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Assessing developing countries students' achievements in international educational testing by socio-economic status across regions, areas, and gender: a case of Vietnam Participating in PISA 2012 and 2015

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Abstract: The literature shows the absence of international educational testing regimes of low-income developing countries. This paper addressed three neglected issues related to Vietnamese students' achievements: 1) the link between family background measured by socio-economic status (SES) and educational skills measured by PISA test scores; 2) the association between low and high-parental SES and students' skills; 3) the link between proficiency levels and SES gradient – the issue more important to the success of young adults. Findings presents distributions of SES gradient in academic skills across Vietnam, regions and gender in 2012 using a comparable measure between parental SES and the 2015 reiteration of test scores. A cross-areas variation identifies indirectly the differences in regional school resources that may lead to inequalities of opportunity. The SES gradient estimations not only relate to math, reading and science skills, but also to proficiency levels in the same cognitive domains at different years.

Keywords: socioeconomic inequalities; PISA; literacy skill; numeracy skill; science skill; proficiency scales; education attainment gradient; region; rural-urban area; gender.

JEL codes: I20, I21, I28.

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1 Introduction Vietnam overview in PISA assessment

For the first time since 2012, Vietnam participated in the Program for International Student Assessment (PISA) – which has been administered every three years since 2000. Vietnamese students were ranked in the 25% top-performing students among all participating countries. For the average scores, Vietnam ranked 8th in science, 17th in mathematics, and 19th in reading among 65 nations, placing Vietnam above the OECD nations. These high-performance records have surprised many academic scholars and policy-makers in the world. It is suggested that educational excellence may be exhibited in countries with a low level of economic development. In the latest round of the PISA 2015, Vietnamese students have done remarkably well with scores results of ranking 8th in science, 22nd in mathematics, and 32nd in literacy among 72 countries.

Table 1 presents PISA 2015 and 2012 of reading, math, and science average scores for students of Asian countries (including Vietnam), Nordic countries, and Canada where according to PISA students' socioeconomic inequalities are weaker (OECD, 2016). The scores for Vietnam in 2015 have fallen slightly (except in science), while the number of the 15-year old tested increased by 17%[1]. PISA results indicate that Vietnamese students are slightly over-performing their peers in several Nordic rich countries. The exception being Finland (and overall Canada)[2] is considered as an effective education system where students had been very successful over almost all PISA waves. The gaps between Vietnam scores and East Asian countries (including Chinese entities), which have ranked the highest and dominate over the years in PISA tests, are not getting wider as is the case in other countries' positions. A small number of developing countries participating in the PISA assessments, in particular, South Asian countries (Thailand, Malaysia, Indonesia), are standing at the lower end of the range by PISA scores, with the unique exception of Vietnam[3].

Table 1 PISA estimated mean score by domain and year, selected countries and Vietnam, 2012 and 2015

Country	*PISA 2015 (main domain science)*					*PISA 2012 (main domain math)*				
	Reading	*Math*	*Science*	*N*	*Rate %*	*Reading*	*Math*	*Science*	*N*	*Rate %*
Singapore	535	564	556	6,115	96	542	573	551	5,546	95
Japan	516	532	538	6,647	95	538	536	547	6,351	91
Korea	517	524	516	5,581	92	536	554	538	5,033	88
CN Taipei	497	542	532	7,708	85	523	560	523	6,046	89
Macao	509	544	529	4,476	88	509	538	521	5,335	81
Hong Kong	527	548	523	5,359	89	545	561	555	4,670	84
B-S-J-G#	494	531	518	9,841	64	570	613	580	6,374	79
Vietnam	487	495	525	5,826	49	508	511	528	4,958	56
Thailand	409	415	421	8,240	71	441	427	444	6,606	73
Malaysia##	##	##	##	8,361	76	398	21	420	5,197	79
Indonesia	397	386	403	6,313	68	396	375	382	5,622	63
Finland	526	511	531	5,882	97	524	519	545	8,829	96
Denmark	508	511	502	7,161	94	496	500	498	7,481	91
Norway	513	502	498	5,456	91	504	489	495	4,686	92
Sweden	500	494	493	5,458	94	483	478	485	4,739	93
Iceland	482	488	473	3.374	93	483	493	478	5,016	93
Canada	527	516	528	20,058	93	523	518	525	21,548	88
France	499	493	495	6,108	91	505	495	499	5,682	89
OECD	493	490	493	-	-	496	494	501	-	-

Notes: For 2015, B-S-J-G (China)# denotes: Beijing, Shanghai, Jiangsu, and Guangdong; in 2012 Shanghai (China) participated and results were criticised for not being representative of Chinese students while the testing sample of 15-year-olds probably does not include nearly enough migrant children, and Shanghai schools were not deemed representative of the country's education system. For 2015, Malaysia ## denotes that no results were made public because less than 50% of selected schools participated. Rate: Indicate the percentage of the total national population of 15-year-olds enrolled.

Source: PISA results in focus, 2015 and 2012, OECD; and PISA Results, volume I

Many explanations have been proposed as to why East Asia students continue to top international educational assessment surveys (PISA, TIMSS, PIRLS)[4]. The OECD (2013a, 2013b), among plausible factors, gives preference for Asia's prioritise in teaching quality investment with a focus on selecting, training, encouraging teachers. The OECD maintains that education authorities set clear goals and teachers are empowered in leading the classroom to achieve these goals. In the literature, besides teacher selection and quality, and teaching methods, other proposed components (Leung, 2006; Jerrim, 2014), are work ethic, 'tiger' parenting, extensive extra-learning, genetics / natural ability, the value that East Asian families place upon education, the design of the school curriculum, along with several other elements, including suggestions that this success is due to foul play. Jerrim (2014) investigates the PISA high-scored children of East Asian descent,

who was born and grew up in Australia, he explores whether or not their outstanding performances are related to Australian heritage. It can be feasible explanations for East Asian students' extraordinary educational achievements. The findings posited that compared to the importance of the education system, the cultural background is superior crucial to the educational attainment for Chinese immigrant students. Similar findings by Becky and Archer (2005), demonstrate that education is extremely important to British-Chinese families, regardless of social class and gender. According to Dr. Andreas Schleicher – the OECD director of education and skills and head of the OECD PISA program, three main factors are leading to impressive educational achievements among Vietnamese students participating in PISA 2012, including committed leadership adopting high spending levels, focused curriculum, and teacher quality investment.

The reasons why East Asian countries are way ahead of the pack of PISA participating countries as far as educational achievements, seem to come down to the four key stakeholders: schools, teachers, students, and parents. In Vietnam, the first factor linking the others is the collective push to change education systematically at the national level by government investments at all levels, including pre-school access. But levels of financial commitments do not guarantee strong results. Elsewhere in the region, for example, Malaysia and Thailand, some of the country's richer neighbours, with decades of important investments in education, lag far behind in PISA with declining performance, also observable in other international education surveys (TIMSS). The second factor is based on the quality of teachers. Vietnamese teachers are capable of sustaining a high standard of professionalism and discipline in classrooms across the country, where absenteeism by both teachers and students is practically unheard of. Part of Vietnam's educational progress, according to Schleicher (2015), is due to teachers' ability to create a healthy learning atmosphere, promote positive attitudes toward learning among students, and sustain strong classroom discipline. Cultural considerations, which have positive behavioural consequences for students and tend to be part of the story behind Vietnam's educational progress, are also likely to be linked to the efficacy of such education policies. Vietnamese culture places a high value on people-centric education and beliefs in personal efforts as the key drivers of success, rather than relying on innate ability. This aspect is commonly indicated by East Asian researchers as the most significant factor for the region's high-scored results. The establishment of a virtuous cycle of deep parental engagement, high demands for their children's schooling, and a degree of emphasis on teachers and schools conducive to ensuring successful classroom discipline are all part of a policy triangle involving societal values and attitudes.

Nonetheless and surprisingly, many of the same challenges that have been blamed for poor levels of student learning in other developed countries remain in Vietnam. A substantial number of children are currently not educated in upper secondary schools (see Table 1). Early school dropout is still a problem in Vietnam, particularly among the poorest and more vulnerable students, who are often ethnic minorities. According to World Bank (2010) figures, the net enrolment rate in upper secondary education is 60%, with just a third of students from the poorest 20% of the population enrolled. Since PISA evaluates the competencies of 15-year-olds in school, it is possible that it only includes Vietnamese students in upper secondary education, who are usually better off and likely to do better. Students must take a high school entry test for the three years of upper secondary education after completing 9 years of compulsory education. The public high school system, though, can only accept between 70% to 80% of students graduating from lower secondary schools. Many who fail the test must attend private schools, which are

usually costly and out of reach for many low-income students (World Bank, 2014)[5]. Household affordability, especially in lower secondary and upper secondary education, maybe a serious problem. Because students must pay tuition fees, which rise with each grade and escalate significantly at the upper secondary level after five years of free primary education. Aside from the costs for sending children to kindergarten, families must pay for additional schooling items. Indirect costs associated with the school building, uniforms, textbooks, additional courses, food, and transportation, which vary by school and location, can be insurmountable obstacles for many poor families[6]. Furthermore, a growing number of Vietnamese children are enrolled in private classes or have a private tutor (Hai-Anh, 2007)[7]. After school tutoring is used to complement formal education. At the secondary level, private lessons are common because students want to improve their academic results and gain more experience to pass high school and university entrance exams[8].

Specific earnings are heavily influenced by educational attainment, and long-term economic stability is also affected. In a series of studies on PISA test scores and simple models of growth, Hanushek and Woessmann's PISA surveys in over years (Hanushek and Woessmann, 2008, 2011a, 2011b, 2012, 2015a, 2015b) show that long-term growth is closely related to the cognitive skills measured by testing assessments. Countries with a significant percentage of children with poor test grades and low proficiency standards in math or reading will certainly earn positive points in their development rates if they will increase their school accomplishments over time so that students would reach various high school skill trajectories. The simulations also show that wealthy countries like Canada, which have a smaller but still significant proportion of students at the bottom of the score distribution who are failing in education, would benefit.

Hanushek (2013) deplores the absence of international educational testing of regimes of low-income developing countries. This current paper is generally aimed to investigate three ignored issues associated with students' school achievement in such a less developed country, Vietnam. The first research objective is to empirically test the link between student's educational achievement and family background which is measured by socio-economic status (SES), and educational skills based on PISA tests scores over the years. As can be seen from the extant literature that there is no evidence of a substantial SES gradient in literacy and numeracy skills across regions, areas, and gender. The second objective of the study is to look at the dispersion of academic deciles achievement in Vietnam at the age of 15. There is no proof of a connection between low and high parental SES and students' abilities across the distribution of the scores. The third research objective is related to proficiency levels and socio-economic gradient, a left out the issue more important for the economic and social success of young adults.

The paper contributes to the literature into threefold. First, it shows the magnitude and distribution of the socioeconomic gradient in academic skills across Vietnam, regions, and gender in 2012, using a comparable measure of parental SES and a reiteration of student test scores from 2015. Second, a cross-areas heterogeneity recognises inferentially geographical disparities in school services that may contribute to inequality in opportunity. Third, our socioeconomic gradient estimates refer not only to abilities in three domains (math, reading, and science), but also to proficiency levels in the same cognitive domains over years. The paper is processed in the following structure. Section 2 describes Vietnamese students' PISA 2012 and 2015 tests scores data and their

socioeconomic profiles. Section 3 outlines the research methodology. Section 4 represents the estimation results of socioeconomic gradients in mean test scores followed by gradients across the achievement distribution (quantile gaps). Section 5 analyses socioeconomic gradients in proficiency scales. Discussion follows in Section 6. Section 7 summarises the analysis and concludes.

2 Academic achievement outcomes and socio-economic groups

2.1 Datasets on the PISA test scores

Follows the secondary data-based approach, we used PISA surveys to estimate socio-economic ability gradients in Vietnam across regions and genders in the last three waves of 2012, 2015, and 2018. Each of the three core domains is evaluated in-depth in each PISA survey including reading, mathematics, and science[9]. Since Vietnam students tests scores were not surveyed for all three major domains, we will focus on all domain scores distribution and their relationship with socio-economic parental background over the two waves, as the skills performances are directly comparable across time, region, and gender, although tests also varied slightly over time (PISA 2012, 2013). Students were surveyed about the educational background and occupation of their parents, along with a series of questions about household possessions. Upon this information, continuous socioeconomic indexes are constructed. The survey test scores for cognitive abilities in all three fields were summed up using an 'item-response model', which in 2012 (in 2015) created five (ten) 'plausible values' to measure children's true ability from the test answers[10]. The scores variables are calculated on a scale with a standard deviation of 100 points and an average of 500 points for all of the OCDE measured children. According to the PISA Technical Report (*PISA 2012 Technical Report*, 2014), 30-40 PISA evaluation points are roughly equal to an extra year of schooling.

Table 2 shows the distribution of Vietnamese student's PISA test scores across the region[11], gender, and area for years 2012 and 2015 in three test domains (math, reading, and science). Across the percentile distribution, there are obvious differences in scores. For each domain, the differences between the 90th percentile and the 10th percentile scores are on average between 150–200 points with ratios of 1.4 to 1.5. For Vietnam regions and gender, the test scores distribution for each domain has not changed much between 2012 and 2015. The changes are more marked at the lower percentiles and to a less extent for the higher-performing students. In science literacy, the main topic of PISA 2015, 15-year-olds in Vietnam earned 528 points compared to an average of 493 points in OECD countries (OECD Education GPS, 2017). On average, Vietnamese girls scored better than boys with a non-statistically significant difference of 1 point (meanwhile the OECD average is 8 points girls scored higher boys). In math, for PISA 2015, 15-year-olds scored 499 points compared to an average of 490 points in OECD countries. Boys performed better than girls only in 2012 with a statistically significant difference of 15 points (OECD average is 27 points higher for girls in 2015). The average reading score of 15-year-olds in Vietnam was 493 points, equivalent to 493 points in OECD countries. With a statistically important differential of 22 points, girls outperformed boy students.

Table 2 Percentile distribution of students test scores by domain across the region, gender and for Vietnam, PISA 2012 and 2015

Region	*N*	*Mean*	*SD*	*P10*	*P25*	*P50*	*P75*	*P90*	*P90/P10*
Math 2012 is the main domain									
North	1,509	535	86	424	472	533	592	649	1.53
Centre	1,536	518	75	424	468	516	568	617	1.46
South	1,406	511	78	407	459	510	563	611	1.50
Remote	190	455	68	374	408	457	495	542	1.45
Vietnam	4,641	519	81	416	464	517	572	625	1.50
Boys	2,114	527	84	418	469	525	582	638	1.53
Girls	2,527	512	78	412	461	511	565	614	1.49
Math 2015									
North	1,722	506	85	398	447	506	565	614	1.54
Centre	1,853	498	90	385	435	493	558	617	1.60
South	1,693	498	72	406	448	496	548	592	1.46
Remote	195	469	83	354	407	474	527	573	1.62
Vietnam	5,463	499	83	393	441	498	555	605	1.54
Boys	2,551	500	87	388	438	500	560	611	1.57
Girls	2,912	498	79	398	443	495	552	599	1.50
Reading 2012									
North	1,509	523	68	436	479	523	568	609	1.40
Centre	1,536	516	67	429	475	518	563	598	1.40
South	1,406	512	68	422	467	514	557	596	1.41
Remote	190	467	77	346	415	476	515	557	1.61
Vietnam	4,641	516	69	426	472	517	562	601	1.41
Boys	2,114	502	71	407	455	501	549	591	1.45
Girls	2,527	527	64	445	487	528	571	607	1.36
Reading 2015									
North	1,722	496	71	405	449	496	544	589	1.45
Centre	1,853	494	77	392	442	495	548	594	1.51
South	1,693	498	63	416	455	498	541	579	1.39
Remote	195	447	68	363	398	460	498	519	1.43
Vietnam	5,463	493	71	399	447	494	542	585	1.47
Boys	2,551	482	74	384	434	482	531	576	1.50
Girls	2,912	504	67	418	459	503	547	591	1.42

Notes: Notes: First plausible value of each test; Restricted to students in grades 9 or 10 and in secondary school programs only. SD: standard deviation; P10 indicates the 10th percentile of the distribution, P25 the 25th percentile, etc. The percentile scores are calculated for each region and year, and separately for Vietnam and the gender of students. Remote refers mainly to areas with a large majority of ethnicities Vietnamese.

Source: Authors' computation from PISA weighted datasets. Remote refers mainly to areas with a large majority of ethnicities Vietnamese

Table 2 Percentile distribution of students test scores by domain across the region, gender and for Vietnam, PISA 2012 and 2015 (continued)

Region	*N*	*Mean*	*SD*	*P10*	*P25*	*P50*	*P75*	*P90*	*P90/P10*
				Science 2012					
North	1,509	544	76	451	494	542	593	639	1.42
Centre	1,536	534	70	443	488	539	582	619	1.40
South	1,406	533	73	439	485	532	581	626	1.43
Remote	190	492	59	412	451	491	529	564	1.37
Vietnam	4,641	536	73	443	488	536	584	627	1.42
Boys	2,114	539	76	441	490	538	589	635	1.44
Girls	2,527	533	71	444	486	533	580	619	1.40
				Science 2015 is the main domain					
North	1,722	529	76	433	476	529	580	628	1.45
Centre	1,853	530	83	427	468	526	584	641	1.50
South	1,693	531	67	448	485	531	576	616	1.38
Remote	195	495	71	404	432	498	547	586	1.45
Vietnam	5,463	528	76	432	475	527	578	626	1.45
Boys	2,551	529	79	427	471	528	581	630	1.48
Girls	2,912	528	73	435	476	527	576	623	1.43

Notes: Notes: First plausible value of each test; Restricted to students in grades 9 or 10 and in secondary school programs only. SD: standard deviation; P10 indicates the 10th percentile of the distribution, P25 the 25th percentile, etc. The percentile scores are calculated for each region and year, and separately for Vietnam and the gender of students. Remote refers mainly to areas with a large majority of ethnicities Vietnamese.

Source: Authors' computation from PISA weighted datasets. Remote refers mainly to areas with a large majority of ethnicities Vietnamese

2.2 Test scores and socioeconomic status

2.2.1 PISA particular economic, social and cultural index (ESCS)

PISA statisticians construct a unique index (not adopted or used in other international or national surveys) to measure the socioeconomic status (SES) of students and their schools. It is qualified as an economic, social, and cultural index. This index, profusely used by PISA to profess the role of social class in test scores, is not very convincing. The index can be criticised for being based on a changing basket of composite elements used over time and the abstruse nature of many calculation operations (via principal component) to derive it. For the year 2012 (2015), each of the 4,959 (5,825) tested students is assigned an index which overall has a mean value of minus 1.81 (–1.87), a standard deviation of 1.11, a minimum value of –5.1 (–5.7), and a maximum value of 1.6 (1.9). These indexes are also used by PISA to compute the index of each school based on the students in the school. No parent would choose a school for their children based on such a cryptic index. Some researchers (e.g., Carnoy and Rothstein, 2013) emphasise the index's arbitrary character and its convoluted computation formula:

> "The ESCS index arbitrarily gives equal weight to parental educational attainment, parental occupational status, and a sub-index of the collection of possessions. Once OECD statisticians calculated the index for each student and weighted the ESCS index by the student weights within each country, they set the mean of the distribution in each country at zero, with a standard deviation of one, and estimate each student's ESCS as the student's standard deviation from the mean of that country's ESCS. The statisticians used the index of student 'possessions in the home' to calculate each country's average position relative to the OECD mean and adjusted each student's ESCS index in that country by that constant term. Finally, they combined all the OECD country distributions of ESCS with their adjusted means into a single OECD distribution. To preserve the integrity of country distributions, the statisticians 'compressed' the data into an artificial 'sample' of one thousand students from each country to construct the distribution of ESCS for the OECD, with a mean of zero and standard deviation of one. The ESCS ranks the index number of each test-taker, in all countries, on that single continuous standardised scale. Since each country is given equal weight in constructing the distribution, relative to the number of 15-year-olds in each country, the ESCS of students in smaller countries is weighted." (p.41)

This index, questionable and contentious in some academic research, take into account three components:

1 the highest international social and economic index (HISEI) of parental occupational status

2 the highest level of parental education level (but transposed in number of years of education according to an international classification (CITE)

3 sub-indexes composed by baskets of material products owned by the family or the student
   - a family 'wealth' such as the number of physical assets (i.e., cars, motorcycles, bathrooms, televisions, cell-phones)
   - b cultural goods (number of poetry books and classic literature, art objects)
   - c educational resources of the student (desk, room, computer, dictionary), and number of books at home (less than 10 to 500 or more).

All the material components are reported by the student and used as proxy measures of family income[12]. Among all Asian countries who participated in the PISA 2015 survey, Vietnam has the lowest ESCS index with Indonesia having a similar index. When the index is separated into quarters or percentiles, Vietnam has a large number of students in the HISEI's lower two deciles (76.3% with rank 1/69 according to statistics from PISA. The percentage of Vietnamese students in the top two deciles of ESCS, compared to other participants of the PISA test, is one of the lowest (2.5%, and rank 68/69).

PISA uses this index to correlate ESCS students' status and schools' profiles based on their students' mean values on the ESCS index with scores results. PISA classifies students as socio-economically advantaged (disadvantaged) whether they are among the 25% of students in their own country who have the best (lowest) ESCS index scores. In most countries and economies that participate in PISA, the ESCS index is linked to major variations in results. By a simple OLS without any other covariate, PISA estimates the relationship between student's performance and their social status which are measured by

ESCS (the strength of the socio-economic gradient) for each country. For the OCDE countries, on average, the percentage of explained variation is respectively 13% in science (2015) and 14.8% in math (2012), and for Vietnam, respectively 11% and 14.6%. On the other hand, the scale of output disparities between socioeconomic classes (the slope of the gradient calculated by the ESCS index, same OLS estimate), that is, the difference in score points correlated with a one-unit rise in ESCS, is 38 in science (2015) and 39 in math for OCDE countries (2012). This is the equivalent of nearly one year of schooling. For Vietnam, these point differences are respectively 23 and 29[13]. Considering the components and calculation of the ESCS index, from a policy perspective, the meaning of a one-unit increase of the index is obscure.

2.2.2 A more conventional SES index

Dataset related to the student's parent occupation was collected via open-ended questions. The samples were coded into four-digit ISCO and then mapped onto the international socio-economic index of occupational status (ISEI) (Ganzeboom and Treiman, 2003). In PISA 2015, the new ISCO and ISEI, in their 2008 version were adopted (Ganzeboom, 2010)[14]. We used HISEI of parental occupational status to assess students' SES over years. This index is a predetermined variable created by the survey organisers, which ranges from 11 to 90. Low values (e.g., 11–20) apply to those have low education qualification, while high values (e.g., 80–90) refer to people who have advanced degrees. Ganzeboom et al. (2010) developed this index, which is commonly used in sociological studies (2010). It assigns a ranking to each occupational group based on a weighted average of the appropriate education level and the earnings associated with the work. Jerrim and Micklewright (2014) show that students' reports of their parents' occupations in PISA offer a very accurate foundation for comparing socioeconomic gradients in test scores. This is less true with another proxy, the number of books at home, which can be viewed as a family measure of literacy importance, academic achievement, and ability to support their child's academic effort in sociological studies. We established dummy variables representing quintiles of the HISEI distribution from this SES predictor for estimation purposes, which are unique to each survey year (reference is the bottom quintile). This SES index is closely related to the social climate of each Vietnamese country, as well as shifts in household occupational practices over time.

Parental education is another alternative indicator of SES. It is an exogenous context variable that has been described as a strong, independent determinant of student test results, and it is commonly used by economists to differentiate between more- and less-advantaged pupils. However, since the datasets for Vietnam use international codes and that education is coded with five levels according to the International Standard Classification of Education (ISCED), and transformed by PISA in several years, the information poses some problems. Parental education levels may be over-stated or over-coded for levels of education higher than a secondary diploma and postsecondary levels. Moreover, it is more difficult to transform education levels to years and years in quantiles, and more cumbersome to use in econometric estimations. Jerrim and Micklewright (2014) conclude that the robustness of the SES gradient measure is lower when a student, instead of a parent reporting parental education.

Table 3 Percentile distribution of student's family highest international social and economic index of occupational status (HISEI) across the region, gender, area, and for Vietnam, PISA 2012 and 2015

Region	*N*	*Mean*	*SD*	*P10*	*P25*	*P50*	*P75*	*P90*
				2012 all				
North	1,506	28	22	11	11	18	35	67
Centre	1,531	25	19	11	11	19	34	58
South	1,395	31	21	11	12	27	35	69
Remote	189	15	12	11	11	11	11	25
Vietnam	4,621	28	21	11	11	21	35	61
Boys	2,106	28	21	11	11	21	35	65
Girls	2,515	27	20	11	11	19	35	61
				2015 all				
North	1,692	33	24	12	12	24	50	75
Centre	1,826	30	21	12	12	23	35	71
South	1,651	31	19	12	18	27	39	69
Remote	193	24	20	12	12	12	23	65
Vietnam	5,362	31	21	12	12	24	37	71
Boys	2,501	31	22	12	12	24	39	71
Girls	2,861	31	21	12	12	24	35	71
				2012 rural				
North	823	20	16	11	11	11	25	38
Centre	831	21	16	11	11	11	27	35
South	647	26	18	11	11	21	35	51
Remote	127	12	6	11	11	11	11	11
Vietnam	2,428	22	17	11	11	11	29	36
				2015 rural				
North	817	28	21	12	12	23	31	71
Centre	999	25	17	12	12	21	29	45
South	724	28	17	12	12	23	31	52
Remote	134	23	19	12	12	12	21	65
Vietnam	2,674	27	19	12	12	21	29	60

Notes: The HISEI index is the highest score, between 11 and 90, assigned to each occupation (father or mother) by the PISA survey. N = number of students in grades 9 or 10 only. SD: standard deviation; P10 indicates the 10th percentile of the distribution, P25 the 25th percentile, etc. The index is calculated for each region and year, and separately for Vietnam. Remote refers mainly to areas with a large majority of ethnics Vietnamese.

Source: Authors' computation from PISA weighted datasets (2012 and 2015)

Table 3 Percentile distribution of student's family highest international social and economic index of occupational status (HISEI) across the region, gender, area, and for Vietnam, PISA 2012 and 2015 (continued)

Region	*N*	*Mean*	*SD*	*P10*	*P25*	*P50*	*P75*	*P90*
				2012 urban				
North	683	36	24	11	11	30	51	77
Centre	700	30	20	11	13	23	35	65
South	748	35	22	11	17	31	39	76
Remote	62	25	17	11	11	19	35	35
Vietnam	2,193	33	22	11	13	29	39	76
				2015 urban				
North	875	37	25	12	12	29	59	76
Centre	827	35	23	12	17	28	50	76
South	927	34	20	12	21	29	39	71
Remote	59	31	23	12	12	21	37	76
Vietnam	2,688	35	23	12	18	29	50	76

Notes: The HISEI index is the highest score, between 11 and 90, assigned to each occupation (father or mother) by the PISA survey. N = number of students in grades 9 or 10 only. SD: standard deviation; P10 indicates the 10th percentile of the distribution, P25 the 25th percentile, etc. The index is calculated for each region and year, and separately for Vietnam. Remote refers mainly to areas with a large majority of ethnics Vietnamese.

Source: Authors' computation from PISA weighted datasets (2012 and 2015)

Table 3 reports the HISEI distribution that Vietnam's overall SES is higher in 2015 than in 2012 with an average rise of 10%. The students' SES by region differs slightly with an increase for the North and Central regions compared to the South, which has higher means, and higher indexes using the median values and the higher percentiles. Overall, these two distributions show rather large differences in the percentile SES distribution. For example, in 2012, the gaps between the 25th percentile indicator and the 50th, 75th, and 90th are respectively 10, 24, and 50 points[15], show large increases in SES gaps. Overall in Vietnam, the gaps have generally increased from 2012 to 2015, in particular for the median percentile and the upper percentiles. Results also present the span of SES inequality in each of the regions, for gender and area. The gaps are much smaller for the rural area, where the index is much smaller with very modest increases from 2012 to 2015. By gender, the differences between percentile points of SES distribution are very small. Table 4 shows test scores for domains and years and anticipates the estimation results for SES indexes. The statistics indicate that socioeconomically disadvantaged students across Vietnam in the three lowest quintiles and the lower levels of scores distribution have scores performance below the more advantaged students. Moreover, even if a significant proportion of students from the lower SES performs well among the top 25% of students across the country, their scores are on average are always less than the high performers.

Table 4 Percentile distribution of students' PISA math, reading and science test scores by quintile of occupational SES (HISEI), Vietnam, 2012 and 2015

Quintiles SES	*N*	*Mean*	*SD*	*P10*	*P25*	*P50*	*P75*	*P90*
				Math 2012				
1	937	498	77	401	447	492	549	599
2	923	500	75	406	452	496	548	599
3	948	506	78	405	451	504	563	607
4	903	531	77	432	480	530	580	628
5	910	558	81	461	503	558	612	661
Total	4,621	519	81	415	464	517	572	624
Q5–Q1		60	4	60	56	66	63	61
				Math 2015				
1	1,043	478	77	375	427	480	530	574
2	1,040	476	81	377	420	471	531	580
3	1,059	492	77	395	440	488	544	594
4	1,097	512	76	415	463	512	562	610
5	1,123	536	86	424	474	538	592	643
Total	5,362	499	83	393	442	498	556	605
Q5–Q1		58	9	49	47	58	62	69
				Read 2012				
1	937	500	67	411	456	503	546	584
2	923	502	70	410	455	502	549	593
3	948	509	69	416	463	512	557	594
4	903	524	62	446	485	526	566	600
5	910	542	66	461	498	543	588	625
Total	4,621	516	69	426	472	517	562	601
Q5–Q1		41	–1	50	42	40	42	41
				Read 2015				
1	1,043	472	65	386	432	475	514	553
2	1,040	473	70	380	426	473	518	566
3	1,059	491	66	405	446	489	538	575
4	1,097	507	65	416	464	508	550	591
5	1,123	524	72	432	477	527	572	613
Total	5,362	494	71	401	447	494	542	585
Q5–Q1		52	7	47	46	53	58	59

Notes: The HISEI index is the highest score, between 11 and 89, assigned to each occupation (father or mother) by the PISA survey. The index was calculated for each year. Scores for students in grades 9 or 10. SD: standard deviation; P10 indicates the 10th percentile of the distribution, P25 the 25th percentile, etc.

Source: Authors' computation from PISA weighted datasets (2012 and 2015)

Table 4 Percentile distribution of students' PISA math, reading and science test scores by quintile of occupational SES (HISEI), Vietnam, 2012 and 2015 (continued)

Quintiles SES	*N*	*Mean*	*SD*	*P10*	*P25*	*P50*	*P75*	*P90*
				Science 2012				
1	937	521	69	436	474	518	568	611
2	923	520	71	426	473	520	566	613
3	948	527	72	428	480	528	575	615
4	903	543	69	458	498	543	588	628
5	910	565	73	468	520	566	614	653
Total	4,621	536	73	443	488	536	584	627
Q5–Q1		44	4	32	46	48	47	42
				Science 2015				
1	1,043	510	70	414	462	511	557	595
2	1,040	510	72	421	457	508	559	602
3	1,059	523	71	432	472	520	570	612
4	1,097	537	73	447	488	534	584	629
5	1,123	561	80	457	506	560	613	666
Total	5,362	529	76	432	475	528	579	627
Q5–Q1		51	10	43	44	49	56	71

Notes: The HISEI index is the highest score, between 11 and 89, assigned to each occupation (father or mother) by the PISA survey. The index was calculated for each year. Scores for students in grades 9 or 10. SD: standard deviation; P10 indicates the 10th percentile of the distribution, P25 the 25th percentile, etc.

Source: Authors' computation from PISA weighted datasets (2012 and 2015)

3 Estimations methodology

Two model types are estimating the SES economic gradient on students' test scores.

The first model: OLS measures the link between reading, math, or science scores

$$\text{OLS: } Read/Math/Science_{isp} = \alpha + \beta_1 SES_i + \beta_2 GIRL_i + \beta_3 X_i + \varepsilon_{is} \forall p. \quad (1)$$

where $Read/Math/Science_{isp}$ is a student's score on a particular PISA test (i), in school (s), and province (p); SES_i represents four dummies variables – quintiles – with the bottom quintile (most disadvantaged group as the reference); *GIRL* is a dummy variable of student's gender (1 for girls and 0 for boys); the vector X_i indicates exogenous characteristics of a student, the age in year-months of the 15-year-old, the grade (grade 10 is 1 and grade 9 is 0), school-private is a dummy variable if a student is enrolled in a private school, preschool are three dummies variables denoting if the student attended (no, 1 year, more than 1 year), and dummy variables indicating region for the whole sample; ε_{is} is an error term using a clustering option of students within schools[16]. All estimations use the students sampling weights, the 80 balanced repeated replication (BRR) weights, Fay's adjustment, the plausible values (5 in 2012 and 10 in 2015), all derived by PISA; and a clustering option for school identity to adjust for the estimated standard errors. Missing information for the control variables implies that the children have dropped off the analysis.

Table 5 Descriptive statistics of covariates by sample and year, PISA 2012 and 2015

		Vietnam		*North Region*		*Centre Region*		*South Region*		*Rural*		*Urban*		*Girls*		*Boys*	
		2012	*2015*	*2012*	*2015*	*2012*	*2015*	*2012*	*2015*	*2012*	*2015*	*2012*	*2015*	*2012*	*2015*	*2012*	*2015*
HISEI quintile %/	1	20/11	20/12	24	22	20	20	12	14	28	25	11	15	20	19	19	21
(mean value)1	2	20/12	20/16	25	18	18	22	12	17	27	25	12	15	20	19	19	21
	3	20/22	20/24	10	18	27	19	26	23	18	20	22	19	21	20	20	18
	4	20/33	20/33	18	15	19	20	25	27	15	16	25	24	19	22	21	18
	5	20/61	20/68	24	27	16	19	25	18	12	15	30	27	20	20	22	22
Boys	0	45	47	45	48	46	46	45	47	46	49	45	46	0	0	100	100
Girls	1	55	53	55	52	54	54	55	53	54	52	55	54	100	100	0	0
Grade	9	9	8	4	5	8	5	13	13	10	12	7	4	7	5	11	11
	10	91	92	96	95	92	95	87	87	90	88	93	96	93	95	89	89
Birth month	1	8	8	8	7	8	10	8	8	8	9	8	8	8	8	8	9
	2	8	7	7	8	8	8	8	5	8	7	7	7	8	7	8	6
	3	8	8	7	7	7	8	9	8	8	9	7	7	8	8	8	8
	4	7	7	7	6	8	8	8	8	8	7	7	8	8	7	7	8
	5	7	8	7	8	7	9	8	9	7	8	7	9	7	8	7	9
	6	8	8	7	8	9	8	7	9	8	8	8	8	8	8	8	8
	7	7	8	8	8	6	8	7	6	8	8	7	7	8	7	7	8
	8	9	9	9	10	10	10	8	8	9	9	9	10	9	9	9	9
	9	10	9	10	9	10	9	9	9	10	10	10	8	10	9	10	9
	10	10	10	11	10	9	9	10	11	10	9	10	10	9	10	11	9
	11	9	9	11	11	9	7	9	10	9	9	10	9	9	9	10	9
	12	8	8	9	8	8	7	9	10	8	7	8	9	8	8	9	8
Preschool	1	8	6	3	2	3	2	19	10	8	6	9	6	8	5	9	7
	2	23	18	12	8	26	19	31	27	23	20	22	17	22	17	23	19
	3	69	76	85	90	71	79	50	63	69	74	69	78	70	78	68	74
Public school	0	9	4	17	6	5	5	5	3	9	6	9	4	7	3	11	6
	1	91	96	83	94	95	95	95	97	91	94	91	96	93	97	89	94
Urban area	0	50	48	50	49	50	49	46	41	100	100	0	0	49	47	50	50
	1	50	52	50	51	50	51	54	59	0	0	100	100	50	53	50	50
Observations		4,621	5,362	1,506	1,692	1,531	1,826	1,395	1,651	2,301	2,54	2,131	2,595	2,515	2,841	2,106	2,481
HISEI index mean		27.5	31.01	27.91	33.00	25.32	29.72	30.84	31.50	21.53	26.55	33.44	35.23	26.81	30.12	28.40	31.35
ESCS index mean		–1.77	–1.84	–1.59	–1.65	–1.88	–1.85	–1.74	–1.84	–2.11	–2.11	–1.44	–1.57	–1.81	–1.85	–1.71	–1.82
School clusters		156	NA	46	NA	52	NA	47	NA	77	NA	69	NA	156	NA	156	NA

Notes: Mean value of HISEI by quintiles for sub-samples are almost similar to overall Vietnam; students in grades 9 or 10 and in secondary school programs only; the HISEI is the student's family highest international social and economic index of occupational status; it is between 11 and 90, and assigned to each occupation (father or mother) by the PISA survey. ESCS is PISA's index of economic, social and cultural status (see text for PISA's calculations). Source: Authors' computation from PISA weighted datasets.

The second model is based on simultaneous estimation of quantile regressions, it means SES measured by HISEI and transposed in quantiles:

$$\text{SQREG}: Read/Math/Science_{isp} = \alpha + \beta_1 SES_i + \beta_2 GIRL_i + \beta_3 X_i + \varepsilon_{is} \forall p. \quad (2)$$

where SQREG are quantiles (q1 to q9); the explanatory variables are the same as in equation (1). The statistical software to perform the estimations (STATA14) does not admit the use of weights, so a bootstrap procedure with replications (500) and clustering for school identity, where the student is enrolled, was adopted:

$$\begin{aligned} &\text{Bootstrap, reps (500) cluster (school-id): SQREG:} \\ &Read/Math/Science_{isp} = \alpha + \beta_1 SES_i + \beta_2 GIRL_i + \beta_3 X_i + \varepsilon_{is} \forall p. \end{aligned} \quad (3)$$

Table 5 show descriptive statistics of covariates by sample and year. By construction of the SES quintiles, each quintile represents 20% of all students. For the other samples, these proportions are different, as expected, it denoted an unequal distribution in each region and area. As for gender, the two upper quintiles for boys are a little bit higher than for girls. The proportion of 15-year girls selected, because they are in upper secondary schools, is generally higher by 5% on average. Around 9% of students are in grade 9 (on average the estimated point scores coefficient value of grade 10 in almost all samples is 100). The proportions of students in grade 9 instead of grade 10 are higher for the South region, the urban area, and the boys. The twelve-birth month age (the median age is 15.8) is distributed almost equally for all samples with slightly more births from August to October). The proportion of students having enrolled in preschool (a significant variable where more than one year of preschool adds on average 30 points for scores) has increased over the two survey years, while being higher in the North region and for girls. Except in the North area for boys only in 2012, the number of students enrolled in private schools is low, at around 5%. The areas of student's residence are divided 50% rural and 50% urban in 2012, with a small rise in 2015 compared to 2012. Table 5 also marks also illustrate the mean index value of the HISEI, it rose in 2015 for all samples, which is expected with the growth of real living standards as observed in Vietnam.

4 Results for socioeconomic test scores gradients

4.1 Simple socio-economic gradient slopes

A socioeconomic gradient is an association between a social consequence and an individual's SES in a given society. Simple socioeconomic gradients are usually presented with three components: their level, their slope, and the strength of the outcome-SES relationship. Results present test scores standardised to a mean of 100 and a standard deviation of 15 points, and SES status standardised to a mean of zero and a standard deviation of 1. On average, levels (expected score from estimation) for the socioeconomic gradient are 100. The SES slopes are statistically significant at around 3, greater than zero ($p < 0.01$), which indicates that students with an average SES of zero have a score of 99.8 points, and their score increase by about 2.5–3.3 points for each unity of standard deviation increase in SES. The gradient's strength refers to how often students' scores differ with SES, either strongly or weakly, above and below the gradient axis.

4.2 Socioeconomic quintiles gradient gaps

We used quintiles of SES to measure socioeconomic gradient gaps. The estimates of socioeconomic inequalities in average PISA math, reading, and science test scores are conducted across the three regions by gender and area in Vietnam (in 2012 and 2015). We estimated mean difference in points between students in the top quintile and those in the bottom quintile of SES. In 2012, the gap between the 'advantaged and deprived' quintiles in math was nearly 45 points; in reading and science, all coefficients were slightly more than 30 points. The estimated coefficients for 2015 are respectively for the same tests, 45, 40, and 40 points, indicating a 15% increase (10 points) in reading and science, corresponding to a full year of schooling. For each region and area density, results show much more heterogeneity in point estimates. The North and Centre regions have higher gaps for both surveys. For rural areas compared to urban areas, the mean test scores difference estimated in 2012 and 2015 have smaller socioeconomic gradients, although they increase in 2015. However, students in rural areas/schools have slightly lower test scores in all three domains. Looking at estimates for gender, the gaps in mean scores are very similar for girls and boys. The socioeconomic gradients are higher in 2015 for both genders and suggest similar academic achievements for students in the upper SES quintile. The four approximate quintiles coefficients relative to the first bottom quintile (Q1) for the 2012 and 2015 test scores by domain and separate samples are estimated and significant at the 5% statistical level, except for the second quintile (Q2/Q1). The findings show that the approximate quintile coefficients increase relative to the reference bottom quintile across regions, gender, areas, and overall for Vietnam. These findings point to a trend of growing non-linear socioeconomic gradient, with a very broad change for the fifth quantile.

4.3 Socioeconomic gradients across the achievement distribution in Vietnam

4.3.1 SES quantile gaps

The quantile regressions as equations (3) capture performance differences at multiple percentage points (deciles) in the distribution of test scores in 2012 and 2015. The quantile regression results in both years have revealed that students in the top quintile of SES attain high levels of achievement across the board, with points differences equal to approximately two years of education (in math). All domain results indicate that students whose parents' SES is higher have higher skills in math, reading, and science around the percentile range of test scores. It also means that students in the lowest quintile of SES gain and develop fewer cognitive abilities.

4.3.2 SES quantile gaps by area

SES gradients of test scores were estimated by decile respectively for the urban and rural areas in 2012 and 2015. The results align with those of mean test scores gaps showing a much lower performance over all the deciles distribution of rural students. The patterns by year of survey for all domains differ, with a decrease in rural areas in 2012 and increases in 2015. In the rural areas, many estimated gaps between Q5 and Q1 in the first decile are not statistically significant while in the urban areas, the gaps increase in almost all deciles, domains, and years. The gaps are more important for the year 2015.

4.3.3 SES quantile gaps for girls and boys

Socioeconomic achievement gaps in gender were estimated gradients from score distributions. In 2012, the length, slope, and strength of the gradients for girl and boy students in math, reading, and science were different, but in 2015, the trends were similar. For girls, in 2012, the gaps show very often flat and more modest disparities between students of a low and high SES over the percentile distribution of all scores. In 2012, for boys, the gap distributions are rather flat and decreasing at the top for reading and science. In math as the main domain, the gaps are higher than for girls and increase from 45 points at decile 10th to 55 points at the 90th decile. For the 2015 survey, both genders indicate systematic increasing gaps for quantile estimations. Therefore, for students of each gender, for whom the scores distribution and SES quintiles are calculated, not only does achievement varies between the ablest students from advantaged and disadvantaged socio-economic backgrounds, but gaps rise with achievement levels.

4.3.4 SES quantile gaps across regions

The socioeconomic gradients across regions were estimated in mean test scores of three domains. The emerging general picture on gaps between the lowest and highest SES quantiles is very mixed. In math tests, if the 2012 results as the main domain are considered as giving the right state of gradient, for overall Vietnam, the Centre and South regions have a similar pattern while in the North, the gaps start decreasing from the 40th decile. Gaps are much smaller in the Centre region. Math gaps for the year 2015 are arising similarly for overall Vietnam and the North and Centre, and are flat for the South region. For science tests, the main domain in 2015, we find similar results of gaps enlargement over the deciles. For 2012, when science was not the main domain, gaps over the distribution were dissimilar for each region, decreasing in North and Centre regions, and getting bigger in the South. For reading, not the main domain in both surveys, the gaps over the distribution of scores were rather flat in Vietnam, and in all regions for 2012; and all increasing in 2015, except in the South region.

5 Results for socioeconomic gradients in proficiency scales

PISA assesses students' abilities not only in terms of standardised scores but also in terms of what they usually know and can do when they reach a certain level on a PISA scale, which are referred to as *proficiency scales* rather than *performance scales*. The difficulty of all PISA tests is used to estimate the ability of all participating students. Scales vary from very low to very high levels of literacy. These proficiency competencies levels can be considered as more important skills in achievement. The difficulty of tasks ranges from level 1 deemed easiest and less complex to the higher levels 6 or 7.

Table 6 Percentage of students in five proficiency levels of math, reading and science by quintiles of SES (HISEI), Vietnam, PISA 2012 and 2015

Quintile HISEI	*Proficiency levels*						
	1(=1+2)	*2*	*3*	*4*	*5 = (5+6+7)*	*Total*	*N*
				Math 2012 main domain			
1	16	29	29	18	9	100	908
2	14	28	32	18	9	100	900
3	14	25	29	22	10	100	936
4	8	18	32	27	15	100	918
5	5	13	27	29	27	100	960
Q1–Q5	11	16	2	–11	–18		
Total	11	22	30	23	14	100	4,621
				Math 2015			
1	23	29	29	16	4	100	1,061
2	25	30	26	14	6	100	1,068
3	17	31	28	18	7	100	1,045
4	12	23	31	23	11	100	1,069
5	9	19	25	28	19	100	1,118
Q1–Q5	14	9	4	–12	–15		
Total	17	26	28	20	10	100	5,362
				Reading 2012			
1	9	26	43	19	3	100	908
2	9	28	40	20	4	100	900
3	9	24	40	24	3	100	936
4	4	19	44	29	4	100	918
5	3	13	40	34	10	100	960
Q1–Q5	6	13	3	–15	–7		
Total	7	22	41	25	5	100	4,621
				Reading 2015			
1	16	38	36	9	1	100	1,061
2	17	36	34	12	1	100	1,068
3	10	35	37	16	2	100	1,045
4	7	26	43	21	3	100	1,069
5	6	20	39	27	8	100	1,118
Q1–Q5	10	18	–3	–18	–7		
Total	11	31	38	17	3	100	5,362

Notes: Band definitions of scales from level 5 to level 1 are respectively: for reading >698, 698–626, 626–553, 553–480, 480–407, 407–335, 335–262; for math >669, 669–607, <607–544, 544–482, <484–420, <420–358, <358. Percentages are calculated for students in grades 9 or 10, and in secondary school programs only.

Source: Authors' computation from PISA 2012 and 2015 weighted dataset

Table 6 Percentage of students in five proficiency levels of math, reading and science by quintiles of SES (HISEI), Vietnam, PISA 2012 and 2015 (continued)

Quintile HISEI	*Proficiency levels*						
	1(=1+2)	*2*	*3*	*4*	*5 = (5+6+7)*	*Total*	*N*
				Science 2012			
1	6	24	41	24	6	100	908
2	6	23	42	24	6	100	900
3	5	20	41	27	6	100	936
4	3	15	41	33	9	100	918
5	2	12	32	37	17	100	960
Q1–Q5	4	12	9	–13	–12		
Total	4	19	39	29	9	100	4,621
				Science 2015 main domain			
1	8	27	41	20	4	100	1,061
2	6	32	37	20	5	100	1,068
3	5	25	39	24	7	100	1,045
4	3	20	39	29	9	100	1,069
5	2	16	31	32	18	100	1,118
Q1–Q5	6	11	10	–13	–14		
Total	5	24	37	25	9	100	5,362

Notes: Band definitions of scales from level 5 to level 1 are respectively: for reading >698, 698–626, 626–553, 553–480, 480–407, 407–335, 335–262; for math >669, 669–607, <607–544, 544–482, <484–420, <420–358, <358. Percentages are calculated for students in grades 9 or 10, and in secondary school programs only.

Source: Authors' computation from PISA 2012 and 2015 weighted dataset

Table 6 indicates the percentage of Vietnamese students in each of the five math, reading, and science proficiency levels, as well as the percentage difference between the lowest (Q1) and highest (Q5) quintiles of SES and the overall percentage in each scale. The first two scale levels (level 1 and level 2) demonstrate a low and very basic proficiency level. At levels 5 to 7, students are excellent and able to understand complex text structure and its implications. At the same levels in math, students can apply insights and understandings to develop new approaches and strategies for dealing with solutions, along with a mastery of symbolic and formal mathematical operations and relationships. At levels 3 and 4, students complete test items of moderate to a relatively higher difficulty. See Table 7 for a direct qualification of each level. The statistics in Table 6 clearly illustrate the disparities in proficiency levels between SES Q1 and Q5. In 2012, the bottom quintile had 11 percentage points more students in the lowest two levels; in the upper two levels, they were 18 percentage points behind their advantaged SES peers. For reading, not the main domain in 2012 and 2015, the point differences for both years are much smaller than for math. In the science main domain for the year 2012, the respective percentage points are 6 and 14. In all domains and years, the number of low-achievers from the top quintile is slightly smaller than that of their counterparts from the bottom quintile. The bottom section of each panel shows that the picture of levels has not improved over years.

Table 7 Percentage of students in five proficiency levels of PISA tests across regions, for Vietnam and gender, by domain (math, reading, and science) and year (2012 and 2015)

Scale levels	*North*	*Centre*	*South*	*Remote*	*VN*	*Urban*	*Rural*	*Girls*	*Boys*
					Math 2012 – main domain				
1+2, low + basic	8.8	9.5	13.2	31.2	11.2	8.5	13.9	11.9	10.3
3, some limits	20.1	22.8	23.0	36.1	22.4	18.7	26.2	24.2	20.3
4, very good	25.6	32.9	31.5	23.1	29.6	26.9	32.3	30.8	28.1
5, excellent	25.8	22.5	21.2	10.3	22.7	26.3	19.1	21.5	24.2
6+7, outstanding	19.8	12.3	11.1		14.1	19.6	8.5	11.6	17.2
4+5+6+7	71.1	67.7	63.8	33.4	66.4	72.8	59.9	63.9	69.5
					Math 2015				
1+2, low + basic	15.8	20.8	13.1	29.4	17.2	14.9	19.7	16.3	18.3
3, some limits	23.7	24.2	30.3	25.7	26.1	24.5	27.8	27.4	24.7
4, very good	27.3	25.0	30.2	27.4	27.5	26.4	28.7	28.2	26.9
5, excellent	22.0	18.3	19.7	17.3	19.6	21.1	18.0	19.8	19.4
6+7, outstanding	11.3	11.7	6.8		9.6	13.1	5.8	8.4	10.8
4+5+6+7	60.5	55.0	56.6	44.8	56.7	60.6	52.9	56.3	57.1
					Read 2012				
1+2, low + basic	4.8	6.8	7.2	21.5	6.8	5.2	8.4	4.0	10.1
3, some limits	20.6	20.7	23.4	32.7	21.9	17.9	26.0	17.7	27.0
4, very good	41.0	41.8	42.2	32.9	41.3	40.4	42.2	43.1	39.2
5, excellent	27.5	26.4	23.1	12.8	25.2	29.6	20.7	29.6	19.9
6+7, outstanding	6.2	4.3	4.2		4.8	6.9	2.7	5.7	3.8
4+5+6+7	74.7	72.5	69.5	45.7	71.3	76.9	65.6	78.3	62.9
					Read 2015				
1+2, low + basic	10.4	13.8	7.6	27.2	11.5	8.5	14.6	7.4	15.9
3, some limits	30.5	29.3	31.0	40.3	30.9	26.1	36.0	28.8	33.2
4, very good	38.4	34.5	41.4	27.9	37.6	37.7	37.5	41.2	33.6
5, excellent	17.4	18.3	17.7	4.6	17.0	22.5	11.1	18.9	14.9
6+7, outstanding	3.4	4.2	2.3		3.1	5.2	0.8	3.7	2.4
4+5+6+7	59.2	57.0	61.4	32.5	57.7	65.4	49.4	63.8	50.8
					Science 2012				
1+2, low + basic	4.1	4.4	4.1	7.7	4.3	3.4	5.2	4.0	4.7
3, some limits	15.7	18.1	20.5	37.3	18.7	14.8	22.6	19.7	17.5
4, very good	37.9	40.5	39.2	42.1	39.3	36.6	42.0	40.0	38.4
5, excellent	30.5	30.4	27.8	12.9	29.0	32.5	25.4	29.1	28.8
6+7, outstanding	11.8	6.6	8.5		8.8	12.7	4.7	7.3	10.6
4+5+6+7	80.2	77.5	75.4	55.0	77.0	81.7	72.2	76.3	77.8

Note: Students in grades 9 or 10 and in secondary school programs only.

Source: Authors' computation from PISA 2012 and 2015 weighted datasets

Table 7 Percentage of students in five proficiency levels of PISA tests across regions, for Vietnam and gender, by domain (math, reading, and science) and year (2012 and 2015) (continued)

Scale levels	*North*	*Centre*	*South*	*Remote*	*VN*	*Urban*	*Rural*	*Girls*	*Boys*
					Science 2015 – main domain				
1+2, low + basic	5.1	5.2	3.4	12.6	5.0	4.5	5.6	4.6	5.4
3, some limits	23.0	26.3	21.2	32.3	23.9	20.9	27.1	23.9	23.9
4, very good	37.8	33.1	41.6	33.6	37.4	36.2	38.7	39.1	35.6
5, excellent	25.6	23.3	27.0	21.5	24.9	26.1	23.6	24.3	25.7
6+7, outstanding	8.5	12.2	6.9		8.8	12.4	4.9	8.1	9.5
4+5+6+7	72.0	68.6	75.4	55.1	71.1	74.6	67.3	71.5	70.7
N 2012	1,509	1,536	1,406	190	4,641	2,205	2,436	2,527	2,114
N 2015	1,722	1,853	1,693	195	5,463	2,745	2,718	2,912	2,551

Note: Students in grades 9 or 10 and in secondary school programs only.

Source: Authors' computation from PISA 2012 and 2015 weighted datasets

Their ESCS index and ranking of status) are almost three times more likely than advantaged students not to achieve the baseline standard of science proficiency. However, about 29% of disadvantaged students are considered resilient, meaning they conquer difficulty and excel academically. They single out for PISA 2015, Korea, Hong Kong, Macao, Shanghai, Singapore, and Vietnam have 13% or more resilient students who perform in the top 25% of students in all participating countries. They also point out that students in Macao and Vietnam, who are at a disadvantage on a global scale, outperform students in around 20 other PISA-participating countries. According to our statistics on proficiency levels, computed from quintiles of our SES index in Table 5, some students in the bottom quintile have a very good performance (level 4), in particular in science for 2015 and math for 2012 (main domains for those years). But there are large gaps of performance at the upper level of proficiency between very disadvantaged (Q1) and very advantaged (Q5) students.

Table 7 exhibits statistics of proficiency levels by years and domains, for overall Vietnam from the perspective of regions, gender and areas. In math main domain, the year 2012, the North region has a higher proportion of students with excellent and outstanding proficiency levels. For reading, years 2012 and 2015, there is not much difference between regions: low percentage in the very low-basic level and a higher percentage in very good to outstanding levels. In science main domain, the year 2015, in all regions the proficiency levels reveal both some strengths and weaknesses, in particular for the South. Percentages of students' proficiency levels by gender are very similar, except in reading, where girls have higher levels and few are in the low-basic category. For the area of residence, students residing in rural areas have lower proficiency competencies levels compared to their urban peers.

Table 8 Estimated marginal probability of being in lower group of proficiency levels (1+2+3) by SES, year (2012 and 2015), test domain (math, reading and science) across region, gender and for Vietnam

Domain and year	*Ratio*	*Estimated logit probability by SES*			
	1+2+3	*(2 vs 1)*	*(3 vs 1)*	*(4 vs 1)*	*(5 vs 1)*
			Vietnam		
Math 2012	39	–0.03#	–0.06	–0.14	–0.21
Math 2015	43	–0.03#	–0.04	–0.13	–0.17
Read 2012	29	0.02#	–0.04	–0.09	–0.14
Read 2015	42	0.00#	–0.06	–0.14	–0.20
Science 2012	23	–0.00#	–0.04	–0.08	–0.18
Science 2015	29	–0.01#	–0.06	–0.11	–0.21
			North		
Math 2012	29	–0.02#	–0.12	–0.12	–0.22
Math 2015	40	0.04#	–0.04#	–0.17	–0.20
Read 2012	25	0.04#	–0.02#	–0.06	–0.14
Read 2015	41	–0.01#	–0.07	–0.18	–0.20
Science 2012	20	0.02#	–0.08	–0.15	–0.20
Science 2015	28	0.04#	–0.01#	–0.04#	–0.13
			Centre		
Math 2012	32	–0.05#	0.00#	–0.13	–0.18
Math 2015	45	–0.03#	–0.07	–0.16	–0.25
Read 2012	28	0.01#	0.00#	–0.09	–0.12
Read 2015	43	–0.10	–0.14	–0.22	–0.31
Science 2012	23	–0.03#	–0.03#	–0.09	–0.21
Science 2015	31	–0.08#	–0.06	–0.16	–0.35
			South		
Math 2012	36	0.01#	–0.08	–0.14	–0.19
Math 2015	43	0.08#	–0.01#	–0.07	–0.04
Read 2012	31	–0.00#	–0.07#	–0.07	–0.11
Read 2015	39	0.04#	0.01#	–0.05	–0.13
Science 2012	25	–0.03#	–0.06#	–0.09	–0.19
Science 2015	25	–0.01#	–0.08	–0.09	–0.15

Notes: 1/0: Observed ratio of proficiency scales (1+2+3 versus 1 to 7); see Table 5 for band scales definition and Table 6 for a number of students. All estimated effects are statistically significant at the 0.05% level of less except those with #. Estimates are restricted to students in grades 9 or 10 and secondary school programs only.

Source: Authors' computation from PISA weighted datasets; and PISA for band definitions of scales

Table 8 Estimated marginal probability of being in lower group of proficiency levels (1+2+3) by SES, year (2012 and 2015), test domain (math, reading and science) across region, gender and for Vietnam (continued)

Domain and year	*Ratio*	*Estimated logit probability by SES*			
	1+2+3	*(2 vs 1)*	*(3 vs 1)*	*(4 vs 1)*	*(5 vs 1)*
			Boys		
Math 2012	31	–0.03#	–0.05#	–0.13	–0.18
Math 2015	43	0.03#	–0.03#	–0.14	–0.16
Read 2012	37	0.00#	–0.07	–0.12	–0.18
Read 2015	49	–0.02#	–0.06	–0.12	–0.19
Science 2012	22	0.05#	–0.05#	–0.08	–0.16
Science 2015	29	–0.04#	–0.08	–0.14	–0.21
			Girls		
Math 2012	36	–0.04#	–0.07	–0.15	–0.22
Math 2015	44	0.04#	–0.05#	–0.13	–0.18
Read 2012	22	0.02#	–0.01#	–0.06	–0.10
Read 2015	36	0.02#	–0.06	–0.15	–0.22
Science 2012	24	–0.04#	–0.03#	–0.07	–0.18
Science 2015	29	0.03#	–0.04#	–0.09	–0.22

Notes: 1/0: Observed ratio of proficiency scales (1+2+3 versus 1 to 7); see Table 5 for band scales definition and Table 6 for a number of students. All estimated effects are statistically significant at the 0.05% level of less except those with #. Estimates are restricted to students in grades 9 or 10 and secondary school programs only.

Source: Authors' computation from PISA weighted datasets; and PISA for band definitions of scales

PISA analysts say that economically deprived students in OECD countries (using Table 8 presents marginal probability estimates of proficiency levels linked to SES by domain and year, for Vietnam, regions, and gender. The ratio of students observed in the three lower scales (scale 1, scale 2, and scale 3) relative to the higher scales is presented in the first two columns of each panel. For all samples in all domains, the ratios have increased by a few points, in some cases by more than 10 points in many samples and domains. The marginal effects (logit estimates) of the respective probability for students in the low proficiency levels (1+2+3) rather than the higher levels (4+5+6+7) are presented in the four following columns in each panel, considering each quintile (Q2 to Q5) relative to the reference gradient (Q1). The Q2/Q1 estimates are all no-statistically significant while the Q3/Q1 ones are small and, in some cases, not significant. A majority of estimates for all three domains, years, and samples indicate that probabilities decline significantly with quintiles 4 and 5. It means that students from upper-middle to high SES have a much lower probability in achieving low proficiency levels in math, reading, and science. These results reinforce the claim that a large and rising proportion of 15-year-old Vietnamese students have difficulty with literacy and numeracy over time.

6 Discussions of results

Overall, PISA offers a wealth of data for examining SES inequality from a variety of perspectives including students, family, and school backgrounds. Many scholars used the datasets to test hypotheses about family SES and academic achievement in different nations, whether in terms of individual, social, and economic conditions or within a world where education policy varies by province, such as in Canada (Lefebvre, 2016). However, it should be noted that the authors used a variety of metrics to represent SES in their studies, such as parents' education (years), occupation reputation, books, and home belongings, which limits comparisons of results on related topics. According to Nonoyama-Tarumi (2008), different composites of the SES measure may have different explanatory power across countries when using PISA results, therefore, studies can overestimate or underestimate SES effects. Furthermore, as Caro et al. (2013) found, the comparability of SES metrics is restricted across countries, which implies that a cross-national analysis requires further careful interpretations.

To our knowledge of peer-reviewed articles on PISA, almost all articles are on rich countries and none on countries similar to Vietnam with comparable aspects of their education systems and culture. On SES gaps, Jerrim (2012) studies the relationship between SES and reading achievement as a key domain only (PISA 2009) for various success ranges across Australia, Canada, Finland, Germany, the United Kingdom, and the United States. He discovered that the relation is stronger in the United States and the United Kingdom than in most other countries and that it is especially strong at high levels of success. Also, on SES gaps based on occupation, five PISA surveys, and all domains Lefebvre (2016) documents large socioeconomic differences for achievements across Canadian provinces and some increases over time. McConney and Perry (2010) looked at whether compositional SES effects (as calculated by PISA's index of ESCS) were comparable for students with different SES levels in Australia, and discovered that while the compositional impact was crucial, it was equally so across different levels of individual SES and subjects. Additionally, in Australia, students in urban schools outperformed students in rural schools. Nevertheless, according to a prior study by Sullivan et al. (2013), it is argued that performance gaps exist even after correcting for SES interventions, for example, differences in resources allocation and teacher recruitment to remote areas. Compared to developed countries participating in PISA 2012, for which we have some information on gradients, Vietnam is a clear outlier. There is a 'social gradient' in education achievement and proficiency scales, but they are gradual and not steep. It is difficult to assert the substantiality as well as the stability of SES outcomes. Other points must be documented in future research. That is while comparing Vietnam with other low-income countries participating in PISA; more PISA surveys for Vietnam to assess trends in socioeconomic achievement gaps (the achievement disparities between children from high- and low-SES families or between children from families with high or low levels of parental educational attainment). This aspect has received far less attention; the SES status of youth who do not have access or enroll in secondary education (from the Vietnam Household Living Standards Survey conducted every two years); school infrastructure and teachers characteristics (from PISA) by area, especially in cities and small towns.

7 Summary and conclusions

This research estimated the socioeconomic gradient relationship between social outcome-tested cognitive abilities and SES of 15-year-old students enrolled in the upper secondary program. The SES, referred here as SES, is the relative position of each student's family on the hierarchical social structure, operationalised as the parental occupational index (social and economic). Students were also clustered by gender and geographically defined units such as the country, regions, and areas.

Simple socioeconomic gradients, also known as the partial-regression leverage plot. The SES slopes were statistically significant. In the construction of the added-variable plot, the relationship between scores and SES is forced to be linear. However, results also indicated steeper gradients - a greater impact of SES on students' outcomes – that is, greater inequality – with increases in standard deviation in SES. To take empirically into account that the gradient rises steadily with increasing levels of SES, and test that gradient gradually tapers off at a higher level of SES, the analysis proceeded with strands. First, the SES status was transformed in quintiles, followed by OLS estimations described in section 3. The results support statistically significant increasing returns associated with the upper quintiles, in particular for the fifth quintile, where the gap compared to the bottom quintile, reaches on average for all domains 30 points in 2012 and 40 points in 2015 for all Vietnam[17]. For subsamples, the gaps are significant but more mixed, depending on a test domain and survey year for the three large regions dividing Vietnam, with large gaps for rural areas compared to the urban area, and no difference between girls and boys.

Afterward, the analysis proceeded to estimate gaps between the bottom and higher quintiles, along with the decile's distribution of scores by test categories. The results show, for almost all samples and Vietnam overall, that the gaps between low- and high-SES students along with the distribution of scores increase. This is more marked in the year 2015. This means that high-SES students are more likely to perform better than their low-SES peers, even when all are at the low end of the distribution of the scores. There are a few exceptions – declining gaps in the distribution of the scores (rural, girls, North region in 2012) or flat gaps (for the South region in 2015), which are difficult to explain. They may be due to samples size and domain test considered as of secondary importance in the design of each PISA, where for each survey there is a rotating major domain. It is difficult to affirm that gaps gradually taper off when considering bright students since high-SES students always have an advantage in scores.

Finally, for socioeconomic gradients in proficiency levels, outcomes are very often overlooked or ignored, although they predict educational outcomes such as a repeat of classes, grades across subjects, and grade levels. They show small declines in test scores at both ends of scales. While results of the SES relations with Vietnam student achievements show moderate socioeconomic gradients, again they must be tempered by noting the underlying reality that the secondary school enrollments are low compared to South Asian countries. Further, PISA surveys are needed to give off stronger evidence on socioeconomic gradients, community differences, converging, and stability of gradients.

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Notes

1 By contrast, in Vietnam, coverage shrank by 7 percentage points between 2012 and 2015 as enrolment decreased, while the total population of 15-year old increased.

2 There are ten provinces, each with school system. The PISA' tests are conducted separately for each province to reflect the diversity of schooling systems (a prerogative of each province), which explains why the sample of Canadians students among participating countries is the largest with Mexico.

3 We abstract from some benchmarking states, such as Himachal Pradesh-India, and Tamil Nadu-India, that seldom participate and have very low scores.

4 This is particularly true in mathematics, where children in Shanghai, Singapore, South Korea and Hong Kong outscore their American, British and Australian counterparts by, on average, more than 40 test points (equivalent to more than one whole year of schooling according to PISA).

5 For that reason, many of them have no choice other than dropping out of high schools or going to vocational schools. Besides the public vocational schools, a large number of private vocational and training schools have been established in the cities and industrial areas.

6 The Vietnam Household Living Standard Survey (VHLSS), which has been implemented every two years by the General Statistics Office of Vietnam (GSO) collects information on income and presents average monthly expense on education per person. Data for 2012 indicate by income quintiles, that the expense on education of the household of richest quintile is nearly six times more than the poorest quintile. Also, expense ratio for the poorest quintile is the highest in comparison with other quintiles due to their low monthly income.

7 Most upper secondary schools in Vietnam offer extra learning activities. For instance, 95% of school principals stated that their schools offered extra learning activities in mathematics, the third highest rate in the PISA sample.

8 At the same time, poor performance at school has been identified as a strong predictor of school drop-out. Many Vietnamese teachers hold extra tutorials, outside of regular school hours, for a small fee per lesson. Not all parents can afford to pay these fees, and so the practice tends to exacerbate inequality.

9 The amount of time allotted for the measurement of each domain is determined by this distinction. As less testing time is devoted to the minor domains, results are currently not available for sub-domain level for each test. For example, math subscales are change and relationship, quantity, space and shape, uncertainty and data, employ, formulate, interpret.

10 Nonetheless, PISA 2012 (2013) asserts that the first plausible value, which we use for some descriptive statistics, represents a valid summary of each participant country test scores.

11 The region 'Remote' refers mainly to areas with a large majority of ethnics Vietnamese.

12 The PISA index of economic, social and cultural status is a composite score derived from these indicators via principal component analysis (PCA). It is constructed to be internationally comparable. For the first time, in PISA 2015, the PCA was run across equally weighted countries, including OECD and partners' countries or economies. Thus, all countries and economies contribute equally to ESCS scores. However, for the purpose of reporting, the values of the ESCS scale are standardised to have a mean of zero and a standard deviation of one for the population of students in OECD countries, with each country given equal weight.

13 The percentage for OECD countries is on average for reading with a score point-difference of 38. Vietnam did not participate in PISA for this wave.

14 Three indices were calculated based on this information: father's occupational status (BFMJ2); mother's occupational status (BMMJ1); and the highest occupational status of parents (HISEI) which corresponds to the higher ISEI score of either parent or to the only available parent's ISEI score. For all three indices, higher ISEI scores indicate higher levels of occupational status.

15 For Canada, from PISA' 2012 data set, the same difference is 22, 39, and 46 points.

16 We did not observe in the datasets other appropriate control variables. Students' type of family or number of siblings is not known. Immigration status is irrelevant for Vietnam.

17 According to PISA, the 30–40 points range corresponds to one more year of education.