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Learning Outcomes in Developing Countries: Four Hard Lessons from PISA-D

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Abstract

The learning crisis in developing countries is increasingly acknowledged (World Bank, 2018). The UN's Sustainable Development Goals (SDG) include goals and targets for universal learning and the World Bank has adopted a goal of eliminating learning poverty. We use student level PISA-D results for seven countries (Cambodia, Ecuador, Guatemala, Honduras, Paraguay, Senegal, and Zambia) to examine inequality in learning outcomes at the global, country, and student level for public school students. We examine learning inequality using five dimensions of potential social disadvantage measured in PISA: sex, rurality, home language, immigrant status, and socio-economic status (SES)—using the PISA measure of ESCS (Economic, Social, and Cultural Status) to measure SES. We document four important facts. *First*, with the exception of Ecuador, *less than a third* of the *advantaged* (male, urban, native, home speakers of the language of instruction) *and* ESCS elite (plus 2 standard deviations above the mean) children enrolled in public schools in PISA-D countries reach the SDG *minimal* target of PISA level 2 or higher in mathematics (with similarly low levels for reading and science). Even if learning differentials of enrolled students along all five dimensions of disadvantage were *eliminated*, the vast majority of children in these countries would not reach the SDG minimum targets. *Second*, the inequality in learning outcomes of the in-school children who were assessed by the PISA by household ESCS is mostly *smaller* in these less developed countries than in OECD or high-performing non-OECD countries. If the PISA-D countries had the same relationship of learning to ESCS as Denmark (as an example of a typical OECD country) or Vietnam (a high-performing developing country) their enrolled ESCS disadvantaged children would do *worse*, not better, than they actually do. *Third*, the disadvantages in learning outcomes along four characteristics: sex, rurality, home language, and being an immigrant country are absolutely large, but still small compared to the enormous gap between the advantaged, ESCS average students, and the SDG minimums. Given the massive *global* inequalities, remediating within-country inequalities in learning, while undoubtedly important for equity and justice, leads to only modest gains towards the SDG targets. *Fourth*, even including both public and private school students, there are strikingly few children in PISA-D countries at high levels of performance. The absolute number of children at PISA level 4 or above (reached by roughly 30 percent of OECD children) in the low performing PISA-D countries is less than a few thousand individuals, sometimes only a few hundred—in some subjects and countries just double or single digits. These four hard lessons from PISA-D reinforce the need to address global equity by "raising the floor" and targeting low learning levels (Crouch and Rolleston, 2017; Crouch, Rolleston, and Gustafsson, 2020). As Vietnam and other recent successes show, this can be done in developing country settings if education systems align around learning to improve the effectiveness of the teaching and learning processes to improve early learning of foundational skills.

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Introduction

SDG Goal 4 aspires to "Ensure inclusive and equitable quality education for all…" The various targets bring learning front and center: Target 4.1 to refers to "relevant and effective learning outcomes"; Target 4.4 to equipping youth with "relevant skills,"; and Target 4.6 that "all youth" achieve "literacy and numeracy." Indicator 4.1.1 measures the proportion of youth "at the end of lower secondary achieving at least a minimum proficiency level in (i) reading and (ii) mathematics." It has been agreed that the PISA (Programme for International Student Assessment) level 2 proficiency "marks the baseline level of proficiency at which students begin to demonstrate the competencies that will enable them to participate effectively and productively in life as continuing students, workers and citizens." (OECD 2017).

This framing of SDG goals, targets and indicators for education raises an empirical question. How much of the deficit from achieving the goal of universal minimum proficiency in the desired skills/competencies/capabilities in reading and mathematics is because a country's education system is not "inclusive and equitable" and how much is because its education system does not provide "quality education"? This question informs ongoing debates about how much of the education agenda should focus on improving the overall quality of the education system so that all children learn versus how much focus and effort should be on equalization in education opportunities and outcomes across various identified categories of potential disadvantage (poverty, sex, rurality, minority language, etc.). We use the recently available PISA-D data from seven countries, which have learning levels typical of developing countries, to examine the relative contributions of overall country performance and the commonly identified social structures of education disadvantage to learning outcomes of students enrolled in public schools to address this question.

The empirical answer is very clear. Our calculations show that even if enrollment and learning inequalities by all of the measured student characteristics (poor/rich, girl/boy, rural/urban, native/migrant, native speaker of instruction language/other language in the home) were eliminated *completely* and *every* child had the same learning achievement of the *advantaged* and socio-economically *elite* child, the vast majority of children in every PISA-D country (except Ecuador) would still be far from getting a minimally adequate education. When the public schools are providing even the social and economic elite an education that does not reach the global minimum—much less levels of performance demonstrated to be achievable--the only possible remedy is system-wide change in the quality of education.

The core of every education system is the classroom and the school and the teaching and learning practices enacted there. To address the learning crisis and prepare their youth with at least the minimal skills/competencies/capabilities needed by successful adults, countries need teaching and learning practices in their classrooms and schools that are both *effective* and *inclusive*. High performing education systems, where nearly every student is already above global minimums in learning foundational skills but structural inequalities remain, often shift focus to inclusivity. The challenge facing education systems where even minimum learning goals are not being achieved broadly (or even by the society's advantaged elite) is more severe. These systems need to simultaneously: (a) expand enrollments and grade attainments so that every child completes basic schooling, (b) dramatically improve the *effectiveness* of teaching and learning practices in basic schooling so that those who complete it are actually equipped with the learnings, skills and competencies they need to thrive as adults, and (c) improve the *inclusivity* of teaching and learning practices so that children who begin school at a disadvantage (e.g. first generation learners, from poor households, girls) have those disadvantages addressed rather than exacerbated by the schooling system.

While this is admittedly an enormous challenge, our analysis here with the PISA-D data adds to the growing empirical literature from a variety of courses that (a) (grade attainment expansion) and (c) (inclusivity) without (b) (effective instruction), is not a viable plan for achieving the learning goals of the SDGs or eliminating learning poverty. Crouch and Rolleston (2017), Crouch and Gustafsson (2018) and Crouch, Rolleston and Gustafsson (2020) review the available evidence from a variety of sources and argue that, while there are inequalities by sex or wealth, the inequalities in learning within systems are much larger and that progress in average achievement in low performing systems comes from "bring up the left tail"—reducing the proportion of students at low levels of learning. Azevedo and Goldemberg (2020) have constructed an interactive tool to examine the inequalities within and across countries in the PISA-D/PISA data and find that only 13 percent of variation is accounted by sex, residence, and SES inequalities and conclude "equal opportunity in a poor-performing educational system does not suffice to deliver learning for all." Patel and Sandefur (2019) construct a linkage between a variety of international assessments to put them onto a common scale and then can show that in the low and lower middle- income countries the predicted average score of even students from the richest households are below 400 (their Figure 11). Pritchett and Sandefur (2017) use the literacy assessment in the Demographic and Health Surveys in 53 countries to show that only about half of adult women in these countries can read a single sentence even after completing six years of primary schooling. Akmal and Pritchett (2021) use the ASER/UWEZO data from five countries (India, Pakistan, Kenya, Tanzania, and Uganda) to show that even if the poor (from households in the bottom 40 percent by an asset index) had the enrollment and learning achievement of children from the richest 20 percent of households these countries would still be far from achieving even minimal levels of numeracy. Beatty et. al. (2018) shows that large expansions in youth who completed junior and senior secondary school between 2000 and 2014 did not lead to improvements in the mastery of even grade school arithmetic. Kaffenberger and Pritchett (2020) use a structural model of learning to show that if learning is increasingly ineffective as children lag behind then efforts to expand enrollment that do not improve teaching and learning practices lead to little or no progress on SDG goals.

None of this is to say that the expansion of schooling attainment does not lead to some progress in learning levels, of course it does, or that inclusion and the elimination of structural inequalities is not an important social justice and education agenda, of course it is. It is just that getting to universal mastery of the abc's will require education systems that do a *and* b *and* c. While it is far beyond the scope of this paper to detail how systems can meet the challenge of a *and* b *and* c we think that education systems that achieve coherence (Pritchett 2015) and are aligned (Silberstein, Hwa, and Kaffenberger 2020) around concrete learning goals like "universal early conceptual and procedural mastery of foundational skills" (Belafi, Hwa and Kaffenberger 2020)—which is a close relative to the World Bank (2018) emphasis on "learning for all through all for learning"--can implement reforms in teaching and learning practices that make rapid learning progress at scale (Piper et al 2018, Banerji, et al 2017).

I) PISA for Development: Measuring Learning Levels and Household Conditions for Examining Inequality

I.A) PISA-D: Measuring low learning levels for SDG progress

PISA is an internationally standardized study conducted by the OECD that has measured learning outcomes in mathematics, reading, and science of in-school 15-year-olds in OECD and partner countries on a three-year cycle since 2000. PISA is designed to assess students' skills and ability to apply knowledge to real-life situation in three domains: reading, mathematics, and science and in each wave one of those subjects is the focus domain. PISA study design ensures national representativeness and cross-country comparability through a national double-level sampling. In the first stage, schools with 15-year-old students at the time of the assessment are sampled from a comprehensive national list of PISA-eligible schools. For the sampled schools, a complete list of 15-year-old students is produced. In the second stage, within schools, students are sampled for the test. The PISA 2015 study was carried out in the 35 OECD countries and 37 partner countries and economies, covering over 540,000 students.

PISA defines levels of proficiency, ranges on the PISA score, characterized by the competencies students demonstrate at those levels. Table 1 shows the numerical ranges for the PISA levels and the descriptions of the skills and capabilities that students at those levels would have for up to Level 3 of the 6 PISA levels in mathematics (similar descriptions exist for reading and science). The PISA assessment is normed so that the typical (mean/median) student in the OECD is at 500, which is in Level 3. Level 2 (above 420.7 but below 488.38) includes very basic skills like interpretations that "require no more than a direct inference" and "can extract relevant information from a single source" "employ basic algorithms" and make "literal" interpretations. Level 1c (up to a score of 295.47) is at a level that is roughly a "rote" level of understanding in which students can only perform to the simplest of questions presented in a familiar format.

The PISA instrument for each subject is normed so that the average across OECD students in 2000 is 500 and the standard deviation across OECD students is 100. We use Denmark as an example of typical OECD country throughout the paper and in Denmark the average mathematics score of 500 with standard deviation of 87. In Denmark only 13.6 percent of students are at Level 2 or below and most those are at Level 1a (10.5 percent) and only 0.4 percent are at Level 1c or below.

Table 1: Descriptions of the PISA Levels 1 to 3 (of 6) for Mathematics	
Level	**Description of capabilities/competencies demonstrated at that level**
Level 3 **Between 482.38 and 544.68**	At Level 3, students can execute clearly described procedures, including those that require sequential decisions. Their interpretations are sufficiently sound to be a base for building a simple model or for selecting and applying simple problem-solving strategies. Students at this level can interpret and use representations based on different information sources and reason directly from them. They typically show some ability to handle percentages, fractions, and decimal numbers, and to work with proportional relationships. Their solutions reflect that they have engaged in basic interpretation and reasoning.
Level 2 **Between 420.07 and 482.38**	At Level 2, students can interpret and recognize situations in contexts that require no more than direct inference. They can extract relevant information from a single source and make use of a single representational mode. Students at this level can employ basic algorithms, formulae, procedures, or conventions to solve problems involving whole numbers. They are capable of making literal interpretations of the results.
SDG 4 indicator measures Level 2 or above as minimum proficiency	
Level 1a **Between 357.77 and 420.07**	At Level 1a, students can answer questions involving familiar contexts where all relevant information is present and the questions are clearly defined. They are able to identify information and to carry out routine procedures according to direct instructions in explicit situations. They can perform actions that are almost always obvious and follow immediately from the given stimuli.
Level 1b **Between 295.47 and 357.77**	At Level 1b, students can respond to questions involving easy to understand contexts where all relevant information is clearly given in a simple representation (for example, tabular or graphic) and defined in a short, syntactically simple text. They are able to follow clearly prescribed instructions.
Level 1c **Between 233.17 and 295.47**	At Level 1c, students can respond to questions involving easy to understand contexts where all relevant information is clearly given in a simple, familiar format (for example, a small table or picture) and defined in a very short, syntactically simple text. They are able to follow a clear instruction describing a single step or operation.
Below 1c **Less than 233.17**	Bottom category that includes students that answered no questions correctly. No description of specific capabilities.
Source: OECD (2017, 2018c)	

PISA for Development (PISA-D) was a pilot exercise of extending PISA to low- and middle- income countries launched in 2014 as a response to the demand of the international community for better global data on learning achievement in the context of the United Nations' Sustainable Development Goals.[1] PISA-D was implemented within the overall PISA framework and in accordance with PISA technical standards. The PISA-D was deliberately different in some ways (OECD 2018a): (i) an equal focus on the three test domains; (ii) the use of test instruments that allowed for the accurate measurement at lower levels of proficiency; (iii) the introduction in

[1] OECD (2017), PISA for Development Assessment and Analytical Framework: Reading, Mathematics and Science, Preliminary Version, OECD Publishing, Paris.

the questionnaires of additional items which are more relevant to low and middle income countries; and, (iv) for a subset of the PISA-D countries at a later stage, an assessment of out-of-school children. The results on learning of in school children were released in 2018[2].

The PISA-D assessment data we use includes around 37,000 students from seven countries: Ecuador, Guatemala, Honduras, Cambodia, Paraguay, Senegal, and Zambia. The country assessments were done in different years: Ecuador (2014), Guatemala (2015), Honduras (2016), Cambodia (2016), Paraguay (2015), Senegal (2015), and Zambia (2014).

The results for the seven countries for the three learning domains with average score, percent below Level 2 and percent at Level 1c or below are in Table 2. One can see that the differences in performance between a typical OECD country and the PISA-D countries are massive, with strikingly more students at very low learning levels. (The large proportion at level 1c or below is why the PISA instrument had to be extended to measure accurately learning differences within the sub-categories of Level 1). For instance, in Mathematics only .4 percent of students (less than 1 in 200) were at Level 1c or below in Denmark whereas this included more than 25 percent (1 in 4) students in all PISA-D countries except Ecuador. Whereas only 13.6 percent of students were not meeting the SDG in Mathematics in Denmark this almost exactly reversed with fewer than 13.6 percent *reaching* the SDG in all countries but Ecuador. In the lowest performing of the PISA-D countries (Cambodia, Senegal, Zambia) more than 90 percent were not reaching Pisa Level 2 proficiency in any subject.

Table 2: Overall learning results for the PISA-D countries show very low learning levels, with between 70 and 95 percent not reaching PISA level 2 in each of the learning domains (except for Ecuador)

Country	Mathematics			Reading			Science		
	Average	Percent below level 2	Percent level 1c or below	Average	Percent below level 2	Percent level 1c or below	Average	Percent below level 2	Percent level 1c or below
Cambodia	325	90.1	33.8	321	92.5	16.5	330	94.8	8.4
Ecuador	377	70.9	14.4	409	50.6	3.2	399	57.2	1.9
Guatemala	334	89.4	28.7	369	70.1	7.7	365	77.2	3.6
Honduras	343	84.6	27.1	371	70.3	6.6	370	75.7	3.0
Paraguay	326	91.7	33.0	370	67.8	9.6	358	76.2	8.5
Senegal	304	92.3	47.2	306	91.3	27.3	309	95.8	17.9
Zambia	258	97.7	71.7	275	95.0	48.9	309	94.2	19.2
Denmark	511	13.6	0.4	500	15.0	0.5	502	15.9	8.9
OECD average	490	23.4	1.9	493	20.1	1.3	493	21.2	0.6

Source: PISA-D Database; OECD 2018b, Tables 9,10 (Reading), 30,31 (Mathematics), 51,52 (Science)

While there are only seven PISA-D countries reporting results and they are not meant to be "representative" of the developing world, their levels of development and their learning levels

[2] The out of school results are only recently available (Ward 2020) and hence are not used here.

are not atypically low among developing countries. Table 3 shows that the PISA-D countries are in the middle ranks by development indicators, ranking from 27th (Senegal) to 76th (Paraguay) on GDP per capita of 111 developing countries and from 36th (Cambodia) to 97th (Ecuador) on an overall ranking of human well-being (Social Progress Index). Table 3 compares the PISA-D countries' learning outcomes to other measures of learning in developing countries and shows that, while the PISA-D countries ranking is the lowest of the set of PISA participants, which are generally OECD and upper income countries, the PISA-D countries are typical developing country performers. For instance, Honduras PISA-D scores places it 10th lowest of all PISA plus PISA-D countries but it is the top of the DHS reading rankings and near the middle of the developing countries, 20th of 45, in the expanded TIMSS/PIRLS rankings in Patel and Sandefur (2019), and near the middle of the developing countries in the World Bank Harmonized Score (62nd worst of 105). The World Bank Harmonized Score population weighted average for all developing countries is 398 and for the seven PISA-D countries is slightly higher, at 407. Nothing we say should be seen as singling out these particular countries for criticism as we think they are typical in learning performance among countries at their level of development and they should be praised for their willingness, courage, commitment, and capability in participating in PISA and in allowing the results to be disseminated.

Table 3: The PISA-D countries are broadly comparable by other rankings of learning achievement to the rest of the developing world and are not atypically low

PISA-D Country (plus DR)	Average PISA Score across all three subjects (rank compared to PISA 2015 participants)	Ranking from 1 (worst) to N (best) among developing countries only			Rank on developing indicators	
		DHS measure of young adult woman literacy of those who completed grade 6 (but no higher)	Patel and Sandefur (2019) 'Rosetta Stone' score/ranking of average math and reading of 4th graders on a TIMSS/PIRLS	World Bank Human Capital Index Harmonized Score 2017	GDP per capita	Social Progress Index
Zambia	262 (1/74)	14/53		358 (26/105)	29/111	37/113
Senegal	299 (2/74)	20/53	416 (23/45)	412 (75/105)	27/111	47/113
Cambodia	314 (3/74)	34/53		452 (95/105)	33/111	36/113
Guatemala	331 (5/74)		384 (15/45)	405 (66/105)	53/111	49/113
Paraguay	334 (6/74)		366 (8/45)	386 (51/105)	76/111	83/113
Honduras	344 (10/74)	53/53	399 (20/45)	400 (62/105)	45/111	50/113
Ecuador	365 (16/74)		411 (22/45)	420 (77/105)	72/111	97/113
Dominican Republic	314 (4/74)	45/53	332 (5/45)	350 (18/105)	97/111	79/113

Source: PISA-D results, DHS: Pritchett and Sandefur (2017), Patel and Sandefur (2019), World Bank Data Bank (1/21/2021).

Notes: GDP per capita ranks are in 2018 by the PWT 10.0 data where "developing" are all countries less than P$24,000 (Chile is the highest under this threshold). The ranking of the Social Progress Index in 2018 where "developing" is all countries less than 80 on a 1 to 100 scale (Argentina and Bulgaria are the highest under this threshold).

Our analysis of PISA results for learning does not imply that we regard cognitive skills as the only important outcome of education systems or that we think PISA is an ideal and perfect measure of the entire variety of skills youth might need in the 21st century. But the PISA assessments are a reliable and valid measure of at least one set of skills that all education systems in their stated goals and official curricula claim they intend to convey and are an accepted measure for the SDGs.

I.B) Measuring household socio-economic background

We use the PISA ESCS index, which summarizes family/household conditions believed relevant to the child's education. The student questionnaire provides information on parents' highest level of education, parents' highest occupation status, and home possessions and from that the ESCS is constructed using the Principal Component Analysis[3]. Home possessions are measured through the availability of 16 household items including proxies of family income and wealth (e.g., works of art, appliances, cars), books in the home and other educational resources (e.g., a room for student's own, availability of computers, educational software, internet). The ESCS index is constructed in the same way across the participating countries. In PISA 2015 the index was standardized to have mean zero and variance one for the average student in OECD countries. In PISA-D the index was extended to include other household items typical of low- and middle-income countries.

Table 4: Level and variation in the ESCS (Economic, Social and Cultural Status) Index from PISA

Country	Percent of all 15 year olds participating in PISA	Country ESCS Index		
		Average	Std. Dev.	ESCS "Elite" threshold (mean+ 2sd)
Zambia	36.0	-1.57	1.41	1.31
Senegal	29.0	-1.97	1.32	.99
Cambodia	28.1	-1.95	1.04	.24
Guatemala	47.5	-1.72	1.06	1.08
Paraguay	55.6	-1.41	1.02	.97
Honduras	41.4	-1.64	1.13	1.29
Ecuador	60.6	-1.22	1.02	1.40
Denmark	89.0	.59	.87	2.33
Vietnam	48.5	-1.87	1.11	.35

Source: Column 1 is from Table 3, Column G reporting "coverage index 3." Columns 2-4 are from authors' calculations with household data.

The ESCS index both is and is not comparable across countries. Mechanically the index is comparable in that the same weights were used on the same variables in each country to construct the index. But there are two important cautions in comparing the index internationally.

[3] The PISA 2015 Technical Report (OECD 2017, pp. 339–340).

One, those who took the test in the developing countries tended to come from the higher economic strata of these countries as only those in school at age 15 were in the PISA sample. For instance, in Zambia, one of the poorer countries which participated, only 36 percent of children aged 15 were in the PISA sample. Of those Zambian households in the PISA sample: 28% of children had a computer at home that they could use for school work; 51% of households had a bank account; 17% of students had a father who completed the second stage of tertiary education; and occupationally 9% of were professionals and 6% managers. This is clearly not nationally representative of Zambian households. In contrast in Denmark 89 percent of 15 year olds were in the sample and hence the ESCS is closer to being representative. A child that is 2 standard deviations higher in the ESCS distribution *of those in the PISA sample* is at an ESCS score of 1.31 in Zambia and 2.33 in Denmark but the Zambian child is even more elite relative to the entire population in Zambia than in Denmark.

Two, this index is not based on comparable in monetary units and does not measure household per capita consumption/income or wealth.[4] A person with a tertiary degree who is a professional will get the same weight for that in Zambia or Denmark whereas their income/assets are much lower. Hence if we compare a household with the same ESCS, say a household at 1.31 in Zambia and a household at 1.31 in Denmark the Danish household will have a much higher level of material goods/income/consumption. Other issues related to the comparability across countries and over time have been acknowledged in the existing literature[5]. However, since we are using the PISA and PISA-D data we use the ESCS index as our measure of household socio-economic status rather than try to construct a new index and this is a reasonable index within each country.

I.C) Regression results to examine inequality

For each country we estimate regressions using three distinct learning outcomes as the dependent variable. In equation 1 the dependent variable is the estimated score of student *i*. In equation 2 the dependent variable is an indicator variable that =1 if the score for student *i* is above the PISA Level 2 proficiency (PL2P) threshold (which is different for each subject). In equation 3 the dependent variable is an indicator variable =1 if the student's score is above the PISA threshold for Level 1c.

$$E[S_{is}|X] = \alpha + \beta_A Age_{is} + \beta_F Female_{is} + \beta_R R_{is} + \beta_L L_{is} + \beta_I I_{is} + \gamma_{SES} \nabla ESCS + \varepsilon_{is} \quad (1)$$

$$E[I[S_{is} > S^{L2}|X]] = \alpha + \beta_A Age_{is} + \beta_F Female_{is} + \beta_R R_{is} + \beta_L L_{is} + \beta_I I_{is} + \gamma_{SES} \nabla ESCS + \varepsilon_{is} \quad (2)$$

$$E[I[S_{is} > S^{L1c}|X]] = \alpha + \beta_A Age_{is} + \beta_F Female_{is} + \beta_R R_{is} + \beta_L L_{is} + \beta_I I_{is} + \gamma_{SES} \nabla ESCS + \varepsilon_{is} \quad (3)$$

The dependent variables included in each regression are:

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[4] Patel and Sandefur (2020) used measured assets and the distribution of per capita consumption to create a comparable dollar value measure of household consumption across countries and estimate SES gradients across and within countries using that measure. We would not expect the broader measure of ESCS to be strictly comparable to those gradients.

[5] Avvisati (2020, pp.8-29) summarizes some of the main limitations of the index related to comparability.

- Age_{is}, the age of student *i* measured in years,
- $Female_{is}$ is a binary indicator taking value one if the student *i* is female,
- R_{is} is =1 if the student *i* attends a school located in rural area, and zero otherwise
- $L_{is}$is =1 if the student speaks at home a language different from the one spoken in school, and zero otherwise
- I_{is} is =1 if the student is either a first or second-generation immigrant in the country, and zero otherwise.
- $\nabla ESCS$ is a matrix with the linear, squared, and cubic values of the PISA index of the economic, social, and cultural status (ESCS) hence γ is a 3 x 1 vector including the three estimates for the coefficients associated with the first, second, and third degree polynomial of the ESCS index included in the matrix $\nabla ESCS$.

For each of the five dimensions of inequality we explore here (sex, rurality, home language, nativity, and ESCS) the detailed PISA-D tables provide results for the distribution of scores and of the likelihood of reaching Level 2 proficiency by these categories (e.g. boy/girl, rural/urban) and by quartiles of the ESCS index. Our OLS regressions extend this descriptive work on inequality to allow for correlations among the multiple comparisons and for the use of ESCS as continuous variable. For instance, when characteristics are correlated (e.g. rural children could have average lower ESCS than urban children) OLS estimates the differences between a rural and urban child with the same ESCS, rather than the raw difference.

Our purpose is very different from the much more common use of OLS (and other more sophisticated) regression (and, more recently, experimental) techniques on data on test scores in the enormous "education production function" literature[6,7]. This literature uses student test scores, student characteristics, and observed variables about the classroom, teacher, school, and school system to investigate the correlates and causes of learning. A typical question in this literature is whether a child would learn more in a larger or smaller class or whether a child would learn more with a teacher with this academic qualification or that academic qualification.

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[6] Some technical points. One, the coefficients would be different using a different set of control variables and hence a more accurate (if pedantic) notation for the coefficient on rurality would be: $\beta^{S}_{R|A,F,L,I,ESCS}$ to emphasize that a different set of conditioning variables (or functional form) potentially produces different estimates of the coefficients depending on the correlations of the conditioning variables. Two, compared to cross-tabulations our simple OLS does impose zero interactive effects, which may exist and hence we are sacrificing some descriptive accuracy for simplicity. Three, even though our dependent variable is binary we use OLS rather than estimation methods that takes that into account (e.g. Probit) as OLS coefficients are consistent but not efficient. In our choices of technique, we chose the simplest, easiest to present and understand and the most natural extension of the existing results from PISA.

[7] This literature is so huge we hesitate to even point to any references as it would be too selective and limiting but will make two exceptions. Self-citation, of course, as Pritchett (2004) and Filmer and Pritchett (1999) are two reviews of this literature, with bite. The other is that the PISA data (and other large cross-national collections, like TIMSS) are used to estimate the association of learning outcomes with characteristics of the system as cross-national data is the only econometric way to get out these type of system level effects, as, for instance, reviewed in Woessmann (2016).

In the "education production function" literature the student characteristics, like sex or ESCS, are not of direct interest but are "control" variables that are included in order to compare, say, class size, for "otherwise identical" students to parse out the "treatment effect" or causal impact of class size[8]. What we are doing is, in some ways, the opposite. Our interest is not to use student characteristics as "controls" to estimate something else, a causal impact, rather our interest in the differences in learning by student characteristics themselves, irrespective of their causal pathways. So, for instance, we do not include any school characteristics (e.g. school resources, teacher qualifications) because we are not attempting to trace out the pathways whereby the included student characteristics, like ESCS, have their impact (either causally or even in a descriptive accounting). Perhaps one reason students in rural schools have lower scores is that rural schools deploy fewer resources per student but this just allows a decomposition of the "total" OLS conditional mean into the "partial" derivative pathways. Similarly, perhaps students from households with higher ESCS attend better schools (with higher learning value added) and this is one of the causal pathways that lead to a higher conditional mean score for students with higher SES, but we are not attempting to do that decomposition, we are interested in the conditional mean itself.

We limit our sample to students enrolled in public schools from the seven participating countries in PISA-D. We decided to limit our analysis to public school students in analyzing inequality for two reasons. One, we are intrinsically interested in comparing the performance of public schools across countries in the world and the systematic determinants of why public schools perform extremely well in some countries and are weak in others (Pritchett 2015). Two, in earlier research we examined variation in learning achievement across the private and public schools (Pritchett and Viarengo 2015) and there are massive differences across countries in the assessed learning of students enrolled in public and private schools and these differences are some complex (and mostly unknown) mix of selectivity of students and causal impacts (Pritchett 2021). In the present paper we want to focus only on the learning inequalities of those who are within the public system and bracket (for now) the additional inequalities generated by the existence of private schools.

In addition to the seven PISA-D countries we also do regressions for five selected countries/regions participating in PISA 2015 (Denmark, Finland, Korea, Beijing-Shanghai-Jiangsu-Guangdong (China), and Vietnam) and for two variants of the OECD as a whole. We selected the PISA 2015 wave given that PISA-D is developed on the assessment frameworks of PISA 2012 and 2015 and matches best the timeline in the PISA-D participating countries. These were chosen to represent different comparators: Denmark is chosen as a typical OECD country as its scores are very near the OECD averages. Finland is chosen as a "high performing" OECD country. Korea is chosen as a very high performing country that was developing but now at OECD levels of income. Vietnam was chosen as it is a developing country with roughly OECD

[8] The methodological debate about whether non-experimental data can ever adequately produce "otherwise identical" students is what has led to the use of randomization to balance student characteristics between "treatment" and "control" to produce unbiased estimates of causal impacts.

levels of PISA performance. We also report, but rarely use, the regions of China as a high performing region.

The regression results for equations for equation 1 (Score), equation 2 (PL2P) and equation 3 (above Level 1c) for each of the subjects (Mathematics, Reading and Science) are in the appendices (Regression Appendix M, Appendix R, and Appendix S). The results and their implications for inequality will be explicated using graphs in the sections below.

One technical point about the regression results, that we return to below, is that although a number of the student characteristics are statistically significant (ESCS for instance is always significantly associated with learning outcome measures in all countries) the overall explanatory power of these regressions is quite low. Put another way, the standard deviation of the residual of the regressions, which is a measure of the variability of the distribution of scores for a child with given characteristics (e.g. a 15 year old girl attending a rural school who speaks the native language, is not an immigrant and has the average ESCS) is not that much smaller than if we did not know anything about the child. This modest explanatory power of the five characteristics implies that there are disadvantaged children who do well and advantaged children who do very poorly.

II) First Hard PISA-D Fact: The Advantaged, SES Elite of PISA-D Countries Perform Badly by Global Standards

II.A) Global and country inequality in PISA mathematics scores

We start by focusing on the distribution of learning outcomes for the *advantaged* children in *ESCS elite* households. By *advantaged* we take the four characteristics measured by PISA-D as common indicators of learning disadvantage and included in the regressions above: sex, rural residence, speaking the language of instruction at home and being a native of the country. We call children "advantaged" if they are male, urban residents, natives of the country and speak the assessment language in their household, even though (as we see below) these characteristics do not convey advantage in each subject in each country. Moreover, our use of the designation of "advantaged" is socially constructed and does not imply these categories are necessarily sources of advantage, nor that they are normatively justified sources of advantage—we are certainly not claiming, for instance, it is everywhere and always an "advantage" to be born male or not be a migrant. By *ESCS elite* we mean those who are at two standard deviations above the mean ESCS for their country. If ESCS had a standard Gaussian Normal distribution these would be households at the 97.5th percentile of the ESCS distribution[9].

Figure 1, for Mathematics results in Zambia, illustrates several points (the equivalent graphs for all other countries and subjects are in Graphical Appendix, GA.M for Mathematics, GA.R for Reading, and GA.S for Science).

[9] The graphs of the actual distribution of the ESCS show that these distributions are not symmetric (skewed) and may be kurtotic (fatter tails than a Normal) and hence the "mean plus two standard deviation" is just a well understood metric for "far into the upper tail" but won't be at exactly the same percentile of the distribution of ESCS for each country.

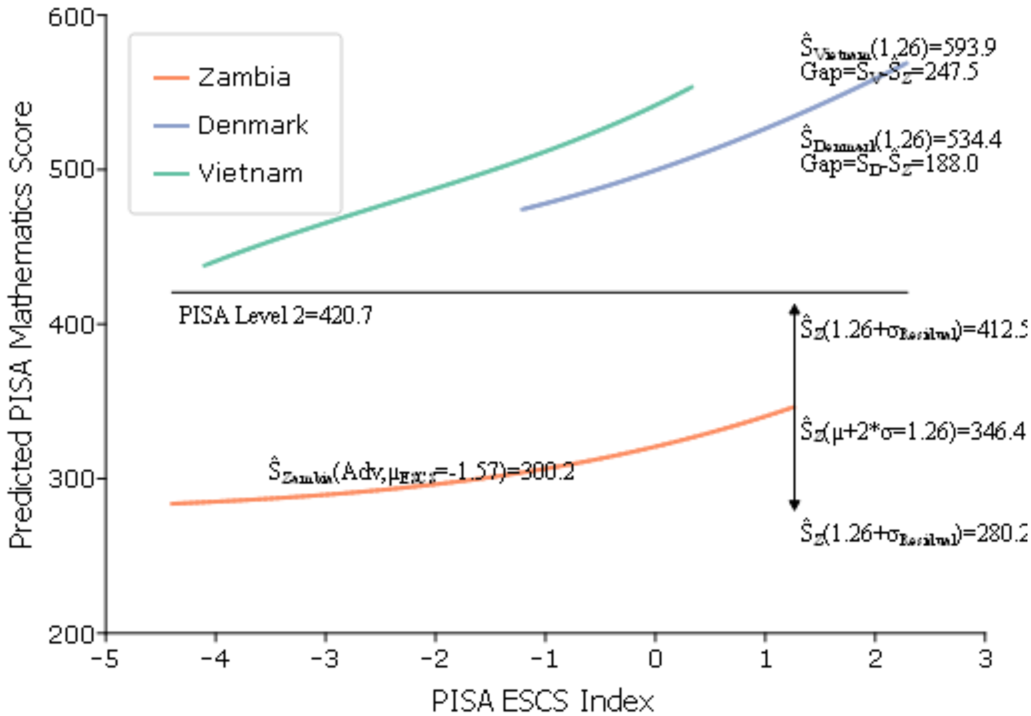
First, there is a substantial learning advantage to being in the ESCS elite. The predicted score of 346 is substantially above 300, the average for the advantaged child from an average ESCS household. The standard deviation on PISA across all Zambian children is 72 so those in the ESCS elite (+2 sd) perform about 2/3 of a standard deviation above the advantaged but average ESCS child.

Second, the advantaged ESCS elite children are far below the threshold for meeting the SDG target of PL2P: their average score of 346 is about 75 points (more than a full Zambian standard deviation) below the SDG threshold of PL2P for mathematics of 420.7. Strikingly, even the *high performing* (+1 residual standard deviation) advantaged, ESCS elite child in Zambia (412.5) performs below the *minimal* SDG standard.

Third, the advantaged, ESCS elite, child in Zambia performed less well than the average child in most other countries. The *average* enrolled child in all but one of the 68 countries that participated in PISA 2015 or PISA 2018 scored above 346.

Fourth, the graph shows that a child with the *same* measured characteristics in a high performing country (Denmark or Vietnam) is predicted to do fantastically better. An advantaged child in Vietnam with the ESCS of the Zambia mean plus 2 sd of 1.31 is predicted to score 594, 248 PISA points higher, which is more than three Zambia residual standard deviations. This implies that essentially no Zambian student scores as well as a Vietnamese student with the same characteristics. Even a very poor child in Vietnam (2 sd below the Vietnam mean) is, on average, predicted to perform better than the high performing, advantaged, ESCS elite, child in Zambia.

Figure 1: Comparing Zambia to Denmark, Vietnam, by ESCS

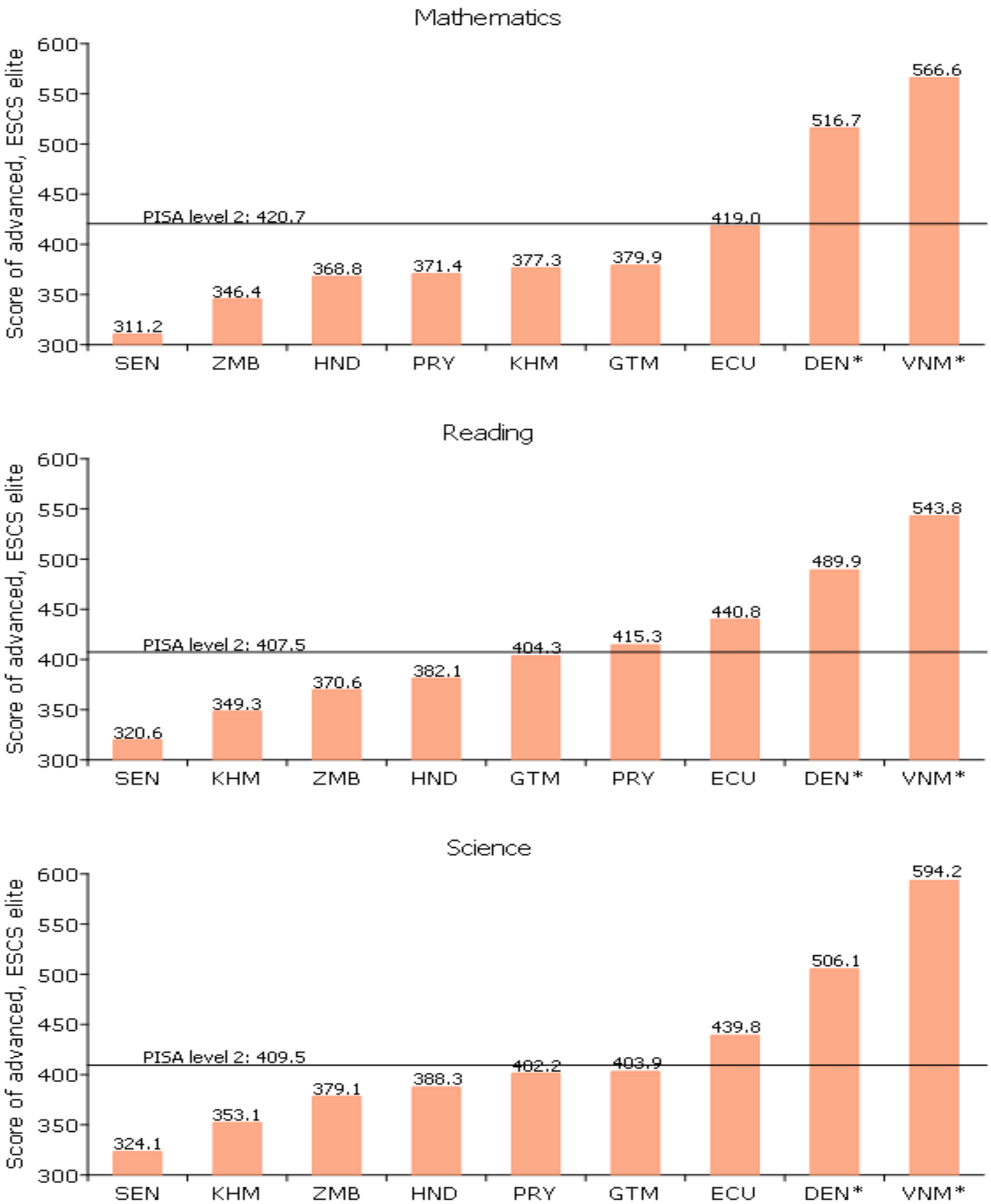


Source: Authors' calculations.

Figure 2 shows the predicted score for the advantaged, ESCS elite student for all seven PISA-D countries and all three subjects (Mathematics, Reading, and Science). The results show that while Zambia is a low performer even among the PISA-D countries, the advantaged, ESCS elite have low performance in all subjects. Importantly, in (nearly) *all* countries and in (nearly) *all* subjects the average of the advantaged, ESCS elite students are *below* PL2P--the only exceptions are Ecuador in Reading and Science and Paraguay in Reading.

Figure 2 also compares the performance of the advantaged, ESCS elite with similarly situated students in a typical OECD (Denmark) or a high performing developing (Vietnam) country. The results for Denmark and Vietnam are the predicted score of a student in that country that is advantaged and at the same level of ESCS as the average PISA-D country elite. The average PISA-D ESCS plus 2 sd score is 1.04, about a standard deviation above the OECD average. Again, this reflects that the ESCS is *not* an absolute comparison of material wellbeing but a measure of material plus status *within* a country (e.g. occupation, education). As can be seen the PISA-D countries are 100 to almost 200 points below a similarly situated (observationally equivalent on the five variables) student in Denmark and 150 to 250 points behind a similar child in Vietnam.

Figure 2: In all three PISA subjects the advantaged, ESCS elite students perform very poorly by global standards, falling below PISA level 2 performance, and far below OECD (Denmark) or high performing developing (Vietnam) countries



Source: Authors' calculations.

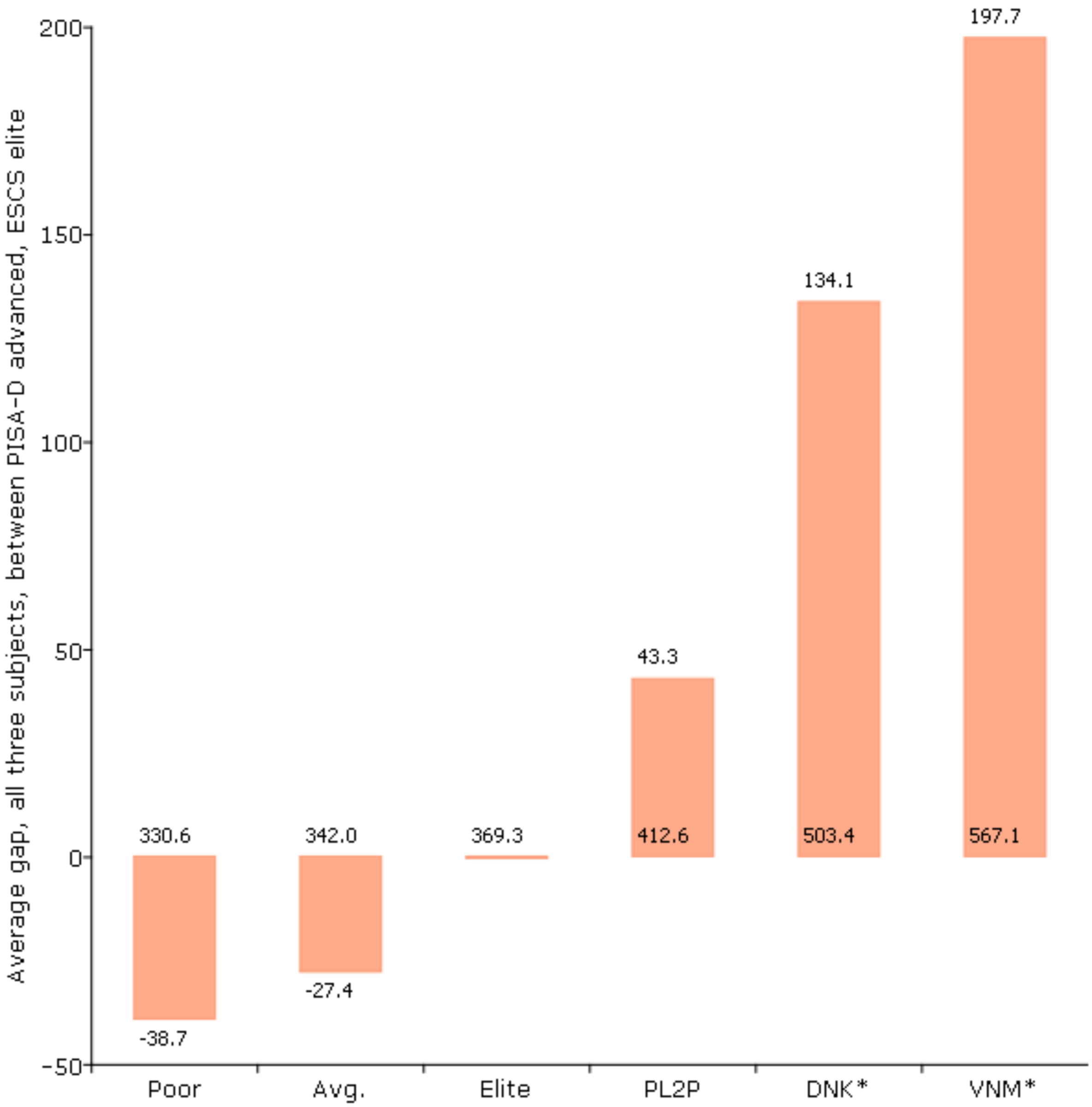
Notes: DEN and VNM* are the predicted results for advantaged students in those countries at the average ESCS of the PISA-D countries.*

We can use the regression results to compare differences in learning due to within country inequalities due to SES, in this case the ESCS index, versus the cross-national differences in learning. Figure 3 shows that the predicted score for the advantaged, ESCS elite in the PISA-D countries less Ecuador (called PISA-D-6), averaged across all three subjects is 369 compared to various other groups. If one compares the ESCS elite to the ESCS "poor" (those who are two standard deviations below the mean) this compares learning across the entire range of ESCS (of the enrolled) and finds that the poor are at 330, roughly 39 points, behind the elite. And the PISA-D-6 average ESCS student is about 27 points behind the elite ESCS child.

Figure 3 gives three points of comparison for the magnitude of the entire range of within country inequality in SES. First, the elite children are farther below the SDG PL2P level (43.3 points) than they are ahead of their fellow own country ESCS poor (38.7 points). Second if one compares the "country effect" of the difference between PISA-D-6 countries and a student in Denmark with the same characteristics (advantaged and at the same ESCS) the gap is 134 points, which is 3.5 times bigger (=134.1/38.7) than the gap between the ESCS elite and ESCS poor within countries. Third, gap with Vietnamese students with the same characteristics is 197.7 points so the "across country" gap is 5 times larger (=197.7/38.7) than the "elite-poor within country" gap[10]. The comparison with Vietnam is even more telling than with Denmark as the ESCS index is more comparable (as the ESCS distribution is in the same range as the PISA-D-6 and other purely economic indicators are at similar levels). Vietnam shows that weak socio-economic conditions is not an insuperable obstacle to achieving good education results[11].

[10] The PISA-D reports a similar calculation, with similar results. Tables 13 (Reading), 34 (Mathematics), and 55 (Science) report the predicted score for a student at ESCS of zero for all countries. This differs from our calculation in using a different functional form, not simultaneously adjusting for other characteristics, in using all students versus just public sector students and predicting at zero rather than the PISA-D-6 elite score. The PISA reported estimated score at ESCS=0, averaged across all three subjects, for the PISA-D-6 is 360 whereas for Denmark is 485 (a 125 point gap) and for Vietnam is 550, an 190 point gap.

Figure 3: The gap between the ESCS elite (+2 sd) and poor (-2 sd) in PISA-D-6 countries is large, 39 points, but smaller than the gap between the PISA-D-6 ESCS elite and the SDG and much smaller than between the PISD-D-6 ESCS elite and ESCS equivalent students in



Source: Authors' calculations.

Notes: DNK and VNM* are the predicted results for advantaged students in those countries at the average ESCS of the PISA-D countries.*

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[11] Singh (2020) uses panel data from the Young Lives study that tracks children from young ages to show that the higher learning achievement in Vietnam is primarily due to higher learning per year of schooling, not any advantage going into schooling.

II.B) Gains to achieving PISA level 2 from country versus global inequality

Using the regression results from equation 2, where the dependent variable is whether a child was above the PISA Level 2 threshold for Math, Reading and Science[12] we do the simple exercise: "what if every child in the country was both (a) in school at age 15 (so all non-enrollment and drop-out up to that age were eliminated) *and* (b) had the same learning outcomes as the assessed advantaged, ESCS elite students?"

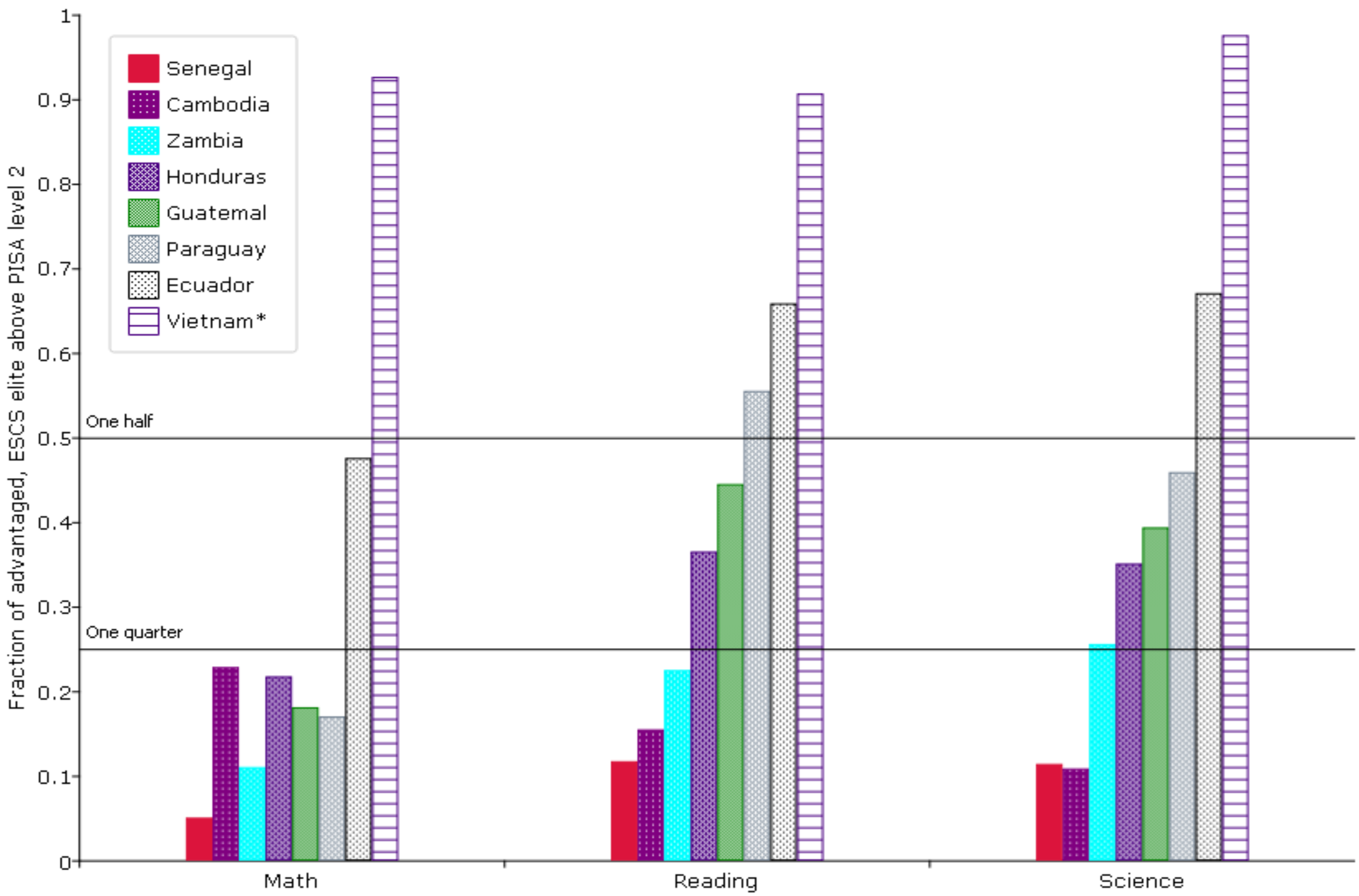
Figure 4 shows the results for all three subjects for the seven PISA-D countries and for Vietnam at the average ESCS for the elite of the PISA-D countries. It is clear that even if expansion to universal enrollment were achieved and even if all learning inequalities of in (public) school children were erased, so that every child achieved the same learning as the advantaged ESCS elite children now enjoy, countries would be far from achieving the SDG targets.

In mathematics all of the PISA-D countries (except Ecuador) would still have less than a quarter of their 15-year-olds reaching the SDG level of PL2P. In reading the outcomes are more variable and three countries (Senegal, Cambodia, and Zambia) would also still be less than one quarter whereas Guatemala and Honduras would be less than one-half. In science there is roughly the same pattern with Senegal, Cambodia, and Zambia at one quarter or less and Guatemala, Honduras, and Paraguay at less than half. The contrast with Vietnam is striking. In all three subjects more than 90 percent of kids at the PISA-D elite levels of the ESCS are over the SDG threshold.

Table 5 shows the details for mathematics and compares the advantaged ESCS elite to other students. The results show two aspects of inequality. *Relative* to other kids in the same country the elite are much more likely to reach PL2P: in Guatemala the average student who took the PISA-D assessment only had a 5.2 percent chance whereas the advantaged ESCS elite student has an 18.2 percent chance, which is more than 7 times higher. But, in the global comparison, 18.2 percent implies that only one in five of the advantaged, ESCS elite students in Guatemala are reaching even a global *minimum* threshold.

[12] Results in Appendix Tables RA.M.PISA-D.Level2 and RA.M.Comparator.Level2 (for math); RA.Reading.PISA-D.Level2 and RA.Reading.Comparator.Level2 (for reading); RA.S.PISA-D.Level2 and RA.S.Comparator.Level2 (for science).

Figure 4: The fraction of advantaged, ESCS elite students in PISA-D countries (except for Ecuador) who reach PISA level 2 between is less than a quarter (in Senegal, Cambodia, Zambia) and less than half (in Guatemala, Honduras, and Paraguay (except for reading) which puts a strong upper bound on what can be achieved from reducing inequality in access alone



Source: Authors' calculations with PISA-D data.

Table 5: Implications of raising all students to performance of advantaged. ESCS elite, students for reaching the SDG goal of PISA level 2 or higher competence							
Country	Percent of the 15 year old cohort both PISA eligible[a] and above PISA level 2	Percent of all 15 year olds not eligible to be assessed (out of school or grade 6 or below)	Average percent level 2 or higher (public sector, weighted)	Predicted Propensity to reach level 2, Advantaged Students at Average ESCS (public sector)	Predicted Propensity to reach level 2, Advantaged, ESCS Elite (+2 sd) Students (public schools)	Total gain to cohort achievement of SDG from bringing all children to (a) eligibility[a] and (b) learning outcomes of advantaged elite ESCS	High performing, advantaged, elite ESCS students (+1 sd of score residual)
Zambia	0.6%	63.9%	1.8%	4.2%	11.8%	11.2%	29.6%
Senegal	1.5%	71.0%	5.1%	6.4%	6.4%	4.9%	29.1%
Paraguay	3.1%	44.2%	5.5%	6.3%	17.4%	14.3%	41.5%
Guatemala	2.5%	52.5%	5.2%	6.9%	18.2%	15.8%	40.2%
Cambodia	2.6%	71.7%	9.1%	13.1%	23.6%	21.1%	50.5%
Honduras	3.8%	58.5%	9.3%	11.3%	22.3%	18.5%	52.6%
Ecuador	13.4%	38.0%	21.6%	19.1%	47.9%	34.5%	88.1%
Source: Author's calculations with PISA-D data. *Notes: (a) PISA Eligible means enrolled in grade 7 or higher at age 15.*							

These simple calculations imply that the elimination of socio-economic differentials in education outcomes in both enrollment/grade attainment and learning can be only one part of any PISA-D country's plan to reach the education SDGs--and in the lower learning countries one empirically small part. Moreover, as we show in Section III below the assumption that a complete elimination (or even substantial reduction) in the learning differences by SES is extremely implausible. Progress to reach the SDG will require *both* expansions in grade attainment *and* the learning of those in school to improve *for (nearly) everyone,* and by *very large amounts*.

II.C) Student Characteristics and very low learning levels (Level 1c or below)

Crouch and Rolleston (2017) and Crouch, Rolleston and Gustaffson (2020) emphasize the importance of "raising the floor." Table 6 uses the PISA-D data on Level 1c or below learning, which, was we saw in Table 1 above represents a truly minimal level of learning. The upper threshold for level 1c for mathematics is about 300, which is 120 points below level 2). Table 6 shows the percent of children predicted to be a Level 1c or below in mathematics and reading for the average child and for the advantaged child at average ESCS. This shows that in five of the seven PISA-D countries more than a quarter of the male, urban, native, dominant language speaking "middle class" children were at Level 1c or below. Of course this was higher for children that did not have all these advantages, but not that much higher. In Cambodia, 41 percent of students (across all conditions) were predicted to be at Level 1c or below and 29 percent of the advantaged, average ESCS students were also at that level.

Table 6: Even the advantaged "middle class" (mean of ESCS) students often reach only very low levels of learning (level 1c or below)				
Country	Mathematics		Reading	
	Average percent at level 1c or below	Advantaged students, at average ESCS	Average percent at level 1c or below	Advantaged students, at average ESCS
Zambia	75.4%	51.6%	45.6%	22.6%
Senegal	60.3%	51.7%	29.5%	23.3%
Paraguay	40.7%	29.4%	4.0%	4.1%
Guatemala	34.6%	16.7%	8.6%	4.3%
Cambodia	41.3%	28.6%	24.1%	19.9%
Honduras	41.8%	33.0%	5.2%	3.6%
Ecuador	17.4%	15.0%	13.5%	13.8%
Source: Authors' calculations with PISA-D data				

This examination of very low performance is important because it illustrates the *typical* (or at least very common) teaching and learning practices in these countries. That is, very low learning levels of rural girls from poor households who are first generation school goers and who do not speak the language of instruction in the home can be understood as the result of a cumulative of disadvantages (see Section IV): rural schools often have difficulties attracting quality teachers, gender bias can work against an emphasis on girl's learning, lack of household income leads to multiple causal pathways of disadvantage, first generation school goers cannot get as much help from parents, lack of mother tongue instruction can make it difficult for students to navigate their early school years. But what is striking about the analysis of the frequency and inequality in very low learning levels is that in five of the seven (Zambia, Senegal, Paraguay, Cambodia, Honduras) PISA-D countries in mathematics at least one in four students (>25%) who face *none* of the four structural disadvantages and is *not* relatively poor (has average ESCS) nevertheless has very low learning performance.

As Crouch and Rolleston (2017) emphasize, if one wants to eliminate low levels of learning one needs to focus on eliminating low levels of learning. This might seem a truism but many would argue one should focus on targeting children with the characteristics that are associated with low learning. But in low performing education systems it is not just the "excluded" or "marginalized" who are getting a very weak education. A focus on "universal, early, conceptual and procedural mastery of foundational skills" is a way of "bringing up the bottom tail" of *learning* which then, necessarily brings up the low learning of the disadvantaged more than others (since, at the margin, they start from lower levels). But this is a system focus to bring about global equity by focusing on attaining global levels rather than an exclusive focus on the differentials across categories.

III) Inequality by ESCS of those assessed is not higher in the PISA-D countries

The previous section ignored two related questions.

- How much of the difference in learning outcomes by ESCS could plausibly be eliminated in PISA-D countries?
- How much of the very weak learning performance of disadvantaged/marginalized/excluded children in the PISA-D countries is due to their lagging further behind the advantaged/elite counter-parts and how much is that they are lagging behind a very low country level?

We suspect many believe that the disadvantaged in poor and less-developed countries lag behind more privileged others by a large extent than they do in rich and high capability or high performing countries. This section shows that, with respect to the learning outcomes of the enrolled and using the ESCS measure of socio-economic status this just isn't the case. Students from low ESCS households in PISA-D countries lag the advantaged elite in their own country *less,* both absolutely and relatively, than in high capability countries like Denmark or Finland or in high performing countries like Vietnam or Korea.

III.A) Differences in learning outcomes by ESCS between PISA-D and high performing countries

We do the following calculations to create the comparison between Denmark and Zambia (and similarly for all other pairs of comparisons).

First, we create a series of ESCS deciles for the comparison country (Denmark, Vietnam, etc.) anchored to be the same for the top decile but spread out so that they have the same range as the comparison PISA-D country. We do this because the coefficients on the cubic terms in ESCS in the comparison country (e.g. Denmark) are estimated in the range of data for Denmark and predicting the score for a Danish student for the lower levels of ESCS for the PISA-D countries would force the predictions far out of the actual range of ESCS. For instance, the average ESCS in the lowest decile for Denmark is -1.23, whereas that is the average for the sixth decile in Zambia and the average of the lowest decile in Zambia in -4.11, almost three units of the ESCS (normed to have standard deviation 1) lower than Denmark's. We slide the whole distribution up to be the same at the 10^{th} decile but then spread it out and use Denmark's coefficients to predict PISA scores at the deciles that reflect Zambia's spread in the ESCS.

Second, we then take the ratio of each decile in the comparison country (Denmark) to the top decile.

Third, we then multiply these ratios across deciles using Denmark's coefficients times the predicted value for the top decile in Zambia.

This produces the answer to the question: "What would have been the predicted PISA score for a child at the d^{th} decile of the Zambian ESCS distribution if the ratio of the predicted score to the top score were the same as would have been predicted moving along the shape of the PISA score-ESCS relationship in Denmark?"

To switch to Guatemala and Finland as an example of how our counter-factual calculations work mechanically. The average ESCS for the 10th (richest) decile in Guatemala .45 and for the 1st (poorest) is -3.24, a spread of 3.69. For Finland the top decile average ESCS is 1.38 and the lowest decile is 1.06 for a spread of 2.44. The predicted value at Finnish coefficients for the 10th decile in Guatemala first predicts the PISA score that is 3.69 ESCS points lower than the Finnish top decile 1.38, so at an ESCS value of -2.31. That is 423 and the ratio of 423 to the score predicted for the top decile is 542 is .78. The predicted value of the top decile for Guatemala is 380.5 so the predicted value for the Guatemalan 10th percentile at the Guatemalan distribution of ESCS (hence spread between the deciles of the ESCS) but the Finnish coefficients is .78*380.5=296.8.

We compare each PISA-D country to four high performing countries: Denmark and Finland and two high performing non-European countries, Korea and Vietnam.

Figure 5 shows the results for Zambia (all other countries are in the Graphical Appendix). We show the actual predicted score at the median (50th percentile) and the 10th percentile of the ESCS index for each country. We then also show the *best* predicted score of the four counter-factual countries. In Figure 5 we see the actual for the 10th percentile in Zambia is 284.7 and if Zambia had Denmark's ESCS gradient (regression coefficients with respect to ESCS) the 10th percentile would have scored about 12 points *lower*, at 273.

Figure 5: Zambia at actual and other country ESCS coefficients

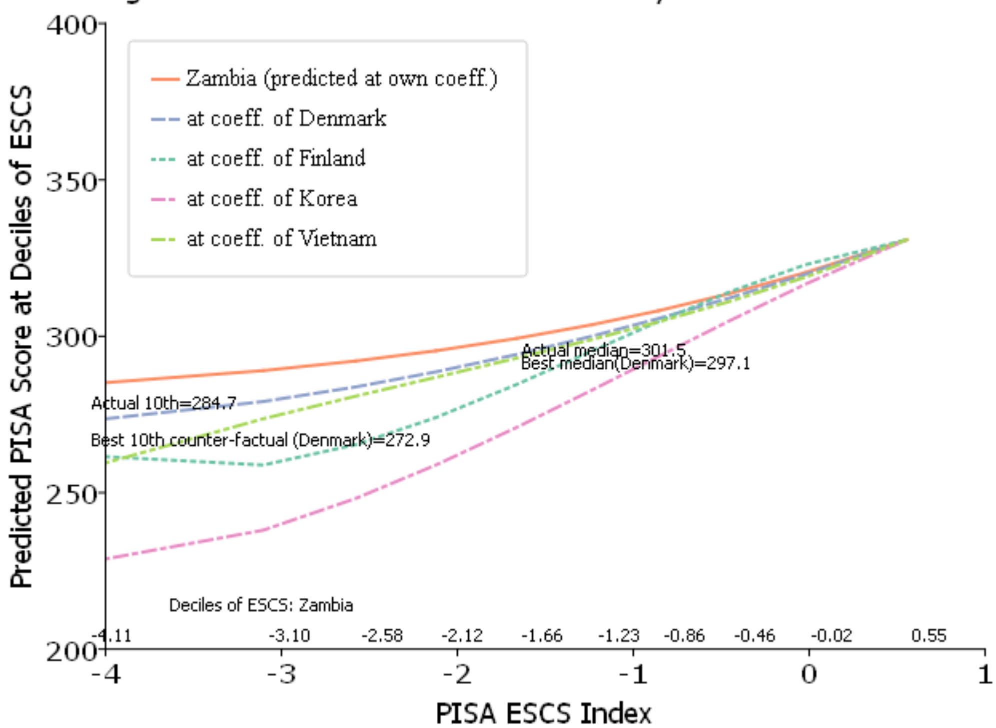


Table 7 shows the Mathematics results at the 10th percent and the median for all PISA-D countries for each of the four counter-factual high performing country comparators. Table 7 shows that for four of the countries: Zambia, Senegal[13], Guatemala and Cambodia the results are uniformly more equal across the entire range of the ESCS distribution than for any of the four comparator countries. There would be no gains to "the poor" or, for that matter, the typical (median) student, in raising their performance relative to "the rich" by moving to the relationships between ESCS and mathematics performance in these four high performing countries.

Table 7: Comparing actual mathematics results for the ESCS median and ESCS 10th percentile of the actual PISA-D country to counter-factual predictions for four high performing countries

	10th percentile					50th percentile (median)				
	Actual	Counter-factual predictions using the empirical relationship of:				Actual	Counter-factual predictions using the empirical relationship of:			
		Denmark	Finland	Korea	Vietnam		Denmark	Finland	Korea	Vietnam
Zambia	285	**273**	262	228	258	302	**297**	290	277	296
Senegal	314	**258**	244	215	246	309	**276**	266	253	275
Paraguay	273	**311**	289	267	306	323	**329**	320	306	328
Guatemala	345	**320**	297	272	313	345	**337**	324	308	335
Cambodia	329	**317**	294	270	311	349	**336**	326	311	334
Honduras	341	**309**	287	261	301	347	**325**	313	297	324
Ecuador	347	**351**	326	300	345	366	**374**	365	349	372

Source: Author's calculations with PISA-D data.

Ecuador's relationship of PISA-D mathematics performance to ESCS leads to slightly worse performance for the ESCS disadvantaged (10th percentile) than Denmark—but not than Vietnam, Finland or Korea. At Denmark's relationship the ESCS disadvantaged would score 4 points higher. Ecuador's relationship between the ESCS 90th percentile and the median is steeper than both Denmark and Vietnam but not Finland or Korea.

Paraguay is the only country that has performance gradients with respect to ESCS much worse than the comparator countries. Most of this additional disadvantage comes below the median. That is, Paraguay has about the same relationship as the four comparator countries until about the middle of the distribution and then Paraguay's relationship gets much steeper and the lower ESCS students score much less well relative to the median student in Paraguay than in the other comparator countries. We are not experts in Paraguay and so do not know why this is so. The regressions already account for whether or not children speak the assessment language at home and, hance takes into account already the large performance deficit for these students in Paraguay.

Table 8 shows that our results confirm, with our modestly more general method, what the PISA-D tables report: the inequality across learning outcomes of the in-school population by student ESCS in the PISA-D countries is smaller absolutely and is no larger relative to country

[13] Though, as discussed above, the extremely flat relationship is Senegal is anomalous and so the country results on ESCS might be discounted.

average score, than the OECD. The proportion of total variance in scores accounted for by student ESCS alone is lower in PISA-D (10.3) than OECD countries, on average (13.0) and, the gains from a unit increase in ESCS, in either absolute points or relative to the country average, is higher in the OECD than PISA-D countries.

Table 8: PISA-D analysis shows that inequality by ESCS is lower absolutely and no higher relatively in PISA-D than in the OECD

Region/country	Percent of variation explained by student ESCS	Mathematics score difference between top and bottom quartile on ESCS (absolute)	Score difference between top and bottom quartile as ratio to average score (relative)	Score difference per unit change in ESCS (absolute)	Score difference per unit change in student ESCS as ratio to average score (relative)
PISA-D average	10.3	56	0.17	18	0.057
OECD average	13.0	84	0.17	37	0.075
Upper-middle income average	10.8	67	0.17	26	0.064
Selected OECD countries					
Norway (lowest)	9.0	67	0.13	35	0.069
Denmark	10.9	69	0.13	31	0.060
Finland	11.6	73	0.14	37	0.073
United States	13.1	86	0.18	30	0.064
France (highest)	20.1	110	0.22	53	0.108

Source: PISA-D Results, Table 34, columns J and AD, Table 49, Column B.

III.B) Keeping learning gaps constant as enrollment expands

The obvious potential reconciliation of the fact that learning does not differ more among PISA participants by ESCS in Zambia than in Denmark with the reader's (and writer's) intuition that Denmark is a much more equal country is that in Zambia (and other PISA-D countries) low SES students drop-out of the schooling system entirely and hence, are not eligible for the PISA assessment while enrollment to age 15 is nearly universal in Denmark. This means that what Denmark has achieved is getting (nearly) every child into school and persisting through schooling to (at least) age 15 and keeping those children learning. In absolute terms the 10th percentile student in Denmark (or Finland or Vietnam, etc.) does much better than even the high performing advantaged ESCS elite students in PISA-D countries. But, this understanding of the goal of providing more equal opportunity to all, irrespective of economic position or social status, as getting students into school and persisting through school while retaining progress in learning is actually an importantly different stance and approach.

The comparisons of inequality in assessed learning of those enrolled showing that the differences are not larger in the PISA-D countries raises three important points.

First, reducing differentials in learning by socio-economic differences beyond a certain level is just very hard. There is a massive literature of descriptive regressions exploring the correlates of scores with observable student, student peers in school, school characteristics (and, for cross-national studies, characteristics of the education system) and this literature consistently shows substantial differences by SES measures. Earlier research has shown that in comparing learning of children in the same grade in a given country a measure of household SES is often the single biggest factor (proximally) accounting for learning differences.[14] This association with household SES runs through potentially many causal pathways.[15] If Denmark and Finland cannot eliminate SES gaps in learning with all the advantages they have: generally high capability and effectiveness of the education system; generous and comprehensive social programs; relatively equal societies, it would be odd to expect less developed countries to be able to achieve lower learning gaps.

The second important point is that in analyzing the learning gaps of a cohort of children one can decompose the inequality in learning outcomes at any given age across different groups or by given characteristics into (a) the difference in the grade attainment between the groups (which is a function of whether children ever enrolled, age at enrollment, grade progression and dropout) and (b) the learning profile of learning achievement for children at any given grade. Currently the PISA-D countries have massive inequality in learning by ESCS (or SES) but this appears to be mostly due to grade attainment, which is mostly drop-out at earlier grades rather than non-enrollment, rather than due to learning differences by ESCS for children in the same grade.

The third important point is that in order for enrollment to expand to bring in more disadvantaged children and keep learning levels high for the previously enrolled and the new enrollees the entire system has to focus on learning outcomes and achieving universal, early, conceptual and procedural mastery of foundational skills. Many countries have an "overambitious" curriculum (Beatty and Pritchett 2012) that tries to cover too many topics at too fast a pace with too little focus on understanding rather than rote learning. Kaffenberger and Pritchett (2020) use simulations of a parameterized "pedagogical production function" and allow for curricular mismatch to show that pushing more kids through a system that is not aligned around achieving learning goals will just expand enrollments and grade attainments without any progress in actual learning. Beatty et al (2018) show that exactly this happened in Indonesia between 2000 and 2014, with a substantial increase in enrollment, grade attainment and the fraction of students completing junior and senior secondary school but with zero improvement in the mastery of the youth cohort of grade school arithmetic.

[14] Schuetz, Ursprung, and Woessmann (2008), Hanushek and Woessmann (2011), Freeman and Viarengo (2014).

[15] The association between a child's learning achievement and household SES can be causally mediated by many factors, such as poor nutrition (Alderman and Bundy, 2011), parental education (Dubow et al., 2009) and attention (Davis-Kean, 2005), and stress factors (Lupien et al., 2000). Analysis by Paxson and Schady (2007) in Ecuador shows that children from wealthier households and more educated parents have higher test scores. This association grows stronger as children grow older, implying that there is an increasing gap in test scores between children from rich and poor households with age. Furthermore, positive sorting between households and schools can further aggravate inequalities: richer households are able to select better schools (Anand et al., 2018).

IV) Social inequalities are large and important to eliminate

Our emphasis on the facts from PISA-D that the overall distribution of learning outcomes in the PISA-D countries is very low, so low that even the advantaged, ESCS elite students are far below the SDG low threshold for global performance and that often even the advantaged, ESCS average students have very low learning performance (Table 6) is not to deny or minimize the massive gaps between students in these countries. If one compares, for instance, the performance of a rural, girl who does not speak Spanish in the home in Guatemala to an urban, boy who speaks Spanish the difference is 80 points on PISA and makes it extremely unlikely that this child, just due to their background, ever has a chance to reach even the global minimum of performance. These within country social inequalities are important to eliminate and, with better teaching and learning practices, they can be dramatically reduced.

IV.A) The magnitude of social disadvantages in learning

Figures 6 shows for Mathematics in Guatemala the regression estimated gaps in learning for the four characteristics of disadvantage and for moving from one unit below average to the average ESCS. Similar graphs for other countries and other subjects are in the Graphical Appendix (GA.M for Mathematics, GA.R for Reading and GA.S for Science).

Figure 6: Estimated social differences (with +/- 2 std err bounds): Guatemala

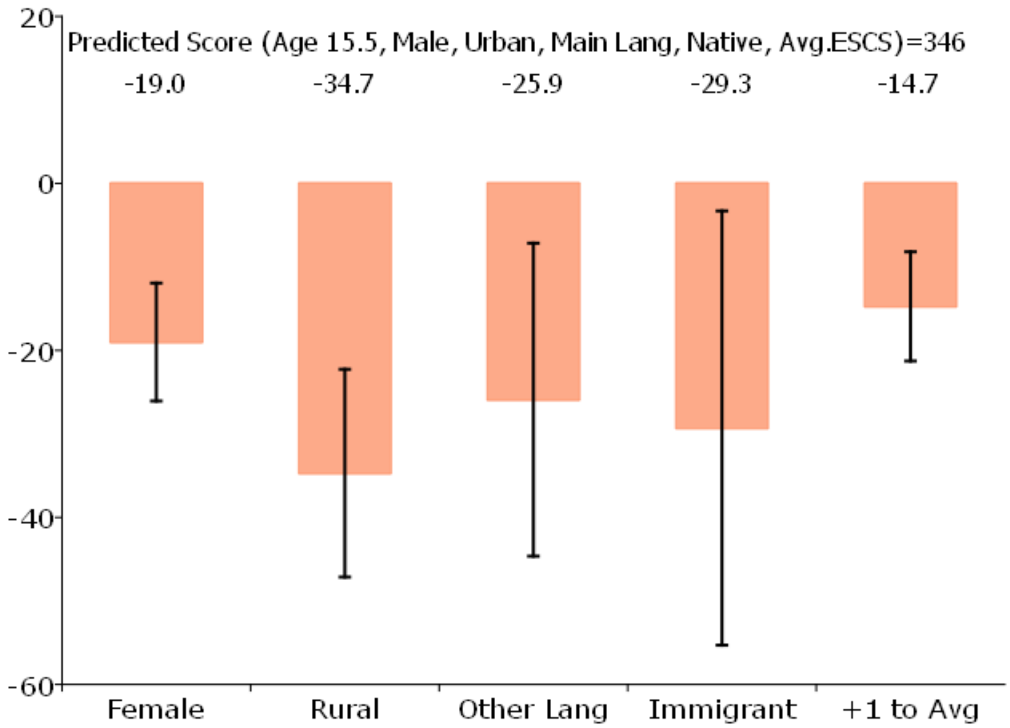


Table 9 shows the regression coefficients for the Mathematics PISA-D score on each of four characteristics of disadvantage: sex, residence, language spoken at home and whether one is a native or immigrant. These are compared to a one unit gain in the ESCS index as a reference point. Two points emerge from this analysis for each of the four categories of disadvantage.

First, the disadvantages are typically quite large. Second, the magnitudes of the disadvantages are quite heterogeneous across countries.

The regressions show that in Mathematics (though not in Reading, as we see below), there is a substantial disadvantage for girls. The median across the seven countries is a deficit of 15 points. However, in some countries (Zambia, Cambodia) this gap is very small and statistically insignificant whereas in all of the Central and South American countries is it substantial.

Similarly, the median score difference for attending a rural school is a loss of 16.6 points. But the difference ranges from small (slightly positive) in Ecuador to a loss of 32.4 and 34.2 points in Zambia and Cambodia.

The median gap for not speaking the assessment language at home is 25.9 points. What is striking is the difference across countries in the extent to which the sample consists of those who do not speak the assessment language at home. This ranges from 95 percent in Senegal and 85 percent in Zambia to 47 percent in Paraguay to less than 10 percent in Cambodia, Guatemala, Honduras and Ecuador. These differences in the fraction of those speaking the assessment language at home are driven both by the choice of assessment language (e.g. English in Zambia) but also by selectivity as almost certainly the fraction of those in school at age 15 varies by language spoken.

The impact of whether the student is an immigrant (keeping in mind these are public sector students only so high status immigrants in private international schools are excluded) also varies widely across the countries. The estimates in Cambodia are very large, but almost certainly driven by the very small number included (only .2 of a percent of the assessed population). The estimates are positive in Paraguay, about zero in Senegal and negative in the other countries. Clearly the learning disadvantage from being an immigrant depends on the country's mix of immigrants.

Table 9: The total magnitudes of gains from eliminating various social disparities in learning outcomes in Mathematics														
Country	Female			Rural			Does not speak instruction language at home			Immigrant			Gain all gaps	Advant-aged to SDG (420.7)
	Coeff.	Fraction in sample	Total gain	Coeff.	Fraction in sample	Total gain	Coeff.	Fraction in sample	Total gain	Coeff.	Fraction in sample	Total gain		
Zambia	3.3	0.51	1.7	-32.4	0.65	-21.0	-26.6	0.85	-22.6	-30.2	0.032	-0.96	44.6	120.5
Senegal	-9.1	0.54	-4.9	-14.5	0.44	-6.4	-4.1	0.95	-3.9	3.0	0.168	0.51	15.2	111.8
Paraguay	-15.2	0.50	-7.6	-7.1	0.35	-2.4	-20.6	0.47	-9.7	26.4	0.015	0.40	19.7	94.7
Guatemala	-19.0	0.46	-8.7	-34.7	0.48	-16.8	-25.9	0.10	-2.5	-29.3	0.014	-0.42	28.4	74.2
Cambodia	-2.4	0.54	-1.3	-34.2	0.75	-25.8	-29.8	0.02	-0.6	-132.0	0.002	-0.27	28.0	70.9
Honduras	-19.2	0.52	-10.1	-16.6	0.38	-6.2	-74.3	0.02	-1.7	-28.5	0.009	-0.25	18.3	73.3
Ecuador	-17.5	0.49	-8.6	3.2	0.22	0.7	-16.1	0.01	-0.2	15.3	0.013	0.20	8.8	53.8
Median	-15.2		-7.6	-16.6		-6.4	-25.9		-2.5	-28.5		-0.2	19.7	74.2
Source: Author's calculations with PISA-D data.														

IV.B) Magnitudes of gains from eliminating various dimensions of social disadvantage

The importance of reducing learning gaps across social categories is often driven by important concerns about justice, fairness and equity in treatment. That is, most societies and governments strive to achieve equal treatment and equal opportunity so that the life-chances of people are not impaired by conditions of their birth. To the extent performance in school determines life choices and chances most regard it as unacceptable that children face obstacles in life-time success simply because they were born in a rural area or born a girl.

We can measure the magnitude of the elimination of these differentials on the overall average country performance by combining the estimated coefficient with the magnitude of that category in the sample. For instance, although the difference of being a girl is smaller than of not speaking the assessment language at home, about half the in school population are girls. Table 9 shows that eliminating the boy/girl disadvantage is mathematics would have the largest total impact, raising the average score by 7.6 points, next is urban/rural, 6.4 points, then language 2.5 points (because so few are in this category) and then immigrant status.

But, no conclusion at all about country priorities can be drawn from the "typical" value as the differences are so large across countries. For instance, in Zambia the gap related to language is 22.6 points, bigger than the urban/rural gap and girls in Zambia already do better in mathematics. In Ecuador, the rural gaps and language gaps are very small but the gains from eliminating the boy/girl gap is 8.6 points. Clearly, each country faces different challenges (and different challenges by subject).

But, as with the gap with ESCS, the extent to which the elimination of the gaps across social categories contributes to raising overall performance, or contributes the reaching the SDG, is modest. Eliminating *all* of the negative learning gaps across all four of these categories would raise the average score by about 20 PISA points, which is a substantial amount. But, the gap between the score of an *advantaged* student at average ESCS (which is the average that would be achieved by eliminating all disadvantage) and the PL2P minimum SDG standard is 74 points. So even after full equalization across these categories and equalization with the average student, these students would still be massively far from a globally adequate education.

IV.C) The sources of social disadvantage in teaching and learning practices

A major purpose of examining social differences in learning outcomes (of the enrolled) is to query the day-to-day teaching and learning practices that produce and reproduce over years of schooling these differential patterns of learning.

We examine, for instance, the patterns by looking at the differences in the "typical" magnitude of disadvantage across subjects. Table 9 and Figure 7 shows the median estimate of learning score disadvantage for each subject (Mathematics, Reading, Science) for each category of disadvantage (sex, residence, language and immigrant). We compare the estimates of differences both unadjusted and adjusted for student socio-economic status which are reported in the PISA results to our, modestly different, method to show the comparative results across categories and across subjects by category are robust.

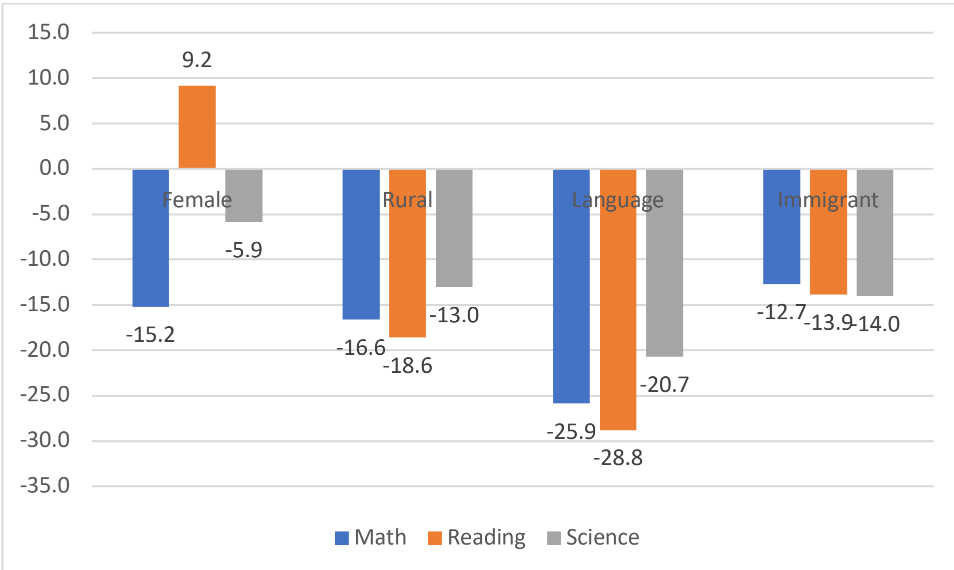
Table 10: PISA-D country median learning gaps by various sources of disadvantage, across the three subjects, our regression estimates and the cross-tabulation differences from the PISA									
Category	Math			Reading			Science		
	PISA Raw	PISA Adj.	Our estimate	PISA Raw	PISA Adj.	Our estimate	PISA Raw	PISA Adj.	Our estimate
Female	-12.8		-15.2	11.8		9.2	-4.7		-5.9
Rural	-33.1	-20.1	-16.6	-42.2	-28.3	-18.6	-28.3	-19.0	-13.0
Language	-38.1	-31.4	-25.9	-38.7	-31.7	-28.8	-32.7	-25.9	-20.7
Immigrant[a]	-5.1	-11.4	-12.7	-17.1	-17.3	-13.9	-14.8	-14.9	-14.0

Source: The PISA Raw is the difference in means across the two categories with no adjustments for ESCS and is from columns B (advantaged category), D (disadvantaged category, and H (after accounting for students' socio-economic status) of tables for boy/girl for Math/Reading/Science 32,11,53, for Urban/Rural 21,42,63, for language at home 19, 40, 61 and for native/immigrant 17, 18, 59. Our estimates are the median of the PISA-D coefficients from Table 8 above.
Notes: (a) PISA does not report an adjusted estimate for "immigrant" and hence we exclude Cambodia from the median of our estimates to enhance comparability.

For instance, it is striking that the median gap between boys and girls and urban and rural students is about the same for Mathematics (-15.2 and -16.6) but, whereas the learning gap is quite similar across subjects across the urban/rural gap (-16.6, -18.6, -13.0) it is strikingly different across subjects between boys and girls. The gap is large in Mathematics whereas in Reading girls perform substantially better than boys, +9.2, and the gap is negative in science, -5.9. This suggests the key to understanding the learning gaps between boys and girls are in specific gendered teaching practices by subject (as the evidence is inconsistent with this being an innate difference between the sexes as the gap is zero or positive in favor of girls in mathematics in many countries) whereas the sources of the urban/rural gap seem to be robust across subjects.

Another intriguing example is the disadvantage from not speaking the language of assessment in the home. In the median across the countries this is the largest single disadvantage in learning (and larger than the typical gaps from differences in SES). Not surprisingly, this disadvantage is largest in Reading, but is also large in Mathematics and in Science. This is suggestive that the disadvantages from lower language skills spills over into other subjects.

Figure 7: PISA-D country median learning gaps by subject and category of disadvantage



Source: Author's calculations from PISA_D data.

V) Too few students are doing really well

So far we have focused on the implications of the relatively low average performance of the PISA-D countries for how many students are in "education poverty"--below a minimum threshold. Achieving a (nearly) universal floor of learning is an important objective for any education system. However, the fact that the average performance is low and the variability of learning performance across students is not absolutely larger than in OECD countries also has very powerful implications for how many students are emerge from their education with high levels of performance (Pritchett and Viarengo 2009). In this section we examine the proportion and absolute number of students who reach Level 4 or above. Note that tn this section we include all students, not just those in public schools as in all tables and calculations above.

In the OECD roughly 30 percent of students reach Level 4 or above. At Level 4 students begin to have the type of advanced skills that are required for creativity and to cope with complex problems and with ambiguity and uncertainty. These are students who are well prepared for tertiary study and to take on the array of professional and technical skills that societies and economies need (e.g. doctors, lawyers/judges, engineers, managers, accountants). The description for Mathematics is:

> *"At Level 4, students can work effectively with explicit models for complex concrete situations that may involve constraints or call for making assumptions. They can select and integrate different representations, including symbolic, linking them directly to aspects of real-world situations. Students at this level can utilize their limited range of skills and can reason with some insight in straightforward contexts. They can construct and communicate explanations and arguments based on their interpretations, arguments, and actions". (OECD 2018a, p.64)*

In the PISA-D countries there are very few students at level 4 and above. Table 11 shows that if one calculates the absolute number of people in an entire age cohort of 15 year olds who are at Level 4 or above in Mathematics it is less than 1,000 individuals in every country but Ecuador. This ranges from as low as 5 in Zambia (and that is five individuals, not five percent) to 519 in Honduras. In the sciences there are similarly few, ranging from zero (that is, no one who took the assessment was at Level 4 or above in Cambodia) to 271 in Honduras.

When one thinks of the range of needs in a modernizing economy for people with skills that require math and science foundations (engineers of all types (civil, mechanical, electrical), doctors, nurses, chemists, statisticians, actuaries, computer specialists, agronomists, accountants, economists, etc.) it is sobering to think that in any given cohort leaving school and looking forward to tertiary (college and university training) there are, in a country like Guatemala of 390,000 people in an age cohort only 141 in Mathematics and 177 in Science that emerge from their basic education well prepared. Compare that with Vietnam, that has almost a quarter of a million students per year in math and in science at Level 4 or above.

Table 11: Estimates of the total number of children in an annual cohort with learning levels at a "globally adequate" level (level 4 or above) as opposed to above a global minimum

Country	Total number of 15 year old in country	Percent taking PISA	Mathematics		Reading		Science	
			Percent at PISA level 4 or above (>544.7)	Estimated total 15 year olds at PISA level 4 or above	Percent at PISA level 4 or above (>552.9)	Estimated total 15 year olds at PISA level 4 or above	Percent at PISA level 4 or above (>558.7)	Estimated total 15 year olds at PISA level 4 or above
Zambia	360,000	36.0%	0.0039%	5	0.0040%	5	0.0017%	2
Senegal	337,636	29.0%	0.351%	344	0.197%	193	0.015%	14
Cambodia	370,856	28.1%	0.103%	108	0.004%	4	0.000%	0
Paraguay	135,869	55.6%	0.048%	37	1.325%	1,000	0.198%	150
Guatemala	387,167	47.5%	0.077%	141	0.695%	1,276	0.096%	177
Honduras	193,268	41.4%	0.649%	519	1.172%	937	0.339%	271
Ecuador	352,702	60.6%	1.174%	2,508	4.231%	9,038	1.414%	3,021
Denmark	68,174	89.0%	35.0%	21,249	28.4%	17,255	27.2%	16,492
Vietnam	1,803,552	48.5%	27.5%	240,605	18.5%	161,466	32.1%	281,245
United States	4,220,325	83.5%	20.6%	727,777	30.1%	1,060,945	27.6%	973,884
Indonesia	4,534,216	68.2%	3.42%	105,742	2.04%	63,070	1.68%	51,858

Source: PISA Results, Tables 3,9 (Reading), 30 (Mathematics), 51 (Science)

This comes back to the point that it is not the case that "the elite" of these countries are getting a good education from which others are "excluded" and hence the challenge is to "include" the "marginalized" into that good education. Take Guatemala, where undoubtedly the social (as shown in Figure 6 in section IV) and economic inequalities are massive and conditions are generally inequitable. In Math and Science less than one tenth of one percent of 15 year olds are reaching the modest ambition (from a global perspective) of Level 4 performance. This implies that even if every one of the "high performers" (Level 4 or higher) was from the economic/social "1 percent" only 1 in 10 of the children from that 1 percent elite are reaching PISA Level 4 or higher and hence receiving a globally "good" education (and in this section this includes private sector students).

Conclusion

The idea of "inclusion/exclusion" is overwhelmingly powerful as it taps into deeply rooted concepts of fairness, equity, and justice. In many ways the "arc of history" has "swung towards justice" as many countries with functional and high quality education systems have systematically reduced the barriers that actively and arbitrarily excluded capable and qualified students because they were of the "wrong" sex or "wrong" race or "wrong" religion.

But, the other feature of the 20th and 21st century is the increasing diversity of country experiences, with many reaching high levels of prosperity and adequately performing education systems (e.g. Denmark, Finland) and some, even without prosperity, reaching high levels of education performance (e.g. Korea in the 1960s/1970s when it was still very poor, or Vietnam today). At the same time, there are many countries with mediocre education systems, those that have voluntarily participated in international assessments and have consistently had average PISA scores in the high 300s to low 400s (e.g. Indonesia, Brazil). What the PISA-D has documented (adding to many strands of research using many different assessment instruments pointing in this same direction) is that there are many countries whose average scores are below those of the lowest previous PISA participants. In these countries, the fraction of all children reaching even the minimal global learning goals of the SDGs are in the single digits.

This means that in many countries in the world today there is not a quality education system to be included into. Although in these countries the advantaged learn more than the disadvantaged and children from the social and economic elite do better than the less SES advantaged, even the advantaged and SES elite are effectively "excluded" from a quality education (especially) in the public sector because a "quality education" with effective teaching and learning practices that produce skills and competencies just there isn't one for anyone.

In the six low performing PISA-D countries (excluding Ecuador) even if education were "inclusive and equitable" and all children were in school and all children had the same learning outcomes as the advantaged elite: (a) 80 percent or more of children would not reach the SDG in Mathematics, (b) there would still be only a tiny percent reaching a "global" threshold of level 4 or above and (c) many would still be functionally illiterate and innumerate (below Level 1c).

In these countries (and the evidence suggests the PISA-D countries are rather typical and many countries have similar performance) *everyone* has to learn more: much, much more per year of schooling and hence the entire system has to improve, over time, dramatically.

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Appendix 1: Regression Results Overview

All of the calculations for the graphs and tables in this paper build from the set of regression results presented in this section. We present at the end of this section 18 different regression result tables with the following common structure: three different subjects (Mathematics, Reading, Science), three different specifications (Test scores, Level 1c, Level 2) for two different country groups (PISA-D and PISA comparators). Consequently the regression result tables are labeled by: subject, then by country groups, and then by the learning outcomes examined.

The main summary of those regressions is: (a) *in general* the regressions show that the five indicators we include (sex, rurality, immigrant status, language at home, and SES) are *typically* statistically and practically significant but that (b) there is large heterogeneity across (b.1) the PISA-D countries, (b.2) subjects and (b.3) between PISA-D and OECD countries.

The table below summarizes the results for the specification with test scores in Mathematics. There is some variation in the sign and statistical significance of the estimated coefficients of the explanatory variables examined. We observe significant variation within the PISA-D group of countries, some heterogeneity within the comparator group, and differences between the PISA-D group and the comparator group.

Table RA.M.Scores – Summary of Results

Variable	Country	Estimated Coefficient		
		Significant		Not Significant
		Positive	Negative	
Age	PISA-D*	4/7[e]		3/7
	Comparator**	4/5		1/5
	OECD (without Mexico)	x		
Sex (female dummy)	PISA-D		5/7	2/7
	Comparator	1/5	1/5	3/5
	OECD (without Mexico)		x	
Rural	PISA-D		5/7	2/7
	Comparator		1/5	4/5
	OECD (without Mexico)			x
Speaks another language at home	PISA-D		5/7	2/7
	Comparator		4/5	1/5
	OECD (without Mexico)		x	
Immigrant	PISA-D	1/7	4/7	2/7
	Comparator		3/5	2/5
	OECD (without Mexico)			x
ESCS***	PISA-D	6/7		1/7
	Comparator	5/5		
	OECD (without Mexico)	x		

Note: The summary tables of the results for the other subjects and specifications are available from the Authors.
[e] Each cell presents the number of countries (/total number of countries) in the related group
*The PISA-D countries include Cambodia, Ecuador, Guatemala, Honduras, Paraguay, Senegal and Zambia
**The comparator countries include: Denmark, Finland, B-S-J-G (China), Korea and Vietnam
***The non-linear terms are rarely significant

More specifically, Table RA.M.PISA-D.Scores reports the regression results for the seven countries in PISA-D (Cambodia, Ecuador, Guatemala, Honduras, Paraguay, Senegal, and Zambia) and Table RA.M.Comparator.Scores for the five countries/regions we use for comparison from PISA 2015 (Denmark, Finland, Korea, Beijing-Shanghai-Jiangsu-Guangdong (China), Vietnam, OECD, and OECD excluding Mexico (which we take as the "typical" value for a "developed" country)).

The estimated coefficients of the explanatory variables are described in what follows.

Age. We include age but not grade as we wanted to adjust all predicted values to a child of the same age but the grade for age is one pathway whereby learning inequality by characteristics is manifest and we purposely did not want to parse that out. In the OECD less Mexico the estimate is 13 points but the age effects show variation among countries. In Guatemala (1.3) and Honduras (6.1) the age coefficient is small (and statistically insignificant) whereas in Cambodia (23.1) and Zambia (17.8) it is larger and statistically significant.

Sex. The estimated coefficient for girls differs as well (and the differences across subjects are important, which we return to below). In OECD less Mexico girls score 9.6 points lower on average. In Zambia, Finland, Korea, and Vietnam the coefficient is positive (but only statistically significant for Finland). On the other hand, in five of seven PISA-D countries the coefficient is substantial (>9 points), negative and statistically significant.

Rural residence. There are also mixed results with respect to rurality, with striking differences between developed and other countries. In the OECD less Mexico the coefficient is almost exactly zero. In contrast, it is negative in each developing economy (both PISA-D and comparator) except for Ecuador and statistically significant in five of the seven PISA-D countries, with magnitudes ranging from -7.1 (Paraguay) to -34.7 (Guatemala).

Speaking another language at home is robustly associated with lower results. In the OECD less Mexico the impact is 16.6 points. The estimated coefficient is negative in all PISA-D countries and statistically significant in five of the seven, with magnitudes ranging from -4.1 in Senegal (insignificant) to a huge -74.4 points in Honduras. In the PISA comparator countries it is large and negative in Korea and China-4R but small and negative in Vietnam and substantial in Denmark and Finland. The differences are likely related to the differences in the frequency and social conditions of school versus home language. In Korea the coefficient is very large but less than 1 percent of students speak another language at home, in Senegal the coefficient is small and 95 percent of students report speaking another language, in Guatemala the coefficient is substantial and 10 percent of the students report speaking another language at home.

Immigrant status. Not surprisingly, given the very different patterns of who is a migrant across the world and their status and conditions vis-à-vis the native residents, the coefficient on immigration status shows wide variation. The OECD less Mexico result shows a small coefficient (1.8) with a large standard error (2.9) almost certainly reflecting the heterogeneity across OECD countries, as it is very large and negative in Denmark (-31.4) and Finland (-31.9). Being a first or second generation immigrant has a large and positive coefficient in Cambodia, Ecuador, Paraguay, and China and a substantial magnitude and negative coefficient in Guatemala, Honduras, Zambia, Korea and Vietnam (and small in Senegal).

ESCS. As the ESCS index was built in part to reflect household conditions that are widely believed to be associated with academic performance, the ESCS results are the most robust. Apart from Senegal, the index of economic, social, and cultural status is positively associated with positive educational outcomes in all countries and in the pooled OECD regressions (with and without Mexico). We allow the ESCS index to enter non-linearly (a cubic functional form). The non-linear terms are only rarely statistically significant. While the linear ESCS terms is robustly associated, the magnitude varies substantially across the PISA-D and the comparator countries (but again this is potentially confounded by the magnitudes of the other terms).

The regression estimates where the dependent variable is whether the student's score in Mathematics is above the PISA Level 2 Proficiency threshold (which is 420.07 for Mathematics)—which is a standard for the SDG-are shown in Tables RA.M.PISA-D.Level 2 and RA.M.Comparator. Level 2. We could have just used the results on scores to calculate the implied shifts in PL2P but it is easier for the graphs and tables presented in the paper to use the coefficients that estimate these directly. In interpreting the magnitude of these coefficients versus those on scores it is important to keep in mind that there is a built-in non-linearity in the connection between a shift in the average and the shift in the proportion above Level 2 that depends on the initial average. Simply put, if almost everyone is below the threshold or almost everyone is already above the threshold then a given shift in the score (coefficient in the tables above) is going to translate into a smaller coefficient on the "Level 2" indicator than the same size coefficient when more kids are near the threshold. For example, Ecuador and Guatemala have very similarly sized negative coefficients on Math scores for girls (-17.5 and -19.0). But the coefficient on achieving PL2P in Ecuador is 8.2 percentage points versus only 2.8 percentage points for Guatemala. This is just because Ecuador's percent of girl's achieving PL2P is higher (24% vs 10%) and hence the same size shift in the distribution of scores pushes more students over/under the threshold in Ecuador than in Guatemala. Or, on the other side, the linear coefficient on ESCS is smaller in Ecuador than in Vietnam (26.8 versus 34.1) but the linear coefficient on achieving PL2P is much larger for Ecuador than Vietnam (.144 versus .044) because nearly all kids in Vietnam are already above the threshold, only 19% below, versus 71% in Ecuador. Again, these non-linear differences between the coefficients are a mechanical consequence of the mathematics of threshold indicators and are not an "insight" and do not have any deeper significance. But, as we see below, this does imply that shifts in scores in most PISA-D countries have relatively small absolute impact on the fraction of those achieving PL2P.

The regression estimates where the dependent variable is whether the student's score in Mathematics is above the PISA Level 1c Proficiency threshold (which is 295.47 for Mathematics) are in Annex M, Tables RA.M.PISA-D.Level1c and RA.M.Comparator.Level1c. Given that this level is reached by very few individuals the relationship with characteristics cannot be precisely predicted by covariates in OECD countries, developed countries or high performing countries.[16]

The regression results for science are presented in Annex S. They are qualitatively similar to those for mathematics, while the magnitudes of the estimated coefficients vary, as the results in science differ from those in mathematics in means and standard deviations. The main differences previously observed among the PISA-D and comparator countries persist.

The regression results for reading are presented in Annex R. There are differences between reading and mathematics. While the patterns of age and the ESCS index remain roughly the same, some of the other explanatory variables: sex, the language spoken at home, and the immigration status present coefficients with different patterns than in the mathematics or science regressions. First, we observe that in the majority of countries girls outperform boys in reading. This is different from what we observed in the mathematics and science regressions where the female coefficient was negative in most countries. Second, if the student speaks a different language at home than in school, then she/he has a higher probability to perform worse in reading. The immigrant status is also more often negatively associated with performance in reading. Similarly, living in a rural area is associated in most countries with a lower performance in reading.

[16] For example, in the case of Vietnam we cannot estimate these regressions for science or reading as there are not enough students who reached only level 1c of performance, and we end up with a dependent variable that is a constant, namely zero.

Regression Appendix M: Math (Scores, Level 1c, Level 2)

Table RA. M. PISA-D. Scores: Student Characteristics and Mathematics Scores in Public Schools in PISA-D

	Dependent Variable: Test scores in mathematics						
	Cambodia	Ecuador	Guatemala	Honduras	Paraguay	Senegal	Zambia
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age	23.131***	16.882***	1.287	6.157	17.646***	10.330	17.818***
	(4.114)	(4.159)	(7.330)	(6.173)	(5.475)	(6.884)	(6.467)
Female	-2.428	-17.565***	-19.061***	-19.297***	-15.206***	-9.109**	3.348
	(2.706)	(2.507)	(3.531)	(3.263)	(3.324)	(3.628)	(4.362)
Socio-Economic Index	18.948***	26.803***	16.596***	13.691**	19.661***	0.515	16.789***
	(4.562)	(2.957)	(3.277)	(5.856)	(3.177)	(4.875)	(4.684)
Socio-Economic Index ^2	4.806*	1.393	-1.556	6.514	6.130**	-0.960	2.625
	(2.789)	(2.466)	(2.488)	(3.985)	(2.997)	(2.910)	(2.618)
Socio-Economic Index ^3	0.843*	-0.681	-1.203*	1.160	0.990	-0.300	0.164
	(0.461)	(0.731)	(0.630)	(0.848)	(0.778)	(0.475)	(0.410)
School in Rural Area	-34.225***	3.186	-34.748***	-16.646***	-7.059	-14.504**	-32.439***
	(5.096)	(7.511)	(6.222)	(5.086)	(5.947)	(7.180)	(9.017)
Speaks Other Language at Home	-29.817***	-16.151	-25.946***	-74.374***	-20.632***	-4.121	-26.629***
	(10.103)	(15.853)	(9.373)	(17.165)	(3.981)	(7.709)	(5.345)
Immigrant	-132.512***	15.286	-29.309**	-28.532**	26.355*	3.047	-30.222**
	(34.108)	(13.672)	(13.052)	(13.734)	(13.614)	(6.135)	(13.307)
Constant	16.23	134.783**	353.575***	262.080***	83.175	151.381	44.651
	(66.647)	(64.915)	(116.406)	(96.586)	(85.008)	(111.82)	(101.867)
Observations	4388	4098	2216	2902	2648	3484	2847

Note: *Estimates are obtained from a student weighted school clustered linear model. The dependent variables are test scores in mathematics. We have ten plausible values of the test score that we use to estimate the reported coefficients and standard errors. Regressions are restricted to students in public schools only. Robust standard errors adjusted for clustering at the school level are reported in parentheses. Significance level. * p <0.1; ** p<0.05; *** p<0.01.*

Table RA.M. Comparator. Scores: Student Characteristics and Mathematics Scores in Public Schools, PISA 2015

	Dependent Variable: Test scores in mathematics						
	Denmark	Finland	Korea	B-S-J-G (China)	Vietnam	OECD	OECD - Without Mexico
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age	15.379***	11.189**	12.302	16.262**	19.469***	13.934***	13.013***
	(5.320)	(4.538)	(7.761)	(7.835)	(5.623)	(2.065)	(2.296)
Female	-10.468***	5.491**	7.405	-5.068	3.026	-9.193***	-9.601***
	(3.552)	(2.289)	(5.877)	(3.274)	(3.033)	(1.208)	(1.314)
Socio-Economic Index	24.251***	39.942***	47.408***	35.14***	34.131***	32.949***	35.355***
	(2.669)	(2.967)	(4.578)	(4.001)	(6.202)	(0.758)	(0.867)
Socio-Economic Index ^2	2.734*	-3.385	-2.499	-2.758	4.995	4.185***	3.197***
	(1.496)	(2.064)	(4.020)	(2.169)	(3.163)	(0.622)	(0.684)
Socio-Economic Index ^3	-0.038	-2.716**	-1.467	-0.102	0.691	-0.076	-0.495**
	(0.468)	(1.104)	(1.633)	(0.647)	(0.583)	(0.190)	(0.229)
School in Rural Area	-8.135	-0.725	-76.64***	-21.747	-7.064	-5.642	0.007
	(6.275)	(5.365)	(8.930)	(16.577)	(7.277)	(3.533)	(4.456)
Speaks Other Language at Home	-28.042***	-17.142**	-87.506***	-52.072***	-5.703	-18.72***	-16.611***
	(6.280)	(7.146)	(31.165)	(10.866)	(12.856)	(2.824)	(2.749)
Immigrant	-31.488***	-31.914***	-27.724	-119.692***	-39.720	0.151	1.782
	(5.163)	(10.845)	(58.322)	(24.483)	(40.532)	(2.936)	(2.874)
Constant	261.309***	327.594***	335.053***	328.743***	239.979***	264.152***	278.275***
	(84.586)	(71.654)	(121.749)	(120.962)	(88.093)	(32.474)	(36.168)
Observations	4453	5380	3659	8435	5271	162448	156002

Note: *Estimates are obtained from a student weighted school clustered linear model. The dependent variables are test scores in mathematics. We have ten plausible values of the test score that we use to estimate the reported coefficients and standard errors. Estimates for the OECD in columns 6 and 7 include country dummies. Regressions are restricted to students in public schools only. Robust standard errors adjusted for clustering at the school level are reported in parentheses. Significance level. * p <0.1; ** p<0.05; *** p<0.01.*

Table RA. M. PISA-D. Level 1c: Student Characteristics and Proficiency Level 1c in Mathematics in Public Schools in PISA-D

	Dependent Variable: Equals to 1 if the proficiency level 1c has been reached in mathematics						
	Cambodia	Ecuador	Guatemala	Honduras	Paraguay	Senegal	Zambia
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age	-0.108***	-0.06***	0.015	-0.009	-0.096**	-0.056	-0.102**
	(0.031)	(0.022)	(0.047)	(0.046)	(0.043)	(0.049)	(0.041)
Female	-0.011	0.045***	0.118***	0.079***	0.083***	0.052**	-0.029
	(0.017)	(0.016)	(0.03)	(0.026)	(0.025)	(0.021)	(0.026)
Socio-Economic Index	-0.07***	-0.063***	-0.070***	-0.033	-0.086***	-0.002	-0.103***
	(0.027)	(0.01)	(0.016)	(0.022)	(0.020)	(0.041)	(0.029)
Socio-Economic Index ^2	-0.022	-0.006	0.015	-0.025	-0.033*	0.002	-0.011
	(0.017)	(0.015)	(0.018)	(0.018)	(0.019)	(0.023)	(0.015)
Socio-Economic Index ^3	-0.005**	0.000	0.006	-0.006	-0.008	0.000	0.000
	(0.002)	(0.005)	(0.005)	(0.004)	(0.005)	(0.003)	(0.002)
School in Rural Area	0.169***	0.003	0.221***	0.094***	0.037	0.081**	0.177***
	(0.027)	(0.032)	(0.042)	(0.031)	(0.041)	(0.041)	(0.056)
Speaks Other Language at Home	0.175***	0.085	0.166**	0.392***	0.128***	0.027	0.151***
	(0.061)	(0.09)	(0.067)	(0.104)	(0.033)	(0.051)	(0.032)
Immigrant	0.475***	-0.003	0.217**	0.183	-0.115	-0.023	0.154**
	(0.116)	(0.059)	(0.105)	(0.113)	(0.134)	(0.039)	(0.073)
Constant	1.776***	1.007***	-0.200	0.335	1.636**	1.284	1.934***
	(0.502)	(0.358)	(0.749)	(0.733)	(0.68)	(0.796)	(0.669)
Observations	4388	4098	2216	2902	2648	3484	2847

Note: *Estimates are obtained from a student weighted school clustered linear probability model. Regressions are restricted to students in public schools only. Robust standard errors adjusted for clustering at the school level are reported in parentheses. Significance level. * p <0.1; ** p<0.05; *** p<0.01.*

Table RA. M. Comparator. Level 1c: Student Characteristics and Proficiency Level 1c in Mathematics in Public Schools in PISA 2015

	Dependent Variable: Equals to 1 if the proficiency level 1c has been reached in mathematics						
	Denmark	Finland	Korea	B-S-J-G (China)	Vietnam	OECD	OECD - Without Mexico
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age	-0.003	-0.005	-0.004	-0.001	-0.005	-0.008***	-0.007**
	(0.005)	(0.005)	(0.008)	(0.005)	(0.005)	(0.003)	(0.003)
Female	0.000	-0.004	-0.009*	0.000	-0.004**	0.000	0.001
	(0.002)	(0.003)	(0.005)	(0.003)	(0.002)	(0.003)	(0.003)
Socio-Economic Index	-0.005	-0.01*	-0.011***	-0.002	-0.001	-0.01***	-0.011***
	(0.004)	(0.006)	(0.003)	(0.002)	(0.002)	(0.001)	(0.001)
Socio-Economic Index ^2	0.002	0.006	0.006	-0.001	-0.001	0.002**	0.002**
	(0.003)	(0.005)	(0.005)	(0.002)	(0.002)	(0.001)	(0.001)
Socio-Economic Index ^3	0.000	0.000	0.001	-0.001	-0.001	-0.001	0.000
	(0.000)	(0.003)	(0.002)	(0.001)	(0.000)	(0.000)	(0.000)
School in Rural Area	0.000	0.000	0.062	-0.002	0.001	0.019***	0.001
	(0.004)	(0.005)	(0.055)	(0.009)	(0.003)	(0.006)	(0.004)
Speaks Other Language at Home	0.005	0.014	0.049	0.024	0.004	0.022***	0.017**
	(0.01)	(0.016)	(0.087)	(0.032)	(0.011)	(0.008)	(0.007)
Immigrant	0.013*	0.039	-0.055	0.073	0.018	0.001	-0.003
	(0.007)	(0.03)	(0.065)	(0.12)	(0.047)	(0.006)	(0.006)
Constant	0.032	0.071	0.072	0.012	0.067	0.13**	0.115**
	(0.079)	(0.094)	(0.13)	(0.081)	(0.088)	(0.053)	(0.054)
Observations	4453	5380	3659	8435	5271	162448	156002

Note: *Estimates are obtained from a student weighted school clustered linear probability model. Estimates for the OECD in columns 6 and 7 include country dummies. Regressions are restricted to students in public schools only. Robust standard errors adjusted for clustering at the school level are reported in parentheses. Significance level. * p <0.1; ** p<0.05; *** p<0.01.*

Table RA. M. PISA-D. Level 2: Student Characteristics and Proficiency Level 2 in Mathematics in Public Schools in PISA-D

	Dependent Variable: Equals to 1 if the proficiency level 2 has been reached in mathematics						
	Cambodia	Ecuador	Guatemala	Honduras	Paraguay	Senegal	Zambia
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age	0.065***	0.059**	0.008	0.043**	0.048**	0.008	0.023**
	(0.021)	(0.024)	(0.034)	(0.018)	(0.02)	(0.018)	(0.01)
Female	-0.019	-0.082***	-0.028**	-0.059***	-0.043***	-0.012	-0.001
	(0.016)	(0.016)	(0.013)	(0.013)	(0.014)	(0.009)	(0.006)
Socio-Economic Index	0.067**	0.144***	0.056**	0.064**	0.068***	-0.006	0.028**
	(0.028)	(0.019)	(0.021)	(0.032)	(0.024)	(0.014)	(0.012)
Socio-Economic Index ^2	0.009	0.008	0.002	0.017	0.019	-0.009	0.004
	(0.013)	(0.014)	(0.013)	(0.016)	(0.016)	(0.008)	(0.004)
Socio-Economic Index ^3	0.000	-0.004*	-0.003	0.001	0.001	-0.002**	0.000
	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)	(0.001)	(0.000)
School in Rural Area	-0.086***	0.021	-0.054***	-0.028	-0.009	-0.01	-0.018
	(0.024)	(0.035)	(0.019)	(0.017)	(0.013)	(0.013)	(0.014)
Speaks Other Language at Home	-0.043	-0.046	-0.026	-0.092	-0.046	0.008	-0.025
	(0.03)	(0.063)	(0.012)	(0.024)	(0.013)	(0.023)	(0.014)
Immigrant	-0.097***	0.089	-0.026	-0.05	0.064	-0.004	-0.008
	(0.03)	(0.086)	(0.026)	(0.032)	(0.057)	(0.014)	(0.02)
Constant	-0.787**	-0.56	0.035	-0.495	-0.623*	-0.068	-0.287*
	(0.367)	(0.372)	(0.552)	(0.317)	(0.337)	(0.319)	(0.164)
Observations	4,388	4,098	2,216	2,902	2,648	3,484	2,847

Note: *Estimates are obtained from a student weighted school clustered linear probability model. Regressions are restricted to students in public schools only. Robust standard errors adjusted for clustering at the school level are reported in parentheses. Significance level. * p <0.1; ** p<0.05; *** p<0.01.*

Table RA. M. Comparator. Level 2: Student Characteristics and Proficiency Level 2 in Mathematics in Public Schools in PISA 2015

	Dependent Variable: Equals to 1 if the proficiency level 2 has been reached in mathematics						
	Denmark	Finland	Korea	B-S-J-G (China)	Vietnam	OECD	OECD - Without Mexico
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age	0.041*	0.028	0.02	0.008	0.042	0.057***	0.047***
	(0.024)	(0.023)	(0.027)	(0.018)	(0.028)	(0.01)	(0.01)
Female	-0.026**	0.035***	0.043**	0.000	0.035**	-0.019***	-0.017**
	(0.013)	(0.009)	(0.018)	(0.010)	(0.016)	(0.006)	(0.007)
Socio-Economic Index	0.068***	0.114***	0.093***	0.032***	0.044***	0.113***	0.119***
	-0.014	(0.012)	(0.017)	(0.008)	(0.011)	(0.004)	(0.005)
Socio-Economic Index ^2	-0.006	-0.034***	-0.043***	-0.013**	0.002	-.001	-.004
	(0.008)	(0.008)	(0.014)	(0.006)	(0.013)	(0.002)	(0.003)
Socio-Economic Index ^3	-0.001	-0.008**	-0.007	0.003	0.003	-.002**	-.003***
	(0.002)	(0.004)	(0.008)	(0.002)	(0.003)	(0.001)	(0.001)
School in Rural Area	-0.010	0.001	-0.317***	-0.054	-0.034	-0.018	0.016
	(0.028)	(0.021)	(0.075)	(0.05)	(0.033)	(0.017)	(0.019)
Speaks Other Language at Home	-0.123	-0.101	-0.298	-0.128	-.012	-.084***	-.076***
	(0.037)	(0.035)	(0.162)	(0.056)	(0.064)	(0.018)	(0.018)
Immigrant	-0.126***	-0.107**	-0.231	-0.404***	-0.198	0.001	0.006
	(0.026)	(0.05)	(0.386)	(0.143)	(0.301)	(0.015)	(0.015)
Constant	0.202	0.379	0.528	0.805***	0.246	-0.168	-0.006
	(0.382)	(0.361)	(0.421)	(0.305)	(0.441)	(0.163)	(0.17)
Observations	4453	5380	3659	8435	5271	162448	156002

Note: *Estimates are obtained from a student weighted school clustered linear probability model. Estimates for the OECD in columns 6 and 7 include country dummies. Regressions are restricted to students in public schools only. Robust standard errors adjusted for clustering at the school level are reported in parentheses. Significance level. * p <0.1; ** p<0.05; *** p<0.01.*

Regression Appendix R: Reading (Scores, Level 1c, Level 2)

Table RA. Reading. PISA-D. Scores: Student Characteristics and Test Scores in Reading in Public Schools

	Dependent Variable: Test scores in reading						
	Cambodia	Ecuador	Guatemala	Honduras	Paraguay	Senegal	Zambia
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age	19.718***	19.896***	3.745	0.034	16.45***	9.634	12.192**
	(3.062)	(4.779)	(8.162)	(5.059)	(5.944)	(5.897)	(4.788)
Female	15.471***	9.195***	6.040	8.898***	10.356***	-2.041	11.150***
	(2.121)	(2.621)	(4.128)	(3.101)	(3.657)	(2.961)	(4.172)
Socio-Economic Index	14.200***	28.859***	19.097***	14.428**	24.12***	6.737	19.145***
	(4.143)	(3.028)	(3.878)	(5.817)	(3.750)	(4.971)	(4.702)
Socio-Economic Index ^2	5.878**	3.480	0.036	6.831*	7.712**	2.205	2.739
	(2.342)	(2.735)	(2.499)	(3.843)	(3.432)	(2.615)	(2.515)
Socio-Economic Index ^3	1.115***	0.110	-0.782	1.139	1.271	0.211	0.282
	(0.37)	(0.755)	(0.620)	(0.831)	(0.891)	(0.373)	(0.387)
School in Rural Area	-30.707***	-3.240	-35.643***	-15.984***	-14.761**	-18.603***	-36.877***
	(3.556)	(7.067)	(7.096)	(4.370)	(6.479)	(4.566)	(8.655)
Speaks Other Language at Home	-18.997**	-35.719	-39.727***	-65.724***	-28.824***	-3.382	-26.072***
	(7.886)	(24.347)	(10.527)	(16.364)	(4.487)	(6.941)	(4.752)
Immigrant	-126.011***	11.217	-44.742***	-40.728***	1.531	-2.784	-25.086*
	(31.207)	(14.82)	(13.629)	(10.875)	(18.074)	(4.622)	(13.206)
Constant	41.842	106.337	338.513***	369.684***	142.099	165.790*	152.608**
	(48.625)	(73.743)	(130.615)	(79.527)	(91.495)	(94.692)	(75.82)
Observations	4388	4098	2216	2902	2648	3484	2847

Note: *Estimates are obtained from a student weighted school clustered linear model. Regressions are restricted to students in public schools only. Robust standard errors adjusted for clustering at the school level are reported in parentheses. Significance level. * p <0.1; ** p<0.05; *** p<0.01.*

Table RA. Reading. Comparator. Scores: Student Characteristics and Test Scores in Reading in Public Schools

	Dependent Variable: Test scores in reading						
	Denmark	Finland	Korea	B-S-J-G (China)	Vietnam	OECD	OECD - Without Mexico
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age	15.619***	16.124***	17.443***	15.281**	11.092**	13.658***	12.326***
	(5.764)	(4.683)	(6.57)	(7.516)	(4.715)	(1.887)	(2.149)
Female	-7.490*	16.457***	7.964	-7.582***	24.949***	-5.787***	-5.699***
	(3.881)	(2.243)	(5.398)	(2.658)	(2.506)	(1.217)	(1.296)
Socio-Economic Index	24.643***	42.001***	39.786***	37.704***	31.725***	34.01***	36.295***
	(2.602)	(3.256)	(3.521)	(3.905)	(4.680)	(0.862)	(1.003)
Socio-Economic Index ^2	4.191***	-4.013*	-3.187	0.000	5.976**	4.814***	3.93***
	(1.521)	(2.258)	(3.77)	(2.098)	(2.623)	(0.639)	(0.719)
Socio-Economic Index ^3	0.459	-2.385**	-2.040	-0.102	0.842*	0.053	-0.326
	(0.472)	(1.174)	(1.599)	(0.607)	(0.501)	(0.194)	(0.235)
School in Rural Area	-7.060	7.905	-59.784***	-30.261*	-11.308*	-4.944	1.781
	(6.859)	(5.504)	(7.074)	(16.275)	(5.818)	(3.307)	(4.064)
Speaks Other Language at Home	-28.191***	-35.398***	-81.529**	-41.421***	-13.613*	-23.039***	-21.449***
	(6.449)	(7.382)	(31.751)	(11.698)	(7.220)	(2.733)	(2.748)
Immigrant	-41.124***	-35.764***	-31.922	-108.624***	-34.870	-2.915	-1.161
	(4.926)	(10.544)	(51.825)	(18.832)	(43.293)	(3.084)	(3.108)
Constant	189.607**	288.786***	277.979***	334.573***	347.853***	287.208***	297.098***
	(86.746)	(73.578)	(103.228)	(115.976)	(73.876)	(29.623)	(33.808)
Observations	4453	5380	3659	8435	5271	162448	156002

Note: *Estimates are obtained from a student weighted school clustered linear model. Estimates for the OECD in columns 6 and 7 include country dummies. Regressions are restricted to students in public schools only. Robust standard errors adjusted for clustering at the school level are reported in parentheses. Significance level. * p <0.1; ** p<0.05; *** p<0.01.*

Table RA. Reading. PISA-D. Level 1c: Student Characteristics and Proficiency Level 1c in Reading, Public Schools

	Dependent Variable: Equals to 1 if the proficiency level 1c has been reached in reading						
	Cambodia	Ecuador	Guatemala	Honduras	Paraguay	Senegal	Zambia
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age	-0.069***	-0.027*	-0.001	0.015	0.015	-0.040	-0.071*
	(0.02)	(0.014)	(0.033)	(0.019)	(0.027)	(0.047)	(0.042)
Female	-0.075***	-0.011	-0.024	-0.018	-0.034**	0.006	-0.057*
	(0.013)	(0.007)	(0.015)	(0.014)	(0.016)	(0.02)	(0.03)
Socio-Economic Index	-0.041**	-0.014***	-0.019***	-0.005	-0.024***	-0.016	-0.087***
	(0.02)	(0.004)	(0.007)	(0.012)	(0.009)	(0.028)	(0.031)
Socio-Economic Index ^2	-0.03**	0.001	-0.001	-0.014	-0.015	-0.005	-0.011
	(0.014)	(0.005)	(0.011)	(0.012)	(0.013)	(0.014)	(0.021)
Socio-Economic Index ^3	-0.007***	0.001	0.000	-0.003	-0.005	-0.001	-0.002
	(0.002)	(0.002)	(0.003)	(0.002)	(0.004)	(0.002)	(0.003)
School in Rural Area	0.102***	0.003	0.073***	0.039**	0.041**	0.117***	0.218***
	(0.015)	(0.015)	(0.022)	(0.017)	(0.018)	(0.024)	(0.046)
Speaks Other Language at Home	0.111**	0.096	0.178**	0.282**	0.04**	0.005	0.132***
	(0.055)	(0.063)	(0.081)	(0.123)	(0.018)	(0.049)	(0.037)
Immigrant	0.575***	0.021	0.15*	0.056	-0.039	0.014	0.07
	(0.149)	(0.036)	(0.087)	(0.068)	(0.077)	(0.031)	(0.114)
Constant	1.165***	0.436*	0.026	-0.175	-0.203	0.833	1.21*
	(0.324)	(0.233)	(0.527)	(0.31)	(0.427)	(0.764)	(0.683)
Observations	4388	4098	2216	2902	2648	3484	2847

***Note**: Estimates are obtained from a student weighted school clustered linear probability model. Robust standard errors adjusted for clustering at the school level are reported in parentheses. Regressions are restricted to students in public schools only. Significance level. * p <0.1; ** p<0.05; *** p<0.01.*

Table RA. Reading. Comparator. Level 1c: Student Characteristics and Proficiency Level 1c in Reading, Public Schools

	Dependent Variable: Equals to 1 if the proficiency level 1c has been reached in reading						
	Denmark	Finland	Korea	B-S-J-G (China)	Vietnam	OECD	OECD - Without Mexico
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age	-0.004	-0.002	0.000	0.002		-0.001	-0.002
	(0.004)	(0.003)	(0.004)	(0.003)		(0.001)	(0.001)
Female	-0.002	-0.001	-0.004**	0.000		-0.002**	-0.002**
	(0.002)	(0.002)	(0.002)	(0.002)		(0.001)	(0.001)
Socio-Economic Index	-0.002	-0.002	-0.004**	-0.002**		-0.002**	-0.003***
	(0.005)	(0.003)	(0.002)	(0.001)		(0.001)	(0.001)
Socio-Economic Index ^2	0.002	0.001	0.003	0.000		0.000	0.000
	(0.002)	(0.003)	(0.002)	(0.001)		(0.000)	(0.000)
Socio-Economic Index ^3	0.000	-0.001	0.000	0.000		-0.001	0.000
	(0.001)	(0.002)	(0.001)	(0.000)		(0.000)	(0.000)
School in Rural Area	0.003	-0.002	0.014	-0.003		0.003	0.000
	(0.006)	(0.002)	(0.029)	(0.004)		(0.002)	(0.001)
Speaks Other Language at Home	0.014	0.008	0.069	0.002		0.006	0.005
	(0.009)	(0.008)	(0.082)	(0.014)		(0.004)	(0.004)
Immigrant	0.011*	0.014	-0.055	0.023		-0.001	-0.001
	(0.006)	(0.013)	(0.062)	(0.076)		(0.003)	(0.002)
Constant	0.065	0.005	0.001	-0.003		0.006	0.021
	(0.077)	(0.058)	(0.073)	(0.057)		(0.032)	(0.03)
Observations	4453	5380	3659	8435		162448	156002

Note: *Estimates are obtained from a student weighted school clustered linear probability model. For Vietnam, the estimates are not possible as there are not enough observations of students reaching only performance level 1c in reading. Estimates for the OECD in columns 6 and 7 include country dummies. Regressions are restricted to students in public school only. Robust standard errors adjusted for clustering at the school level are reported in parentheses. Significance level. * p <0.1; ** p<0.05; *** p<0.01.*

Table RA. Reading. PISA-D. Level 2 Student Characteristics and Proficiency Level 2 in Reading, Public Schools

	Dependent Variable: Equals to 1 if the proficiency level 2 has been reached in reading						
	Cambodia	Ecuador	Guatemala	Honduras	Paraguay	Senegal	Zambia
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age	0.052**	0.082***	0.030	0.021	0.096**	0.028	0.030**
	(0.023)	(0.028)	(0.055)	(0.033)	(0.038)	(0.023)	(0.013)
Female	0.026**	0.057***	0.023	0.043*	0.036	-0.006	0.020*
	(0.011)	(0.019)	(0.029)	(0.024)	(0.023)	(0.011)	(0.012)
Socio-Economic Index	0.050*	0.153***	0.106***	0.089***	0.14***	0.025	0.054***
	(0.027)	(0.016)	(0.037)	(0.034)	(0.027)	(0.018)	(0.019)
Socio-Economic Index ^2	0.012	0.007	0.0001	0.035*	0.036	0.007	0.008
	(0.013)	(0.016)	(0.025)	(0.021)	(0.024)	(0.008)	(0.009)
Socio-Economic Index ^3	0.001	-0.003	-0.005	0.005	0.004	0.00001	0.00001
	(0.001)	(0.004)	(0.005)	(0.004)	(0.005)	(0.001)	(0.001)
School in Rural Area	-0.075***	-0.026	-0.155***	-0.076***	-0.053	-0.012	-0.049**
	(0.016)	(0.039)	(0.043)	(0.028)	(0.033)	(0.012)	(0.023)
Speaks Other Language at Home	-0.027	-0.135	-0.112***	-0.159***	-0.142***	-0.017	-0.049***
	(0.030)	(0.116)	(0.032)	(0.052)	(0.025)	(0.026)	(0.017)
Immigrant	-0.059**	0.093	-0.154**	-0.177***	0.009	-0.015	-0.026
	(0.026)	(0.087)	(0.069)	(0.046)	(0.08)	(0.013)	(0.027)
Constant	-0.657*	-0.741*	-0.062	-0.03	-1.034*	-0.336	-0.32
	(0.367)	(0.435)	(0.885)	(0.526)	(0.604)	(0.366)	(0.203)
Observations	4388	4098	2216	2902	2648	3484	2847

Note: *Estimates are obtained from a student weighted school clustered linear probability model. Regressions are restricted to students in public school only. Robust standard errors adjusted for clustering at the school level are reported in parentheses. Significance level. * p <0.1; ** p<0.05; *** p<0.01.*

Table RA. Reading. Comparator. Level 2: Student Characteristics and Proficiency Level 2 in Reading in Public Schools

	Dependent Variable: Equals to 1 if the proficiency level 2 has been reached in reading						
	Denmark	Finland	Korea	B-S-J-G (China)	Vietnam	OECD	OECD - Without Mexico
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age	0.037 (0.026)	0.025 (0.016)	0.034 (0.022)	0.005 (0.024)	0.027 (0.024)	0.041*** (0.009)	0.029*** (0.009)
Female	0.055*** (0.013)	0.095*** (0.010)	0.111*** (0.020)	0.052*** (0.011)	0.102*** (0.014)	0.083*** (0.006)	0.08*** (0.006)
Socio-Economic Index	0.064*** (0.013)	0.085*** (0.012)	0.076*** (0.012)	0.051*** (0.009)	0.036*** (0.010)	0.081*** (0.004)	0.085*** (0.005)
Socio-Economic Index ^2	0.001 (0.007)	-0.03*** (0.009)	-0.039*** (0.014)	-0.015** (0.007)	0.009 (0.010)	-0.009*** (0.002)	-0.009*** (0.002)
Socio-Economic Index ^3	-0.001 (0.002)	-0.005 (0.004)	-0.005 (0.007)	0.004** (0.002)	0.003 (0.002)	-0.002** (0.001)	-0.003*** (0.001)
School in Rural Area	-0.023 (0.035)	-0.001 (0.019)	-0.215*** (0.07)	-0.136** (0.064)	-0.038 (0.028)	-0.054*** (0.013)	-0.007 (0.013)
Speaks Other Language at Home	-0.129*** (0.039)	-0.127*** (0.034)	-0.152 (0.159)	-0.094 (0.069)	-0.045 (0.053)	-0.1*** (0.012)	-0.094*** (0.012)
Immigrant	-0.128*** (0.027)	-0.117** (0.052)	0.285** (0.144)	-0.371*** (0.144)	-0.191 (0.249)	0.016 (0.013)	0.023* (0.013)
Constant	0.211 (0.413)	0.454* (0.265)	0.305 (0.354)	0.811** (0.38)	0.461 (0.389)	0.089 (0.144)	0.271* (0.148)
Observations	4453	5380	3659	8435	5271	162448	156002

Note: *Estimates are obtained from a student weighted school clustered linear probability model. Estimates for the OECD in columns 6 and 7 include country dummies. Regressions are restricted to students in public school only. Robust standard errors adjusted for clustering at the school level are reported in parentheses. Significance level. * p <0.1; ** p<0.05; *** p<0.01.*

Regression Appendix S: Science (Scores, Level 1c, Level 2)

Table RA. S. PISA-D. Scores Student Characteristics and Test Scores in Science in Public Schools in PISA-D

	Dependent Variable: Test scores in science						
	Cambodia	Ecuador	Guatemala	Honduras	Paraguay	Senegal	Zambia
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age	19.762***	12.745***	6.408	5.555	12.610**	4.878	17.533***
	(3.528)	(4.428)	(7.162)	(4.490)	(5.574)	(4.749)	(3.837)
Female	2.953*	-13.429***	-10.285***	-8.205***	-5.875**	-0.410	4.510
	(1.655)	(2.480)	(3.534)	(2.688)	(2.997)	(2.666)	(3.609)
Socio-Economic Index	9.871**	27.72***	17.486***	12.613***	18.67***	6.434*	13.627***
	(3.960)	(2.829)	(4.162)	(4.583)	(3.055)	(3.449)	(3.617)
Socio-Economic Index ^2	3.697*	4.246*	-1.134	5.717**	4.761*	2.353	1.868
	(2.105)	(2.512)	(2.440)	(2.873)	(2.738)	(1.894)	(2.042)
Socio-Economic Index ^3	0.697**	0.091	-0.991*	0.999	0.830	0.238	0.147
	(0.324)	(0.664)	(0.542)	(0.636)	(0.734)	(0.281)	(0.32)
School in Rural Area	-19.729***	8.164	-26.296***	-13.043***	-9.113	-12.637***	-27.259***
	(4.389)	(6.447)	(5.567)	(3.626)	(6.490)	(4.471)	(7.214)
Speaks Other Language at Home	-20.246**	-18.034	-25.262***	-54.17***	-21.596***	-6.460	-20.718***
	(7.956)	(18.909)	(8.515)	(15.606)	(4.636)	(5.168)	(4.033)
Immigrant	-116.096***	10.760	-19.6*	-41.706***	-8.415	-3.639	-23.958*
	(26.453)	(12.113)	(11.693)	(11.587)	(16.075)	(3.843)	(12.959)
Constant	45.439	216.543***	297.708***	291.877***	193.167**	243.046***	86.996
	(56.47)	(68.725)	(115.12)	(70.325)	(86.204)	(76.482)	(60.046)
Observations	4388	4098	2216	2902	2648	3484	2847

***Note**: Estimates are obtained from a student weighted school clustered linear model. Regressions are restricted to students in public school only. Robust standard errors adjusted for clustering at the school level are reported in parentheses. Significance level. * p <0.1; ** p<0.05; *** p<0.01.*

Table RA. S. Comparator. Scores: Student Characteristics and Test Scores in Science in Public Schools in PISA

	Dependent Variable: Test scores in science						
	Denmark	Finland	Korea	B-S-J-G (China)	Vietnam	OECD	OECD - Without Mexico
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age	19.231***	14.533***	15.241**	15.083**	17.554***	13.326***	12.652***
	(5.483)	(4.683)	(6.570)	(7.516)	(3.954)	(1.887)	(2.149)
Female	-7.490*	16.457***	7.964	-7.582***	2.170	-5.787***	-5.699***
	(3.881)	(2.243)	(5.398)	(2.658)	(2.424)	(1.217)	(1.296)
Socio-Economic Index	24.643***	42.001***	39.786***	37.704***	35.101***	34.01***	36.295***
	(2.602)	(3.256)	(3.521)	(3.905)	(5.450)	(0.862)	(1.003)
Socio-Economic Index ^2	4.191***	-4.013*	-3.187	-1.625	8.724***	4.814***	3.930***
	(1.521)	(2.258)	(3.770)	(2.098)	(2.843)	(0.639)	(0.719)
Socio-Economic Index ^3	0.459	-2.385**	-2.040	-0.102	1.245**	0.053	-0.326
	(0.472)	(1.174)	(1.599)	(0.607)	(0.510)	(0.194)	(0.235)
School in Rural Area	-7.060	7.905	-59.784***	-30.261*	-10.167*	-4.944	1.781
	(6.859)	(5.504)	(7.074)	(16.275)	(5.864)	(3.307)	(4.064)
Speaks Other Language at Home	-28.191***	-35.398***	-81.529**	-41.421***	-13.844*	-23.039***	-21.449***
	(6.449)	(7.382)	(31.751)	(11.698)	(7.558)	(2.733)	(2.748)
Immigrant	-41.124***	-35.764***	-31.922	-108.624***	-21.018	-2.915	-1.161
	(4.926)	(10.544)	(51.825)	(18.832)	(35.194)	(3.084)	(3.108)
Constant	189.607**	288.786***	277.979***	334.573***	294.238***	287.208***	297.098***
	(86.746)	(73.578)	(103.228)	(115.976)	(60.985)	(29.623)	(33.808)
Observations	4453	5380	3659	8435	5271	162448	156002

Note: *Estimates are obtained from a student weighted school clustered linear model. Estimates for the OECD in columns 6 and 7 include country dummies. Regressions are restricted to students in public school only. Robust standard errors adjusted for clustering at the school level are reported in parentheses. Significance level. * p <0.1; ** p<0.05; *** p<0.01.*

Table RA. S. PISA-D. Level 1c: Student Characteristics and Proficiency Level 1c in Science in Public Schools

	Dependent Variable: Equals to 1 if the proficiency level 1c has been reached in science						
	Cambodia	Ecuador	Guatemala	Honduras	Paraguay	Senegal	Zambia
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age	-0.041***	-0.020*	-0.013	-0.003	-0.005	-0.030	-0.070*
	(0.015)	(0.011)	(0.017)	(0.017)	(0.022)	(0.043)	(0.041)
Female	-0.017*	0.011	0.016	0.011	0.002	0.006	-0.020
	(0.01)	(0.007)	(0.012)	(0.009)	(0.013)	(0.018)	(0.024)
Socio-Economic Index	-0.020	-0.009***	-0.01**	-0.007	-0.015**	-0.025	-0.027
	(0.016)	(0.003)	(0.005)	(0.006)	(0.007)	(0.025)	(0.019)
Socio-Economic Index ^2	-0.015	-0.001	0.002	-0.009	-0.012	-0.013	-0.010
	(0.012)	(0.004)	(0.007)	(0.007)	(0.011)	(0.012)	(0.016)
Socio-Economic Index ^3	-0.003	0.000	0.001	-0.003	-0.005*	-0.002	-0.003
	(0.002)	(0.001)	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)
School in Rural Area	0.045***	0.001	0.033**	0.017	0.020	0.073**	0.102***
	(0.011)	(0.011)	(0.015)	(0.011)	(0.018)	(0.031)	(0.026)
Speaks Other Language at Home	0.094*	0.020	0.074	0.194*	0.029*	0.023	0.050**
	(0.055)	(0.036)	(0.051)	(0.113)	(0.017)	(0.039)	(0.024)
Immigrant	0.707***	-0.002	0.027	0.094	0.031	0.003	0.086
	(0.161)	(0.026)	(0.052)	(0.081)	(0.102)	(0.034)	(0.102)
Constant	0.673***	0.316*	0.189	0.050	0.090	0.580	1.121*
	(0.246)	(0.178)	(0.273)	(0.276)	(0.355)	(0.697)	(0.663)
Observations	4388	4098	2216	2902	2648	3484	2847

***Note**: Estimates are obtained from a student weighted school clustered linear probability model. Regressions are restricted to students in public school only. Robust standard errors adjusted for clustering at the school level are reported in parentheses. Significance level. * p <0.1; ** p<0.05; *** p<0.01.*

Table RA. S. PISA-D. Level 1c: Student Characteristics and Proficiency Level 1c in Science in Public Schools

	Dependent Variable: Equals to 1 if the proficiency level 1c has been reached in science						
	Denmark	Finland	Korea	B-S-J-G (China)	Vietnam	OECD	OECD - Without Mexico
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age	-0.005	-0.001	0.000	0.000		-0.001	-0.001
	(0.004)	(0.003)	(0.004)	(0.003)		(0.001)	(0.001)
Female	-0.002	-0.001	-0.004**	0.000		-0.002**	-0.002**
	(0.002)	(0.002)	(0.002)	(0.002)		(0.001)	(0.001)
Socio-Economic Index	-0.002	-0.002	-0.004**	-0.002**		-0.002**	-0.003***
	(0.005)	(0.003)	(0.002)	(0.001)		(0.001)	(0.001)
Socio-Economic Index ^2	0.002	0.001	0.003	0.000		0.000	0.000
	(0.002)	(0.003)	(0.002)	(0.001)		(0.000)	(0.000)
Socio-Economic Index ^3	0.000	-0.001	0.000	0.000		-0.001	0.000
	(0.001)	(0.002)	(0.001)	(0.000)		(0.000)	(0.000)
School in Rural Area	0.003	-0.002	0.014	-0.003		0.003	0.000
	(0.006)	(0.002)	(0.029)	(0.004)		(0.002)	(0.001)
Speaks Other Language at Home	0.014	0.008	0.069	0.002		0.006	0.005
	(0.009)	(0.008)	(0.082)	(0.014)		(0.004)	(0.004)
Immigrant	0.011*	0.014	-0.055	0.023		-0.001	-0.001
	(0.006)	(0.013)	(0.062)	(0.076)		(0.003)	(0.002)
Constant	0.065	0.005	0.001	-0.003		0.006	0.021
	(0.077)	(0.058)	(0.073)	(0.057)		(0.032)	(0.03)
Observations	4453	5380	3659	8435		162448	156002

Note: *Estimates are obtained from a student weighted school clustered linear probability model. For Vietnam, the estimates are not possible as there are not enough observations of students reaching only performance level 1c in science. Estimates for the OECD in columns 6 and 7 include country dummies. Regressions are restricted to students in public school only. Robust standard errors adjusted for clustering at the school level are reported in parentheses. Significance level. * p <0.1; ** p<0.05; *** p<0.01.*

Table RA. S. PISA-D. Level 2: Student Characteristics and Proficiency Level 2 in Science in Public Schools

	Dependent Variable: Equals to 1 if the proficiency level 2 has been reached in science						
	Cambodia	Ecuador	Guatemala	Honduras	Paraguay	Senegal	Zambia
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age	0.045**	0.069**	0.023	0.043	0.071**	-0.005	0.048***
	(0.02)	(0.032)	(0.058)	(0.03)	(0.035)	(0.012)	(0.017)
Female	-0.005	-0.075***	-0.06***	-0.046**	-0.028	-0.001	0.003
	(0.008)	(0.02)	(0.021)	(0.018)	(0.019)	(0.005)	(0.013)
Socio-Economic Index	0.037	0.179***	0.096**	0.089***	0.12***	0.008	0.052**
	(0.027)	(0.017)	(0.041)	(0.032)	(0.025)	(0.013)	(0.021)
Socio-Economic Index ^2	0.009	0.019	-0.004	0.03	0.022	0.001	0.007
	(0.013)	(0.016)	(0.028)	(0.02)	(0.021)	(0.005)	(0.01)
Socio-Economic Index ^3	0.001	-0.003	-0.005	0.004	0.001	0.000	0.000
	(0.001)	(0.004)	(0.005)	(0.004)	(0.005)	(0.000)	(0.001)
School in Rural Area	-0.045**	0.059	-0.11***	-0.046**	-0.029	-0.007	-0.059**
	(0.021)	(0.042)	(0.034)	(0.022)	(0.034)	(0.007)	(0.027)
Speaks Other Language at Home	-0.032	-0.107	-0.087***	-0.132***	-0.107***	-0.014	-0.06***
	(0.022)	(0.099)	(0.026)	(0.051)	(0.027)	(0.017)	(0.02)
Immigrant	-0.043**	0.084	-0.097*	-0.112***	-0.04	-0.005	-0.033
	(0.018)	(0.084)	(0.051)	(0.04)	(0.052)	(0.006)	(0.028)
Constant	-0.593*	-0.557	0.000	-0.383	-0.724	0.109	-0.564**
	(0.326)	(0.502)	(0.95)	(0.48)	(0.553)	(0.194)	(0.258)
Observations	4388	4098	2216	2902	2648	3484	2847

***Note**: Estimates are obtained from a student weighted school clustered linear probability model. Regressions are restricted to students in public school only. Robust standard errors adjusted for clustering at the school level are reported in parentheses. Significance level. * p <0.1; ** p<0.05; *** p<0.01.*

Table RA.S.Comparator.Level 2: Student Characteristics and Proficiency Level 2 in Science in Public Schools

	Dependent Variable: Equals to 1 if the proficiency level 2 has been reached in science						
	Denmark	Finland	Korea	B-S-J-G (China)	Vietnam	OECD	OECD - Without Mexico
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age	0.047*	0.028	0.041	0.000	0.017	0.045***	0.034***
	(0.025)	(0.018)	(0.026)	(0.021)	(0.016)	(0.009)	(0.009)
Female	-0.012	0.055***	0.052***	0.000	0.013*	0.004	0.007
	(0.016)	(0.009)	(0.019)	(0.011)	(0.007)	(0.006)	(0.006)
Socio-Economic Index	0.068***	0.093***	0.084***	0.036***	0.012**	0.091***	0.094***
	(0.012)	(0.012)	(0.013)	(0.008)	(0.006)	(0.004)	(0.004)
Socio-Economic Index ^2	-0.003	-0.036***	-0.046***	-0.011*	0.008	-0.007***	-0.007***
	(0.007)	(0.009)	(0.014)	(0.006)	(0.008)	(0.002)	(0.002)
Socio-Economic Index ^3	0.000	-0.004	-0.012	0.003	0.003	-0.002**	-0.003***
	(0.002)	(0.004)	(0.008)	(0.002)	(0.002)	(0.001)	(0.001)
School in Rural Area	-0.008	0.013	-0.245***	-0.096*	-0.029*	-0.034***	0.01
	(0.027)	(0.017)	(0.048)	(0.057)	(0.015)	(0.012)	(0.013)
Speaks Other Language at Home	-0.102***	-0.136***	-0.289*	-0.146**	-0.009	-0.095***	-0.088***
	(0.039)	(0.032)	(0.148)	(0.058)	(0.032)	(0.012)	(0.012)
Immigrant	-0.182***	-0.094**	-0.157	-0.363***	-0.114	-0.006	0.000
	(0.028)	(0.047)	(0.434)	(0.139)	(0.195)	(0.012)	(0.012)
Constant	0.081	0.428	0.211	0.924***	0.701***	0.078	0.242
	(0.395)	(0.288)	(0.416)	(0.328)	(0.267)	(0.144)	(0.15)
Observations	4453	5380	3659	8435	5271	162448	156002

Note: *Estimates are obtained from a student weighted school clustered linear probability model. Estimates for the OECD in columns 6 and 7 include country dummies. Regressions are restricted to students in public school only. Robust standard errors adjusted for clustering at the school level are reported in parentheses. Significance level. * p <0.1; ** p<0.05; *** p<0.01.*

Appendix 2: Graphical Appendix

GA.M: Graphs for each PISA-D Country compared to Denmark, Vietnam, by ESCS, Mathematics

Figure GA.M.1a: Comparing Zambia to Denmark, Vietnam, by ESCS

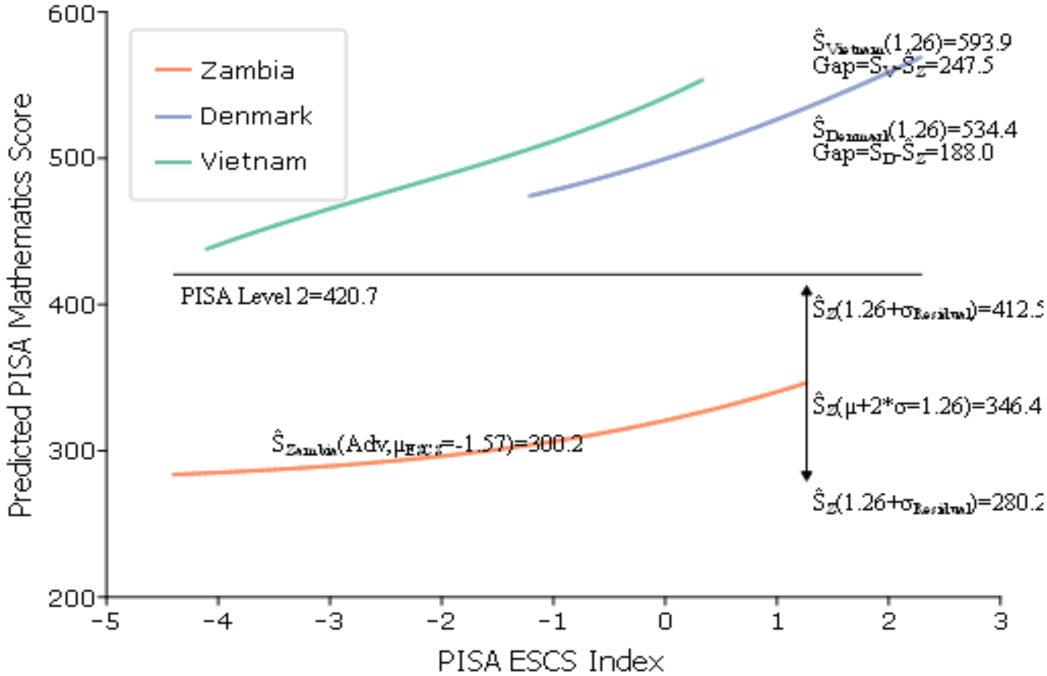


Figure GA.M.1b: Comparing Senegal to Denmark, Vietnam, by ESCS

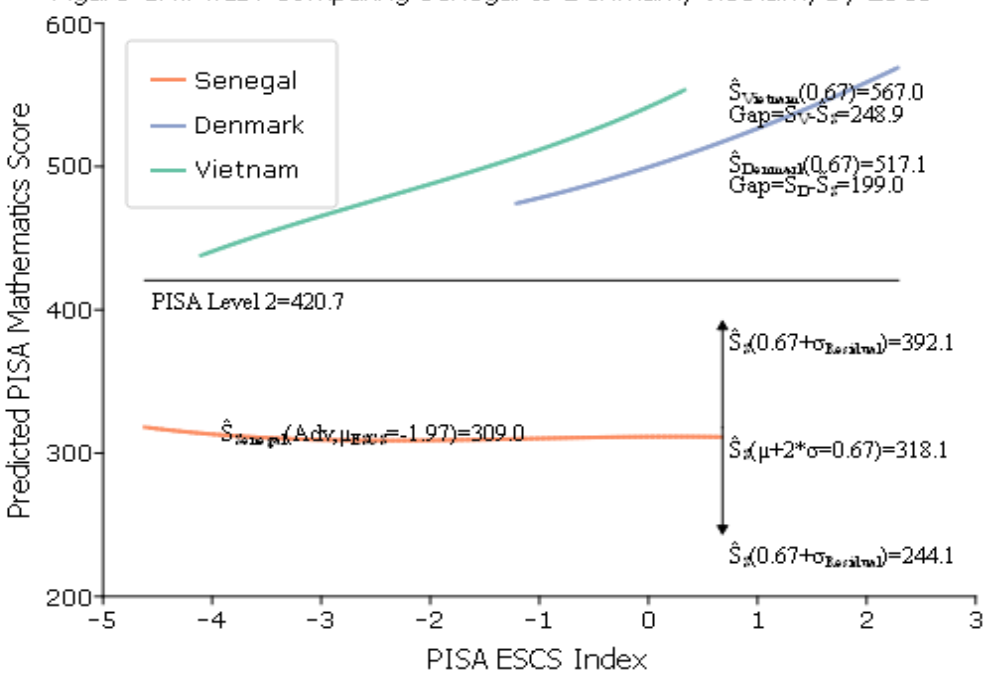


Figure GA.M.1c: Comparing Paraguay to Denmark, Vietnam, by ESCS

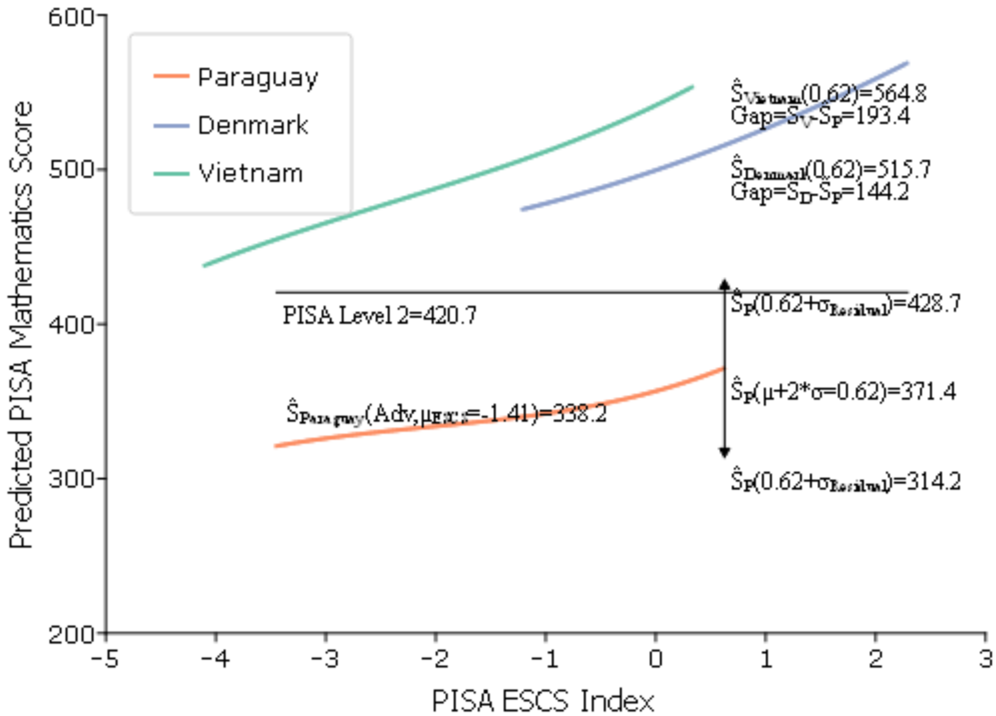


Figure GA.M.1d: Comparing Guatemala to Denmark, Vietnam, by ESCS

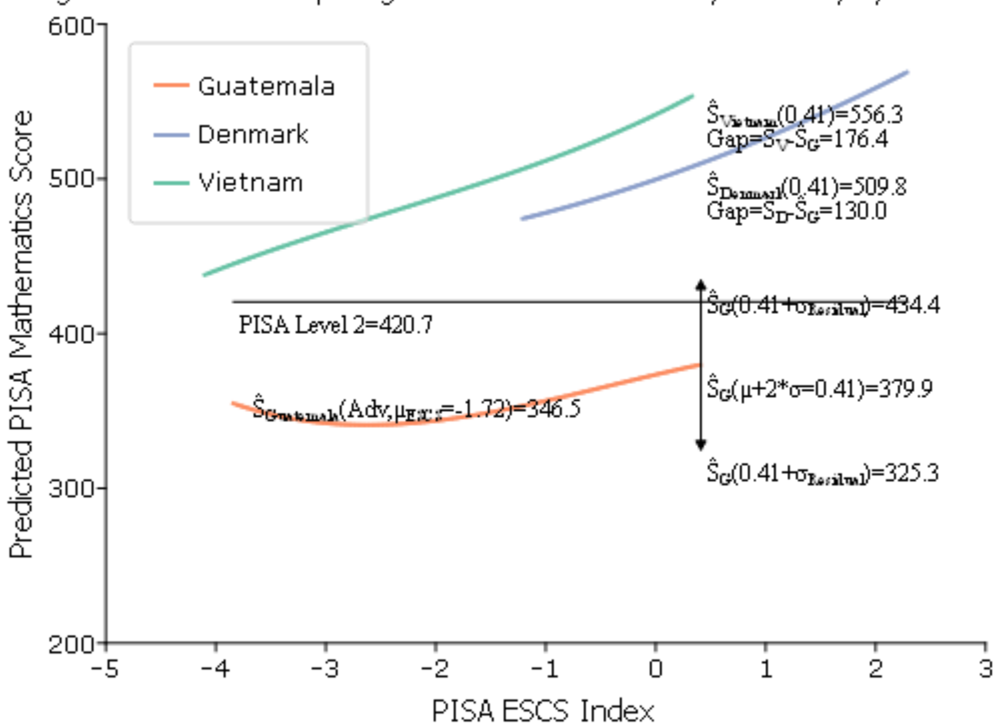


Figure GA.M.1e: Comparing Cambodia to Denmark, Vietnam, by ESCS

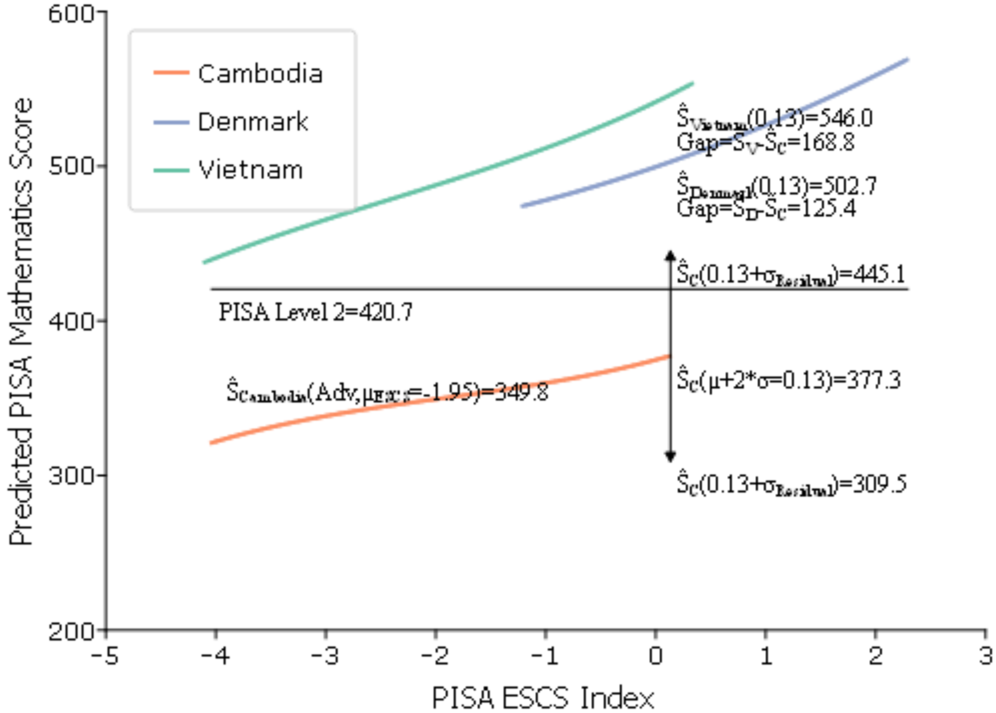


Figure GA.M.1f: Comparing Honduras to Denmark, Vietnam, by ESCS

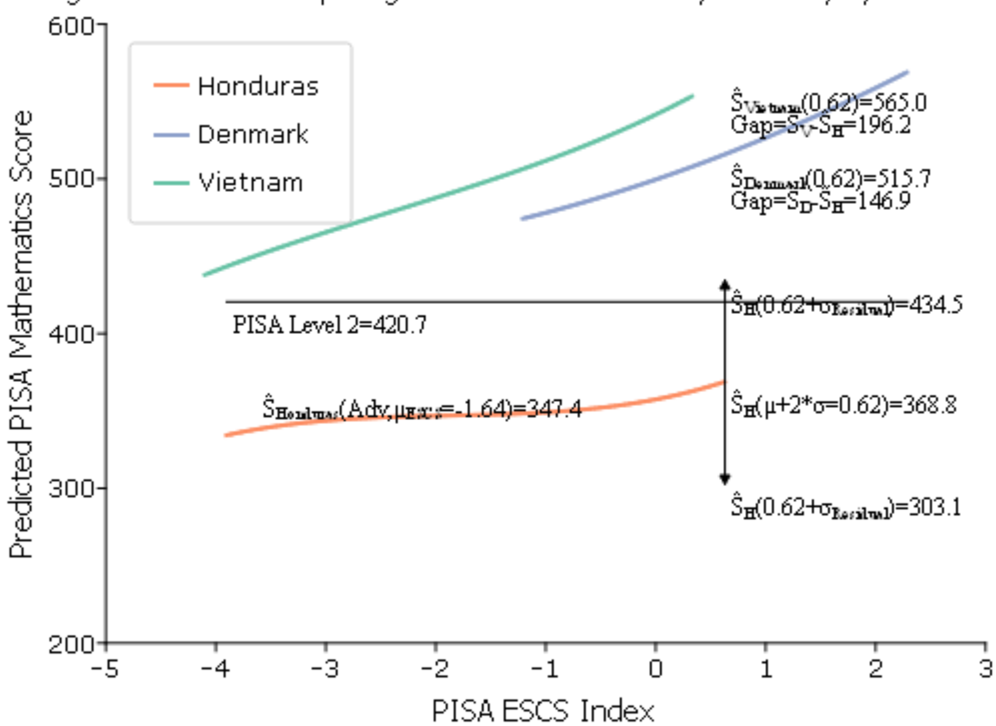
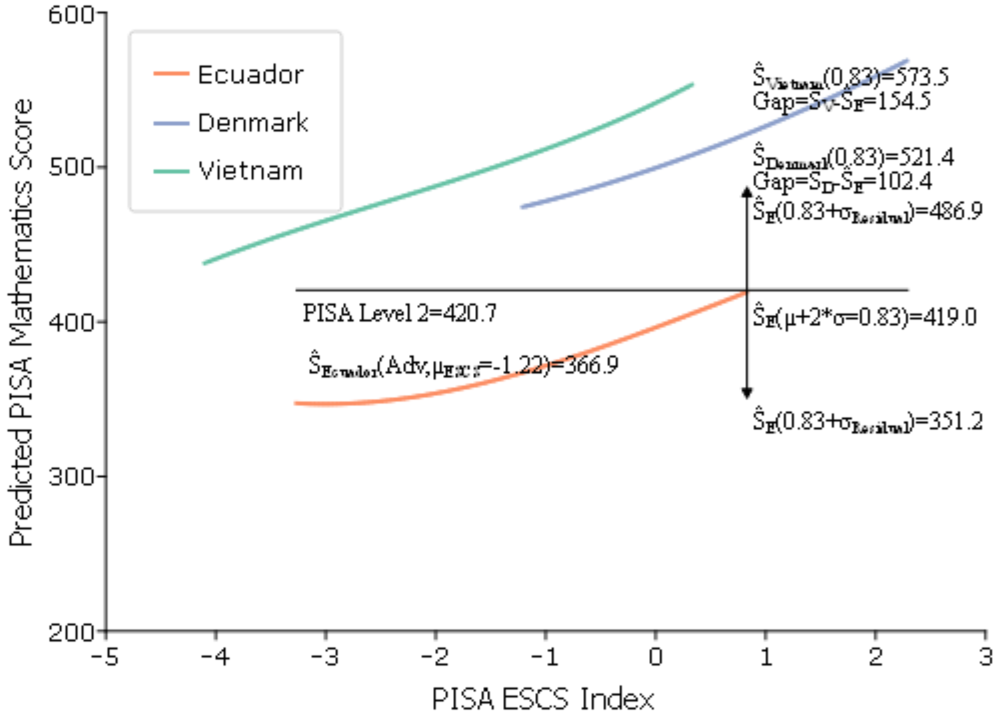


Figure GA.M.1g: Comparing Ecuador to Denmark, Vietnam, by ESCS



GA.R: Graphs for each PISA-D Country compared to Denmark, Vietnam, by ESCS, Reading

Figure GA.R.1a: Comparing Zambia to Denmark, Vietnam, by ESCS

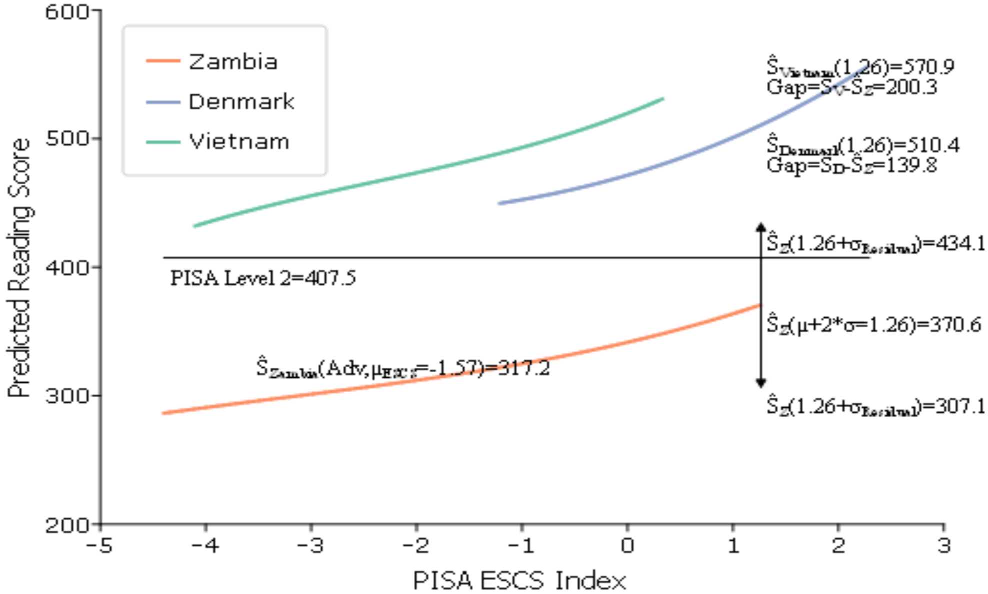


Figure GA.R.1b: Comparing Senegal to Denmark, Vietnam, by ESCS

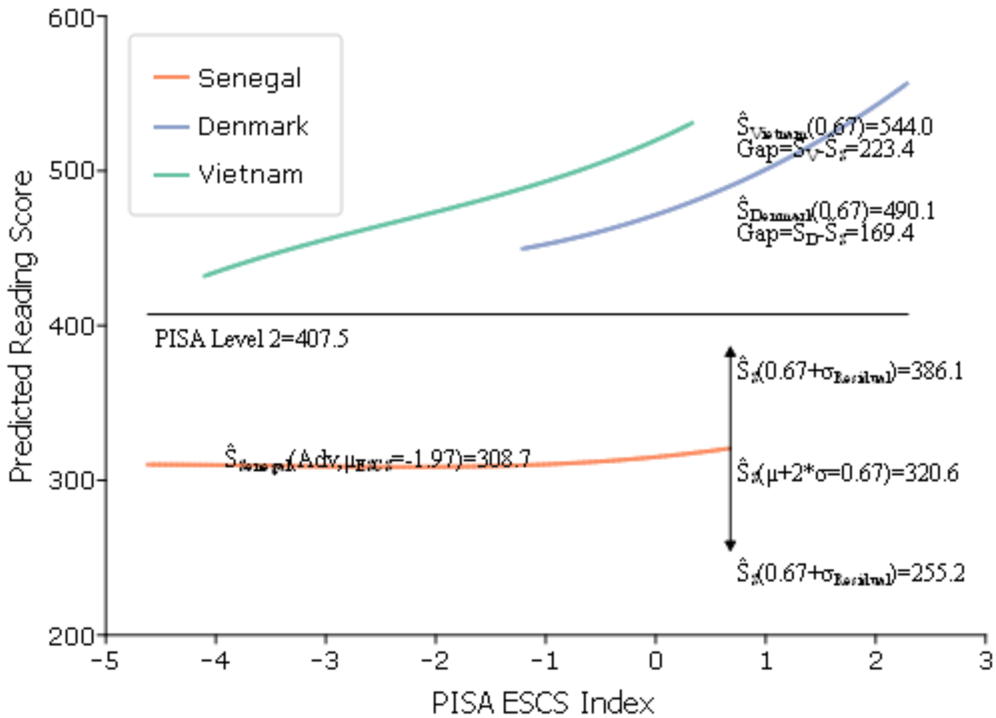


Figure GA.R.1c: Comparing Paraguay to Denmark, Vietnam, by ESCS

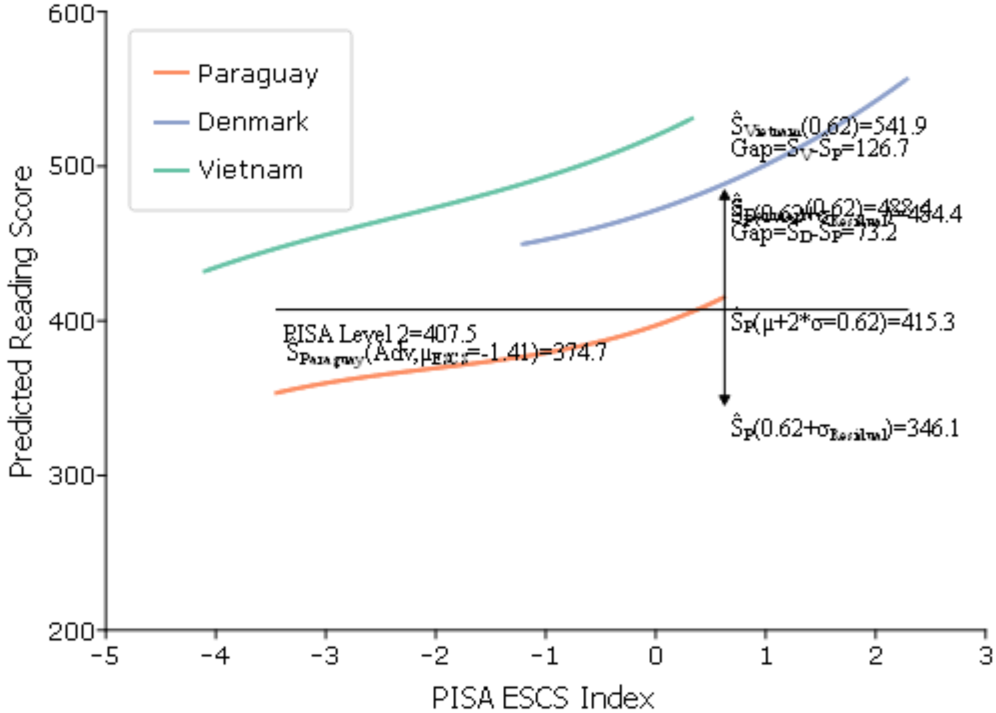


Figure GA.R.1d: Comparing Guatemala to Denmark, Vietnam, by ESCS

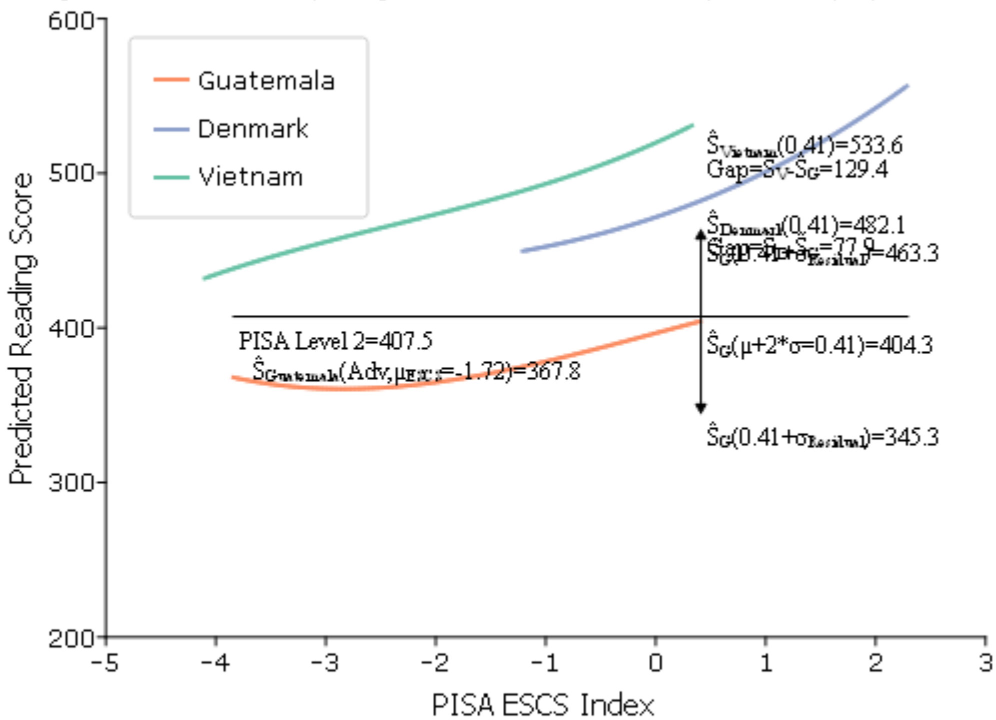


Figure GA.R.1e: Comparing Cambodia to Denmark, Vietnam, by ESCS

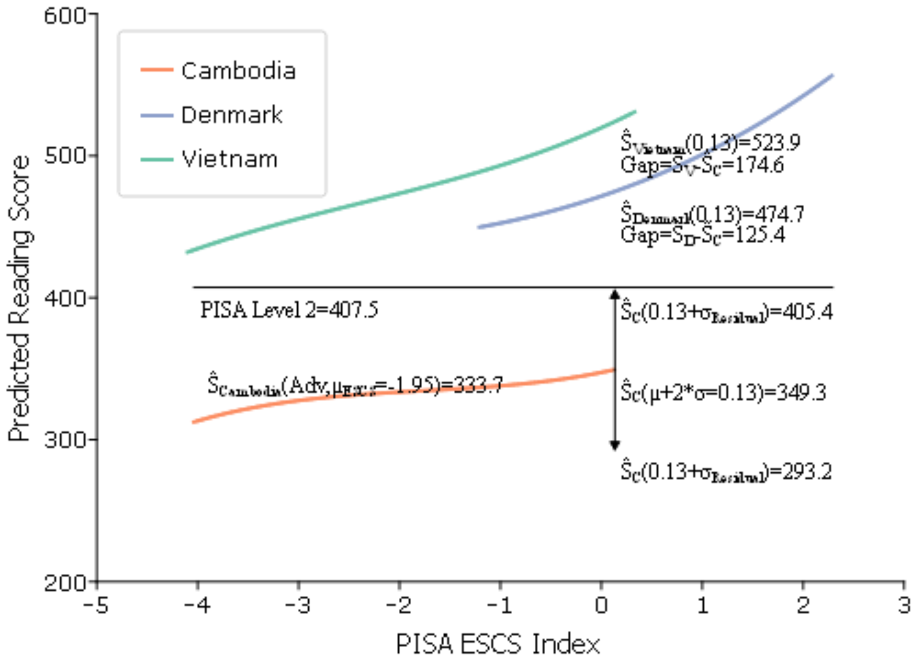


Figure GA.R.1f: Comparing Honduras to Denmark, Vietnam, by ESCS

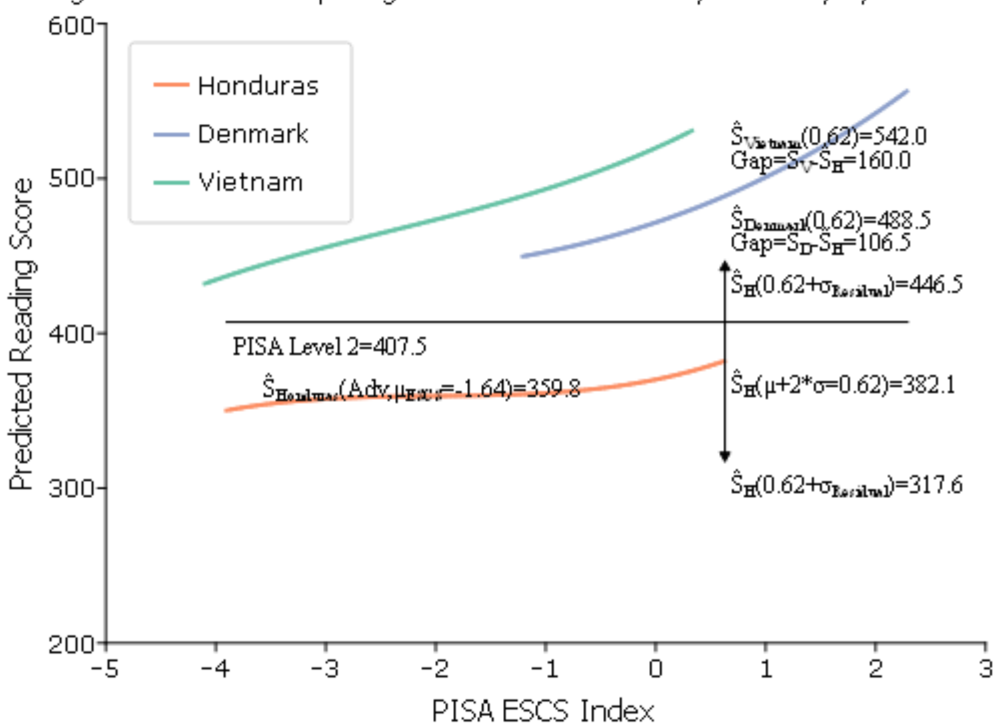
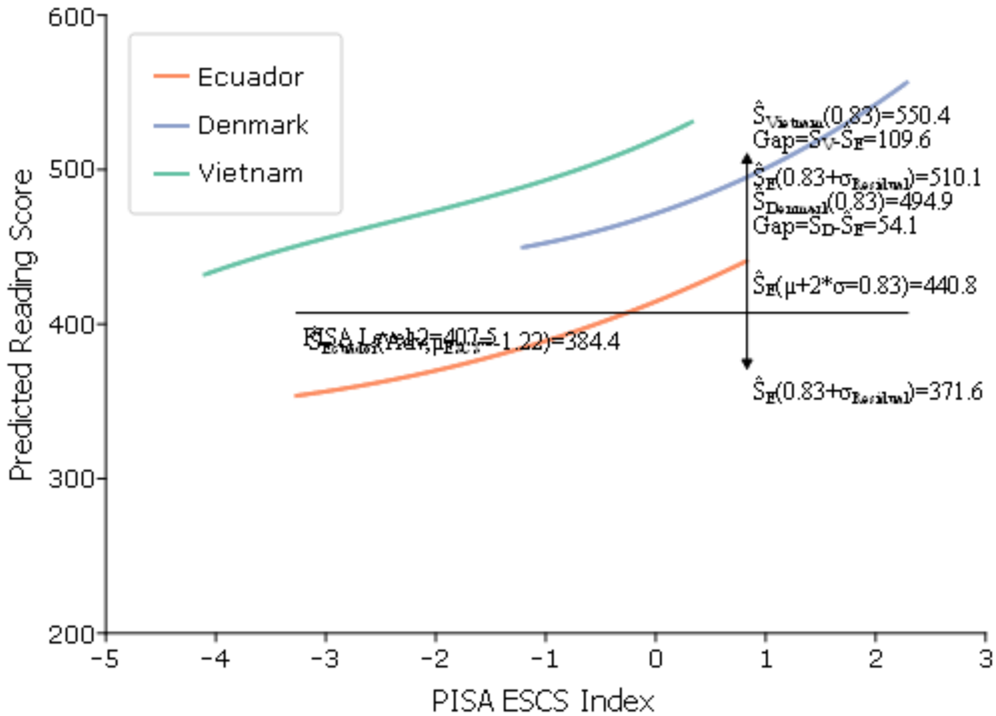


Figure GA.R.1g: Comparing Ecuador to Denmark, Vietnam, by ESCS



GA.S: Graphs for each PISA-D Country compared to Denmark, Vietnam, by ESCS, Science

Figure GA.S.1a: Comparing Zambia to Denmark, Vietnam, by ESCS

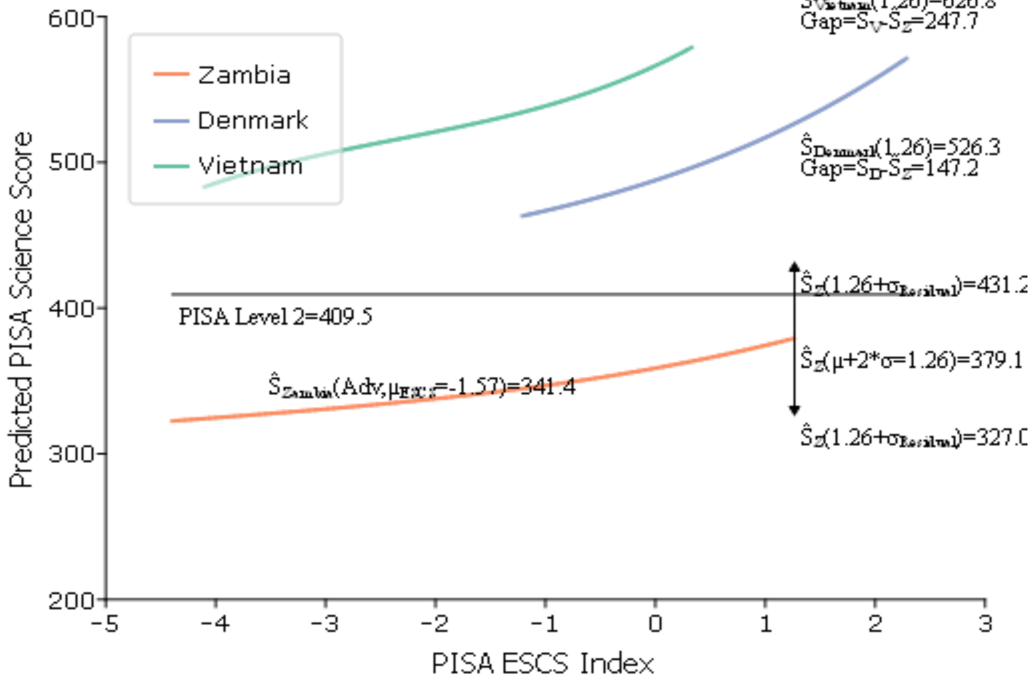


Figure GA.S.1b: Comparing Senegal to Denmark, Vietnam, by ESCS

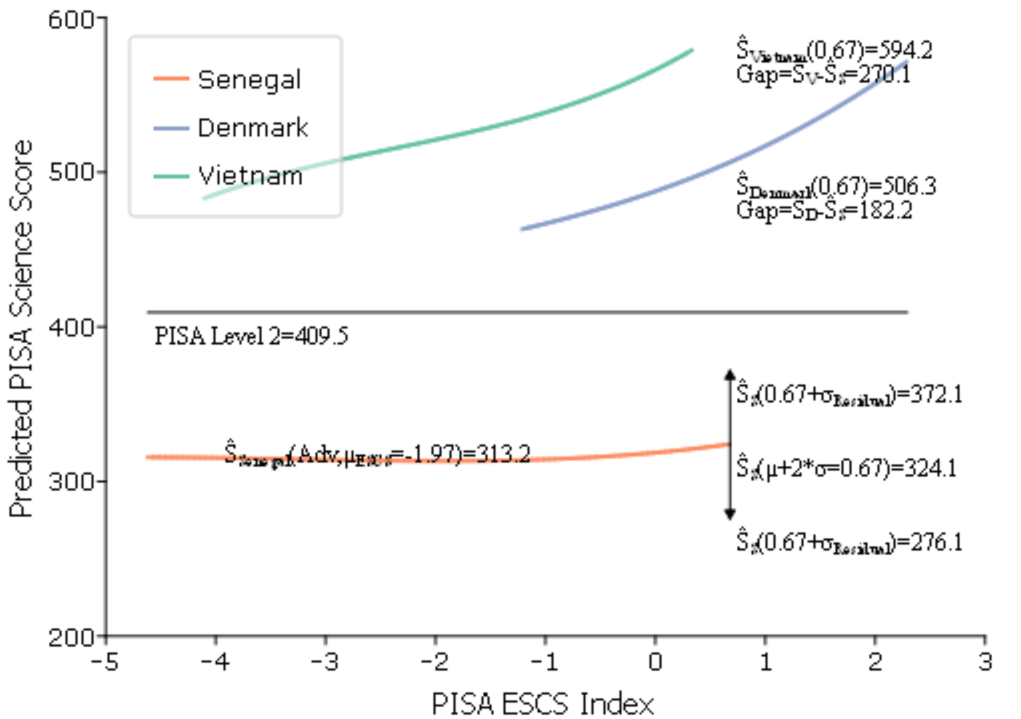


Figure GA.S.1c: Comparing Paraguay to Denmark, Vietnam, by ESCS

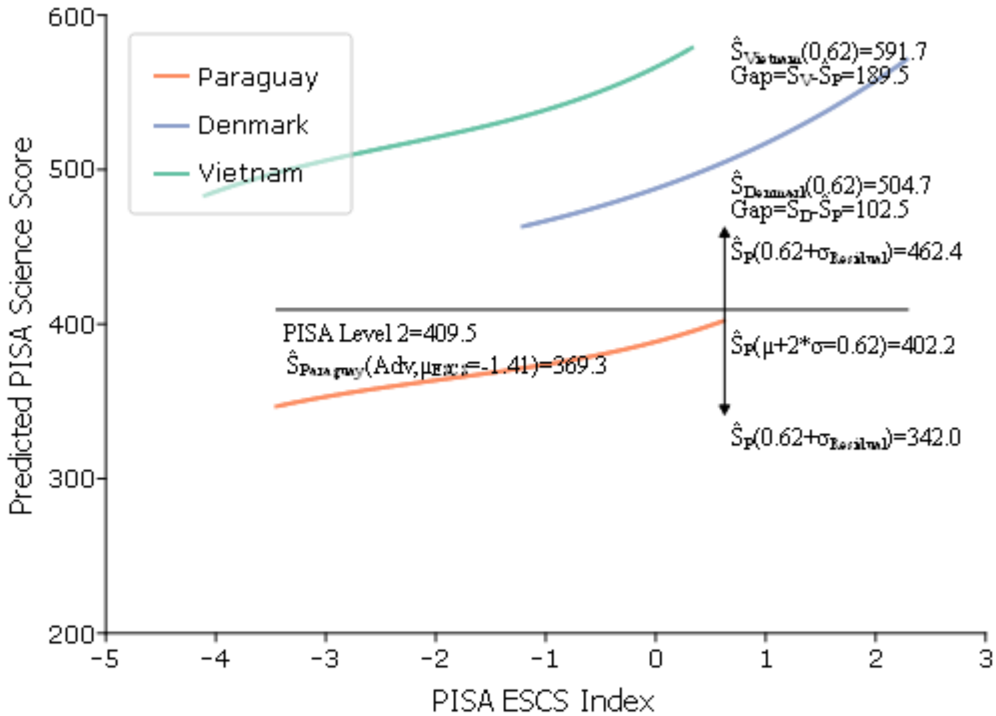


Figure GA.S.1d: Comparing Guatemala to Denmark, Vietnam, by ESCS

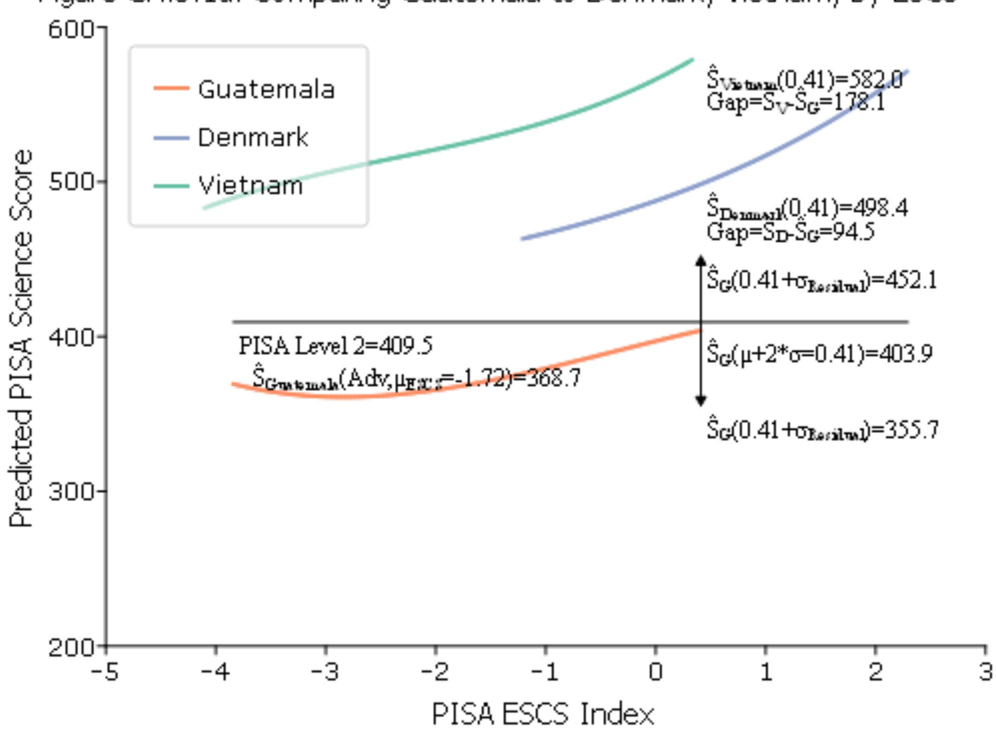


Figure GA.S.1e: Comparing Cambodia to Denmark, Vietnam, by ESCS

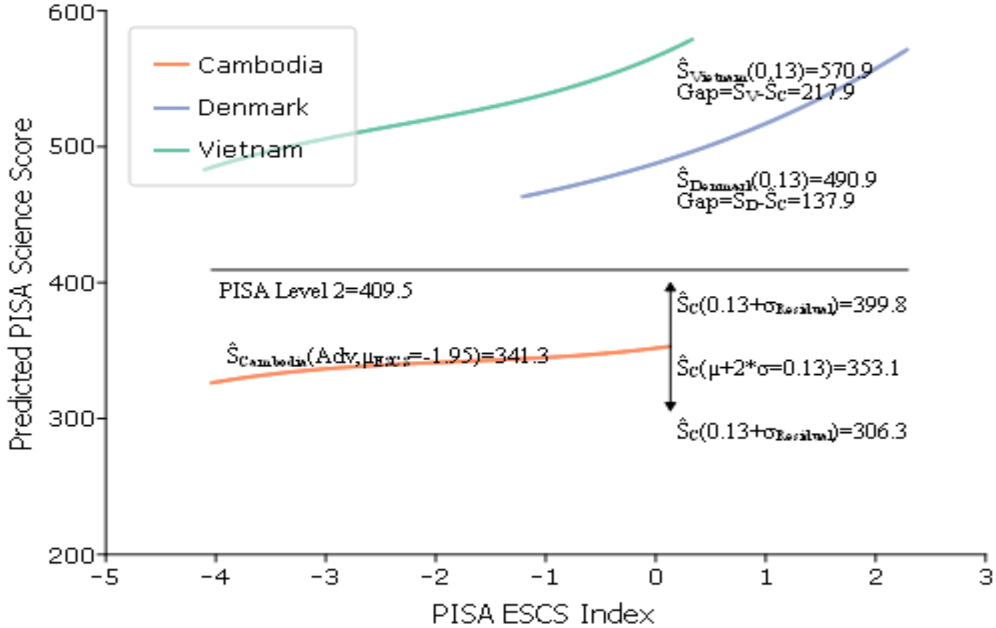


Figure GA.S.1f: Comparing Honduras to Denmark, Vietnam, by ESCS

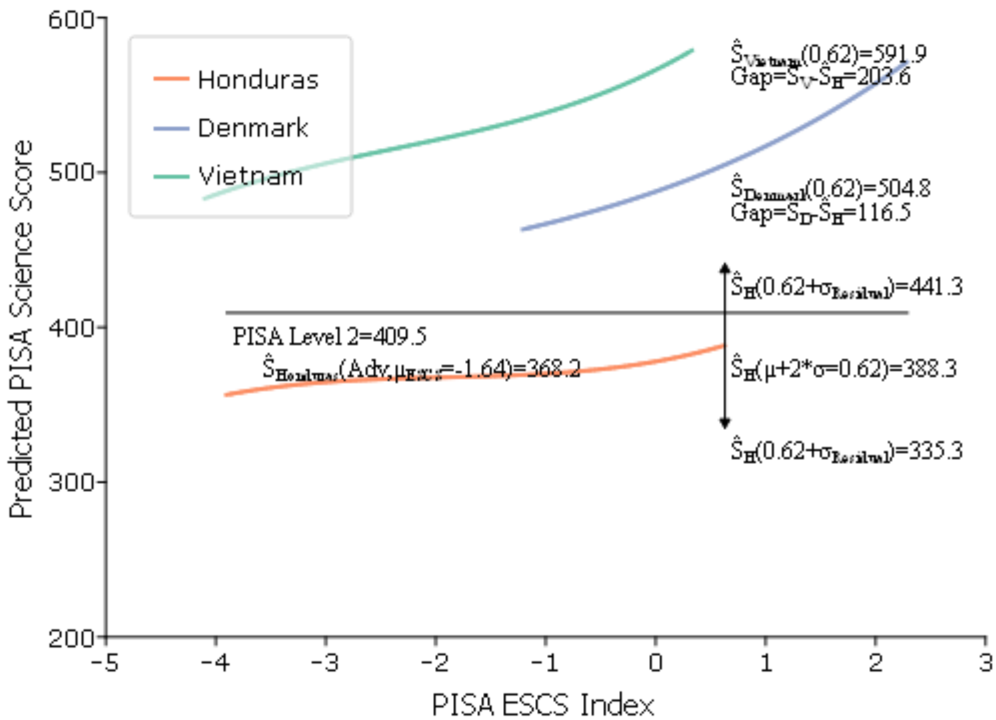
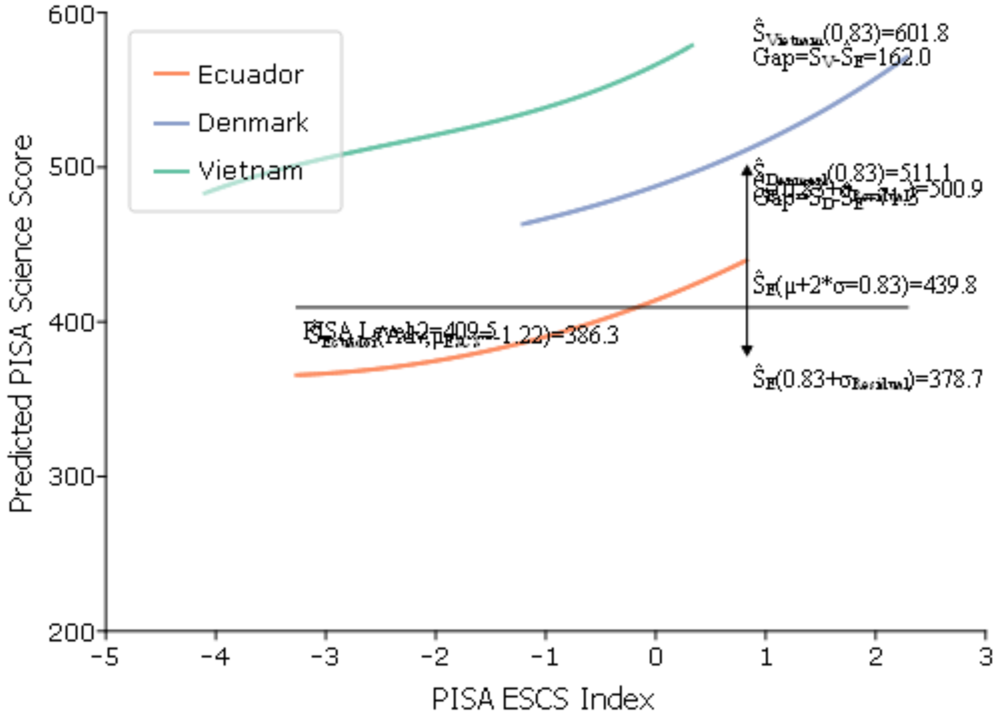


Figure GA.S.1g: Comparing Ecuador to Denmark, Vietnam, by ESCS



GA.M: Graphs for each PISA-D Country at actual and other country ESCS coefficients

Figure GA.M.2a: Zambia at actual and other country ESCS coefficients

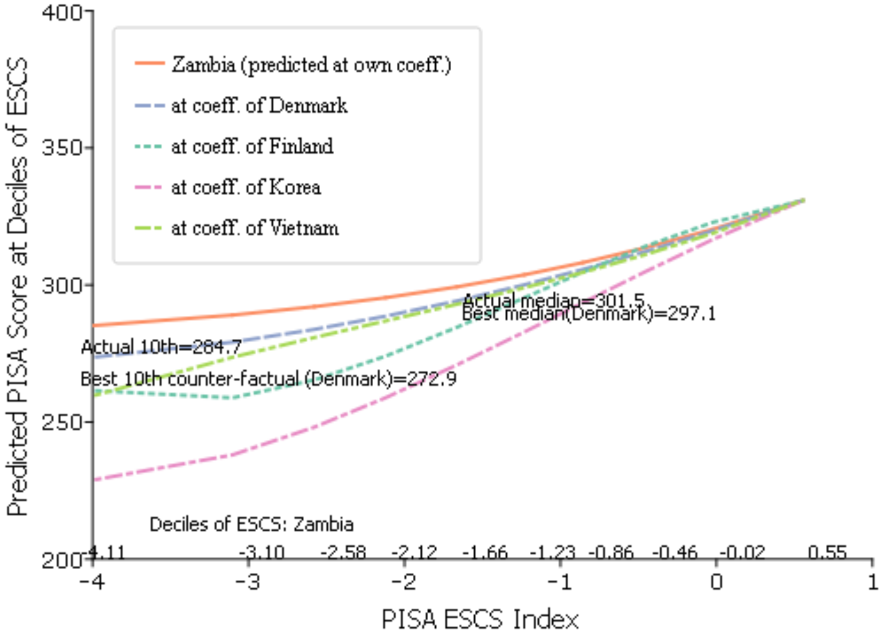
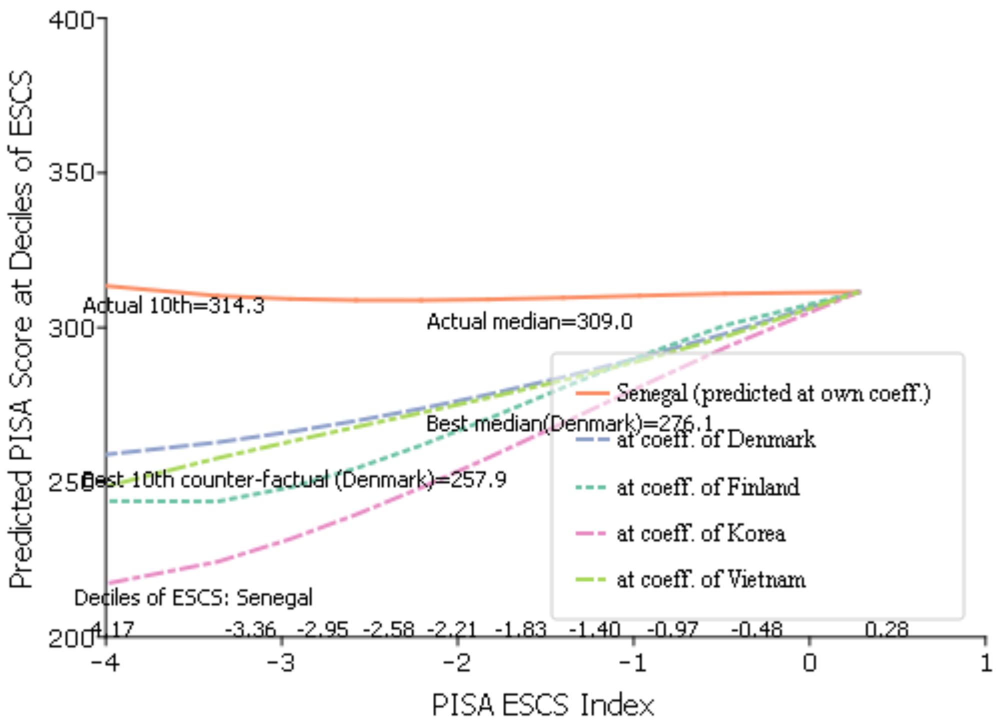


Figure GA.M.2b: Senegal at actual and other country ESCS coefficients



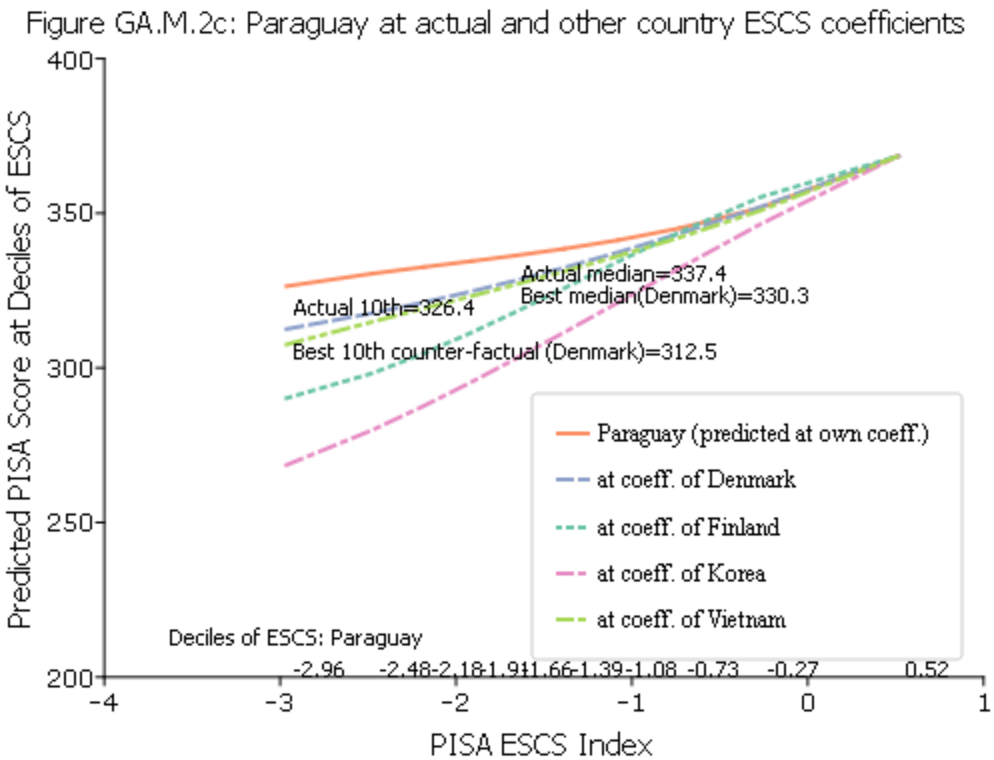


Figure GA.M.2c: Paraguay at actual and other country ESCS coefficients
Predicted PISA Score at Deciles of ESCS
PISA ESCS Index
Actual median=337.4
Best median(Denmark)=330.3
Actual 10th=326.4
Best 10th counter-factual (Denmark)=312.5
Paraguay (predicted at own coeff.)
at coeff. of Denmark
at coeff. of Finland
at coeff. of Korea
at coeff. of Vietnam
Deciles of ESCS: Paraguay

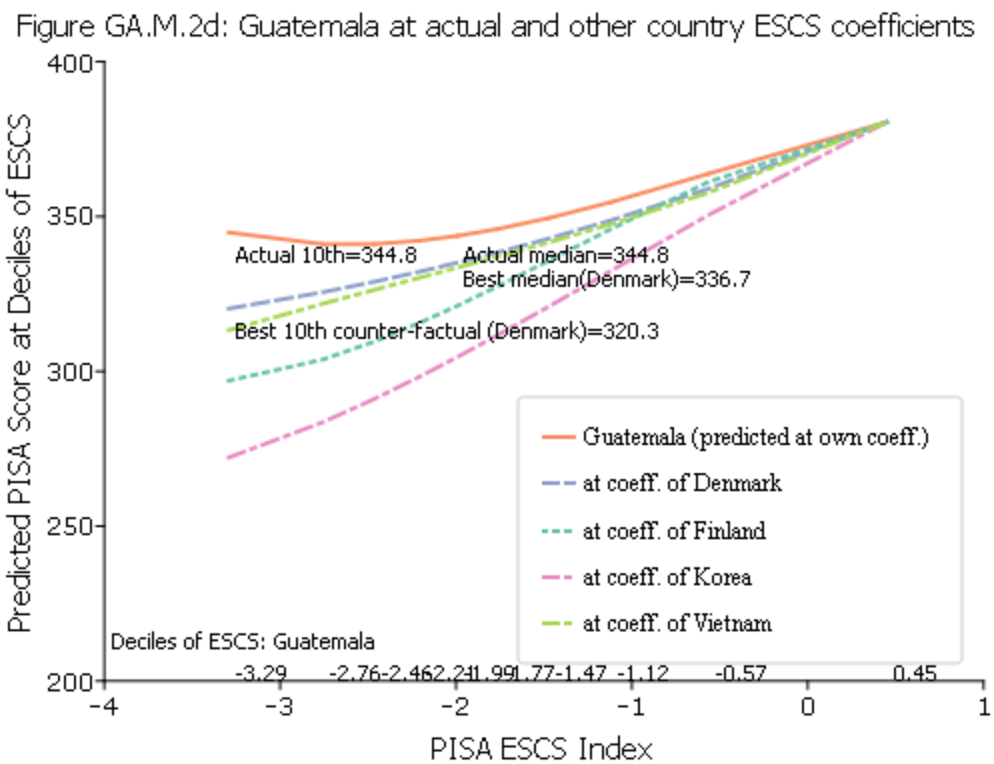


Figure GA.M.2d: Guatemala at actual and other country ESCS coefficients
Predicted PISA Score at Deciles of ESCS
PISA ESCS Index
Actual 10th=344.8
Actual median=344.8
Best median(Denmark)=336.7
Best 10th counter-factual (Denmark)=320.3
Guatemala (predicted at own coeff.)
at coeff. of Denmark
at coeff. of Finland
at coeff. of Korea
at coeff. of Vietnam
Deciles of ESCS: Guatemala

Figure GA.M.2e: Cambodia at actual and other country ESCS coefficients

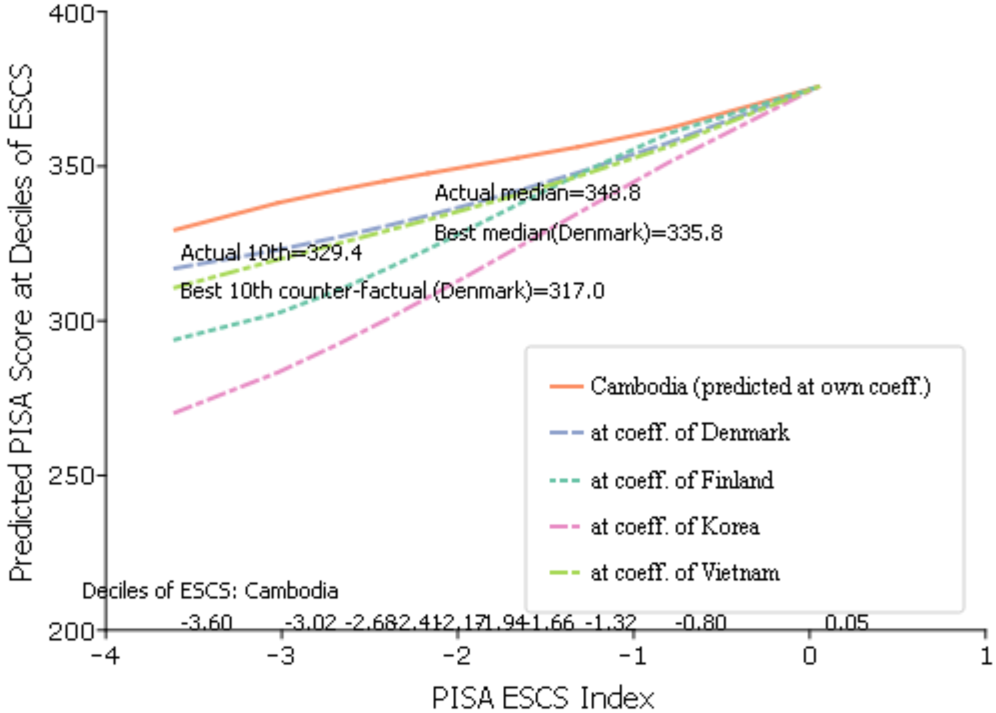
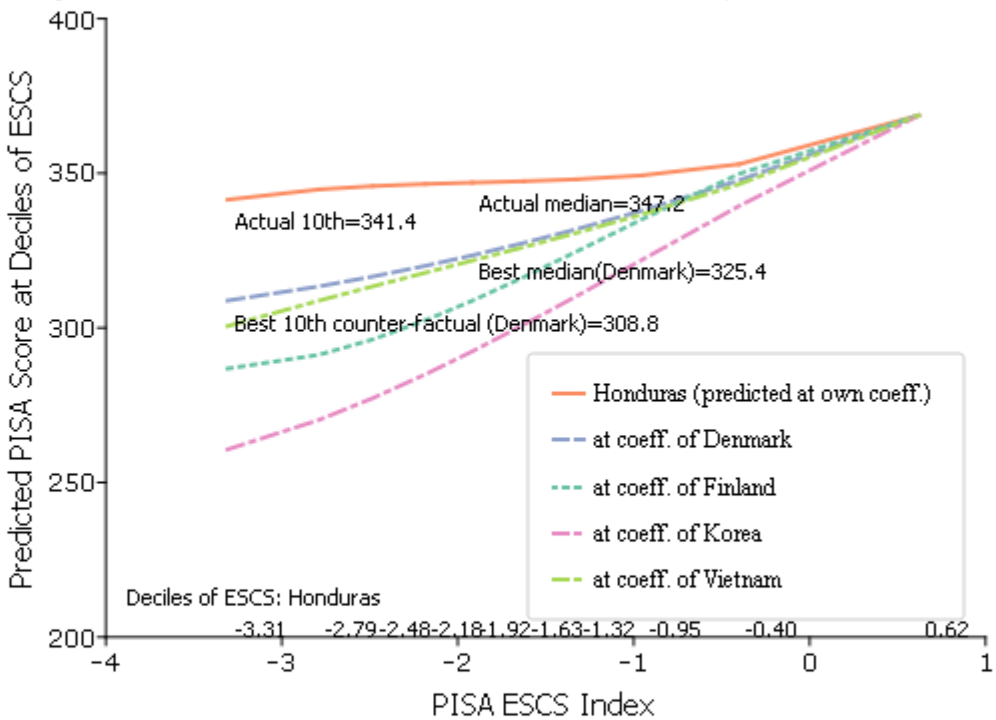


Figure GA.M.2f: Honduras at actual and other country ESCS coefficients



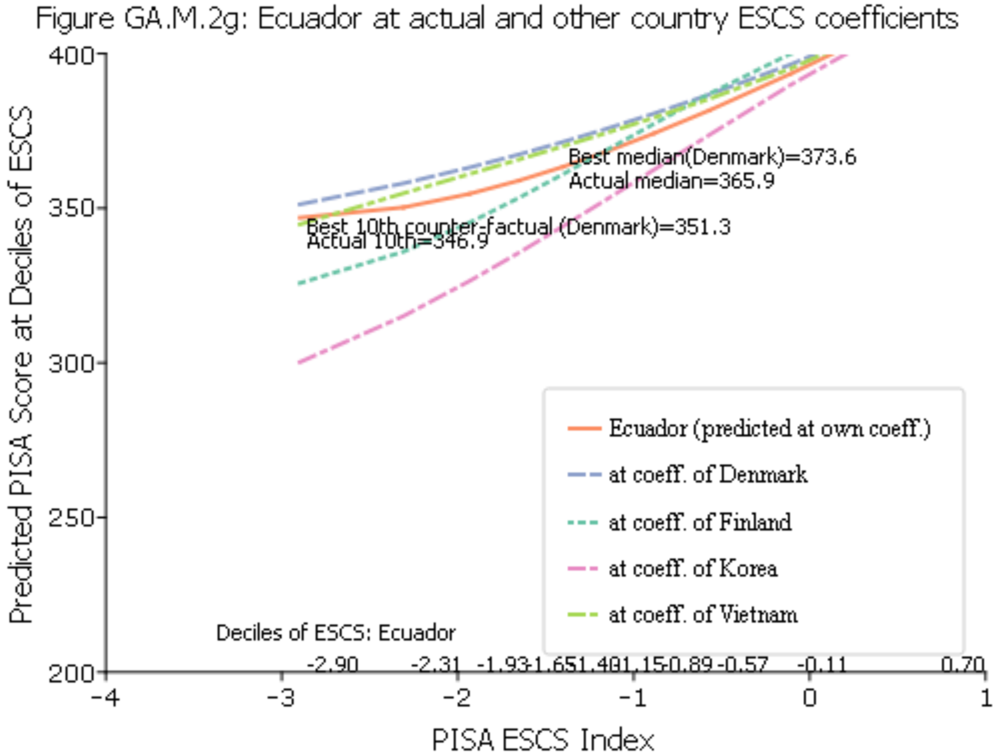
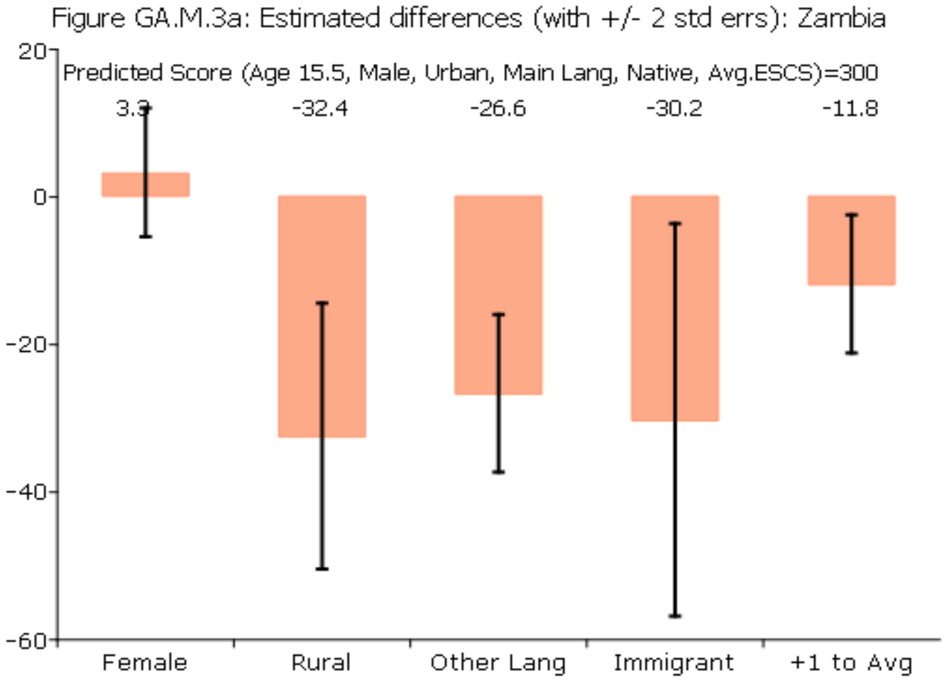


Figure GA.M.2g: Ecuador at actual and other country ESCS coefficients
Predicted PISA Score at Deciles of ESCS
PISA ESCS Index
Best median(Denmark)=373.6
Actual median=365.9
Best 10th counter-factual (Denmark)=351.3
Actual 10th=346.9
Ecuador (predicted at own coeff.)
at coeff. of Denmark
at coeff. of Finland
at coeff. of Korea
at coeff. of Vietnam
Deciles of ESCS: Ecuador
-2.90
-2.31
-0.57
-0.11
0.70

GA.M: Graphs for each PISA-D Country – estimated differences (with +/- 2 s.e.) coefficients, Mathematics



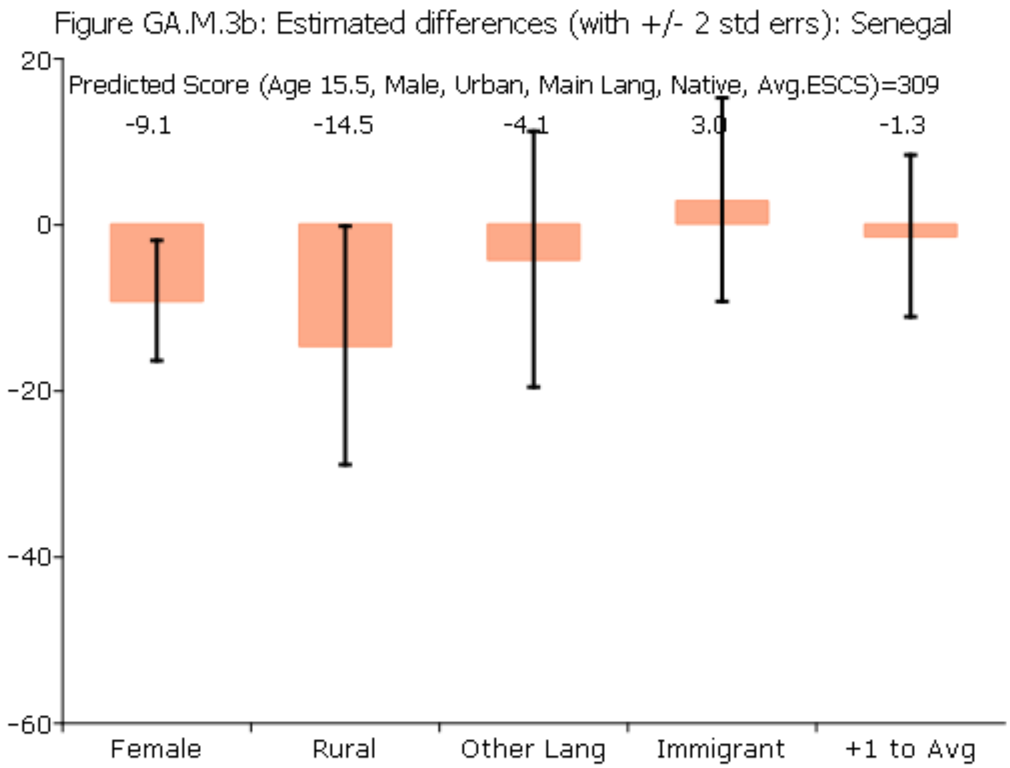


Figure GA.M.3c: Estimated differences (with +/- 2 std errs): Paraguay

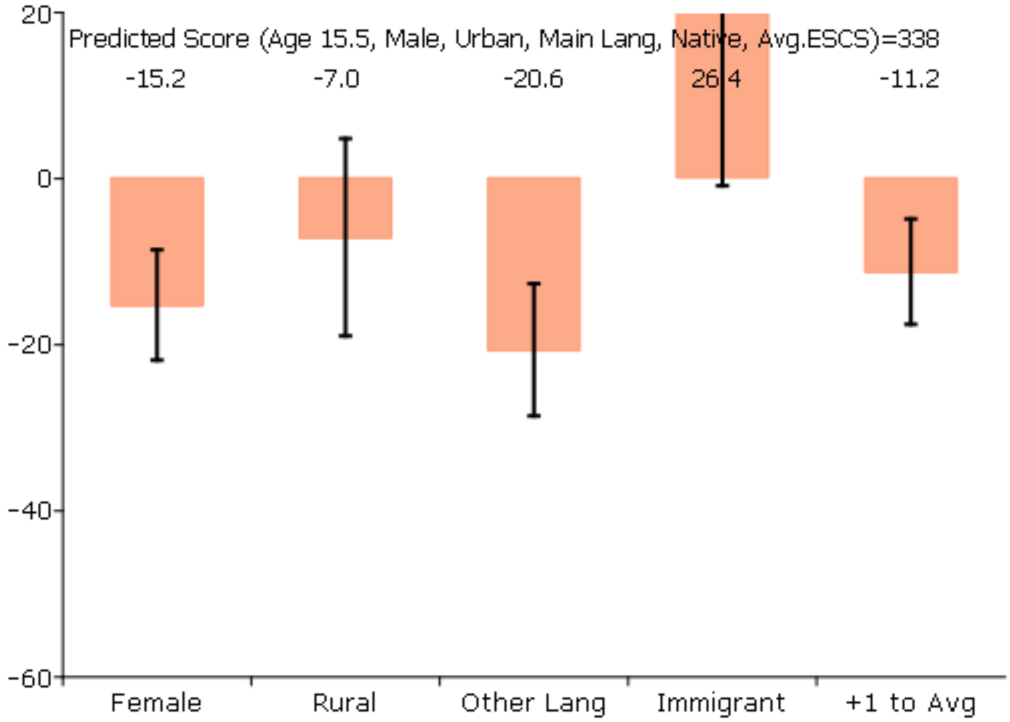
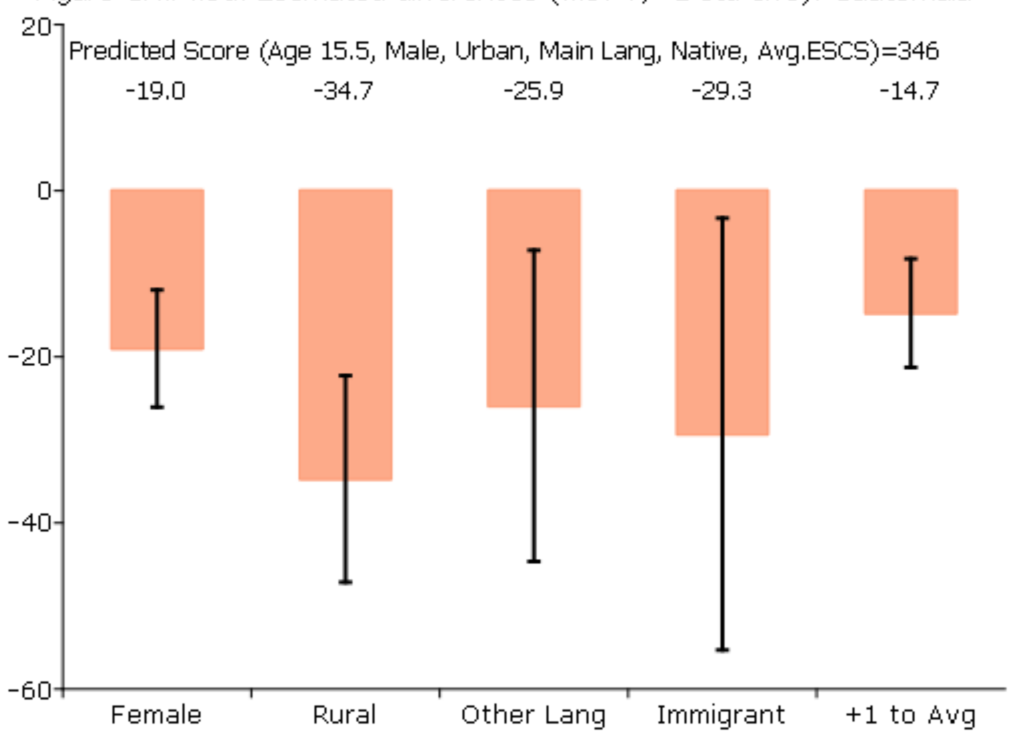


Figure GA.M.3d: Estimated differences (with +/- 2 std errs): Guatemala



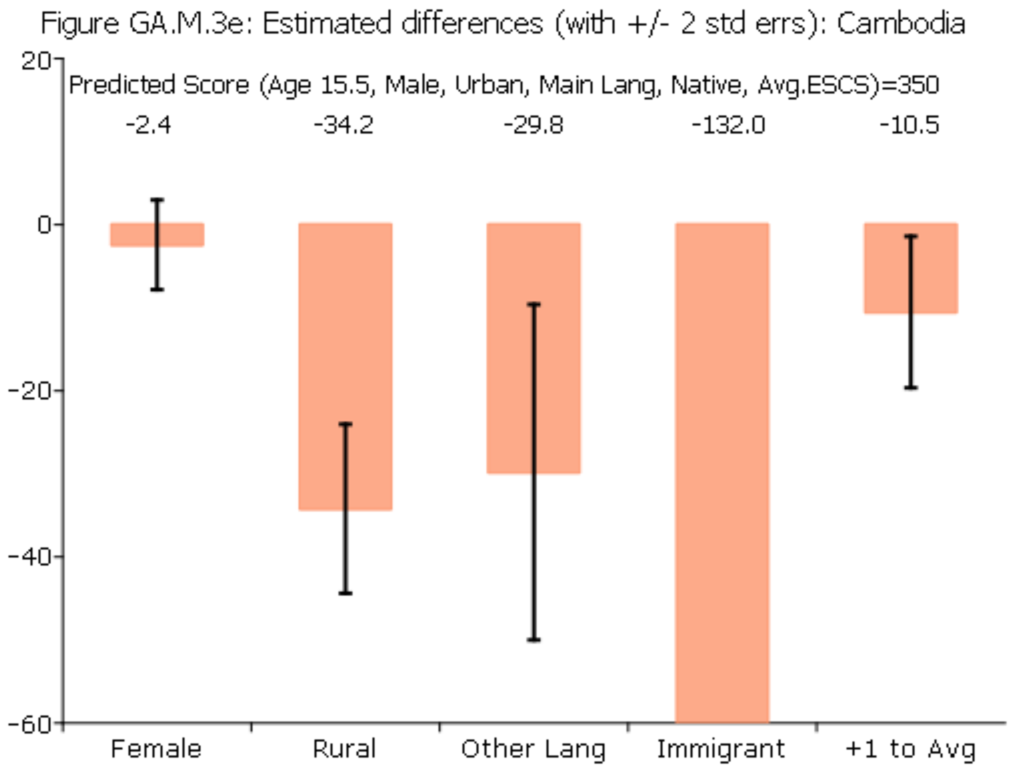


Figure GA.M.3e: Estimated differences (with +/- 2 std errs): Cambodia
Predicted Score (Age 15.5, Male, Urban, Main Lang, Native, Avg.ESCS)=350
-2.4
-34.2
-29.8
-132.0
-10.5
20
0
-20
-40
-60
Female
Rural
Other Lang
Immigrant
+1 to Avg

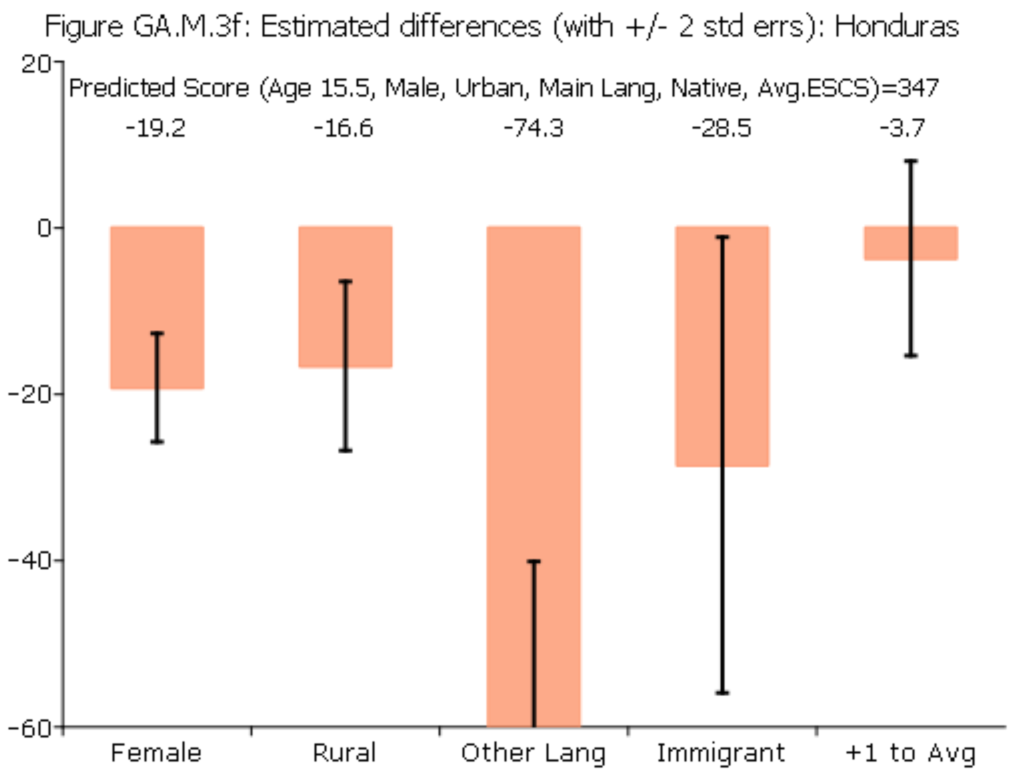


Figure GA.M.3f: Estimated differences (with +/- 2 std errs): Honduras
Predicted Score (Age 15.5, Male, Urban, Main Lang, Native, Avg.ESCS)=347
-19.2
-16.6
-74.3
-28.5
-3.7
20
0
-20
-40
-60
Female
Rural
Other Lang
Immigrant
+1 to Avg

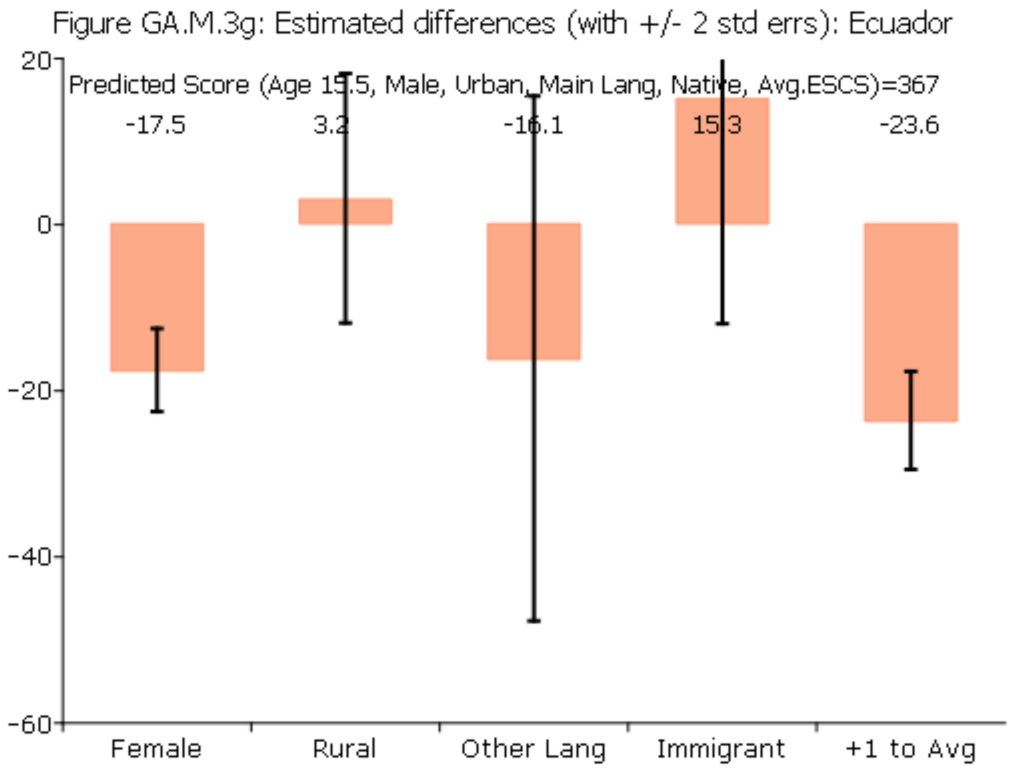


Figure GA.M.3g: Estimated differences (with +/- 2 std errs): Ecuador
Predicted Score (Age 15.5, Male, Urban, Main Lang, Native, Avg.ESCS)=367
-17.5
3.2
-16.1
15.3
-23.6
20
0
-20
-40
-60
Female
Rural
Other Lang
Immigrant
+1 to Avg

GA.R: Graphs for each PISA-D Country – estimated differences (with +/- 2 s.e.) coefficients, Reading

Figure GA.R.3a: Estimated differences (with +/- 2 std errs): Zambia

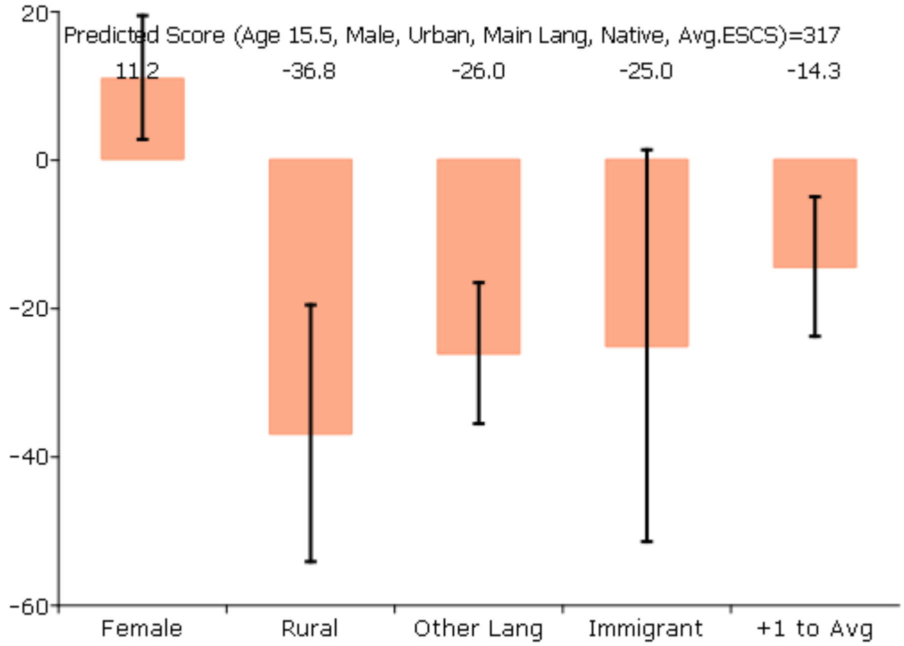


Figure GA.R.3b: Estimated differences (with +/- 2 std errs): Senegal

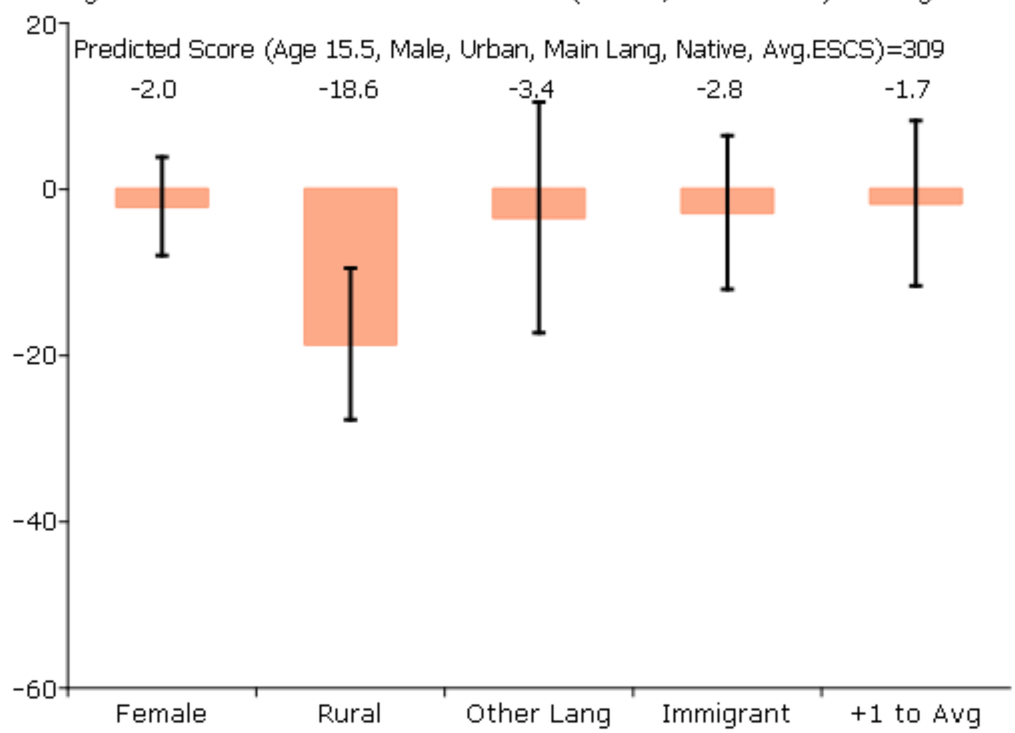


Figure GA.R.3c: Estimated differences (with +/- 2 std errs): Paraguay

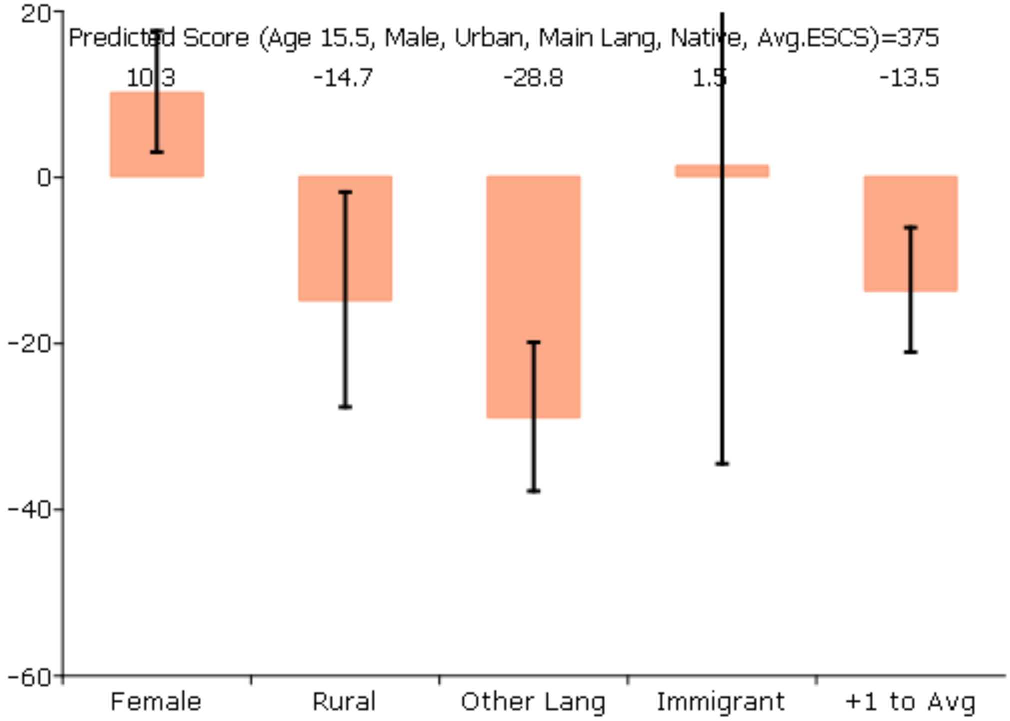
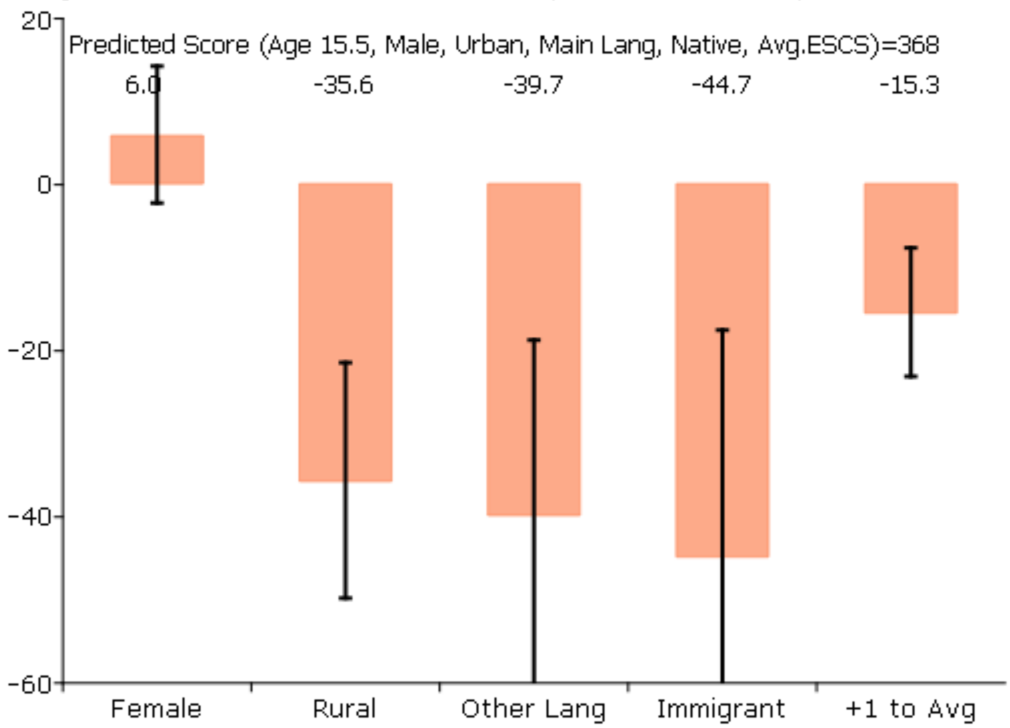


Figure GA.R.3d: Estimated differences (with +/- 2 std errs): Guatemala



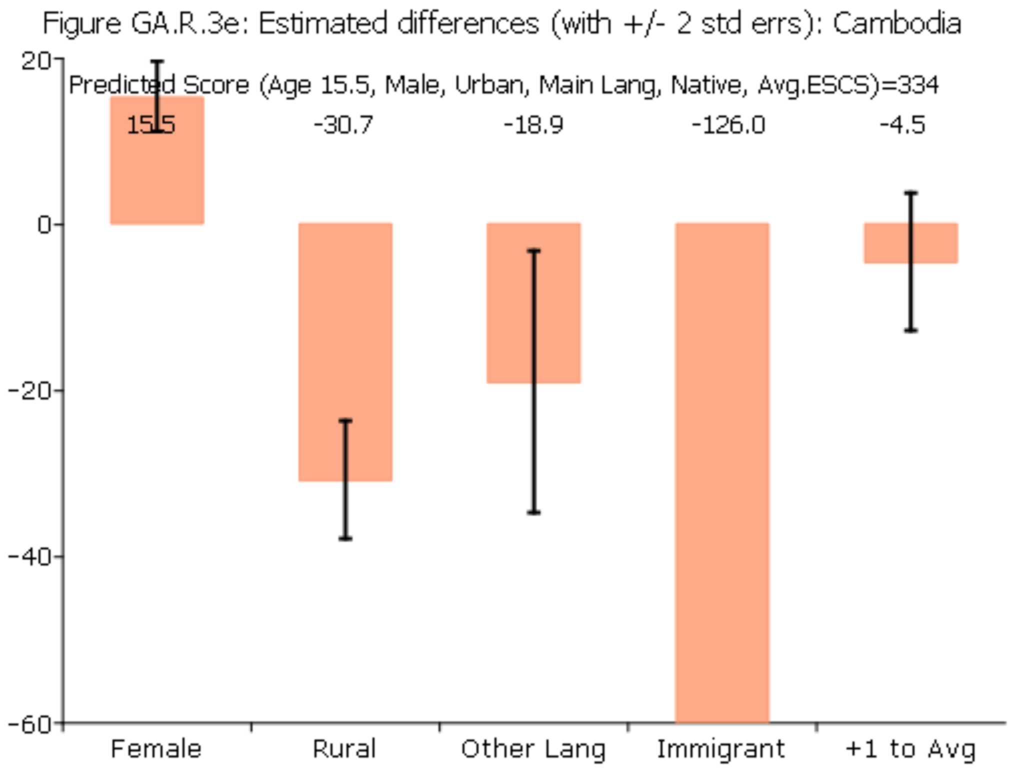


Figure GA.R.3e: Estimated differences (with +/- 2 std errs): Cambodia
Predicted Score (Age 15.5, Male, Urban, Main Lang, Native, Avg.ESCS)=334
15.5
-30.7
-18.9
-126.0
-4.5
20
0
-20
-40
-60
Female
Rural
Other Lang
Immigrant
+1 to Avg

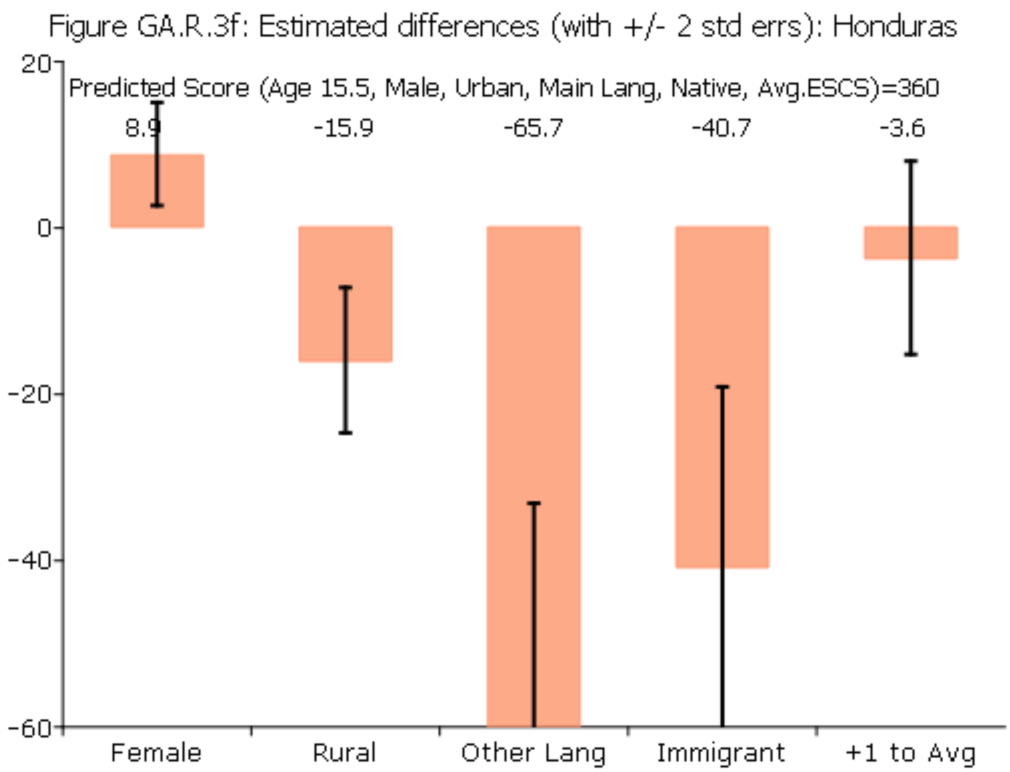


Figure GA.R.3f: Estimated differences (with +/- 2 std errs): Honduras
Predicted Score (Age 15.5, Male, Urban, Main Lang, Native, Avg.ESCS)=360
8.9
-15.9
-65.7
-40.7
-3.6
20
0
-20
-40
-60
Female
Rural
Other Lang
Immigrant
+1 to Avg

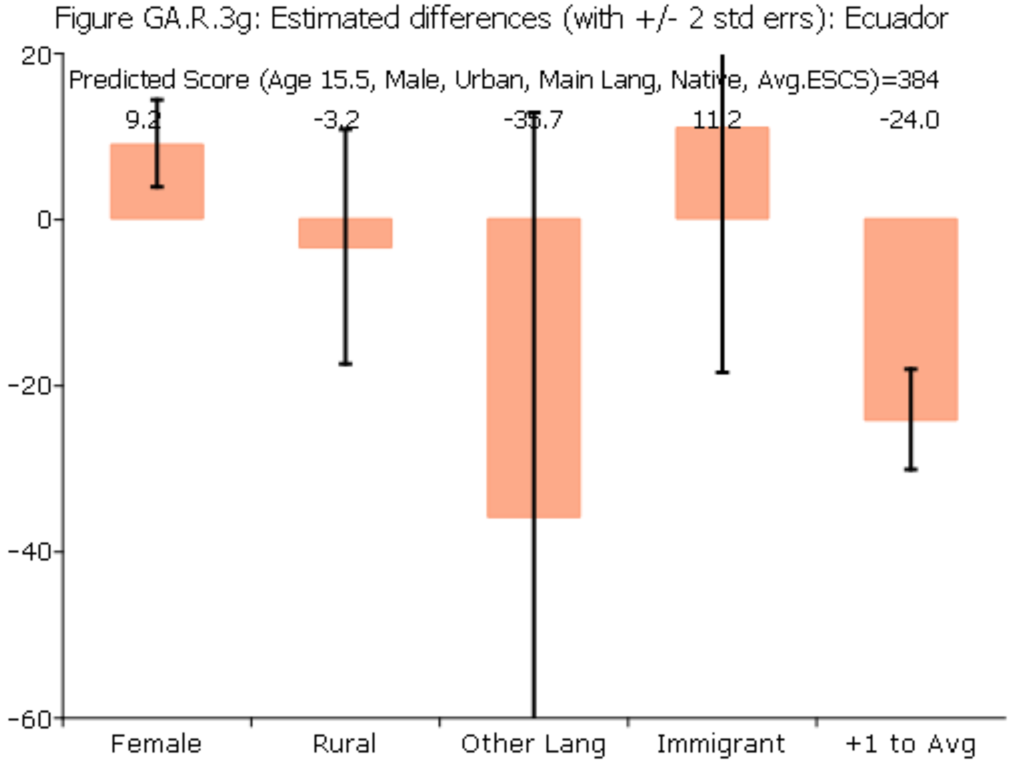
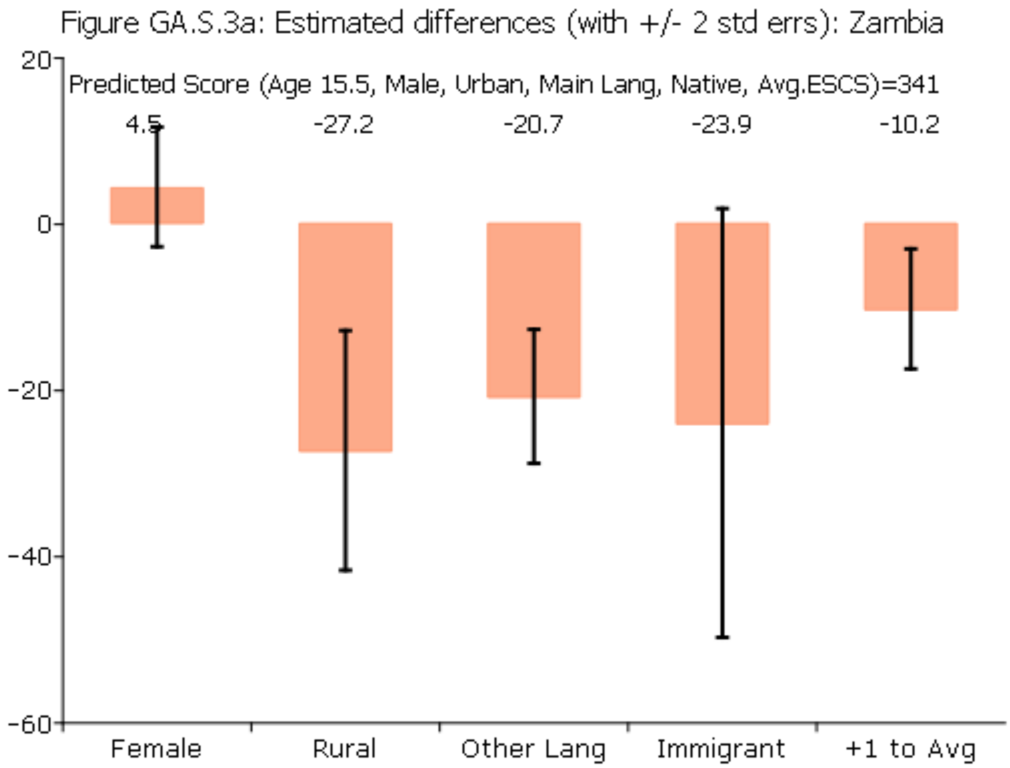
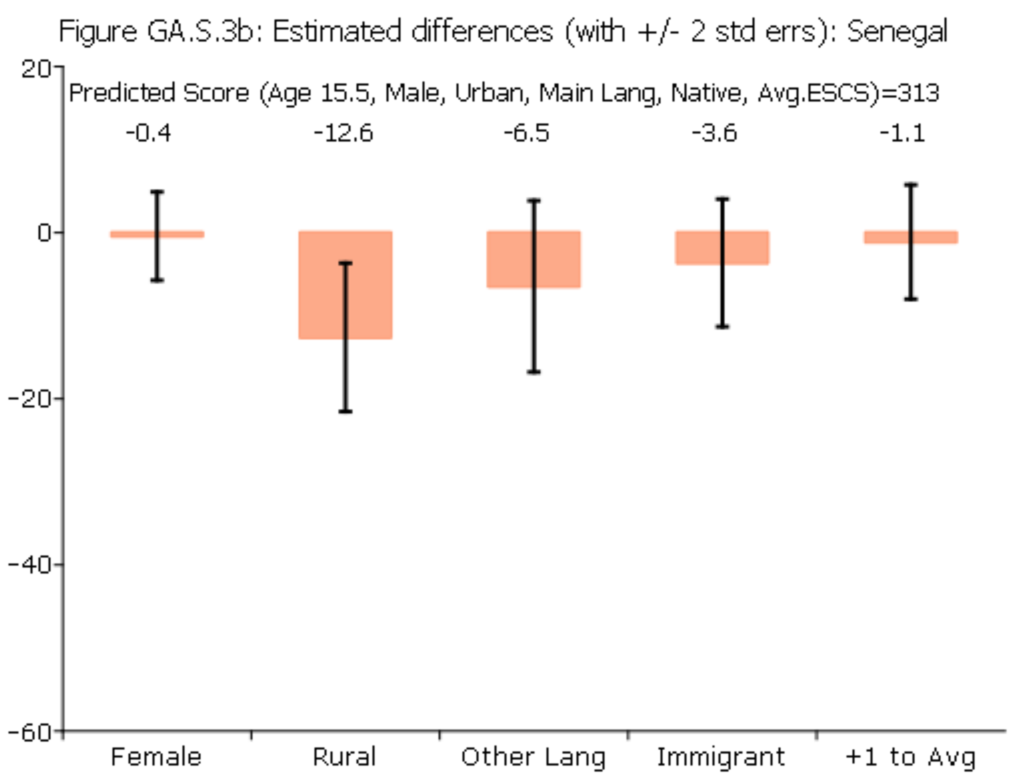


Figure GA.R.3g: Estimated differences (with +/- 2 std errs): Ecuador
Predicted Score (Age 15.5, Male, Urban, Main Lang, Native, Avg.ESCS)=384
9.2
-3.2
-35.7
11.2
-24.0
20
0
-20
-40
-60
Female
Rural
Other Lang
Immigrant
+1 to Avg

GA.S: Graphs for each PISA-D Country – estimated differences (with +/- 2 s.e.) coefficients, Science





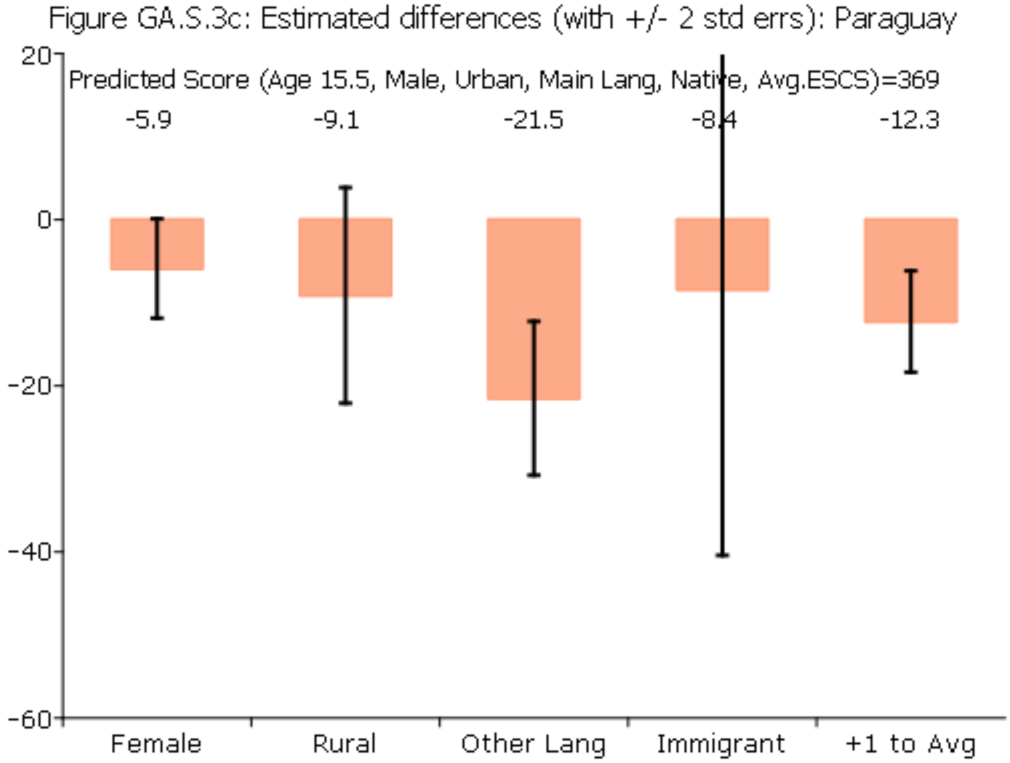


Figure GA.S.3c: Estimated differences (with +/- 2 std errs): Paraguay
Predicted Score (Age 15.5, Male, Urban, Main Lang, Native, Avg.ESCS)=369
-5.9
-9.1
-21.5
-8.4
-12.3
20
0
-20
-40
-60
Female
Rural
Other Lang
Immigrant
+1 to Avg

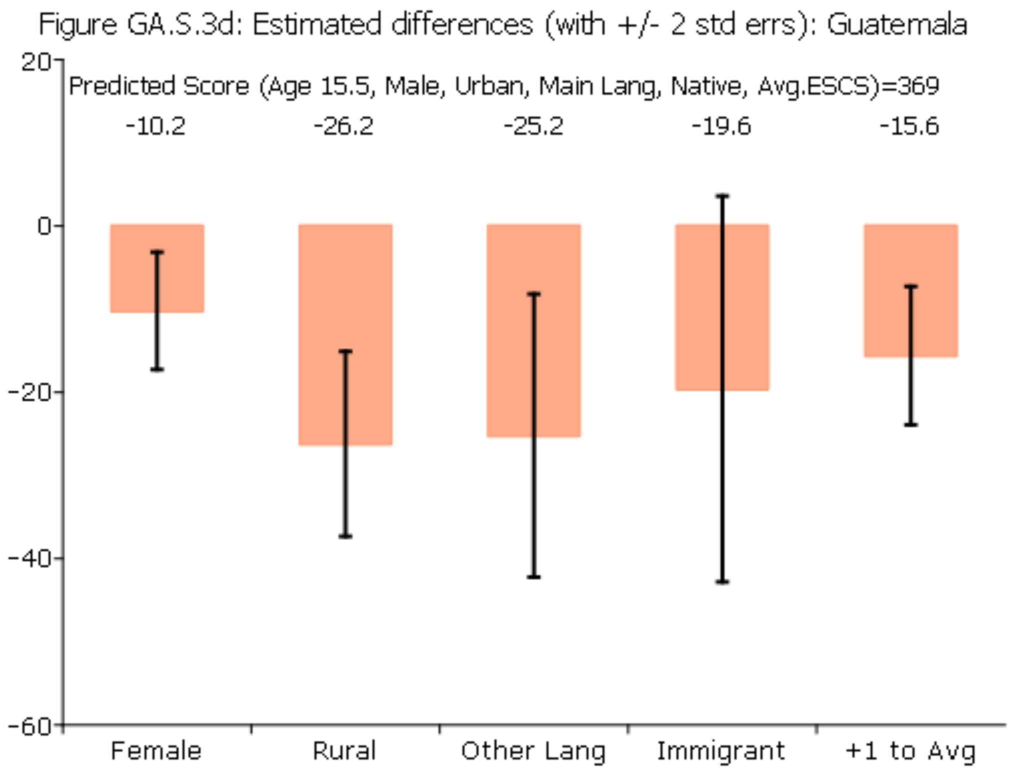


Figure GA.S.3d: Estimated differences (with +/- 2 std errs): Guatemala
Predicted Score (Age 15.5, Male, Urban, Main Lang, Native, Avg.ESCS)=369
-10.2
-26.2
-25.2
-19.6
-15.6
20
0
-20
-40
-60
Female
Rural
Other Lang
Immigrant
+1 to Avg

Figure GA.S.3e: Estimated differences (with +/- 2 std errs): Cambodia

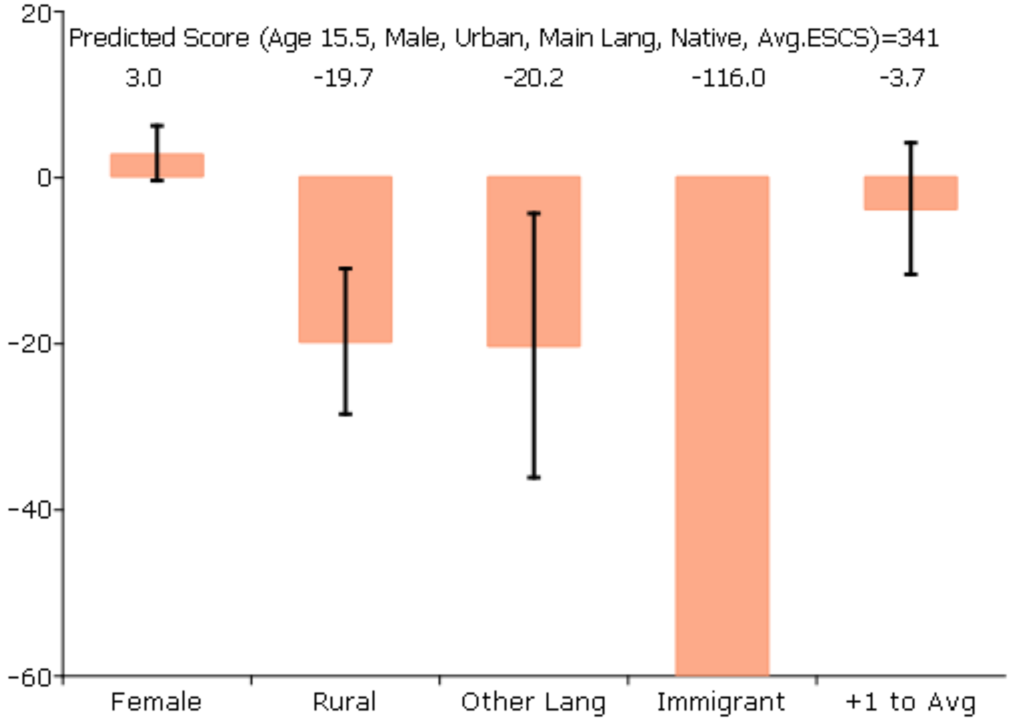
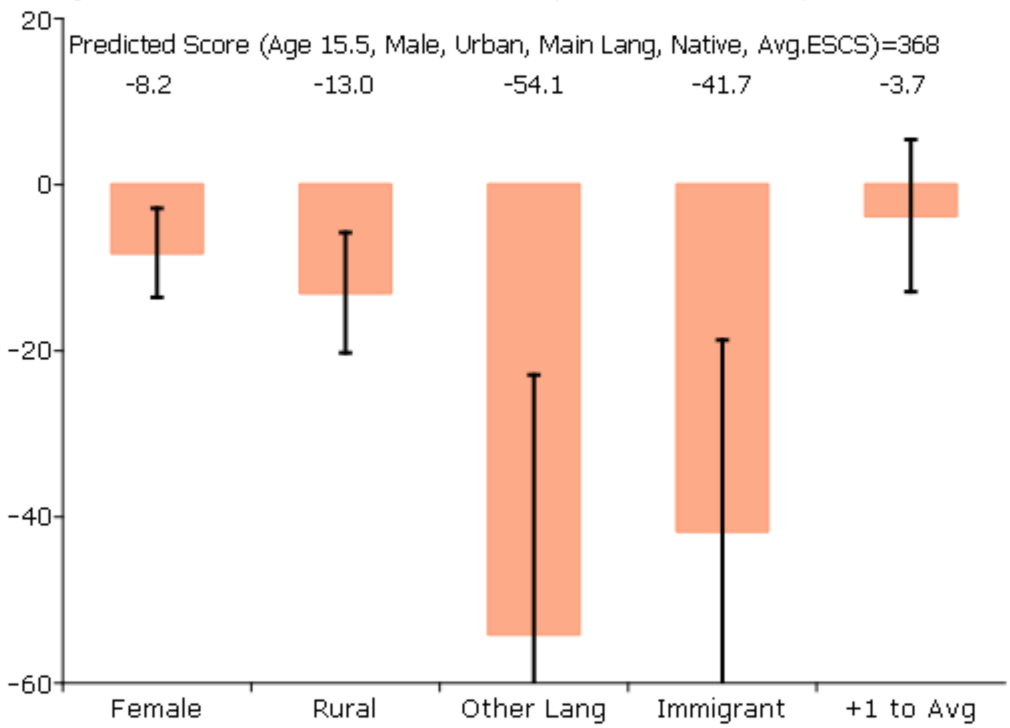


Figure GA.S.3f: Estimated differences (with +/- 2 std errs): Honduras



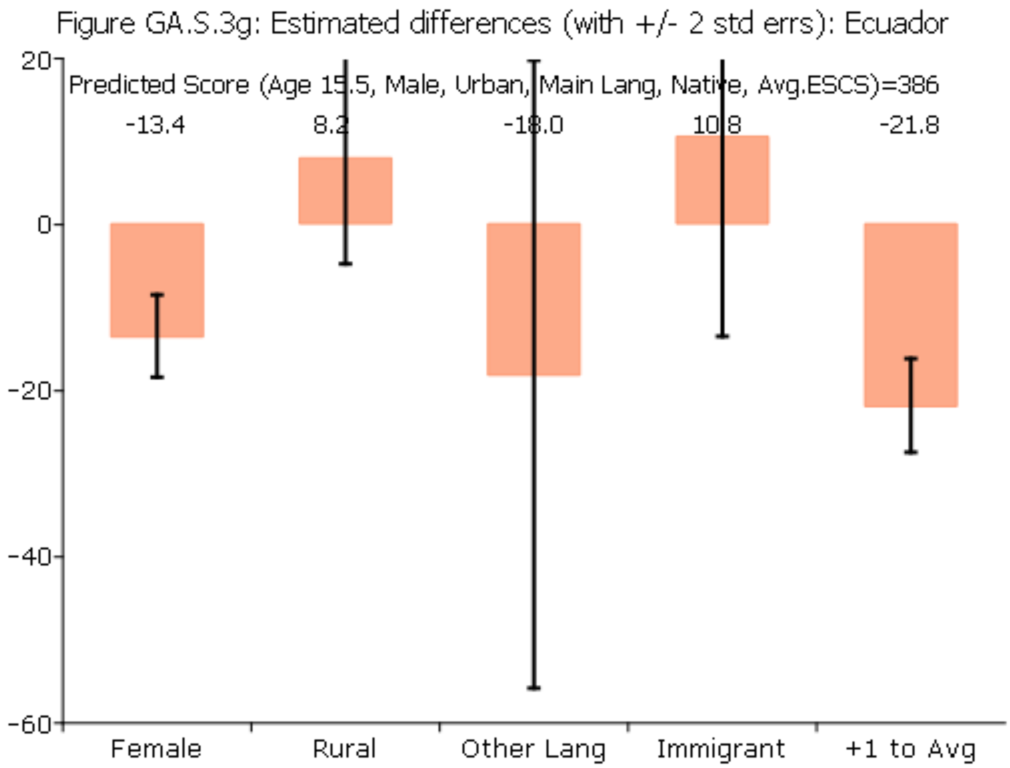


Figure GA.S.3g: Estimated differences (with +/- 2 std errs): Ecuador
Predicted Score (Age 15.5, Male, Urban, Main Lang, Native, Avg.ESCS)=386
-13.4
8.2
-18.0
10.8
-21.8
20
0
-20
-40
-60
Female
Rural
Other Lang
Immigrant
+1 to Avg

Annex Table R.1: Comparing predicted reading scores for the PISA-D countries									
Country	Predicted score at average SES and actual demographics	Predicted Score of advantaged students at average ESCS	Predicted Score, Advantaged, ESCS elite (+2sd)	Predicted score, advantaged, ESCS elite, high performer (plus one sd of residual)	Predicted score, advantaged, ESCS elite, low performer (minus one sd of residual)	Gap between advantaged, ESCS elite and SDG minimum for reading (407.5)	Gap between country and Vietnam at same ESCS	Mean ESCS	Std Dev ESCS
Zambia	276.1	317.2	370.6	434.1	307.1	36.9	200.3	-1.57	1.41
Senegal	295.7	308.7	320.6	386.1	255.2	86.8	223.4	-1.97	1.32
Paraguay	361.1	374.7	415.3	484.4	346.1	-7.8	126.7	-1.41	1.02
Guatemala	349.0	367.8	404.3	463.3	345.3	3.2	129.4	-1.72	1.06
Cambodia	318.2	333.7	349.3	405.4	293.2	58.2	174.6	-1.95	1.04
Honduras	356.6	359.8	382.1	446.5	317.6	25.4	160.0	-1.64	1.13
Ecuador	387.8	384.4	440.8	510.1	371.6	-33.4	109.6	-1.22	1.02
Source: Author's calculations with PISA-D data.									

Annex Table R.2: Gains in the average score from eliminating the social differentials from disadvantage														
Country	Female			Rural			Does not speak assessment language at home			Immigrant			Gain all gaps	Advantaged, average ESCS, to SDG
	Coeff.	Fraction in sample	Total gain	Coeff.	Fraction in sample	Total gain	Coeff.	Fraction in sample	Total gain	Coeff.	Fraction in sample	Total gain		
Zambia	11.2	0.51	5.7	-36.8	0.65	-23.9	-26.0	0.85	-22.1	-25.0	0.032	-0.80	46.7	90.3
Senegal	-2.0	0.54	-1.1	-18.6	0.44	-8.2	-3.4	0.95	-3.2	-2.8	0.168	-0.47	13.0	98.8
Paraguay	10.4	0.50	5.1	-14.7	0.35	-5.1	-28.8	0.47	-13.6	1.5	0.015	0.02	18.7	32.8
Guatemala	6.0	0.46	2.8	-35.6	0.48	-17.2	-39.7	0.10	-3.8	-44.7	0.014	-0.63	21.6	39.6
Cambodia	15.5	0.54	8.3	-30.7	0.75	-23.1	-18.9	0.02	-0.4	-126.0	0.002	-0.26	23.8	73.7
Honduras	8.9	0.52	4.7	-15.9	0.38	-6.0	-65.7	0.02	-1.5	-40.7	0.009	-0.35	7.9	47.6
Ecuador	9.2	0.49	4.5	-3.2	0.22	-0.7	-35.7	0.01	-0.5	11.2	0.013	0.14	1.2	23.1
Median	9.2		4.7	-18.6		-8.2	-28.8		-3.2	-25.0		-0.4	18.7	47.6
Source: Author's calculations with PISA-D data.														

Annex Table S.1: The performance on the PISA-D mathematics assessment is very poor even for the advantaged, ESCS elite students, in all countries their predicted average is below the SDG 4 goal of PISA level 2 (420.7)										
Country	Average Score (students in public sector, weighted)	Predicted scores from regressions in Table M.1b.P-D above of advantaged student at various levels of the ESCS index					Shortfall of advantaged ESCS elite predicted score from SDG minimum of PISA Level 2	Gap between advantaged Vietnamese students with country average ESCS index	Country ESCS index	
		Advantaged Students at Average ESCS (public sector)	Advantaged Students, Elite ESCS (+2 sd)	Predicted gain from +2 sd of ESCS over average	High performing, advantaged, elite ESCS students (plus 1 sd of score residual)	Low performing, advantaged, elite ESCS students (minus 1 sd of score residual)			Average	Std. Dev.
Zambia	307.7	341.4	379.1	431.2	327.0		30.4	247.7	-1.57	1.41
Senegal	300.7	313.2	324.1	372.1	276.1		85.5	270.1	-1.97	1.32
Paraguay	353.0	369.3	402.2	462.4	342.0		7.3	189.5	-1.41	1.02
Guatemala	348.7	368.7	403.9	452.1	355.7		5.7	178.1	-1.72	1.06
Cambodia	327.4	341.3	353.1	399.8	306.3		56.5	217.9	-1.95	1.04
Honduras	357.4	368.2	388.3	441.3	335.3		21.3	203.6	-1.64	1.13
Ecuador	381.3	386.3	439.8	500.9	378.7		-30.2	162.0	-1.22	1.02

Source: Author's calculations with PISA-D data.
Notes: All predictions are at age 15.5. "Advantaged" students is predictions for: male, urban, natives of the country (non-immigrant), and the language of assessment is spoken at home.

Annex Table S.2: Gains in the average PISA score in Science from eliminating the social differentials from disadvantage (among those enrolled in public sector schools)														
Country	Female			Rural			Does not speak assessment language at home			Immigrant			Gain all gaps	Advantaged, average ESCS, to SDG
	Coeff.	Fraction in sample	Total gain	Coeff.	Fraction in sample	Total gain	Coeff.	Fraction in sample	Total gain	Coeff.	Fraction in sample	Total gain		
Zambia	4.5	0.51	2.3	-27.2	0.65	-17.6	-20.7	0.85	-17.6	-23.9	0.032	-0.76	36.0	68.2
Senegal	-0.4	0.54	-0.2	-12.6	0.44	-5.6	-6.5	0.95	-6.2	-3.6	0.168	-0.61	12.5	96.3
Paraguay	-5.9	0.50	-2.9	-9.1	0.35	-3.2	-21.5	0.47	-10.2	-8.4	0.015	-0.13	16.4	40.2
Guatemala	-10.2	0.46	-4.7	-26.2	0.48	-12.6	-25.2	0.10	-2.4	-19.6	0.014	-0.28	20.0	40.9
Cambodia	3.0	0.54	1.6	-19.7	0.75	-14.8	-20.2	0.02	-0.4	-116.0	0.002	-0.24	15.5	68.2
Honduras	-8.2	0.52	-4.3	-13.0	0.38	-4.9	-54.1	0.02	-1.3	-41.7	0.009	-0.36	10.8	41.3
Ecuador	-13.4	0.49	-6.6	8.2	0.22	1.8	-18.0	0.01	-0.3	10.8	0.013	0.14	6.9	23.3
Median	-5.9		-2.9	-13.0		-5.6	-20.7		-2.4	-19.6		-0.3	15.5	41.3

Source: Author's calculations with PISA-D data.