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ABSTRACT

Vietnam's Extraordinary Performance in the PISA Assessment: A Cultural Explanation of an Education Paradox*

This paper examines the nature and drivers of Vietnam's paradoxical performance in the Program for International Student Assessment (PISA) – consistently high student achievement despite being the poorest of all participating countries and a centralized education system. We first document 'Vietnam advantage' in a wide-range of supply and demand-related indicators such as school participation rate, educational inequality, inputs and expenditure in cross-country regression models. We then estimate an augmented educational production function to show that these supply and demand-side advantages don't explain away Vietnam's positive deviance in PISA when compared to other participating developing and developed countries. We then conduct student-level analysis to examine Vietnam's performance in PISA 2012 in a regional context, vis-a-vis three high-spending but low-performing ASEAN member countries (Malaysia, Indonesia and Thailand) and two high performing Asian countries (South Korea and Singapore). Pooled regression estimates show that, holding differences in various indices of socioeconomic background, the gap in average student test scores between Vietnam and South Korea in Reading and Science becomes statistically insignificant. Moreover, once school-specific differences are also accounted for, Vietnamese students do just as well as Singaporean across all subjects — equalizing for existing socioeconomic differences between countries would give Vietnam an even better advantage in the PISA. A similar gain in PISA scores is absent in the case of Malaysia, Indonesia and Thailand. The paper concludes by offering a cultural explanation for the significant variation in educational performance among high-spending East Asian countries.

JEL Classification: A20, I21, I28

Keywords: ASEAN, Confucian culture, expenditure policy, school quality, Malaysia

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1. Introduction

Whether higher budgetary allocations matter for educational production is a hotly debated policy question in the economics and education literature (Wößmann, 2005; Hanushek and Wößmann, 2010; 2017). Many attribute East Asia's economic miracle to heavy public investment in education (World Bank, 1993; McMahon, 1998; Perkins, 2013; Hanushek and Wößmann, 2016). The region has not only succeeded in achieving near universal secondary education in a short span of time, East Asian countries such as South Korea and Singapore also dominate international assessments of student performance in reading, mathematics and science. This has motivated other high income countries such as the UK to borrow policy lessons from high-performing education systems (HPES) of East Asia and experiment with Singapore-inspired curriculum design and teaching methods in primary and secondary schools (Jerrim and Vignoles, 2015).

Within East Asia, however, high spending in the region did not have the same impact on learning outcomes in all countries. Vietnam, for instance, excelled in international assessments like PISA despite the lowest per capita income among all participating countries (US$ 4,098 in 2010 PPP dollars), a high level of corruption and a multitude of same kinds of problems that have been blamed for a low level of student learning in other developing countries (Bodewig and Badiani-Magnusson, 2014). In the Program for International Student Assessment (PISA) 2012 round, it ranked 19th in reading, 17th

in mathematics and 8th in science among 65 participating nations. There is no substantial difference in PISA performance within country, across regions and social groups, suggesting that Vietnam ensures equity and opportunity to learn for all children (Thien, Razak, Keeves and Darmawan, 2016). On the other hand, its ASEAN neighbors such as Malaysia, Indonesia and Thailand could not replicate Vietnam's success despite a more supportive expenditure policy and larger education budget. Public spending on education as a percentage of GDP during last three decades in these countries were similar to that of South Korea (UNESCO Institute for Statistics, 2014). Malaysia, Indonesia and Thailand also have a longer history of participation in PISA and suffer from significant socioeconomic inequality in PISA performance (Thien, Razak, Keeves and Darmawan, 2016).

In the above context, Vietnam is an important case study for middle income countries which aspire to build an inclusive and high quality education system. We examine Vietnam's education performance asking how and in what dimensions it is exceptional. The empirical analysis involves a global assessment based on cross-county regression analysis of indicators of school enrolment, educational inequality, inputs and expenditure. We test whether Vietnam's surprising performance in PISA could be explained away by country-level differences in supply (e.g. educational inputs and expenditure) and demand (enrolment rate) indicators. This exercise is complemented by a detailed student-level analysis of Vietnam's performance in a regional context. Data from two high performers (Singapore and South Korea) and three low performers

(Malaysia, Indonesia and Thailand) in the 2012 round of PISA are combined to study Vietnam's advantage. We ask to what extent differences in individual, family background, school and teacher and especially institutional characteristics contribute to explaining observable test score gaps between three low performers and the three high performers group. We answer this question by estimating a student-level educational production function pooling data on six countries where family and school-specific covariates are added sequentially. This step-wise pooled regression framework helps understand which student, family, school, teacher or institutional structure characteristics in the PISA 2012 data can explain the Vietnam's advantage in a regional context. In doing so, we complement the existing debate on educational excellence of East Asian countries as well as Vietnam's PISA surprise in a global and regional (i.e. ASEAN) context and contribute to the literature on education development in East Asia with a focus on cultural factors (Byun, Schofer and Kim, 2012; Rolleston and Krutikova, 2014; Jerrim, 2015; Jerrim and Vignoles, 2015; Tijana and Anna, 2015; Glewwe, Lee, Vu and Dang, 2017; Thien, Razak, Keeves and Darmawan, 2016;; Iyer and Moore, 2017). Moving up the value chain of production and export more technologically advanced products through investment in education is key to escaping the so-called "middle income trap" (Agénor and Canuto, 2015). Therefore, our findings would be equally insightful for understanding the 'PISA disadvantage' of Vietnam's upper middle income neighbors -- Malaysia, Indonesia and Thailand – which aim to achieve high-income status in the coming decade.

The remainder of this paper is structured as follow. The next section provides an overview of the educational systems and policies of Vietnam and empirically describe Vietnam's educational advantage in a number of domains relative to Malaysia, Indonesia and Thailand. Section 3 describes the data and methodology. Section 4 presents the main results. Section 5 discusses the cultural origin of Vietnam's PISA paradox while section 6 is conclusion.

2. Background: Major reforms and education policy initiatives

The role of education in sustaining Vietnam's economic growth through productivity increase during the 1990s and early 2000s is well-acknowledged (Bodewig and Badiani-Magnusson, 2014). This reflects sustained policy focus on and high regards for education in Vietnamese society throughout its history. Following independence in 1945, the country's President Ho Chi Minh identified "fighting against illiteracy" as one of three key important tasks of the Vietnamese Government. In response to this, within less than a year, a massive education campaign was launched involving 75 thousand literacy classes and nearly 96 thousand teachers which helped 2.5 million people get out of illiteracy. During the years of resistance war (1946-1954), schools continued to operate in demilitarized areas. In order to prepare skilled human resources to contribute to the 'resistance war' and the country's development after victory, the Government officially passed an education reform project in 1950. Moreover, in temporarily occupied areas, schools taught a 12-year curriculum with an aim to reduce the influence of colonial education. Vietnamese language was used in teaching in schools in lieu of French. A number of national elements were also included in school

curriculum. However, the curriculum used in the temporarily occupied areas was still heavily influenced by French education.

Once peace was achieved in the North, the Vietnamese Government took over the education system in the newly liberated areas. New reforms abolished the command education system and introduced a more equitable relationship between teachers and students, brought into play the usefulness of extra-curricular activities, and gradually introduced production activities into schools as an important way to shape personalities (London, 2011). In parallel with the reform of general education system, the Government created the "Central Steering Committee on Illiteracy Elimination", which identified popular education as an integral part of the State plan and launched a 3-year plan for illiteracy elimination from 1956 to 1958.

For educational development in Southern provinces, the Government focused on two tasks: (1) the removal of leftover influences from the old education system; (2) implementation of anti-illiteracy activities for people in the age group of 12-50 years old (Nguyen and Nguyen, 2008). By 1978, all southern provinces eliminated illiteracy. The third major education reform started in 1981-1982 school year, when textbooks at all school levels were replaced with those with more consistent components (Hamano, 2008). The reformed curriculum comprised elements that are more modern and therefore created pre-conditions for the improvement of education quality. This coincided with major reforms of the economy. In order to overcome the economic crisis,

the government in 1986 implemented a major national reform to move away from the centralized planning system to socialist-oriented market mechanism (Griffin, 2016). In the education sector, the government introduced tuition fees at all levels while also granting permission to open private schools. Other changes include streaming the upper secondary curriculum and classification of learning activities according to student's abilities and expectations. In the subsequent years, the education sector at all levels from pre-school, general education, vocation education to higher education expanded significantly. New curricula and textbooks have been also introduced for teaching and learning in all grades at primary and lower secondary schools in 2006. The revised curricula focused on harmonizing subject content and the teaching/learning methodology and strengthened practical components, reduced emphasis on theoretical elements, and recognized social and humanity sciences along with science and technology education as necessary for a student's cognitive development (Viet, 2009). Other notable recent policies implemented include the National Foreign Languages 2020 Project (NFL 2020) for teachers (Nguyen and Nguyen, 2008; Nguyen, 2011; Nguyen, Grainger and Carey, 2016; Nguyen and Burns, 2017); the "Year of ICT" (Peeraer and Van Petegem, 2012; Nguyen *et al*., 2017) and Teaching in the Training of Math Teachers (Tran, 2017).

3. Data and Methodology

3.1 Data and Sample

For the country-level analysis, we use data from the World Development Indicators (WDI) database of the World Bank. For student level analysis, we use data from the

2012 round of PISA. The dependent variables are the PISA student test scores on mathematics, reading and science. In addition to data on math, reading and science performance, PISA survey also collected a rich set of cross-nationally comparable information on students and their family backgrounds through the student questionnaire. Data on schools' institutional structure and educational provision were collected using an additional questionnaire administered to the principals. After dropping cases with large number of missing observations, our final sample contains 32963 students in the PISA 2012 round.[2] In our final sample, the number of students (schools) from Vietnam, Malaysia, Indonesia, Thailand, Korea and Singapore are 4959 (162), 5197 (164), 5622 (209), 6606 (239), 5033 (156) and 5546 (172) respectively.

The raw data[3] show some differences in student (and family) characteristics across the six study countries. Singapore has the highest number of immigrants across the six countries with 18.3 percent of total number of students being first-generation or second-generation immigrants while almost all students in Korea, Vietnam, Indonesia, Thailand and Malaysia are native. However, there are significant differences in terms of ethnic and linguistic identity. While almost all Korean (99.9%) and Vietnamese (97.8%) students speak the test language at home, only 41.4%, 45.6%, 55.4% and 57.7% students in Indonesia, Singapore, Thailand and Malaysia respectively spoke the test

[2] As with all survey data, the PISA dataset contains missing values. Since a large number of student and school variables are considered in this study, dropping all observations with missing values on at least one variable would severely reduce the sample size. A handful of binary variables had more than 3% of missing data. Instead of dropping these cases entirely, missing values are imputed with zero. To ensure that the results are not driven by the imputed data, dummy indicators are introduced into all regressions for variables with imputed values (one if the value is imputed and zero otherwise).

[3] Descriptive statistics table not reported but available from the authors upon request.

language at home.

Turning to parental background, there are significant differences as well. For example, 56.7% of the Korean parents and 47.8% of the Singaporean parents have completed tertiary education while this figure is only 11.2% in case of Vietnam. The index of parental occupation status For Singapore and Korea, is 57.52 and 53.38 respectively and is much higher than the figure (27.03) for Vietnam. The percentage of students' families having more than 100 books at home in the case of Vietnam (11.5%) is much less than Korea (60.2%) and Singapore (31.9%) and even lower than Malaysia (25.4%). The lower occupational status and fewer books at home are proxies of overall socioeconomic status and the low figures are not surprising given Vietnam's lower per capita income. In terms of students' study efforts, the proportion of Vietnamese students who spend more than four hours per week on out-of-school lessons in all three subjects is the highest one among all study countries. Complementary learning inputs are also offered at the family level. Vietnamese students engage in 17 hours of extracurricular learning activities, the fourth highest rate among countries participating in PISA (after Kazakhstan, China-Shanghai, and Russia). This is in line with the well-known phenomenon of primary and high school children taking extra classes to supplement to in-school instruction in Vietnam.

Moving to school and teacher specific variables, the average disciplinary climate in class (as reported by students) is much higher in Vietnam (0.36) even when compared

to South Korea (0.18) and Singapore (0.21). The percentage of high schools located in rural areas (defined in PISA by population below 3,000 inhabitants) was 45% in Vietnam compared to less than 10% in South Korea and Singapore. This figure is less than 30% in the case of Malaysia, Indonesia and Thailand. In the case of schools located in cities and large cities (defined by a population above 100,000 inhabitants), the figure is only 24.7% for Vietnam. In contrast, 70% Korean schools and 100% Singaporean schools were in city areas. The average school size in Vietnam is also larger, with average enrollment of 1290 students compared to less than 1000 students per school in South Korea, Malaysia and Indonesia. This means that class size, a common proxy for school quality, is less favorable in Vietnam. Moreover, Vietnam also has a smaller share of private schools (only 8.2%); government funding accounts for 81.76% of the school's financing. This compares to 65.6% in South Korea and 62.4% in Indonesia. In terms of teacher characteristics, Vietnamese teachers devote slightly more learning time on several subjects than Korean teachers and those in other three Southeast Asian sample countries. But teachers in Vietnam overall are less likely to be certified and schools more likely to be short of teachers. With regard to institutional structure, the education system remains centralized; there appears to be less autonomy in Vietnam in all three dimensions – content autonomy, personnel autonomy and budget autonomy.

3.2 Empirical Approach

In order to test whether Vietnam's surprising performance in PISA can be explained away by country-level differences, we conduct a cross-country regression analysis of indicators of school enrolment, educational inequality, inputs and expenditure. The

equation for country-level estimate of educational production function is presented as follows:

$$T_k = a_0 + X_{viet}a_1 + \sum_{k=1}^{n-1} X_k a_k + Income_k a_2 + \varepsilon_k \quad (1)$$

where T_k is the average score in PISA test of country ***k*** in reading, mathematics and science, $\mathbf{X}_{viet}$ is the country dummy for Vietnam and $\sum X_k$ is the sum of dummies for Malaysia, Indonesia, Thailand, South Korea, Singapore and other non-OECD countries. $Income_k$ is lagged per capita income in country ***k***. Our main parameter of interest is the coefficient on Vietnam country dummy, where the reference category here is OCED countries. Next, we re-estimate equation (1) replacing PISA scores six individual indicators of gross enrolment (i.e. per-primary enrolment, primary enrolment and private school enrolment rates), input (i.e. student-teacher ratio) and education inequality (i.e. education gini). Lastly, we estimate an augmented version of equation (1) where each of these six indicators enter as a regressor which is as follows:

$$T_k = b_0 + X_{viet}b_1 + \sum_{k=1}^{n-1} X_k b_k + Income_k b_2 + \sum_{k=1}^{n} Y_k b_k + \varepsilon_k \quad (2)$$

where $\sum Y_k$ is a set of six supply and demand-side indicators relating to gross enrolment, input and education inequality. Equation (2) helps us test which of these six indicators helps explain away Vietnam's country-level performance in PISA in a step-wise framework.

We complement the above cross-country regression analysis with a student-level analysis of Vietnam's performance in the regional context. Our main objective here is

to test whether the mean differences in student test scores across sample countries are primarily explained by differences in socioeconomic backgrounds and related factors such as students' effort on extracurricular learning activities the effect of parental pressure on school's academic standard's setting, supply-side factors such as school-size, teacher backgrounds and system-wide factors such as centralized education governance To this end, we adopt a pooled regression framework based on five different specifications. The first specification uses a parsimonious specification which only includes country dummies for Malaysia, Indonesia, Thailand, Vietnam and Korea (using Singapore as the reference category). This specification produces estimates of the raw test scores gaps. Next two specifications we control for a wide range of student and family characteristics. The last two models add controls for school-specific variables and institutional structure characteristics.

The covariates used in the regression model are selected based on the education production function specification of Hanushek, Link and Wößmann (2013) who also used PISA data. We additionally include a few variables such as the grade of students, out-of-school lessons and average disciplinary climate reported by students.[4] We account for the clustered nature of the PISA data or interdependence of the error terms between students of the same school by estimating survey regressions model in Stata using "svy" command and adjust the standard errors.

[4] Variables such as immigrant status and language spoken at home are not included in these regressions since some countries had the same value for all students as we discussed in last section. For example, South Korea had only native students in PISA 2012 sample. Since the individual country regressions would be affected by lack of variation in these variables, they are not included in the pooled regressions as well.

The estimable equations are summarized below:

$$T_{isk} = b_0 + X_{\text{viet}} b_1 + \sum_{i=1}^{j-1} X_{isk} b_{isk} + \varepsilon_{isk} \quad (3)$$

$$T_{isk} = c_0 + X_{\text{viet}} c_1 + \sum_{i=1}^{j-1} X_{isk} c_{isk} + B_{isk} c_2 + F_{isk} c_3 + \varepsilon_{isk} \quad (4)$$

$$T_{isk} = d_0 + X_{\text{viet}} d_1 + \sum_{i=1}^{j-1} X_{isk} d_{isk} + B_{isk} d_2 + F_{isk} d_3 + S_{sk} d_4 + \vartheta_{sk} + \varepsilon_{isk} \quad (5)$$

$$T_{isk} = e_0 + X_{\text{viet}} e_1 + \sum_{i=1}^{j-1} X_{isk} e_{isk} + B_{isk} e_2 + F_{isk} e_3 + S_{sk} e_4 + I_{sk} e_5 + \vartheta_{sk} + \varepsilon_{isk} \quad (6)$$

where $\boldsymbol{T_{isk}}$ is the test score of student $\boldsymbol{i}$ in school $\boldsymbol{s}$ in country $\boldsymbol{k}$ in reading, math and science in PISA 2012 test, , $\mathbf{X}_{\boldsymbol{viet}}$ is the country dummy for Vietnam and $\sum X_k$ is the sum of dummies for other target Asian countries – Malaysia, Indonesia, Thailand, South Korea. B_{isk} is a set of individual characteristics, F_{isk} is a set of family background variables, S_{sk} is a set of variables on teacher characteristics and school resources, I_{sk} comprises variables on institutional structure of schools and ϑ_{sk} and ε_{isk} are the error terms at the school- and student-levels, respectively. Here we don't give the exact specification for model 4, compare to the last specification, the frequency of participating the out-of-school lessons, the average disciplinary climate of school that reported by students, learning time in minutes per week and parental pressure on academic standards, all together four variables are not include in model 6. Once again, our main parameter of interest is the coefficient on Vietnam country dummy, β_5 where the omitted category is Singapore.

4. Results

4.1 Cross-country regressions analysis

In this section, we study Vietnam's educational advantage in a cross-country setting. **Table 1** reports the coefficient on Vietnam dummy, controlling for lagged per capita income. Other controls include country dummies for Malaysia, Thailand, Indonesia and Korea (the base category being other OECD countries). In all PISA subjects, the Vietnam dummy is statistically significant. In contrast, the coefficients on country dummy specific to Indonesia, Thailand and Malaysia are either negative or statistically insignificant. This confirms a Vietnam advantage in PISA regardless of whether comparison is made to countries of similar income level or from the same region.

Table 1: OLS regression estimates of 'Vietnam advantage' in PISA, 2012 (basic specification)

VARIABLES	Reading	Science	Mathematics
Vietnam	79.75**	96.90**	89.25**
	(8.871)	(9.631)	(10.16)
Malaysia	-33.74**	-14.48	-4.930
	(8.905)	(9.643)	(10.32)
Indonesia	-33.01**	-49.84**	-47.66**
	(8.834)	(9.582)	(10.14)
Thailand	11.11	11.30	3.280
	(8.822)	(9.562)	(10.15)
Korea	48.40**	46.07**	70.20**
	(6.790)	(8.063)	(8.376)
Non-OECD	-50.35**	-52.12**	-51.27**
	(13.99)	(15.63)	(17.07)
Per capita income, 2006-2010	0.000461	0.000447	0.000552
	(0.000285)	(0.000319)	(0.000348)
Constant	478.0**	482.7**	472.4**
	(12.17)	(13.98)	(14.96)
Observations	61	61	61
R^2	0.583	0.536	0.534

Notes: (a) Robust standard errors in parentheses (b) ** p<0.01, * p<0.05, + p<0.1 **(c)** Singapore dummy omitted because of collinearity.

Table 2 repeats the analysis using 9 different outcome variables. In gross enrolment indicators, Vietnam has a larger proportion of children attending pre-primary education though the enrolment share of private school is significantly lower. In terms of educational inputs, it does have a significantly favorable student-teacher ratio, higher proportion of trained teachers, higher per capita expenditure on primary education. This pattern also holds for Malaysia and Thailand. However, Vietnam has a significantly more equitable education system. The Vietnam dummy is significant and negative in both inequality of education opportunity and education gini while it's significant and positive in the regression on share of resilient children.

Therefore **Tables 3** presents country level estimate of educational production function using average PISA scores as outcome variables where we sequentially add as controls pre-primary enrolment, primary enrolment and private school enrolment rates, student-teacher ratio, per capita educational expenditure and an index of inequality of educational opportunity. However, in all cases, the coefficient on Vietnam dummy remains significant and positive. This implies that although Vietnam enjoys an advantage in pre-primary enrolment, equality of educational opportunity and has favorable educational inputs/expenditure, these differences do little to explain the country's exceptional performance in reading, science and mathematics in PISA.

Table 2: OLS regression estimate of 'Vietnam advantage' in indices of enrolment, inputs and inequality 2011-2015

	Gross Enrolment indicators			Input indicators			Educational inequality indicators		
VARIABLES	Pre-primary	Primary	Private school	STR	Trained teachers	Edu Exp, pc	Inequality of Op	Resilience	Education gini
Vietnam	28.20**	3.011*	-14.76**	-9.150**	19.65**	5.852**	-9.117**	12.78**	-0.0583**
	(3.036)	(1.339)	(1.588)	(1.213)	(2.196)	(0.833)	(1.404)	(1.186)	(0.0192)
Malaysia	34.24**	-2.317+	-3.557*	-14.90**	15.82**	2.233**	2.199	-1.684	-0.115**
	(2.816)	(1.213)	(1.628)	(1.113)	(1.928)	(0.802)	(1.379)	(1.169)	(0.0171)
Indonesia	-0.840	2.309+	2.600+	-10.49**		-1.578+	3.352*	-1.677	0.0189
	(2.972)	(1.308)	(1.569)	(1.185)		(0.823)	(1.397)	(1.181)	(0.0186)
Thailand	17.89**	-4.956**	4.039*	-11.53**	19.19**	13.73**	-1.068	2.056+	-0.0166
	(2.909)	(1.275)	(1.567)	(1.156)	(2.049)	(0.813)	(1.389)	(1.176)	(0.0181)
Korea	6.620*	-3.329**	-7.694*	0.0762		3.752**	-4.486**	7.164**	-0.0397*
	(2.906)	(0.891)	(3.419)	(1.154)		(0.896)	(0.665)	(0.500)	(0.0164)
Singapore						-7.315**	-7.553**	9.506**	-0.0185
						(1.364)	(1.613)	(1.284)	(0.0260)
NON-OECD	-25.97**	0.287	9.261+	6.533**		-7.62e-07	5.215**	-0.735	0.111**
	(4.326)	(1.392)	(4.727)	(1.762)		(2.62e-05)	(1.620)	(1.311)	(0.0254)
PC income, 2006-10	0.000441**	-5.32e-05	0.000164+	-0.000225**	0.000234**	21.11**	-4.19e-05	3.50e-05+	-1.38e-06+
	(0.000103)	(3.44e-05)	(9.39e-05)	(4.28e-05)	(8.56e-05)	(1.319)	(2.65e-05)	(1.77e-05)	(7.03e-07)
Constant	76.93**	104.6**	5.874	22.16**	79.69**	131	7.453**	4.811**	0.197**
	(4.391)	(1.491)	(4.769)	(1.864)	(2.253)	0.208	(1.142)	(0.794)	(0.0288)
Observations	175	181	180	174	109	131	60	64	142
R^2	0.273	0.011	0.047	0.274	0.043	0.208	0.414	0.299	0.183

Notes: (a) Robust standard errors in parentheses **(b)** ** p<0.01, * p<0.05, + p<0.1 **(c)** All dependent variables are based on the average for the period 2011-2015 except education gini (2010), inequality of opportunity index and resilience student share (2012). (d) Data on inputs corresponding to primary education.

Table 3: OLS regression estimates of 'Vietnam advantage' in PISA, accounting for possible confounders (augmented specification)

	Reading						Science						Mathematics					
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Vietnam	74.91**	88.45**	76.69**	79.54**	74.76**	87.89**	90.93**	106.5**	92.33**	96.45**	94.09**	107.4**	80.83**	100.3**	85.96**	89.85**	87.64**	101.1**
	(10.29)	(6.91)	(10.13)	(9.41)	(11.35)	(10.48)	-11.48	(7.21)	(10.76)	(10.27)	(12.8)	(11.19)	(11.88)	(7.21)	(11.23)	(10.73)	-14.02	-12
Malaysia	-42.29**	-32.53**	-35.01**	-46.97**	-	-34.96**	-25.03+	-13.39	-16.74+	-29.20*	-15.68	-17.04	-19.82	-3.914	-6.482	-23.61+	-2.86	-6.239
	-12.18	-8.228	-9.241	-12.32	-13.51	-9.892	-13.55	-9.056	-9.853	-14.02	-14.74	-10.26	-14.16	-9.538	-10.4	-14.05	-16.19	-10.7
Indonesia	-24.86*	-25.27**	-33.19**	-36.24**	-33.99*	-15.37	-39.80**	-41.29**	-	-	-	-26.06+	-	-37.93**	-	-51.53**	-41.42*	-22.49
	-10.27	-6.903	-9.424	-9.501	-15.66	-13.19	-9.862	-7.26	-10.19	-10.23	-16.96	-14.29	-10.19	-7.287	-10.94	-10.76	-18.27	-15.52
Thailand	10.5	8.267	11.14	5.393	1.587	23.64*	10.55	7.817	10.69	4.829	4.311	27.97*	2.221	-1.033	2.979	-4.273	-6.767	21.29
	-8.817	-9.383	-9.511	-9.885	-10.38	-11.51	-9.534	-10.42	-10.31	-10.68	-13.49	-12.29	-9.893	-11.11	-11.18	-11.18	-14.11	-13.34
Korea	47.82**	42.70**	47.33**	53.93**	47.56**	48.44**	45.35**	39.67**	44.60**	52.06**	44.54**	45.99**	69.19**	62.83**	69.12**	77.82**	66.13**	70.32**
	-6.635	-6.921	-7.376	-7.719	-7.631	-5.967	-7.794	-8.142	-8.748	-9.668	-8.519	-6.939	-8.011	-8.39	-9.241	-9.129	-8.892	-7.267
NON-OECD	-41.59*	-55.88**	-47.78**	-45.21**	-42.34*	-41.16**	-41.32*	-57.98**	-	-	-47.48*	-38.65*	-36.02+	-57.71**	-	-44.81*	-47.79*	-38.70*
	-15.96	-12.27	-13.58	-14.63	-16.27	-14.01	-17.66	-13.9	-14.88	-16.5	-19.08	-15.58	-18.88	-15	-16.08	-17.65	-20.34	-16.82
PC income	0.0004	0.0003	0.0005+	0.0003	0.0005+	0.00056*	0.00036	0.0003	0.0005	0.0002	0.0005	0.0006+	0.0004	0.0004	0.0006+	0.0003	0.0006+	0.0007*
	-0.0002	-0.0002	-0.0003	-0.0003	-0.0003	-0.0003	-0.0003	-0.0003	-0.0003	-0.0003	-0.0003	-0.0003	-0.0003	-0.0003	-0.0003	-0.0003	-0.0003	-0.0003
Pre-primary	0.455						0.56						0.791+					
	(0.38)						(0.39)						-0.406					
Primary		-1.468*						-1.669*						-1.946*				
		(0.66)						(0.70)						-0.832				
Private Sch			-0.167						-0.212						-0.161			
			(0.32)						-0.365						-0.442			
STR				-1.951+						-2.141						-2.868*		
				(1.15)						-1.51						-1.363		
Edu exp, pc					0.552						0.516						1.061	
					-0.915						-1.102						-1.091	
Education						-129.1+						-180.6*						-181.1*
gini						-71.55						-77.86						-80.55
Constant	438.0**	633.4**	478.6**	511.0**	464.1**	492.6**	433.3**	659.0**	483.6**	519.0**	470.7**	503.3**	402.6**	677.8**	473.0**	520.9**	449.6**	492.7**
	(36.52)	-69.55	-12.34	-19.04	-21.61	-14.52	-37.33	-73.36	-14.21	-24.07	-27.68	-14.96	-39.48	-86.07	-15.25	-23.31	-26.12	-15.77
Observations	61	60	60	57	49	59	61	60	60	57	49	59	61	60	60	57	49	59
R^2	0.606	0.687	0.58	0.577	0.618	0.603	0.566	0.641	0.532	0.526	0.571	0.576	0.589	0.655	0.529	0.541	0.597	0.575

Notes: (a) Robust standard errors in parentheses **(b)** ** p<0.01, * p<0.05, + p<0.1 **(c)** Singapore dummy omitted because of collinearity. (d) All regressors are in lag form (2010 value).

4.2 Student-level regression analysis

The results of the determinants of Reading, Mathematics and Science Test Scores in PISA 2012 based on the education production function have been shown in **Table 4**. As explained earlier, we present estimates from four different models. Model 1 includes only the countries dummies. Model 2 additionally controls for student and family background characteristics while model 3 further adds controls for school and teacher characteristics. Model 4 we additionally controls for institutional structure characteristics including extracurricular learning activities (i.e. students' time spent on out-of-school lessons per week), school-specific institutions and policy (i.e. disciplinary climate of school, schools' regulation on learning time per week and parental involvement in school administration).

The regression estimate of Model (1) for Reading scores (**Table 4)** shows that the Vietnam dummy has a coefficient of 34.0 and is significantly negative, when no other covariates are added; this is the absolute difference in mean reading scores between Vietnam and the reference country Singapore. However, the coefficients on Malaysia, Indonesia and Thailand are much larger 144.0, 146.1 and 101.0 respectively. Model 2 therefore examines the extent to which observed student and family characteristics in the PISA dataset explains the gap in students' performance in reading test. The student characteristics included are – gender, age, immigrant status and other language than test language spoken at home. While family background covered parents' educational and occupational status, number of books at home, and time spent on out-of-school lessons.

In PISA data, family wealth and parental education are much lower for Vietnam compared to Singapore. Therefore, Vietnam's higher PISA scores cannot be explained by higher parental wealth or parental education. Once these variables are included, the negative coefficient on the Vietnam dummy or "the Vietnamese disadvantage compared to Singapore" in reading scores reduces by nearly 20 points to 12.36. In other words, one key reason for the observed gap between Vietnam and the top performing country Singapore is because of the relatively poorer student and family related variables. However, it is puzzling why Malaysia, Thailand and Indonesia do not see similar reduction in their achievement relative to Singapore and South Korea. More precisely, this negative coefficient on Malaysia, Indonesia and Thailand dummies only decreased slightly from 144.0 to 118.5, 146.1 to 121.06, and 101.0 to 76.6 respectively from model 1 to model 2. . Note that of Model (2) also includes one factor that we earlier identified as potential reasons for Vietnam's success i.e. students' extra effort on extracurricular learning activities. This variable is statistically significant and has a sizeable impact on the reading score.

Model 3 augments the regression specifications by adding key supply-side variables: alongside student and family related factors, school and teacher specific covariates are included. Despite these additions, country dummies on Malaysia, Thailand and Indonesia remains negatively signed and significant. In stark contrast, the Vietnam dummy becomes statistically insignificant. The same result holds in Model (4) after we add institutional variables, i.e. averaged autonomy level in school on three dimensions

– which is insignificant in determining students' reading performance in PISA 2012. As noted in section 2, Vietnamese schools are subject to centralized policies and another school-related factor, i.e. Vietnamese parents involvement in school's institution such as the setting of academic standard are much larger compare to other three low performing countries. In additionally removed the two confirmed significant determinants of reading performance for these selected countries, extracurricular learning activities (i.e. students' time spent on out-of-school lessons per week) and culture related factor (i.e. parental pressure towards schools on academic standard's setting) from model 4 (results not reported); the insignificant result for Vietnam dummy still stands.

Table 4: OLS Estimates of the Student-, Family- and School-Specific Determinants of Test Scores, PISA 2012

	Reading				Maths				Science			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Country dummies												
Malaysia	-144.02***	-118.59***	-92.40***	-88.40***	-152.96***	-127.33***	-91.03***	-86.62***	-131.99***	-112.17***	-85.36***	-78.94***
	(-39.64)	(-25.46)	(-10.79)	(-10.75)	(-44.90)	(-29.83)	(-9.49)	(-9.96)	(-37.76)	(-25.18)	(-11.37)	(-10.82)
Indonesia	-146.10***	-121.06***	-89.48***	-84.97***	-198.35***	-169.50***	-130.75***	-124.19***	-169.58***	-145.72***	-118.23***	-112.89***
	(-34.51)	(-32.12)	(-9.71)	(-9.04)	(-47.58)	(-40.10)	(-12.07)	(-11.41)	(-43.70)	(-39.01)	(-15.05)	(-13.55)
Thailand	-101.00***	-76.64***	-69.31***	-68.22***	-146.73***	-115.50***	-98.58***	-93.93***	-107.49***	-82.13***	-75.06***	-73.42***
	(-29.89)	(-19.02)	(-8.23)	(-6.99)	(-40.04)	(-26.94)	(-9.27)	(-7.93)	(-32.21)	(-20.65)	(-9.86)	(-8.41)
Korea	-6.43	-11.73**	-1.6	7.16	-19.70***	-29.84***	-11.29	-0.06	-13.71***	-22.17***	-7.36	-0.59
	(-1.56)	(-2.89)	(-0.24)	-0.96	(-4.07)	(-6.65)	(-1.57)	(-0.01)	(-3.54)	(-5.31)	(-1.23)	(-0.09)
Viet Nam	-34.00***	-12.36**	5.3	5.06	-62.13***	-37.43***	-8.05	-6.87	-23.07***	-2.61	14.69	18.34*
	(-7.65)	(-2.70)	-0.62	-0.58	(-12.67)	(-7.41)	(-0.73)	(-0.65)	(-5.10)	(-0.53)	-1.86	-2.25
Student characteristics												
Girl		30.88***	30.07***	30.25***		-4.63*	-6.14***	-5.88**		3.43	1.97	2.11
		-15.48	-15.93	-15.78		(-2.26)	(-3.29)	(-3.13)		-1.9	-1.18	-1.26
Age		9.37***	4.79	5.29*		7.27**	2.64	3.36		9.10***	4.25	4.37
		-3.55	-1.93	-2.19		-2.58	-1.04	-1.36		-3.62	-1.87	-1.93
Immigrant: 1st generation		-0.26	1.17	1.25		1.56	2.86	2.33		-2.41	-2.24	-1.99
		(-0.02)	-0.1	-0.11		-0.11	-0.18	-0.16		(-0.17)	(-0.15)	(-0.15)
Immigrant: 2nd generation		-13.98	-16.15	-16.77		-12.81	-10.27	-11.06		-22.88*	-23.53*	-26.00*
		(-1.37)	(-1.72)	(-1.77)		(-1.21)	(-1.00)	(-1.03)		(-2.27)	(-2.35)	(-2.46)
Other language spoken at home		2.64	4.69	4.76*		7.17*	12.83***	13.39***		3.63	6.28**	6.79**
		-0.75	-1.96	-2		-2.07	-5.05	-5.15		-1.17	-2.62	-2.78
Family background												
Parents' education												
Primary		17.79***	14.21***	13.65**		15.95***	11.24**	11.32**		13.05**	8.68	8.33
		-4.26	-3.31	-3.2		-3.64	-2.58	-2.62		-3.22	-1.96	-1.88

Lower secondary	16.74***	9.73*	10.21**	18.81***	11.73**	11.93**	13.90***	7.03	7.82*
	-4.43	-2.49	-2.69	-4.6	-2.92	-3.04	-3.71	-1.82	-2.02
Vocational upper secondary	29.03***	17.43**	18.38***	37.96***	25.74***	26.90***	28.62***	17.79***	18.88***
	-4.42	-3.22	-3.3	-5.83	-4.48	-4.68	-4.94	-3.32	-3.47
Upper secondary	24.84***	14.81***	15.12***	27.38***	16.43***	16.81***	22.92***	12.42**	12.76**
	-5.88	-3.45	-3.52	-5.95	-3.73	-3.85	-5.78	-2.98	-3.01
Vocational tertiary	29.78***	18.02***	17.52***	28.70***	17.16**	16.93**	28.66***	16.62**	16.77**
	-6.04	-3.54	-3.33	-4.81	-3.03	-2.91	-5.27	-2.88	-2.8
University-level tertiary	34.77***	20.42***	20.46***	45.17***	29.20***	28.84***	34.97***	20.45***	20.75***
	-6.98	-4.37	-4.35	-7.5	-5.73	-5.53	-6.63	-4.28	-4.26
Parental occupational status	0.69***	0.48***	0.47***	0.73***	0.48***	0.47***	0.63***	0.43***	0.41***
	-11.75	-8.85	-8.81	-11.89	-8.86	-9.03	-11.35	-8.47	-8.34
Books at home: 11-100	8.22***	4.46*	3.64	6.48***	3.11	2.49	5.98**	1.82	1.25
	-4.23	-2.2	-1.76	-3.57	-1.74	-1.37	-3.29	-1.04	-0.69
Books at home: 101-500	22.67***	15.93***	14.81***	24.81***	18.31***	17.49***	24.50***	16.61***	15.98***
	-8.71	-6.07	-5.59	-9.2	-7.2	-6.78	-9.67	-6.95	-6.62
Books at home: 500+ books	20.84***	19.90***	16.59***	24.07***	24.90***	21.44***	18.14***	16.04***	13.05***
	-4.95	-4.63	-3.76	-5.83	-6.1	-5.26	-4.68	-4	-3.3
Out-of-school lessons: <2 hours	-24.56***	-16.95***	-16.91***	-13.21***	-7.07**	-6.81**	-11.93***	-7.84***	-7.83***
	(-9.45)	(-6.70)	(-7.06)	(-6.24)	(-3.20)	(-3.11)	(-5.71)	(-3.45)	(-3.44)
Out-of-school lessons: 2 -4 hours	-8.02**	-3.73	-5.15*	8.09***	9.81***	8.94***	9.58***	9.82***	9.22***
	(-3.26)	(-1.55)	(-2.20)	-3.29	-4.35	-3.78	-4.41	-4.6	-4.22
Out-of-school lessons: 4-6 hours	-14.08***	-7.71	-8.47*	19.15***	19.84***	19.13***	12.14***	13.33***	13.29***
	(-3.35)	(-1.90)	(-2.15)	-6.65	-6.45	-6.27	-3.35	-4.01	-3.96
Out-of-school lessons: 6+ hours	-16.24**	-7.42	-8.07	26.88***	27.76***	26.54***	26.40***	25.96***	24.67***
	(-3.13)	(-1.59)	(-1.66)	-8.62	-8.59	-7.94	-6.1	-7.55	-6.98
School characteristics									
Avg. disciplinary climate of school		46.26***	45.05***		45.59***	43.92***		39.00***	37.75***
		-7.65	-7.48		-7.87	-7.5		-7.49	-7.11

Number of students	0.02***	0.02***	0.01***	0.01***	0.01***	0.01***
	-5.53	-5.22	-5.29	-4.85	-4.91	-4.53
School's location: Town	1.9	0.03	3.99	3.67	-1.4	-3.13
	-0.36	-0.01	-0.76	-0.66	(-0.28)	(-0.60)
School's location: Large town	8.74	6.52	9.62	8.81	5.4	4.3
	-1.44	-1.06	-1.57	-1.47	-0.98	-0.79
School's location: City	18.09*	15.88*	22.23**	20.83**	12.08	10.52
	-2.31	-2.04	-2.81	-2.68	-1.77	-1.5
Large city	29.62**	30.13**	39.58***	41.01***	24.50**	26.42**
	-3.19	-3.26	-3.65	-3.84	-3.07	-3.22
Privately operated	-12.19**	-18.57**	-11.16*	-14.67*	-11.84**	-15.74**
	(-2.85)	(-3.12)	(-2.40)	(-2.57)	(-2.88)	(-3.03)
Share of government funding	-0.32***	-0.31***	-0.31***	-0.31***	-0.31***	-0.29***
	(-4.30)	(-3.95)	(-3.91)	(-3.76)	(-4.25)	(-3.74)
Learning time (language)	0.01	0.01	0.07***	0.07***	0.07***	0.07***
	-1.43	-1.12	-6.25	-6	-10.13	-10.3
% of fully certified teachers	9.26	9.83	13.93	15.03	8.48	8.77
	-1.24	-1.35	-1.75	-1.92	-1.16	-1.21
Teacher shortage index	-1.9	-2.02	-0.29	-0.23	-0.53	-0.57
	(-0.95)	(-1.00)	(-0.14)	(-0.11)	(-0.26)	(-0.28)
Institutional characteristics						
Content autonomy		-2.76		-8.11		2.43
		(-0.31)		(-0.96)		-0.35
Personnel autonomy		11.04		8.01		6.88
		-1.68		-1.32		-1.18
Budget autonomy		-4.88		-2.13		-3.5
		(-0.98)		(-0.45)		(-0.82)
Parental pressure: Minority of parents		-9.92*		-14.96***		-7.98*
		(-2.50)		(-3.72)		(-2.34)

Parental pressure: Largely absent				-10.22				-13.69*				-9.27
				(-1.52)				(-2.06)				(-1.53)
Constant	542.22***	306.94***	364.99***	366.86***	573.47***	371.66***	403.85***	404.24***	551.49***	333.53***	391.19***	391.50***
	-395.92	-7.21	-8.76	-9.1	-433.6	-8.26	-9.35	-9.78	-366.15	-8.38	-10.53	-10.66
Student observations	32963	31208	28940	27694	32963	31208	28940	27694	32963	31208	28940	27694
R^2	0.334	0.4459	0.4982	0.4949	0.4159	0.5016	0.5495	0.5445	0.4384	0.511	0.5541	0.5494

Notes: Cluster-robust standard errors are reported in parentheses, based on “svy” command in Stata. *Significant at 10%; **significant at 5%; ***significant at 1%. Learning time is measured in “minutes per week”. Ref. group for "Other language spoken at home" is "test language". Ref. group for "books at home" is "0-10 books". Ref. group for immigrant is native. Ref. group for parental education is "none". "Average disciplinary climate" is based on student response. Ref. group for "out-of-school-lesson" is "none". Ref. group for "school location" is "village or rural ". Ref group for "parental pressure (on academic standards)" is "many parents". Out-of-school lessons is in language and time spent per week.

For Mathematics scores, results of model 1 shows that the absolute difference in mean mathematics scores between Vietnam and the reference country Singapore (i.e. when no other covariates are added), indicating by the coefficient of 62.1 with a significant and negative sign for the Vietnam dummy is much bigger than that absolute difference in reading subject. Consistent with findings for reading, the coefficients on Malaysia, Indonesia and Thailand are much larger 152.9, 198.3 and 146.7 respectively. Another similar finding is, for mathematics, the convergence still stands for Vietnam with another two top performers (i.e. Singapore and South Korea) after we additionally control for students' characteristics and family background in model 2, but not for Malaysia, Indonesia, Thailand where the coefficient only declined by less than 30 points from model (1) to (2). In model (3), Vietnamese students just do as well as Singaporean students in PISA mathematics test after additionally controlling differences in school and institutional- structure characteristics.

However, the coefficient for Vietnam dummy in science regression becomes insignificant after we only control for the student and family background factors (model 2, Table 4). This implies that Vietnam's performance in science converges with Singapore even when we allow for differences in school-specific factors to prevail. Although the coefficient for Vietnam dummy is insignificant, it becomes significant and positive after controlling for institution and family-related factors. Moreover, the coefficient for South Korea dummy is still significantly negative and large (see model 2). Therefore, equalizing the socioeconomic background differences among students from the two countries (i.e. Vietnam and South Korea) would give Vietnamese students an even better performance in the PISA Science test.

5. Discussion: Pathways to Vietnam's high performance in PISA

The paradox of high performing East Asian learners has stimulated research into teaching and learning approaches in Hong Kong, mainland China, Taiwan, South Korea and Singapore (Watkins and Biggs, 1996; Deng and Gopinathan, 2016; Perera and Asadullah, 2019). However, research on Vietnam's high performance in PISA is lacking. Our cross-country regression analysis shows that Vietnam does have a favorable teacher-student ratio, higher proportion of trained teachers, higher per capita expenditure on primary education compared to other developing countries. This pattern also holds for Malaysia and Thailand. Given the evidence on the positive impact of public education expenditure on economic growth (Jung and Thorbecke, 2003) and the significance of teacher quality as a determinant of student performance in PISA (Meroni, Vera-Toscano and Costa, 2015; Cordero and Gil-Izquierdo, 2018), Vietnam's PISA advantage could follow from policies governing budgetary allocations and composition (e.g. greater spending on trained teachers). However, such country-level supply and demand-side specific advantages in inputs and expenditure alongside differences in enrolment rate, private school participation rate, educational inequality, do *not* explain Vietnam's PISA advantage in a global setting. In a regional context, student level analysis also confirms that Vietnam's surprising performance in PISA cannot be explained away by child-level differences in family background, educational inputs and expenditure even when compared to other ASEAN countries including high-performing South Korea. Moreover, there is a convergence in average student science test scores between Vietnam and Singapore when holding differences in socioeconomic background constant. After differences in school-specific characteristics are accounted

for, Vietnamese students do just well as Singaporean students in all three subjects. Such convergence in PISA performance is lacking in the case of Malaysia, Indonesia and Thailand. In other words, if socioeconomic conditions improve further in the near future, Vietnam's PISA performance relative to regional high performers is likely to improve further.

What do these findings tell us about Vietnam's success in PISA? One strand of the literature scrutinizes the representativeness of the PISA sample for Vietnam (e.g. better socioeconomic status of participating children) as a source of its surprising performance in international education assessments (Glewwe,2016). [5] However, adjusting the educational production model in our cross-country analysis by controlling for participation rate in school did not wash out the Vietnam advantage. This is also consistent with our student-level analysis which finds that socio-economic and family background related differences of children do not explain the performance gap vis-à-vis economically advanced HPES countries such as Singapore and South Korea. Therefore, our findings confirm that Vietnam's advantage is not a matter of economic development or poverty reduction policies.

The second strand of the literature emphasizes superior performance incentives in the school system which can increase productivity of public educational investment in the country (Gundlach and Wößmann, 2004). However, the exact sources of institutional advantages remain unclear. One channel is the policy of encouraging private schools to make education service delivery more competitive. But our cross-country results do not

[5] 44.3% of 15-year-olds who did not participate in the 2012 PISA assessment (Glewwe, Lee, Vu and Dang, 2017).

suggest that country- or student-level differences in private school enrolment rates explain Vietnam's superior performance in PISA. If anything, the proportion of students who attend private school in other ASEAN countries is much higher than that in Vietnam. Moreover, in other ASEAN countries (e.g. Indonesia), students with better socio-economic status are more likely to attend public schools. Indonesian public school students also score 16 points higher in science than students in private schools, once socio-economic status is accounted for.[6] This is also one reason why private school coefficient is negatively signed in our student-level regression model.

Among other policy explanations, Tijana and Anna (2015) stress that Vietnam's performance in PISA 2012 benefitted from the country's prior experience with seven national large-scale assessments carried out since 2001, and associated capacity building support received from development partners especially from the government side. Vietnamese students have long learning time within regular school lessons. Other studies have attributed performance difference to better institutional structure such as autonomy in the education system (e.g. Rolleston and Krutikova, 2014; Thien, Razak, Keeves and Darmawan, 2016; Glewwe, Lee, Vu and Dang, 2017; Iyer and Moore, 2017). A significant percentage of students' achievement data is not only tracked by an administrative authority, it is also posted publicly which facilitates accountability and greater parental involvement. However, it is noteworthy that schools in Thailand also enjoy autonomy though this is not true in the case of Malaysia (Thien and Ong, 2015) and our empirical models already control for such institutional differences.

Lastly, a fourth strand of the literature argues that performance variation in East Asia

[6] https://www.oecd.org/pisa/PISA-2015-Indonesia.pdf

could well be owing to hard-to-observe cultural and family-specific factors which increases returns to commonly observed socio-economic correlates of student achievement.[7] Students from countries of Confucian Heritage Culture (CHC) share certain values which reflect in their academic outcomes and learning approaches (Tweed and Lehman, 2002). The PISA success of CHC countries sharing "chopstick cultures" can be attributed to the positive attitudes among students towards studying especially that towards mathematics and spending more time on learning and attending extra class after school. Chinese students see learning as a long process rather than as a rapid insightful process. Researchers have pointed out the importance of epistemological belief that learning requires significant effort instead of being determined by intelligence (Dahlin and Watkins, 2000; Tweed and Lehman, 2002) and such beliefs are culturally transmitted. Vietnam belongs to the CHC group in that Chinese cultural practices coexist alongside traditional Vietnamese culture.[8]

Jerrim (2015) argues that the attitudes and beliefs East Asian parents instill in their children make an important contribution to their higher levels of academic achievement. He finds little evidence that a single factor can explain the exceptionally strong PISA performance of East Asian children residing in Australia. Instead, a combination of school selection, a high value placed upon education, substantial out-of-school tuition, hard work ethics, a belief that anyone can succeed with effort and high aspirations for the future -- all play an important and inter-linked role in determining student's performance. Other studies on the superior performance of children from Asian immigrant families in the US and other Western countries have also emphasized the

[7] For example, in South Korea, the effect of family background on test scores is as large as the effects of 3.4 years of schooling completed (Wößmann, 2005).

[8] For research on how CHC values shape the practice of school leadership and management in Vietnam, see Truong, Hallinger and Sanga (2017).

role of parenting styles (e.g. Chua, 2011; Hsin and Xie 2014). In their study on the school performance of second generation immigrants from different nationalities but educated in the same school, De Philippis & Rossi (2016) find a Pisa advantage among students coming from high-scoring countries than their peers. About 40% of the gap in PISA scores between East Asia and other regions is attributed to various parental inputs confirming the importance of deeper cultural values (e.g. aspirations; attitudes towards school; non-cognitive skills) beyond the quality of a country's educational system.

In sum, the pro-learning attitudes parents transmit to their children in CHC countries regardless of their own educational background are rooted in national culture and history. This not only makes a direct contribution to student's academic achievement, such cultural advantage can also positively influence teacher performance. The student achievements are influenced by the quality of the learning environment in school (Hopkins, Hargreaves, Lieberman, & Fullan, 2005; Lee and Williams, 2006; Harris and Chrispeels, 2006) which is also determined by cultural capital that are mostly beyond the control of school authorities. Moreover, cultural factors can shape teaching practices (OECD, 2009) thereby improving productivity of public investment in education. When these advantage prevail at the country level, they can create a positive deviance in educational performance at the international level.

Regional variation within East Asia in cultural attitudes could be an explanation for less satisfactory performance of non-CHC countries such as Indonesia, Malaysia and Thailand in PISA. Existing evidence confirms a higher level of anxiety and stress in learning mathematics, and low level of mathematics self-efficacy among the Malaysian, Indonesian and Thai students have been confirmed as a reason for their

underperformance in PISA (Thien and Ong, 2015). A related variable included in our model is the role of parental expectations from schools. Of the 65 countries that participated in PISA, Vietnam ranks 8th in terms of the level of parental pressure, reflecting the high level of commitment and parental aspiration for their children's education, which may be owing to their Confucian heritage. High parental aspirations for educated children may be a key reason why returns, in terms of performance in PISA, to public investment in education have been high in Vietnam. Our findings therefore support viewpoint that cultural factors are likely to be important in explaining Vietnam's PISA surprise. As also argued by other scholars (e.g. Jerrim, 2015; Lagravinese, Liberati, and Resce, 2019), cultural differences can affect the performance of students as well as the overall education systems themselves. Thus, policies should close the gap among students with different socio-cultural backgrounds both between and within systems.

6. Conclusion

If the influence of the cultural determinants of student learning persists over time, improving a country's educational system in the absence of progress in cultural aspect will not be enough to improve rankings in Pisa. Our analysis of individual (student) and aggregate (country) level PISA scores offers indirect evidence that is supportive of this view. We have shown that there are many influences upon student performance of a country like Vietnam. But the conventional drivers of educational outcomes are unable to explain Vietnam's superior performance in PISA. The lesson for countries like Malaysia, Indonesia and Thailand is that a significant improvement in PISA rankings is unlikely to be achieved by policy efforts that focus on schools factors alone.

The primacy of cultural and family backgrounds in educational production have long been recognized in the literature (e.g. see Coleman, 1966). The evidence presented here therefore calls for greater recognition of country-specific cultural traits in public policy discourse. However, our analysis also has an important limitation. We could not directly measure the significance of cultural contribution. As shown by De Philippis and Rossi (2016) and Jerrim (2015), the average PISA score of a country captures the combined effect of school quality, economic, institutional, and cultural factors. Differences in student performance often manifest through expenditure channels making it hard to separate the effect of cultural values and attitudes from that of resources and socio-economic status (Byun et al., 2012). There is an emerging body of social science research that has quantified the part of individual level performance difference related to country-specific culture in a variety of socio-economic outcomes.[9] Future research should follow this approach and analyze the performance and attitudes of children born to Vietnamese immigrants who are educated in non-CHC countries.

[9] These include studies on the persistence of cultural background (associated with the country of origin) for second or later generation immigrants on their effect on female labor force participation (Antecol, 2000; Fernandez, 2008; Fernandez and Fogli, 2009), social trust (Guiso, Sapienza and Zingales, 2006; Algan and Cahuc, 2010).

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