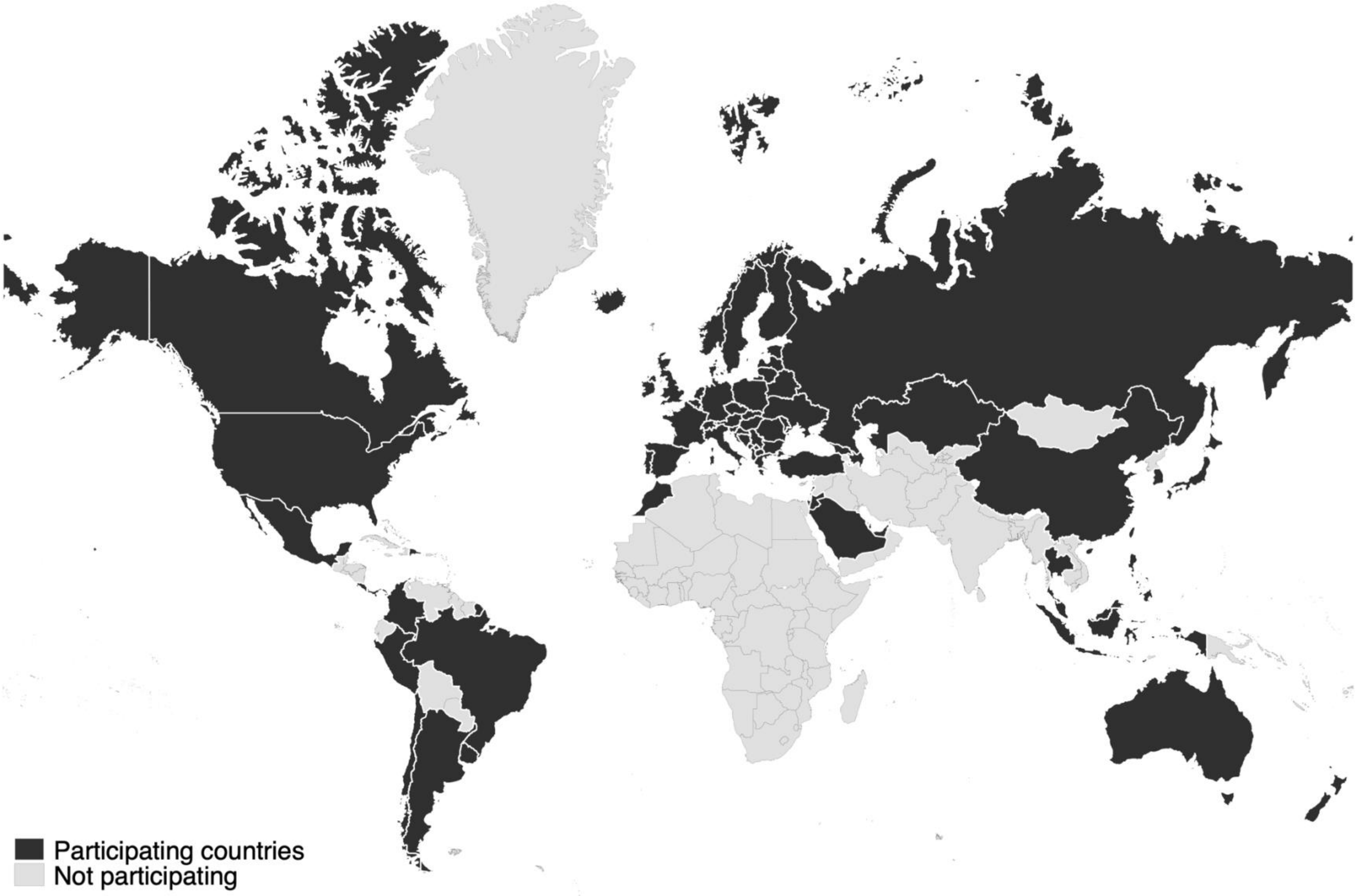


Figure 2 PISA 2018 participating countries

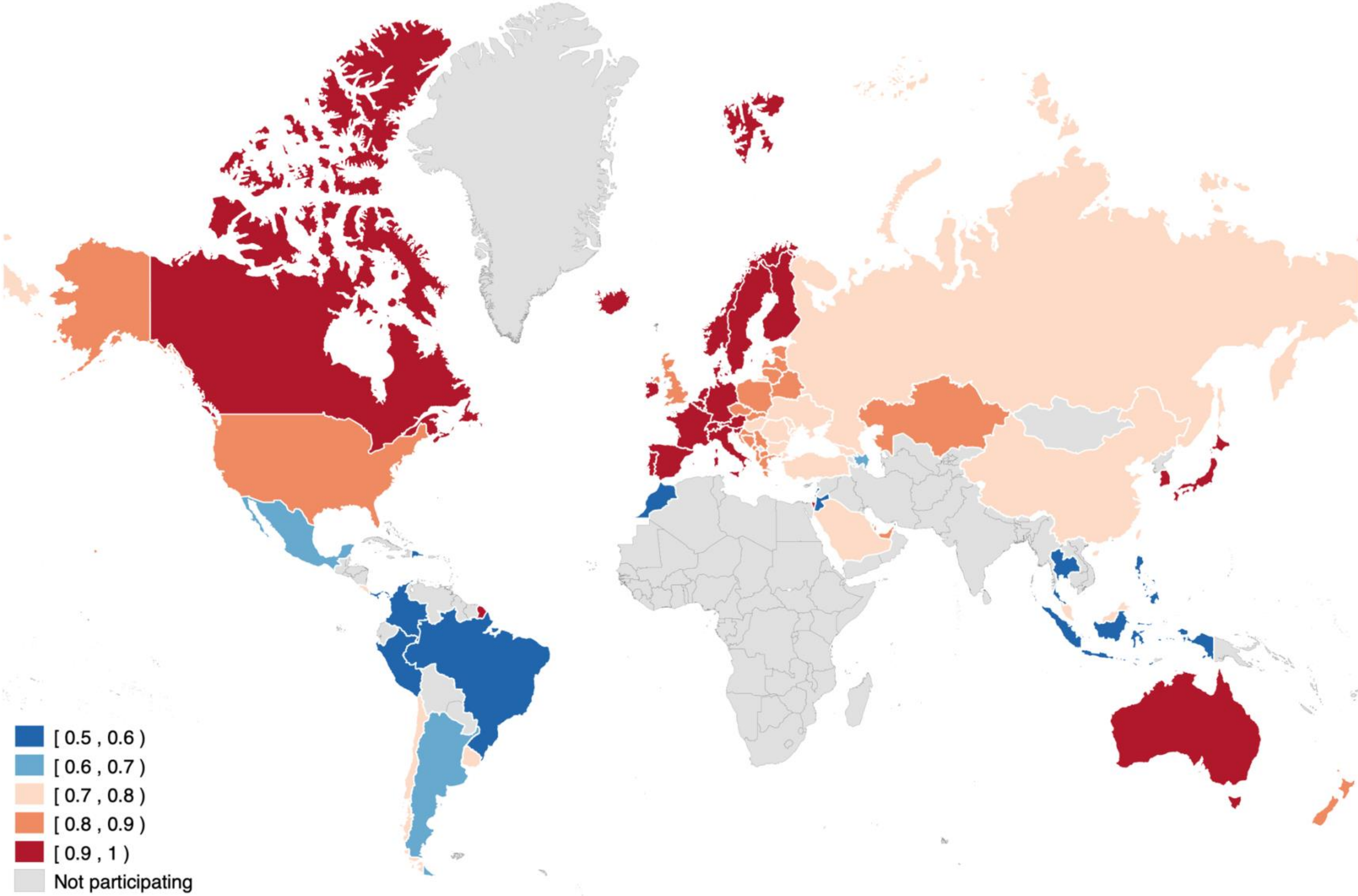


Figure 3 UN Gender Equality Index for PISA 2018 participating countries (higher values indicate greater gender equality)

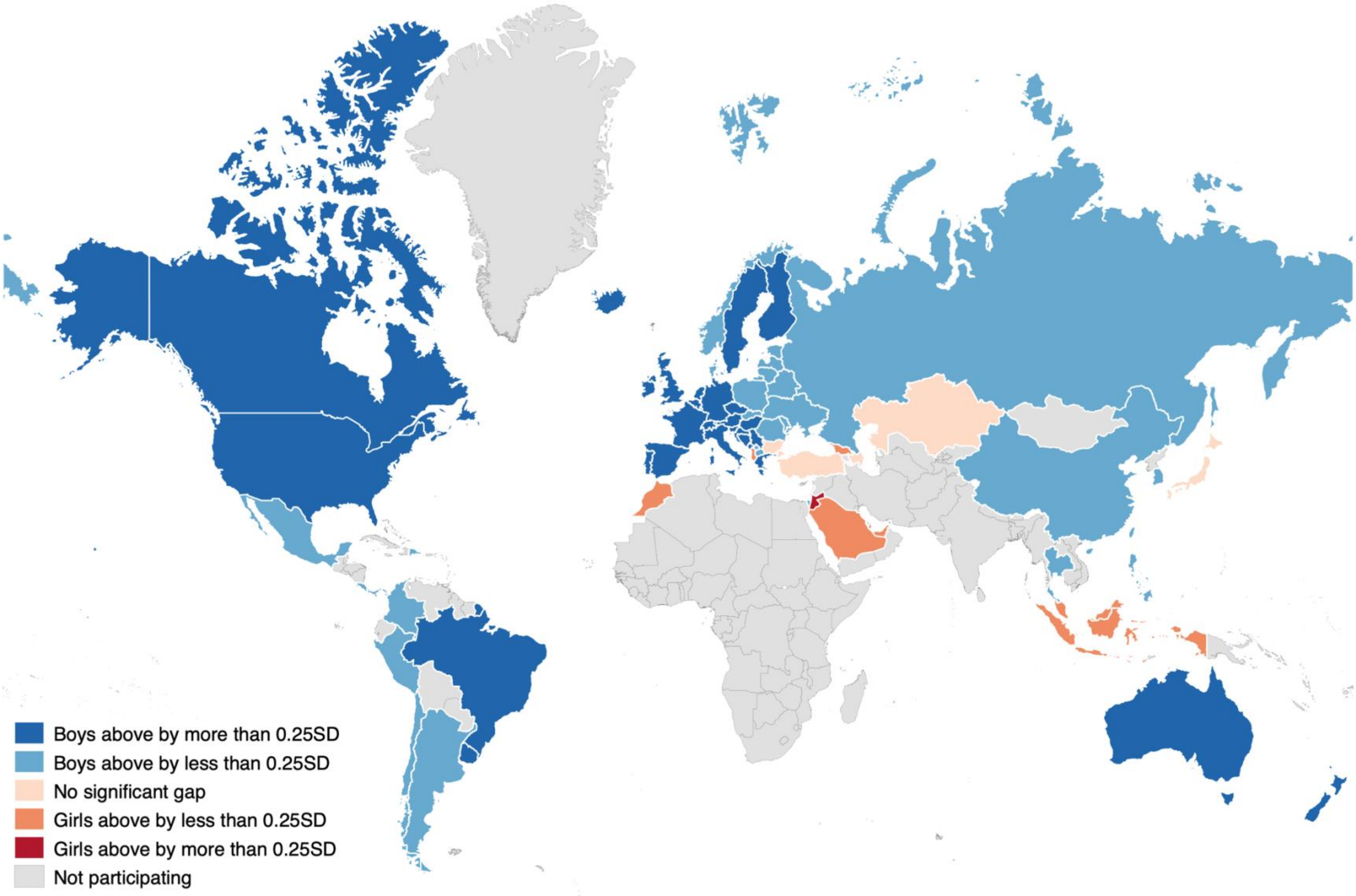
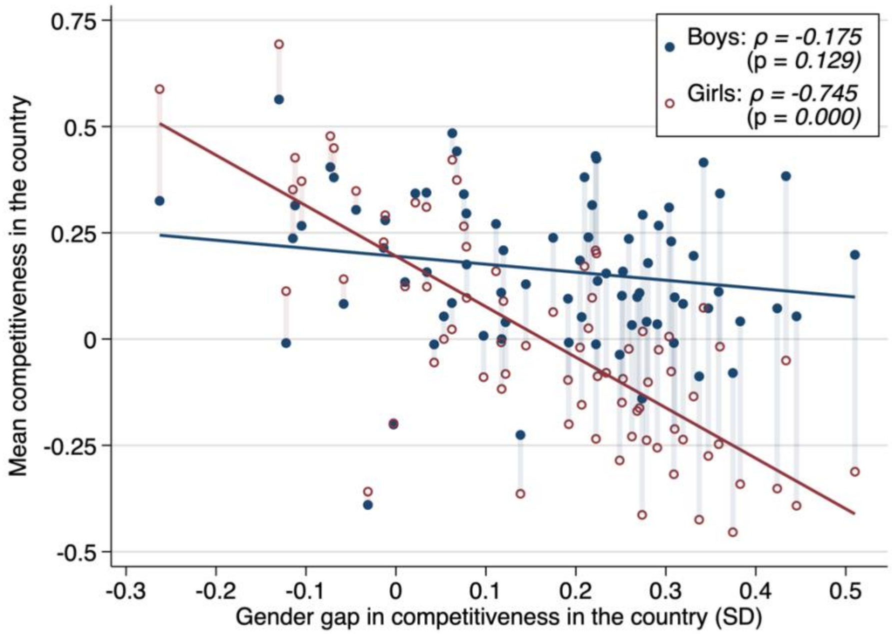
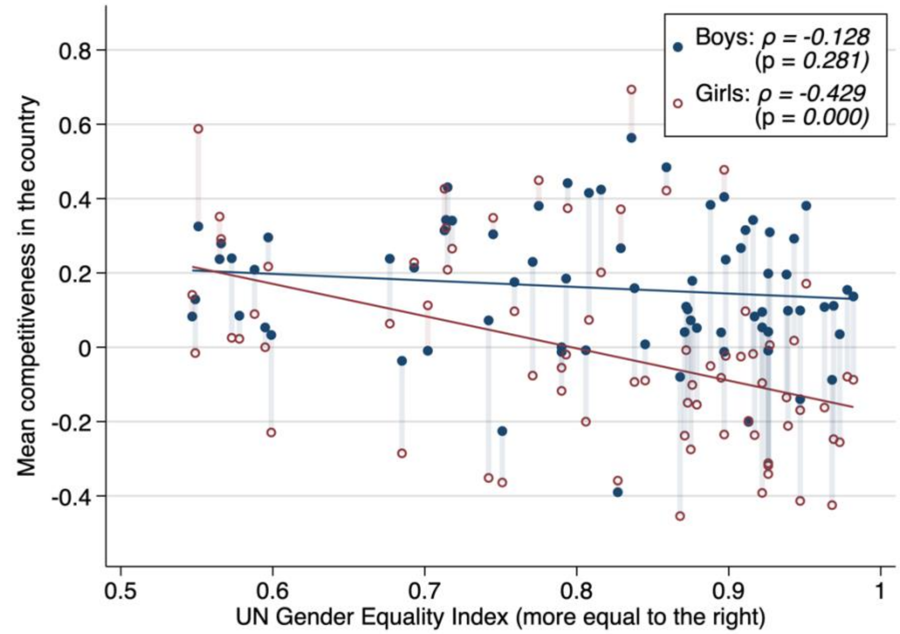


Figure 4 Mean gender gap in competitiveness for PISA 2018 participating countries

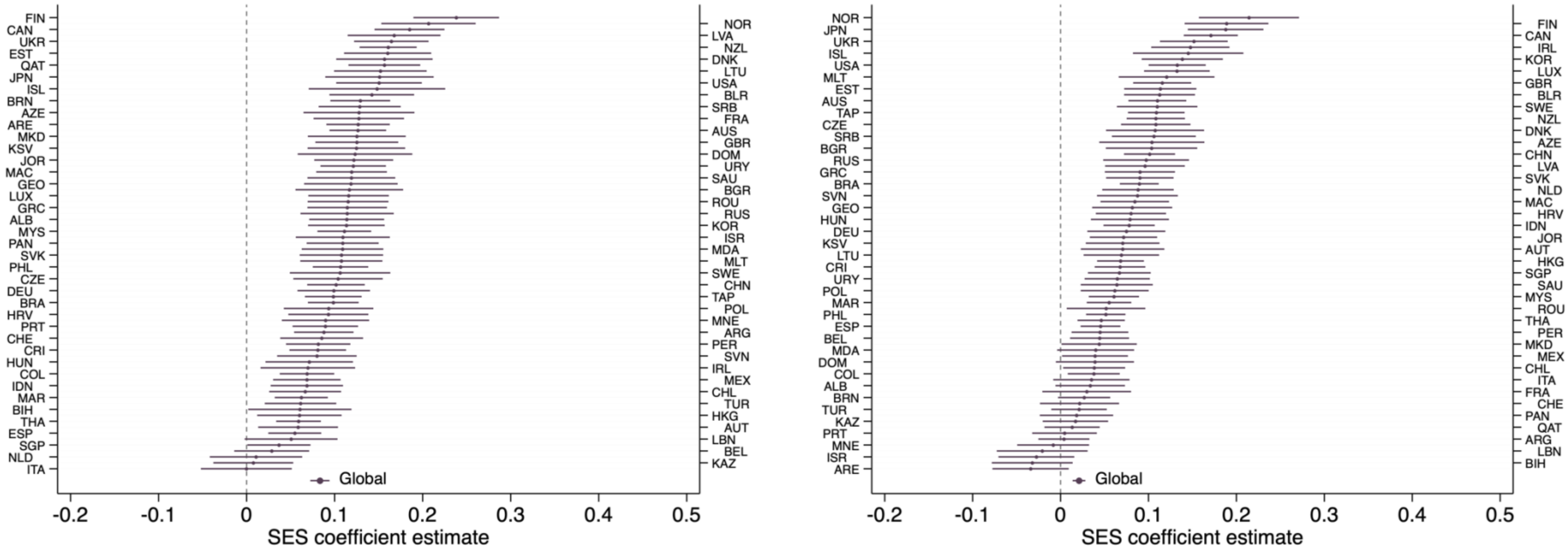


a. Mean competitiveness of boys and girls



b. Mean competitiveness of boys and girls by gender equality

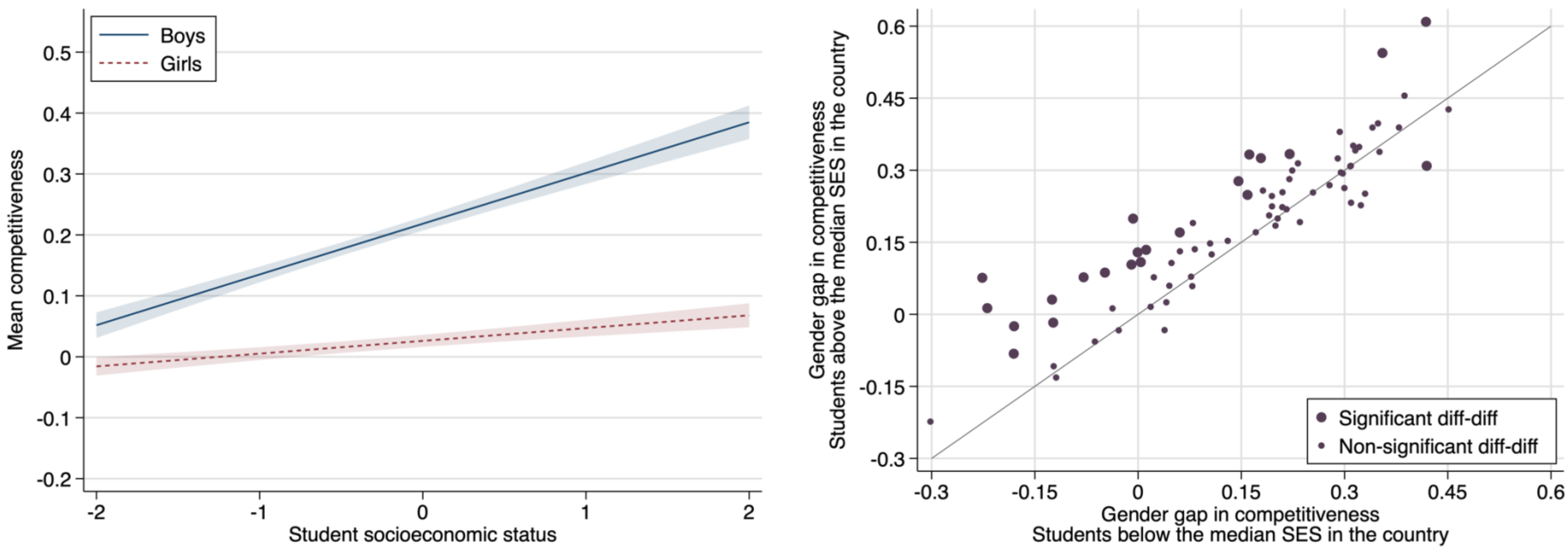
Figure 5 Competitiveness of boys and girls across countries



a. Boys **b.** Girls

Figure 6 Effect of SES on the competitiveness of boys and girls

Notes: We regress the student's competitiveness on the student's SES for each country and gender separately. Figures plot each country's SES coefficient estimate with its 95% confidence interval, as well as the coefficient estimate from a global regression for each gender.

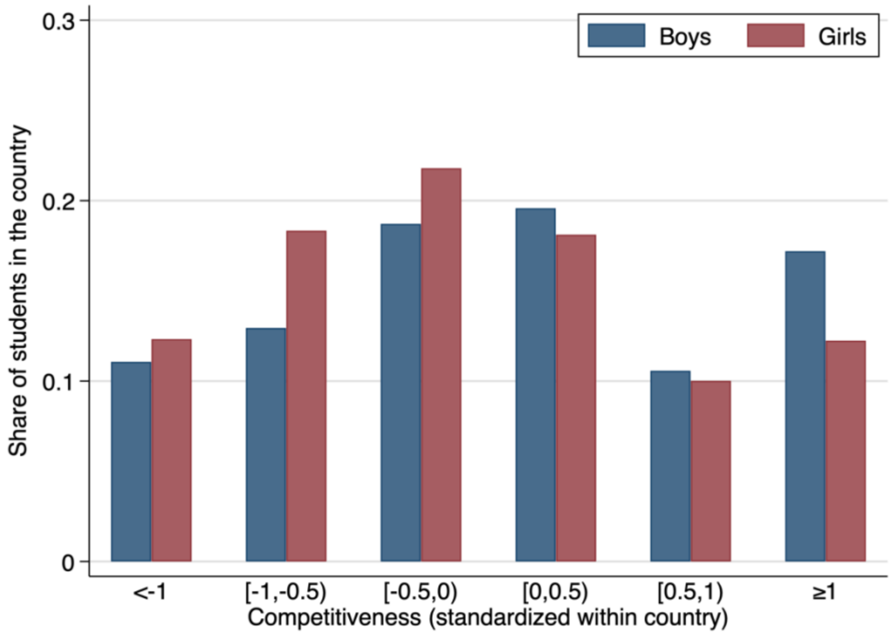


a. Competitiveness of boys and girls by SES, global regression

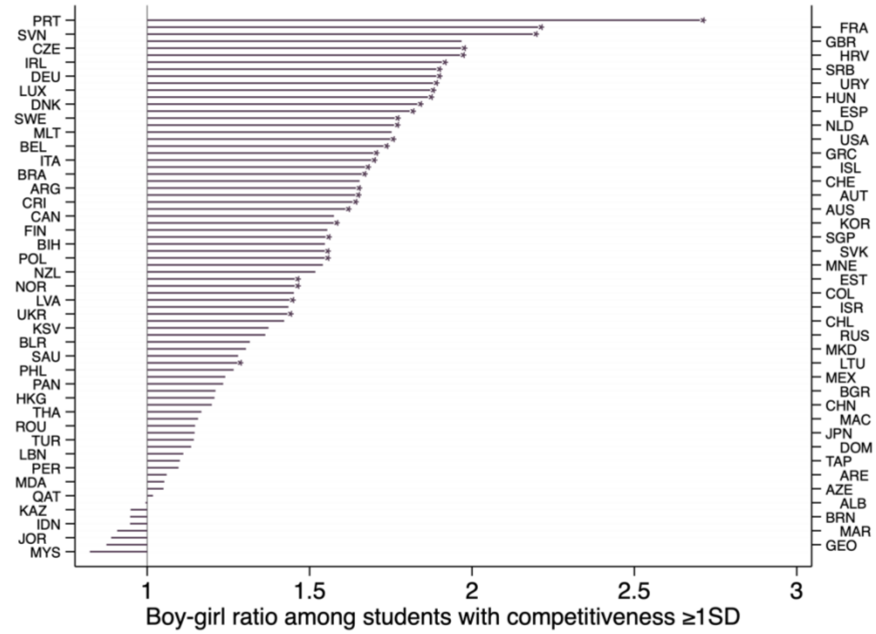
b. Gender gap in competitiveness, median split by SES in the country

Figure 7 Effect of resources on the gender gap in competitiveness

Notes: Panel a plots the estimated competitiveness of boys and girls as a function of SES with 95% confidence intervals shaded, estimated from a regression of the student competitiveness on a female indicator, the student SES, and the interaction of the two, pooling observations from all countries, with observations weighted so that the contribution of each country depends on its population size. In panel b, each dot represents a country and indicates the estimated gender gap in competitiveness among students below the median SES of their country on the x-axis and students above the median SES of their country on the y-axis. A positive gender gap indicates that boys are more competitive than girls. A significant diff-diff indicates that the difference in the gender gap between students below the median SES of the country and the students above the median SES of the country is statistically significant at a 10% level or less.



a. Average distribution of competitiveness across all countries



b. Boy-girl ratio among students with competitiveness 1SD or higher

Figure 8 Representativeness of boys and girls among the most competitive students in the country

Notes: For these figures, we first divide into six bins the distribution of competitiveness for boys and girls separately for each country, where competitiveness is standardized within country pooling both genders. In Panel a we compute for each country separately the share of boys and girls in each bin and then plot the average share across all countries, with countries weighted equally. In panel b we plot the boy-girl ratio among students in the highest competitiveness bin (the "≥ 1" bin) for each country, where a star (*) indicates that the "≥ 1" bin is the bin with the largest overrepresentation of one gender relative to the other in the country.

Table 1 Global gender gap in competitiveness

	(1)
Female	-0.157****
	(0.007)
R^2	0.0065
N observations	556,249
Population size	25,539,452

Notes: OLS regression estimating the student competitiveness on a female indicator. Observations from students from all countries, weighted so that the contribution of each country is proportional to student population size in the country. Standard errors in parentheses obtained from 80 balance repeated replicate (BRR) weights and a Fay correction coefficient of 0.5. $^{*}p<0.1$, $^{**}p<0.05$, $^{***}p<0.01$, $^{****}p<0.001$.

Table 2 Competitiveness as a function of GEI in the country

	Gender gap	Boys	Girls	Interaction
	(1)	(2)	(3)	(4)
GEI	0.692****	-0.176	-0.868****	-0.176
	(0.126)	(0.162)	(0.217)	(0.191)
Female				0.388*
				(0.223)
Female x GEI				-0.692**
				(0.271)
Intercept	-0.388****	0.303**	0.691****	0.303*
	(0.104)	(0.133)	(0.178)	(0.157)
N observations	73	73	73	73

Notes: Country-level OLS regressions. The dependent variable is the mean gender gap in competitiveness in column 1, and the mean competitiveness of boys or girls or both in columns 2, 3, and 4, respectively. Regressors are the UN Gender Equality Index in columns 1-3, and in addition a female indicator and the interaction of the two in column 4. *p<0.1, **p<0.05, ***p<0.01, ****p<0.001.

Table 3 Competitiveness as a function of economic development and GEI subindices

Panel A. GEI subindices

	Gender gap in competitiveness (1)		Boys' competitiveness (2)		Girls' competitiveness (3)	
	ρ	p-value	ρ	p-value	ρ	p-value
Maternal Mortality	0.359***	0.002	-0.039	0.741	-0.252**	0.031
Adolescent Fertility	0.227*	0.052	-0.029	0.809	-0.162	0.167
F:M Secondary School	0.213*	0.069	-0.226*	0.053	-0.288**	0.013
Female Parliamentary Seats	0.460****	0.000	0.004	0.975	-0.286**	0.014
F:M Labor Force Participation	0.569****	0.000	-0.288**	0.013	-0.554****	0.000

Panel B. GEI subindices residualized of log GDP per capita

	Gender gap in competitiveness (1)		Boys' competitiveness (2)		Girls' competitiveness (3)	
	ρ	p-value	ρ	p-value	ρ	p-value
Log GDP Per Capita	0.470****	0.000	0.022	0.853	-0.282**	0.014
Maternal Mortality	0.088	0.460	-0.063	0.595	-0.098	0.408
Adolescent Fertility	-0.088	0.454	-0.052	0.658	0.020	0.865
F:M Secondary School	0.078	0.506	-0.241**	0.038	-0.214*	0.068
Female Parliamentary Seats	0.311***	0.007	-0.004	0.971	-0.198*	0.093
F:M Labor Force Participation	0.386****	0.001	-0.333***	0.004	-0.470****	0.000

Notes: Observations at the country level. Each row shows the linear correlation coefficient (ρ) and the corresponding p-value between the given indicator and the gender gap in competitiveness in column (1) and the mean competitiveness of boys and girls in columns (2) and (3). In Panel B, GEI subindices are residuals from a country-level regression of the subindex on the log GDP per capita. *Maternal Mortality* is measured in maternal deaths per 100,000 live births (reverse coded). *Adolescent Fertility* is measured in births per 1000 women under the age of 19 (reverse coded). *F:M Secondary School* is the share of females with at least some secondary education divided by the share of males with at least some secondary education. *Female Parliamentary Seats* is the share of parliamentary seats held by women. *F:M Labor Force Participation* is the female labor force participation rate divided by the male labor force participation rate. $^{*}p<0.1$, $^{**}p<0.05$, $^{***}p<0.01$, $^{****}p<0.001$

Table 4 Competitiveness by SES, global regression

	Boys (1)	Girls (2)	Both (3)
SES	0.083****	0.021****	0.083****
	(0.005)	(0.004)	(0.005)
Female			-0.192****
			(0.007)
SES x Female			-0.062****
			(0.006)
R^2	0.0102	0.0008	0.0123
N observations	273,187	280,381	553,568
N population	12,580,058	12,839,037	25,419,094

Notes: OLS regressions of the student competitiveness on the student SES in columns 1 and 2, and in addition on a female indicator and the interaction of the two in column 3. Observations from students from all countries, weighted so that the contribution of each country is proportional to student population size in the country. Standard errors in parentheses obtained from 80 balance repeated replicate (BRR) weights and a Fay correction coefficient of 0.5. *p<0.1, **p<0.05, ***p<0.01, ****p<0.001.

Table 5 Competitiveness of second-generation immigrant students by their parents' average GEI

	Boys (1)	Girls (2)	Both (3)
Parents' GEI	-0.075	-0.308^{**}	-0.018
	(0.149)	(0.129)	(0.121)
Female student			0.043
			(0.093)
Parents' GEI x Female student			-0.350^{***}
			(0.121)
Intercept	0.280^{**}	0.231^{**}	0.235^{**}
	(0.113)	(0.097)	(0.091)
SES control	Y	Y	Y
Country of test-taking FE	Y	Y	Y
R^2	0.0441	0.0821	0.0618
N students	5,729	5,797	11,526

Notes: OLS regressions estimating the competitiveness of second-generation immigrant students (i.e., students born in the country of test-taking and whose parents were both born elsewhere). Parents' GEI is the average GEI of the father's and mother's countries of origin (when only one parent is reported or data from only one parent is available, the average GEI is the GEI for that parent). Regressions control for the student's socioeconomic status and country of test-taking fixed effects. Robust standard errors in parentheses. $^{*}p<0.1$, $^{**}p<0.05$, $^{***}p<0.01$, $^{****}p<0.001$.

Appendix to

Gender-equality paradox in competitiveness: Evidence and explanations

David Klinowski and Muriel Niederle

(For online publication)

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A. 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 the list of participating countries in the official PISA 2018 documentation. We change Baku (Azerbaijan)'s code from QAZ to AZE to match the code given to Azerbaijan in the UN dataset. We change B-S-J-Z (China)'s code from QCI to CHN to match the code given to China in the UN 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 UN dataset. B-S-J-Z refers to the Chinese provinces of Beijing, Shanghai, Jiangsu, and Zhejiang.

Table S2 Country-level variation in the competitiveness of boys and girls

	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 item 1	0.0242	0.0450	0.1068	0.1638	0.0074	0.0070
Competitiveness item 2	0.0199	0.0460	0.0997	0.1688	0.0003	0.0001
Competitiveness item 3	0.0205	0.0480	0.0944	0.1417	0.0003	0.0014

Notes: 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. Competitiveness items are 1 *I enjoy working in situations involving competition with others*, 2 *It is important for me to perform better than other people on a task*, and 3 *I try harder when I'm in competition with other people*.

Table S3 Share of students in single-sex schools in the country

Code	Share	Code	Share	Code	Share
ALB	0.0639	GEO	0.0191	NLD	0.0023
ARE	0.6759	GRC	0.0145	NOR	0.0071
ARG	0.0127	HKG	0.1635	NZL	0.3063
AUS	0.1700	HRV	0.0450	PAN	0.0181
AUT	0.0871	HUN	0.0485	PER	0.1062
AZE	0.0000	IDN	0.0333	PHL	0.0056
BEL	0.0444	IRL	0.3692	POL	0.0147
BGR	0.0124	ISL	0.0130	PRT	0.0097
BIH	0.0009	ISR	0.2591	QAT	0.6058
BLR	0.0240	ITA	0.0168	ROU	0.0152
BRA	0.0147	JOR	0.9004	RUS	0.0082
BRN	0.1703	JPN	0.1005	SAU	1.0000
CAN	0.0218	KAZ	0.0102	SGP	0.1891
CHE	0.0166	KOR	0.4088	SRB	0.0104
CHL	0.0966	KSV	0.0106	SVK	0.0545
CHN	0.0000	LBN	0.1083	SVN	0.1465
COL	0.0312	LTU	0.0214	SWE	0.0033
CRI	0.0121	LUX	0.0427	TAP	0.0367
CZE	0.0368	LVA	0.0085	THA	0.0526
DEU	0.0088	MAC	0.2085	TUR	0.1743
DNK	0.0093	MAR	0.0000	UKR	0.0211
DOM	0.0131	MDA	0.0158	URY	0.0011
ESP	0.0077	MEX	0.0203	USA	0.0298
EST	0.0095	MKD	0.0027		
FIN	0.0052	MLT	0.5168		
FRA	0.0084	MNE	0.0071		
GBR	0.1346	MYS	0.0620		

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

Table S4 Male-female ratio in secondary school enrollment

Code	MF ratio	Code	MF ratio	Code	MF ratio
ALB	0.9946	GEO	0.9859	NLD	0.9895
ARE	.	GRC	1.0542	NOR	1.0467
ARG	0.9588	HKG	1.0310	NZL	0.9417
AUS	1.0628	HRV	0.9548	PAN	.
AUT	1.0373	HUN	1.0045	PER	1.0543
AZE	0.9988	IDN	0.9756	PHL	0.8997
BEL	0.8899	IRL	0.8768	POL	1.0292
BGR	1.0333	ISL	1.0107	PRT	1.0042
BIH	.	ISR	0.9829	QAT	.
BLR	1.0143	ITA	1.0139	ROU	0.9975
BRA	0.9696	JOR	0.9679	RUS	1.0305
BRN	0.9771	JPN	0.9955	SAU	1.0600
CAN	0.9894	KAZ	0.9919	SGP	1.0097
CHE	1.0514	KOR	1.0072	SRB	0.9903
CHL	0.9996	KSV	.	SVK	0.9883
CHN	.	LBN	.	SVN	0.9763
COL	0.9494	LTU	1.0376	SWE	0.9383
CRI	0.9300	LUX	0.9804	TAP	.
CZE	0.9958	LVA	1.0103	THA	1.0205
DEU	1.0621	MAC	1.0026	TUR	1.0247
DNK	1.0006	MAR	1.0929	UKR	.
DOM	0.9275	MDA	1.0071	URY	0.9003
ESP	0.9816	MEX	0.9194	USA	1.0095
EST	0.9721	MKD	1.0218		
FIN	0.9061	MLT	0.9983		
FRA	0.9944	MNE	0.9863		
GBR	0.9749	MYS	0.9223		

Notes: Male-female ratio in secondary school enrollment in the country. Values computed from World Bank data of secondary school enrollment (% gross) in 2018.

Table S5 Month of birth as a function of GEI in the country

	Gender gap	Boys	Girls	Interaction
	(1)	(2)	(3)	(4)
GEI	-0.027	-0.078**	-0.051	-0.078*
	(0.029)	(0.039)	(0.043)	(0.041)
Female				-0.025
				(0.047)
Female x GEI				0.027
				(0.058)
Intercept	0.025	2.593****	2.568****	2.593****
	(0.024)	(0.032)	(0.035)	(0.033)
N observations	71	71	71	71

Notes: Country-level OLS regressions. The dependent variable is the month of birth gender gap in column 1, and the mean month of birth of boys or girls or both in columns 2, 3, and 4, respectively, where month of birth is coded as quarters (1 = January, February, or March; 2 = April, May, June; 3 = July, August, September; 4 = October, November, December). Regressors are the UN Gender Equality Index in columns 1-3, and in addition a female indicator and the interaction of the two in column 4. Norway and Sweden dropped from the sample due to lack of data on month of birth. *$p<0.1$, **$p<0.05$, ***$p<0.01$, ****$p<0.001$.

Table S6 Teacher comprehension as a function of GEI in the country

	Gender gap	Boys	Girls	Interaction
	(1)	(2)	(3)	(4)
GEI	0.034	-0.228**	-0.262**	-0.228**
	(0.041)	(0.106)	(0.106)	(0.106)
Female				0.073
				(0.123)
Female x GEI				-0.034
				(0.150)
Intercept	-0.073**	2.992****	3.064****	2.992****
	(0.034)	(0.087)	(0.087)	(0.087)
N observations	70	70	70	70

Notes: Country-level OLS regressions. The dependent variable is the gender gap in column 1, and the mean of boys or girls or both in columns 2, 3, and 4, respectively, of the PISA variable that records agreement from 1 to 4 ("strongly disagree", "disagree", "agree", or "strongly agree") with the statement "*Thinking of the past two language lessons, I felt that my teacher understood me"*. Regressors are the UN Gender Equality Index in columns 1-3, and in addition a female indicator and the interaction of the two in column 4. Canada, Lebanon, and North Macedonia dropped from the sample due to lack of data on the dependent variable. *p<0.1, **p<0.05, ***p<0.01, ****p<0.001.

Table S7 Distribution of GEI subindices in the sample

	GEI components				
	Maternal Mortality	Adolescent Fertility	F:M Secondary School	Female Parliamentary Seats	F:M Labor Force Participation
Minimum	177.0	83.87	72.59	4.69	23.82
5th percentile	88.0	61.29	82.84	9.76	33.77
10th percentile	52.0	51.03	89.27	13.72	59.27
25th percentile	25.0	27.31	92.62	18.54	69.74
Median	10.0	11.79	98.33	23.46	78.13
75th percentile	5.0	6.37	100.00	33.13	83.88
90th percentile	3.0	2.99	102.54	38.64	87.27
95th percentile	2.0	2.49	105.65	42.00	89.35
Maximum	2.0	2.35	114.52	48.41	93.07

Notes: Observations at the country level. *Maternal Mortality* is measured in maternal deaths per 100,000 live births (reverse coded). *Adolescent Fertility* is measured in births per 1000 women under the age of 19 (reverse coded). *F:M Secondary School* is the share of females with at least some secondary education divided by the share of males with at least some secondary education. *Female Parliamentary Seats* is the share of parliamentary seats held by women. *F:M Labor Force Participation* is the female labor force participation rate divided by the male labor force participation rate.

Table S8 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 S8 continued Managerial and professional occupations in PISA (high-paying occupations starred)

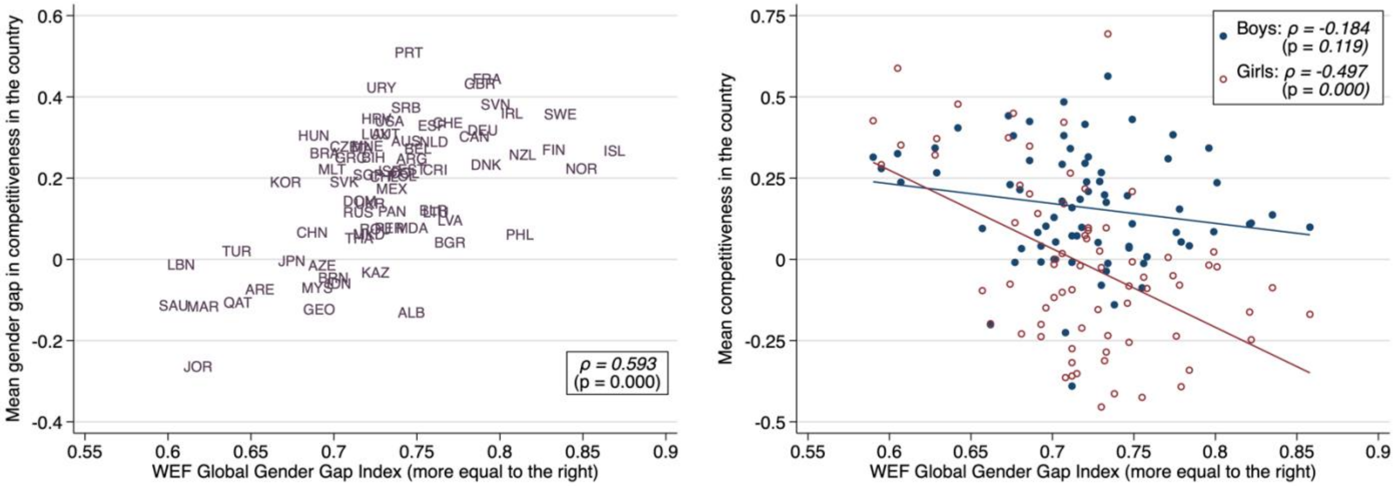
	Code	Occupation		Code	Occupation
*	2221	Nursing professionals		2433	Technical and medical sales professionals (excluding ICT)
	2222	Midwifery professionals		2434	Information and communications technology sales professionals
	2230	Traditional and complementary medicine professionals		2500	Information 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 S9 Competitiveness of second-generation immigrant students by their parents' GEI

	Parent: Father			Parent: Mother		
	Boys	Girls	Both	Boys	Girls	Both
	(1)	(2)	(3)	(4)	(5)	(6)
Parent's GEI	-0.010	-0.279**	0.010	-0.092	-0.288**	-0.010
	(0.155)	(0.134)	(0.124)	(0.157)	(0.133)	(0.126)
Female student			0.014			0.045
			(0.096)			(0.096)
Parent's GEI x Female			-0.315**			-0.355***
			(0.126)			(0.127)
Intercept	0.233**	0.208**	0.216**	0.301**	0.219**	0.236**
	(0.117)	(0.101)	(0.094)	(0.118)	(0.100)	(0.095)
SES control	Y	Y	Y	Y	Y	Y
Country of test-taking FE	Y	Y	Y	Y	Y	Y
R^2	0.0482	0.0796	0.0630	0.0439	0.0824	0.0625
N students	5,185	5,263	10,448	5,272	5,375	10,647

Notes: OLS regressions estimating the competitiveness of second-generation immigrant students (i.e., students born in the country of test-taking and whose parents were both born elsewhere) on the GEI of either the father's or the mother's country of origin. Regressions control for the student's socioeconomic status and country of test-taking fixed effects. Robust standard errors in parentheses. *p<0.1, **p<0.05, ***p<0.01, ****p<0.001.

B. Supplementary figures

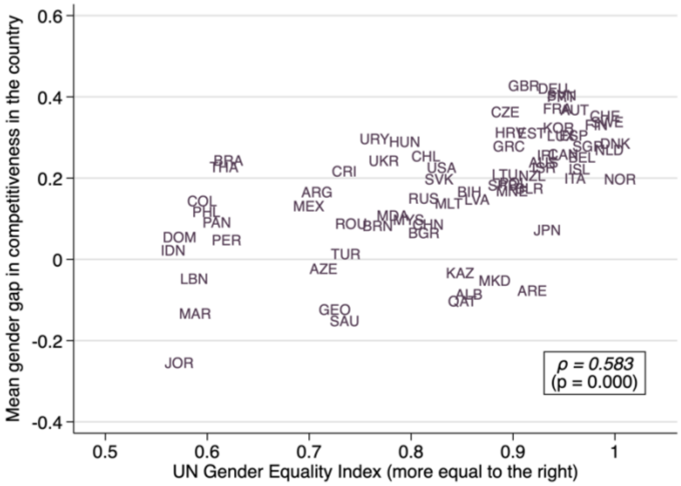


a. Mean gender gap in competitiveness

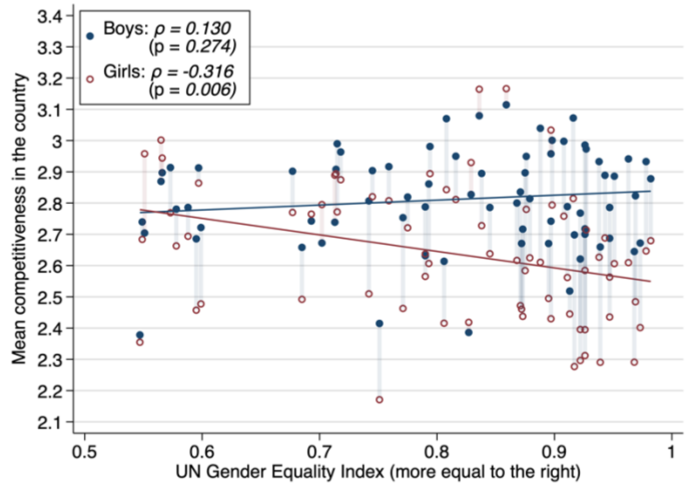
b. Mean competitiveness of boys and girls

Figure S1 Competitiveness and gender equality in the country

Notes: Gender equality measured with the World Economic Forum's Global Gender Gap Index. A positive gender gap indicates that boys are more competitive than girls.

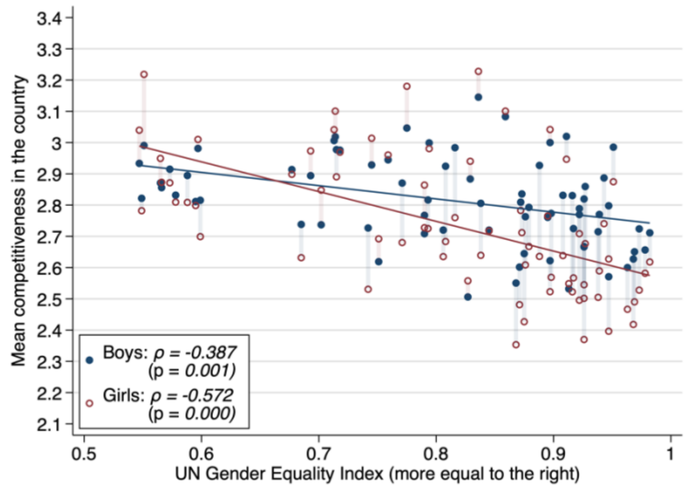


a. Competitiveness item 1, gender gap

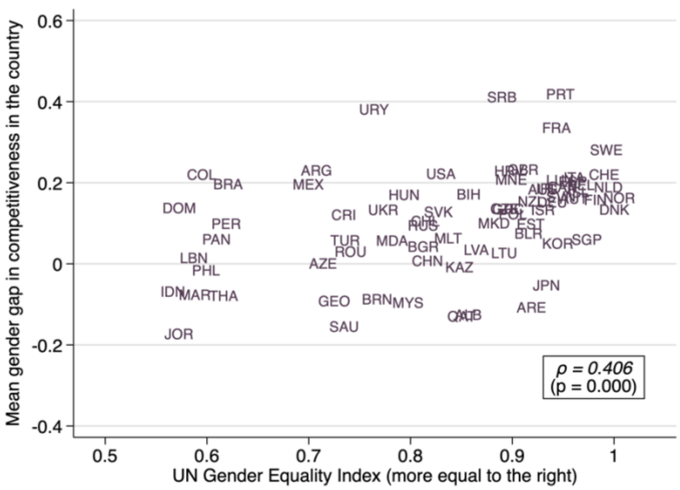


b. Competitiveness item 1, boys and girls

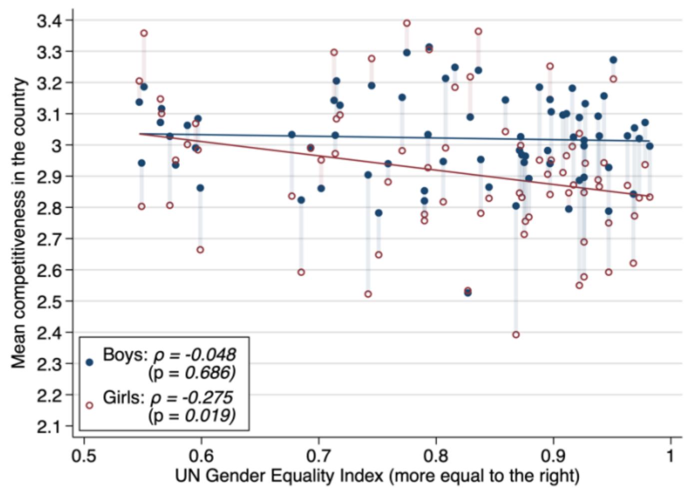
c. Competitiveness item 2, gender gap



d. Competitiveness item 2, boys and girls

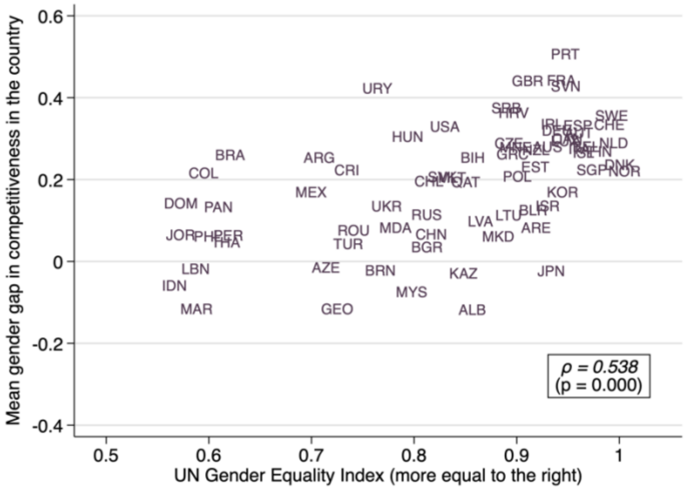


e. Competitiveness item 3, gender gap

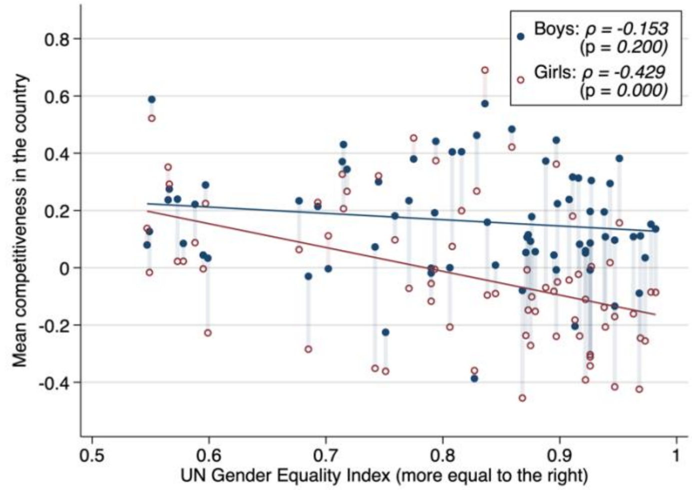


f. Competitiveness item 3, boys and girls

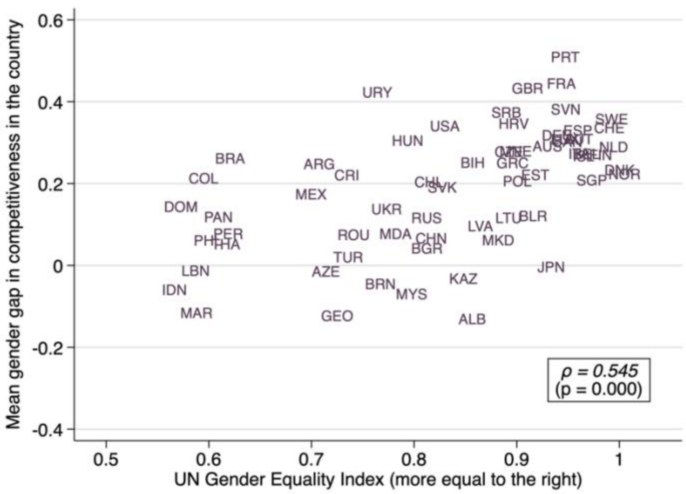
Figure S2 Competitiveness items and gender equality in the country



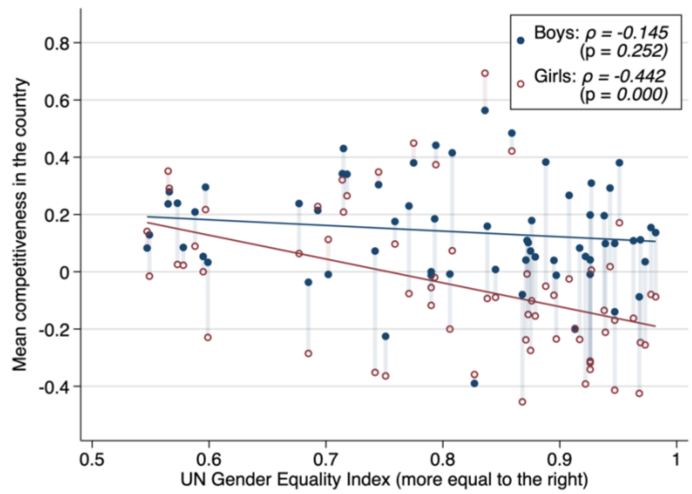
a. Mean gender gap in competitiveness



b. Mean competitiveness of boys and girls



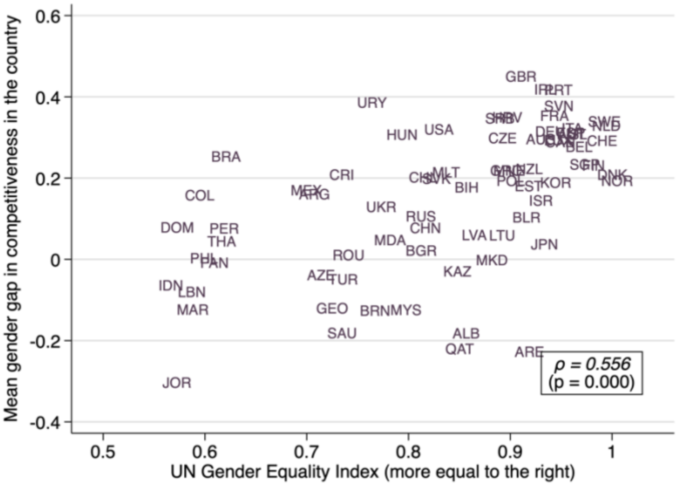
c. Mean gender gap in competitiveness



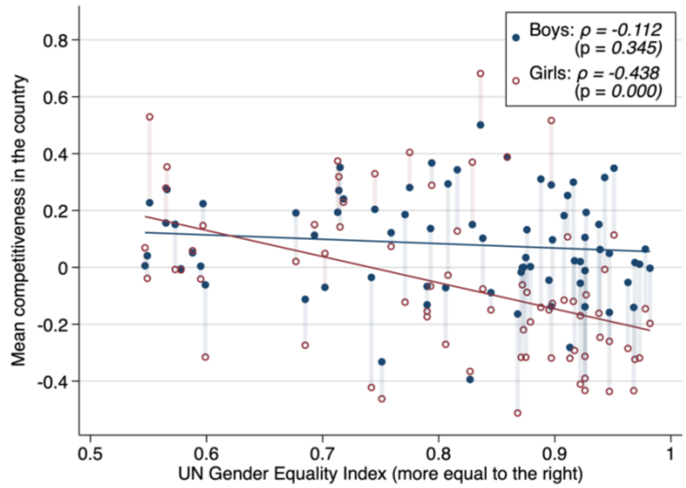
d. Mean competitiveness of boys and girls

Figure S3 Competitiveness and gender equality in the country

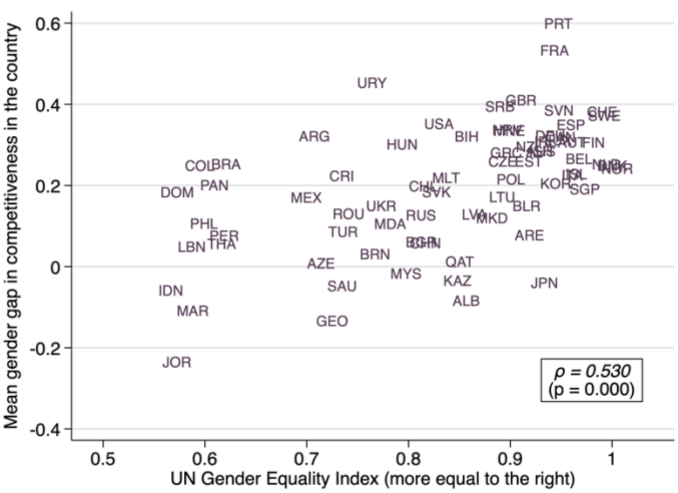
Notes: The sample excludes students in single-sex schools from all countries in Figures a-b, and countries with more than 20% of students in single-sex schools (United Arab Emirates, Ireland, Israel, Jordan, Korea, Macao, Malta, New Zealand, Qatar, and Saudi Arabia) in Figures c-d.



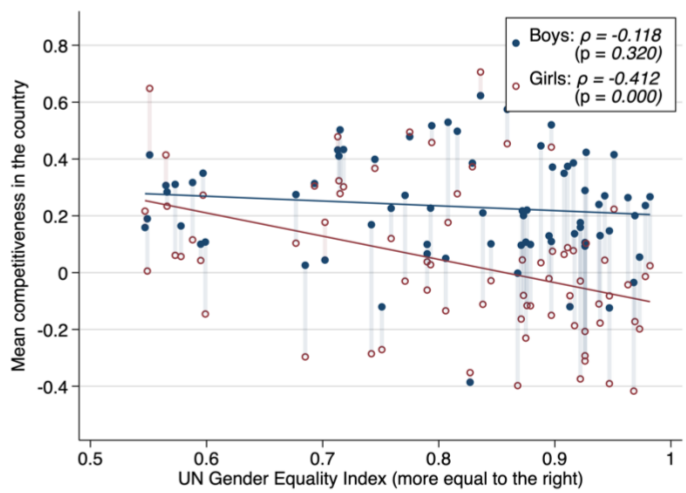
a. Mean gender gap in competitiveness
students below median SES in their country



b. Mean competitiveness of boys and girls
students below median SES in their country



c. Mean gender gap in competitiveness
students above median SES in their country



d. Mean competitiveness of boys and girls
students above median SES in their country

Figure S4 Competitiveness and gender equality in the country, median split SES

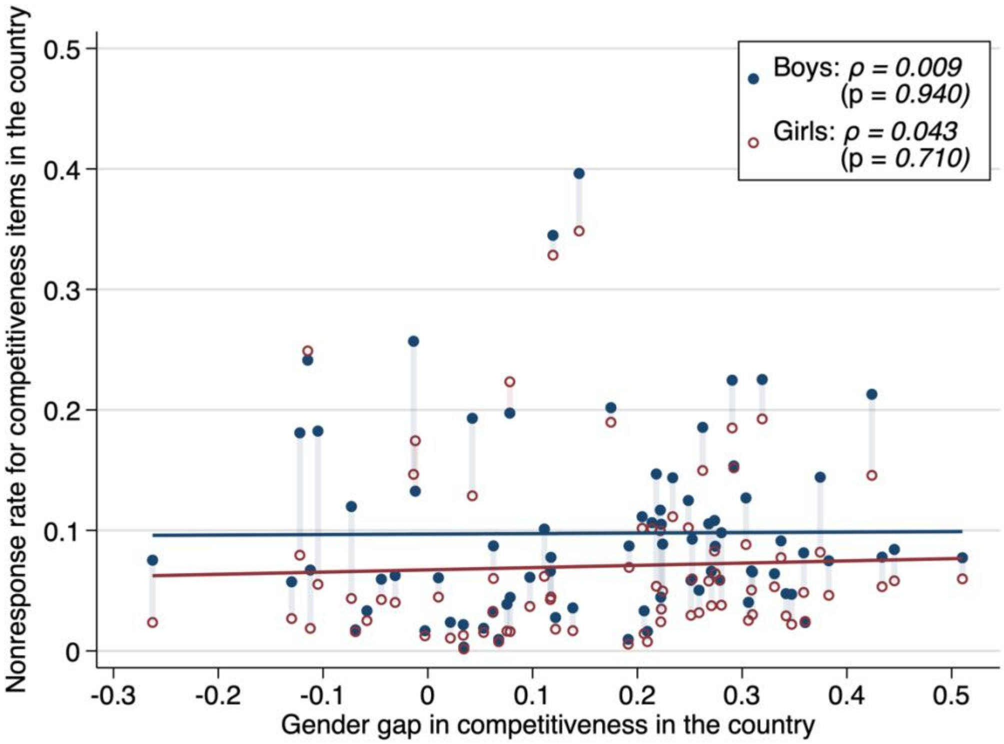


Figure S5 Nonresponse rate of boys and girls

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

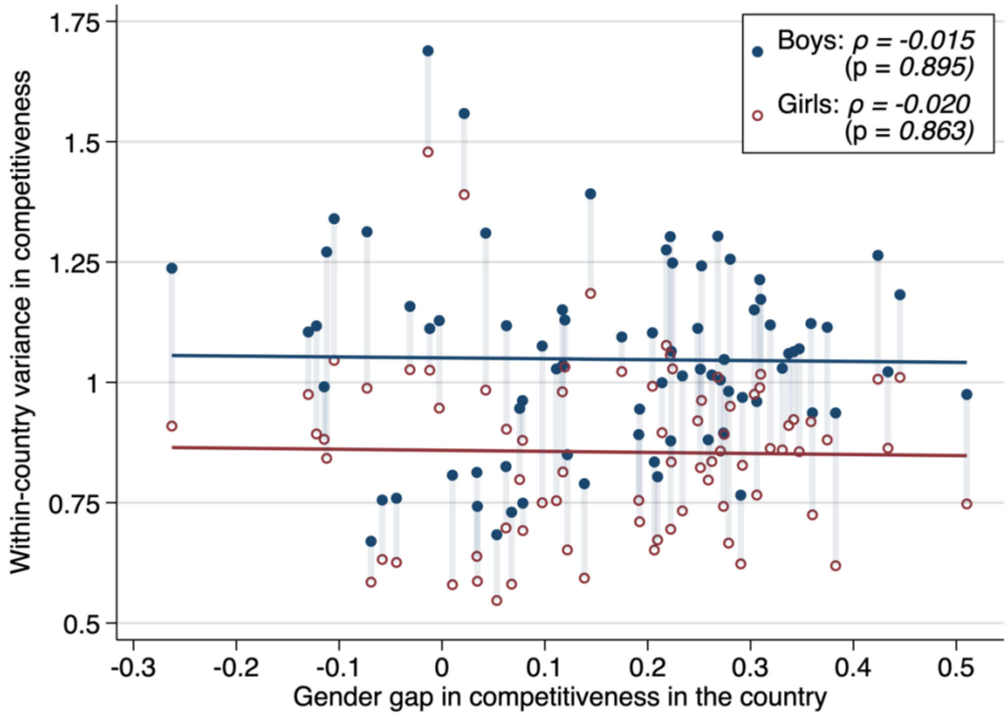
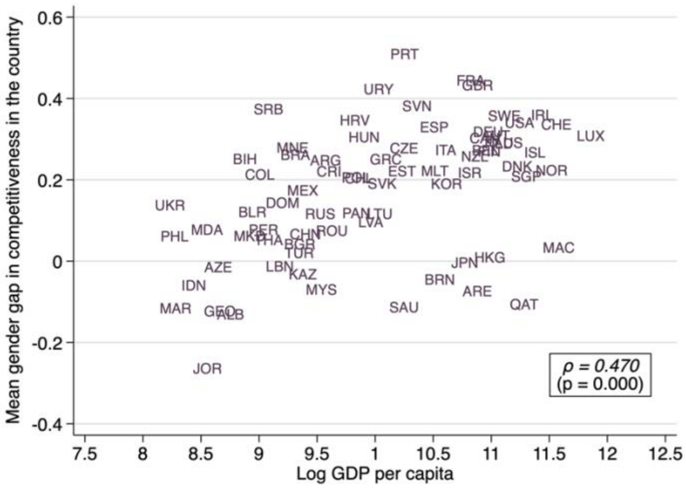
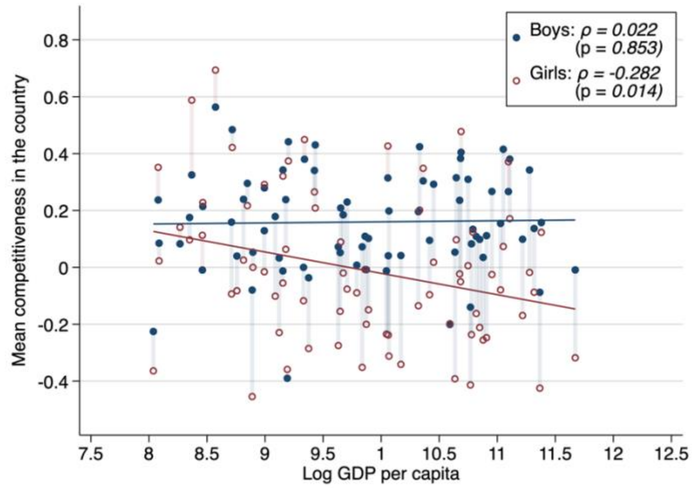


Figure S6 Within-country variance in competitiveness of boys and girls

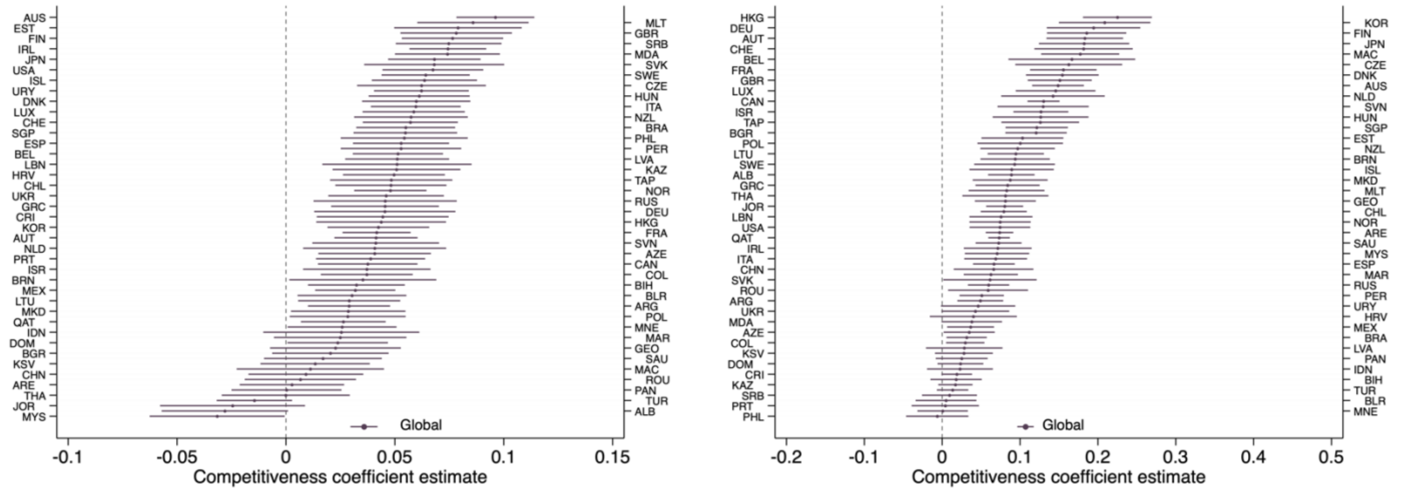


a. Mean gender gap in competitiveness



b. Mean competitiveness of boys and girls

Figure S7 Competitiveness and GDP per capita in the country



a. Coefficient estimate on math test score **b.** Coefficient estimate on interest in high-paying occupation

Figure S8 Effect of competitiveness on PISA math test score and interest in high-paying occupations

Notes: In panel a, we regress the student's math test scores on the student's competitiveness controlling for the student's verbal test score and SES, for each country separately. In panel b, we regress an indicator that the student is interested in pursuing a high-paying occupation on the student's competitiveness, controlling for the student's math test score, verbal test score, and SES, for each country separately. Figures plot each country's competitiveness coefficient estimates with their 95% confidence intervals, as well as the coefficient estimate from a global regression.

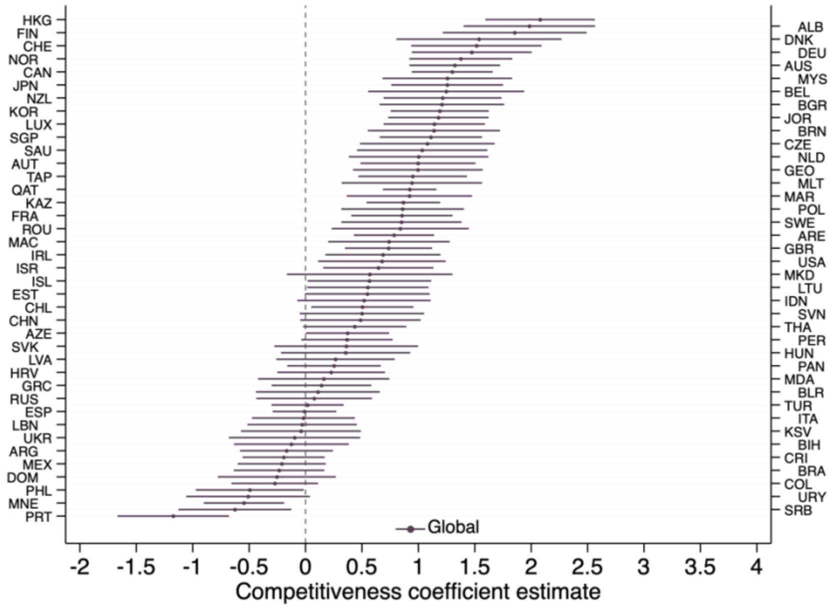


Figure S9 Effect of competitiveness on the occupational status of the student's occupation of interest

Notes: We regress the ISEI of the student's occupation of interest on the student's competitiveness, math test score, verbal test score, and SES, for each country separately. ISEI refers to the international socioeconomic index of occupational status (Ganzeboom, 2010), a measure that ranges from 10 to 89 and that intends to capture the status of an occupation and that is increasing in the average level of education and average earnings of job holders of that occupation. The figure plots each country's competitiveness coefficient estimate with its 95% confidence interval, as well as the coefficient estimate from a global regression.

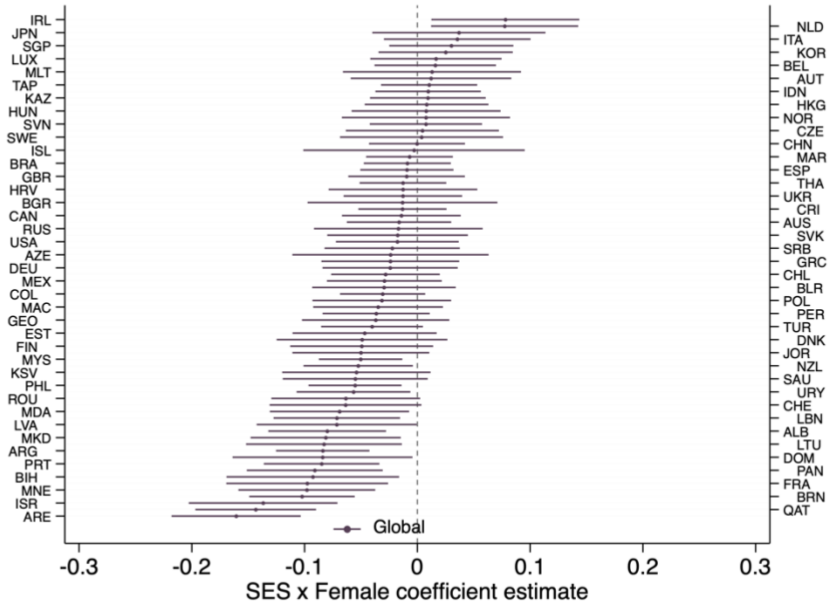
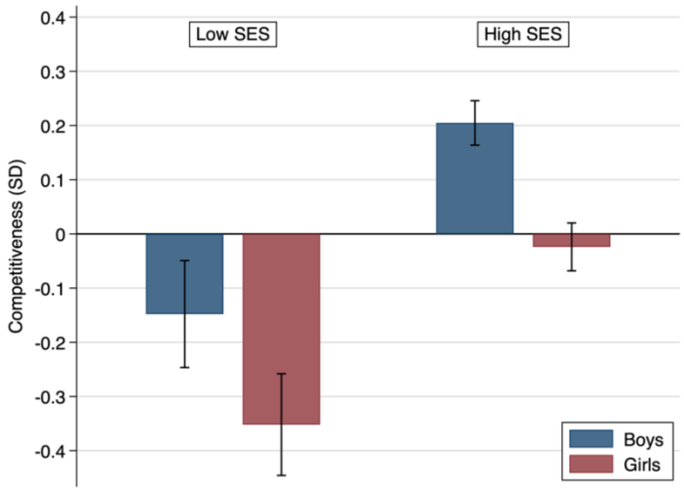
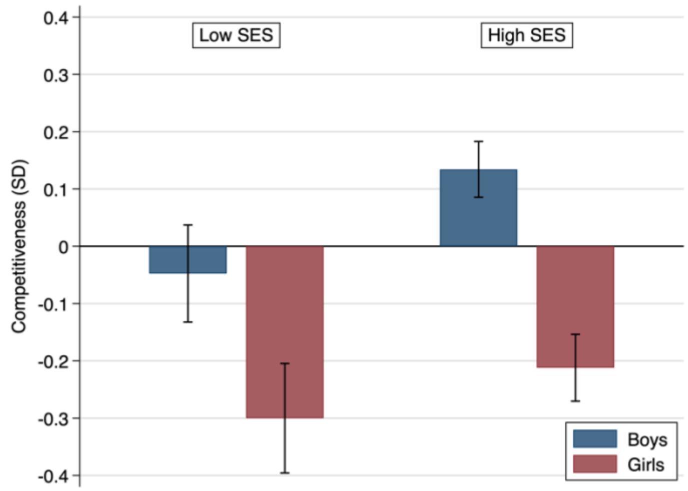


Figure S10 Competitiveness and student socioeconomic status (SES), interacted model

Notes: We regress the student's competitiveness on the student's SES, a female indicator, and the interaction of the two for each country separately pooling observations from both boys and girls in the country. Figures plot each country's SES x Female coefficient estimate with its 95% confidence interval, as well as the coefficient estimate from a global regression. A negative interaction coefficient indicates that boys are more responsive to SES than girls are.



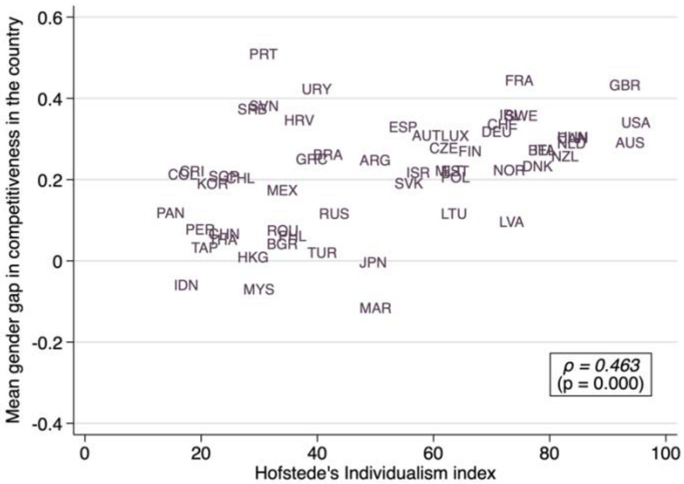
a. Norway



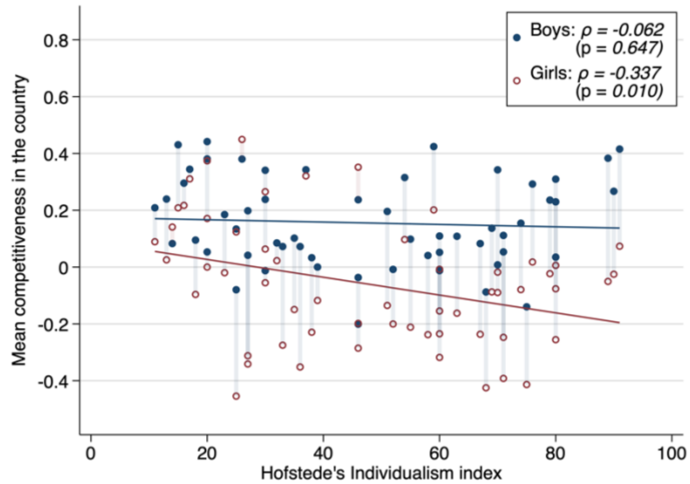
b. Germany

Figure S11 Competitiveness of boys and girls by SES in the PISA 2018 Norway and Germany samples

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



a. Mean gender gap in competitiveness



b. Mean competitiveness of boys and girls

Figure S12 Competitiveness and Hofstede's Individualism index