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If You Pay Peanuts, You Get Monkeys? Education Spending and Schooling Quality in the Philippines

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Abstract

Cross-country comparison of education financing is often limited to public sector spending, which only provides a partial view of the global education financing landscape. Using recent National Transfer Accounts estimates of public and private education consumption for 74 economies around the world, we uncovered important trends in education financing in the Philippines and benchmarked its performance against its peers. Based on a synthetic measure of basic education consumption, we showed that education spending per person in the country has grown robustly over the past 25 years, even surpassing the growth in per capita income. Despite this feat, the Philippines' education spending levels trail behind its regional and aspirational peers, which contributes to its poor performance in international standardized student assessments. While such is the case, there may still be opportunities to improve schooling quality by identifying and scaling cost-effective education interventions that better translate resource inputs to desired education outcomes.

Keywords: Education financing, National Transfer Account, Philippines

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If You Pay Peanuts, You Get Monkeys? Education Spending and Schooling Quality in the Philippines

Michael R.M. Abrigo[1]

1. Introduction

In 2015, the National Economic and Development Authority (NEDA) commissioned a national survey to learn about Filipinos' aspirations, values, and principles (NEDA, 2016). In this *Ambisyon Nation 2040* survey, practically all respondents who either have or intended to have children expressed that the education of their (future) children is important to attain their ambitions or plans in life. Ninety percent of these respondents were confident that their (future) children will finish their studies. However, 86% of them also said that insufficient livelihood or family income may be a possible challenge that could hinder them from achieving their education dream.

Across the world, the public sector plays an important role in providing education services. This may be warranted for at least two reasons. First, education is known to have many positive benefits that spillover from individuals and households to the larger society, including increasing incomes (e.g. Acemoglu and Angrist, 2000), lowering crime rates (e.g. Lochner and Moretti, 2004), and breaking intergenerational poverty transmissions (e.g. Duarte, et. al., 2017).[2] If left on their own, myopic households who generally do not internalize these positive externalities to society and to future generations in their decision processes will typically underinvest in education. Second, government concerns for equity may also drive public spending on education. In particular, paternalistic governments may set minimum social protection guarantees for primary goods, including education (c.f. Rawls, 1971; Gutmann, 1980), to which everyone is entitled and even compelled to consume.

That being said, both households and governments spend substantial amounts for education. Recent basic education reforms in the Philippines, particularly through the passage of Republic Act 10533 or the Enhanced Basic Education Act of 2013, together with expanding school-aged population and household incomes, has contributed to greater aggregate education spending in the country. In 2019, Filipino households spent a total of PhP753 billion on education (Philippine Statistics Authority [PSA], 2021), while the national government spent PhP655 billion[3] (Department of Budget and Management [DBM], 2021). These values are more than double the aggregate spending levels ten years prior.

Beyond similar within-country analyses, little is known of how the Philippines fare in comparison with its regional and aspirational peers with regard education spending. The dearth in comparable international education financing data has effectively hampered cross-country

[1] Fellow II, Philippine Institute for Development Studies. The author is grateful for the excellent research assistance by Ms. Zyra Eunice Diego. The paper has benefited from thoughtful discussions by seminar participants at the 2021 PIDS Research Workshop series. All remaining errors are by the author.

[2] See McMahon (2004) for a review.

[3] This value excludes other education-related government spending, such as those for the conditional cash transfer Pantawid Pamilyang Pilipino Program (4Ps) implemented by the Department of Social Welfare and Development (DSWD). In 2019, DBM reports that the 4Ps spent PhP138.8 billion on program benefits and administration.

appraisals and benchmarking, which would have been beneficial for policymaking. Several countries have estimated National Education Accounts[4] (NEA) to complement their country's System of National Accounts (SNA). However, global education spending data are largely confined to those based on public administrative records, which only provide a partial view of the whole education sector financing. But even with public sector records, only as much as 60 percent of countries report data on total public education expenditures, and largely with considerable time lag among reporting countries (UNESCO, 2016b).

In this study, we draw from recent National Transfer Account (NTA) estimates for the Philippines and countries around the world to uncover and describe trends in global education financing with particular focus on the Philippines as a case study. The NTA is a system of accounts that measure how different generations produce, consume, and reallocate resources in a manner that is consistent with the United Nations (UN) SNA (UN, 2013; Lee and Mason, 2011). Earlier studies (e.g. Abrigo, et. al., 2018; Mason and Lee, 2011; Tung, 2011) have used NTA to characterize human capital investments, i.e., including both education and health, and found wide variation in spending patterns across economies.

We focus on three critical questions on education financing. First, how much are countries, particularly the Philippines, spending on education? Second, what drive the differences in spending levels? Finally, does education spending levels matter? Providing evidence-based answers to these questions may help guide future policy directions, and open new research on education financing using alternative data sources, such as the NTA.

2. How much are Filipinos spending on education?

Over the last 15 years, total education expenditures in the Philippines increased by about 6.4% annually, with a large part of the growth happening more recently. In 2019, the total current education bill, i.e., excluding capital outlay, for all school levels reached almost PhP1.2 trillion (in 2012 prices) from only PhP0.8 trillion in 2015 and PhP0.5 trillion in 2005 (Table 1). During this period, households bear majority of the expense, reaching as high as 59.3% in 2005, although increasing government expenditures contributed to the decline in the household share, settling at 54.5% in 2019.

Education spending has been increasing as a share of the country's gross domestic product (GDP). By 2019, education spending in the country represent 7.5% of GDP, a considerable increase compared with the recorded 5.8% share in 2005. Over the same period, public sector spending on education increased from 2.1- to 3.1-percent of GDP[5] – an important feat, but still behind the benchmark 4- to 6-percent by the Education 2030 Incheon Declaration.

The Philippine Constitution guarantees the highest budgetary priority to education.[6] In 2019, actual education spending by the national government reached 18.1% of its total expenditures. Programmed and proposed education spending for 2020 and 2021, on the other hand, are both

[4] National Education Account is an accounting framework consistent with the UN system of National Accounts that measures the financial flows in the education sector. In 2001, the Philippine National Statistical Coordination Board, now part of the Philippine Statistics Authority, compiled a similar set of accounts, named the National Education Expenditure Accounts, covering 1991 to 1998, but the series has since been discontinued (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2016a)

[5] Including expenditures for capital outlay raises the shares to 2.5- to 3.4-percent in 2005 and 2019, respectively.

[6] Article XIV, Section 5(5)

about 17% of the national budget. These figures are around the 15- to 20-percent thresholds suggested by the Education 2030 Incheon Declaration for this metric.

Among government units, basic education expenditures by the Department of Education (DepEd) comprise about 75- to 80-percent of the total current public education spending between 2005 and 2019. Public higher education, represented by state universities and colleges (SUCs) and the Commission on Higher Education (CHED), on the other hand, comprise about 11- to 17-percent. Public technical and vocational education through the Technical Education and Skills Development Authority (TESDA) captures about 1- to 2-percent. Finally, local governments, which fund different education and manpower training services, together with museums, education institutions in other government offices, and other education-related institutions, represent about 5- to 10-percent.

Table 1. Education expenditure (PhP billion, 2012=100): Philippines, 2005-2019

	2005	2010	2015	2017	2019
Households	289.0	360.0	453.5	518.8	636.1
Government	198.5	254.1	326.7	352.8	531.1
National government	181.5	239.3	312.5	337.4	511.2
DepEd	150.5	203.7	261.9	267.7	410.5
TESDA	2.8	3.1	4.9	6.4	10.3
SUCs	24.4	26.8	33.9	44.2	48.3
CHED	1.1	1.7	5.8	17.1	28.2
Others	2.8	3.9	5.9	2.1	13.8
Local government	17.0	14.8	14.2	15.4	20.0
All financing agents	487.5	614.1	780.1	871.6	1,167.3

Source: PSA (2021), DBM (various years), DOF-BLGF (various years). Note: Values only include current education expenditures, and exclude expenditures for capital outlay. DepEd – Department of Education; TESDA – Technical Education and Skills Development Authority; SUCs – State Universities and Colleges; CHED – Commission on Higher Education.

Compared with other countries in the Asia and the Pacific region, the Philippine's public spending per student in the primary and secondary education levels lag behind its regional and aspirational peers (Table 2). While per student public spending appears to be strongly correlated with per capita income, the Philippines spends only about 60- and 72-percent of Indonesia's per student public spending for primary and secondary levels, respectively, despite the Philippines' per capita income being 84% of Indonesia for the years presented. Singapore, which leads the set of countries presented in Table 2, spends PPP$16,704 and PPP$20,632 per primary- and secondary-level student, respectively. The Philippines, on the other hand, spends PPP$813 and PPP$777 per student in the same respective education levels.

An important issue with relying solely on public expenditures to gauge education financing is that it may not be representative of the total education costs faced by society in general, and by students and their families in particular. It may be the case that government shares in total education spending vary quite significantly across countries, which may affect the ordering of country rankings in per student spending. Estimates based on NEAs presented in UNESCO (2016c), for instance, show households' share of aggregate education expenditures ranging between 24- and 57-percent in their four-country case study. However, estimation of NEAs has not gained much traction across governments for a number of reasons, including the technical

complexity of the estimation process and the limited supply of international and national NEA expertise (UNESCO, 2016a).

Table 2. Public expenditure per student: Philippines and selected countries

Country	Year	Per capita GDP (2017 PPP$)	Public expenditure per student (2017 PPP$)	
			Primary	Secondary
Singapore	2017	95,350	16,704	20,632
Brunei Darussalam	2016	60,867	5,401	14,392
Japan	2016	40,031	8,719	9,628
South Korea	2016	39,815	11,087	11,219
Malaysia	2017	26,662	4,302	6,024
Thailand	2013	15,767	3,676	2,838
Indonesia	2015	10,150	1,348	1,068
Philippines	2018	8,516	813	777
Lao PDR	2014	6,193	564	776
Myanmar	2018	5,029	393	518
Timor-Leste	2014	3,265	272	259

Source: World Bank [WB] (2021a). Note: Philippine expenditure per student estimates based on author's calculation using enrollment data (PSA, 2021), public education expenditure by level (DBM, 2020), and GDP in constant 2017 international (purchasing power parity, PPP) dollars (WB, 2021a). Per student public spending for the rest of the countries are calculated based on WB (2021a) data.

An alternative to NEA is NTA. Similar to NEA, NTA is an accounting framework consistent with the UN-SNA. Unlike NEA that is designed specifically as a satellite education account to the SNA (UNESCO, 2016a), NTA is an elaboration of the SNA to capture economic flows across age groups (UN, 2013). There are important conceptual differences between the two frameworks. First, NTA records the value of consumption, i.e., expenditures less taxes net of subsidies on products, while NEA includes taxes as part of expenditures. Second, the main economic agents in NTA are the generations or age groups in an economy, while these are the private and public sectors in the NEA. In NTA, the public and private sectors are only viewed as mediators through which economic resources flow. Third, NEA has more elaborate treatment of economic flows on education, while in NTA this is confined to age-specific public and private consumption and the related resources financing the consumption. Fourth, although it is possible to disaggregate NTA education consumption by levels of education, like in NEA, this is seldom reported, and only aggregates by age are usually available.[7]

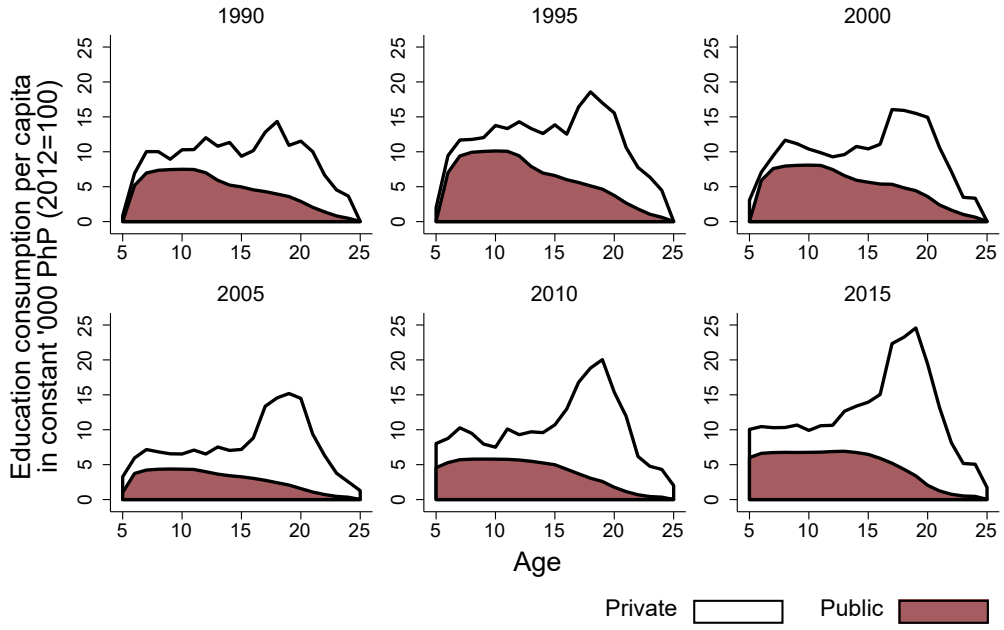
A key advantage of NTA over NEA, however, is that NTA is more widely estimated, although not particularly to compare cross-country education spending. In 2021, NTA has been estimated for more than 90 countries, representing more than 80% of the world's population. In addition, modeling exercises has allowed the estimation of NTAs for the rest of the countries around the world (e.g. Mason, et. al., 2017).

[7] Estimates of age-specific NTA education consumption by education level are usually available to NTA country team compilers as part of the NTA estimation process, but these are not part of the standard template reported in the global database.

Figure 1 presents estimates of per capita NTA public and private education consumption in the Philippines for age groups 5 to 24 years between 1990 and 2015.[8] These values capture age-specific differences in school attendance and schooling costs, as well as the many different factors that affect these variables. Public education consumption includes government expenses on direct provision of education services in public institutions, excluding capital outlays. Private education consumption, on the other hand, includes private-sector procured education supplies, tuition and other fee payments, transportation costs related to education, etc., regardless whether a student is enrolled in a public or private education institution. These accounts also include non-schooling, but education-related consumption, i.e., general public education, such as maintenance of museums and cultural centers, cost of books not specific to a schooling level, and the like.

There are some notable patterns in per capita education consumption over the 25-year period covered in Figure 1. First, per capita education consumption up to around age 16 hovers at around PhP10,000 (in 2012 prices), although there is a large drop in 2005. Second, per capita education consumption starts to increase rapidly after age 16 and peaks around age 20, representing the relative costs of higher education compared with basic education, then tapers off as students leave formal education. The peak appears to be shifting to the right across years. Third, public consumption dominates in younger ages, i.e., in primary and secondary school-ages, while private consumption dominates in later ages, i.e., in tertiary school-ages and beyond. Fourth, public education consumption per capita has become flatter, potentially showing increased school attendance rates in higher grade levels in more recent years.

Figure 1. Education consumption per capita by age: Philippines, 1990-2015



Source: Abrigo, et. al. (2020)

[8] For a discussion of the quinquennial Philippine NTA between 1990 and 2015, see Abrigo, et. al. (2020). For a discussion of the NTA estimation methodology, please see the UN NTA Manual (UN, 2013).

Focusing on basic education, Figure 2 presents total education consumption up to age 16 as a share of labor income.[9] While this measure may be rather unconventional[10] it has a particularly attractive interpretation. The values presented in Figure 2 may be seen as the tax rate on labor income that is needed to finance basic education if this is to be wholly financed by working.

Basic education consumption as a share of labor income varies widely among the 73 economies represented in Figure 2. It ranges from less than one percent in 2010 Guinea Bissau to 15.7% in 2010 Mexico. The Philippines spent 3.7% of labor income for basic education in 2015, only a little ahead of Vietnam's 3.5% in 2012. Other countries in the Asia and the Pacific region spends significantly larger shares: Singapore (4.7%), Japan (6.0%), Thailand (8.3%), South Korea (9.2%), Malaysia (10.1%), and Indonesia (10.5%).

The division between public and private spending also differ substantially across countries. In Asia and the Pacific region, Vietnam and Cambodia stand out with less than 25% of their basic education consumption financed by government. Other countries in the region rely more heavily on government. In Thailand and Singapore, in particular, more than 80% of basic education consumption are financed through government. Meanwhile, financing basic education in the Philippines is roughly equally shared between the public and private sectors.[11]

The substantial share of the private sector in education financing is quite surprising given the dominant role of governments in providing basic education services as reflected in school enrollment rates. In East Asia and the Pacific, only about a tenth of primary school pupils and a fifth of secondary school students are enrolled in private schools (UNESCO, 2021). This may suggest that complementary spending by the private sector, primarily by households, are significant even with a large public education sector, which is reflected as private consumption in the NTA. While education instruction may be financed by government, other important education inputs, such as school supplies, may be financed privately.

The metric summarized in Figure 2 is based on the aggregate basic education consumption of countries in a particular snapshot, and depends not only on spending per capita but also on the distribution of school-age children. That is, the estimates are not really comparable since an economy with more school-age population will appear to spend more as a share of labor income compared with a comparable economy with the same education spending and labor income per capita by age but with less school-age population.

Figure 3 presents an alternative indicator based on a synthetic cohort. The figure shows the expected cumulative per capita public and private education consumption of an individual who would have lived up to age 16 if faced with the particular schedule of per capita consumption for the year of the NTA estimate. A higher (lower) value would indicate greater (lesser) spending on basic education consumption over the entirety of the basic education cycle. The values are converted into 2017 international dollars in purchasing power parity (PPP$) to further facilitate comparison.[12]

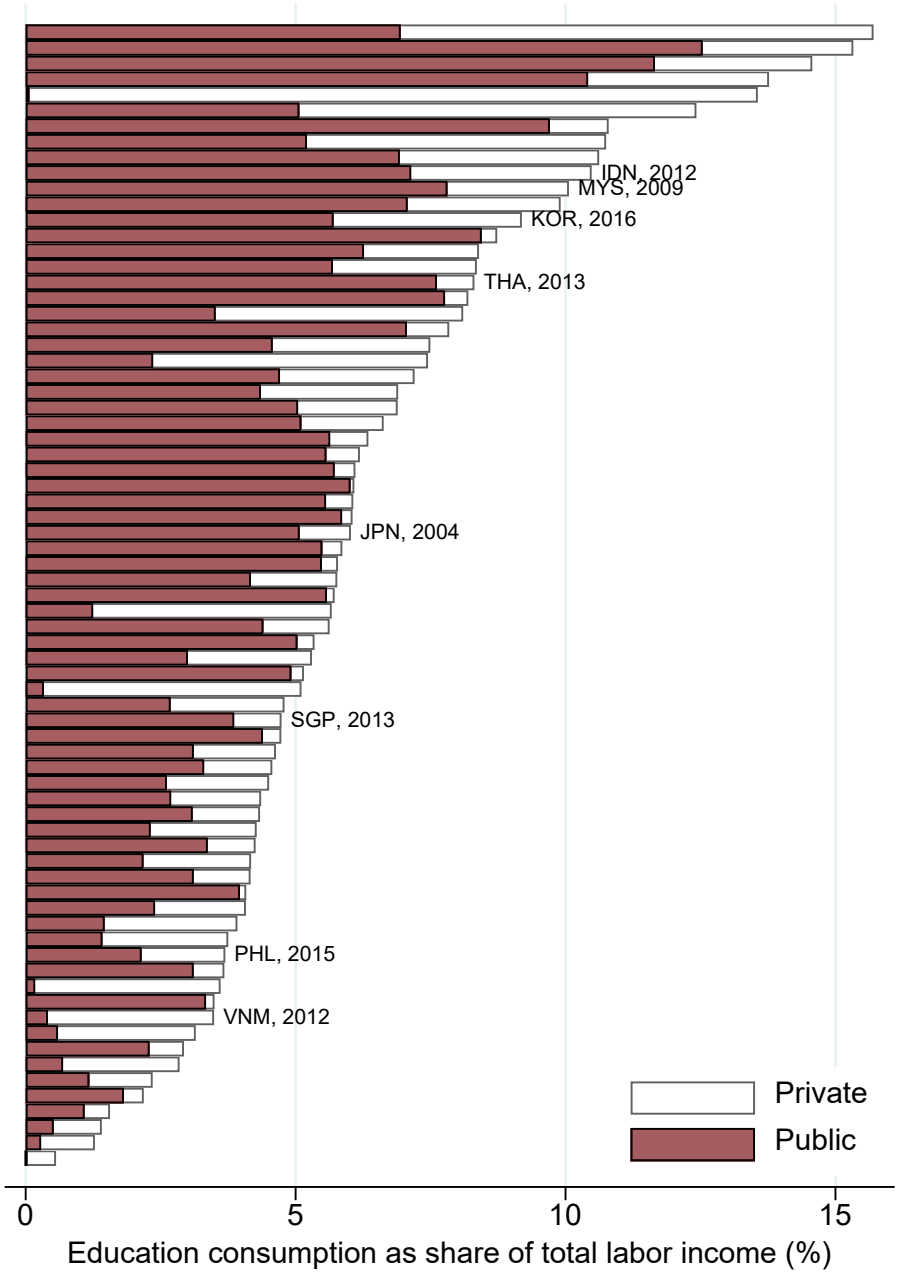
[9] The upper age limit of 16 is chosen to roughly match the education cycle in the Philippines in 2015. This has since been increased to 18, similar to the usual completion age for basic education in many other countries.

[10] Usual cross-country measures include education spending per capita, as share of GDP, and as share of total government spending.

[11] Based on 2015 Philippine NTA estimates. More recent data suggest an increasing share of government.

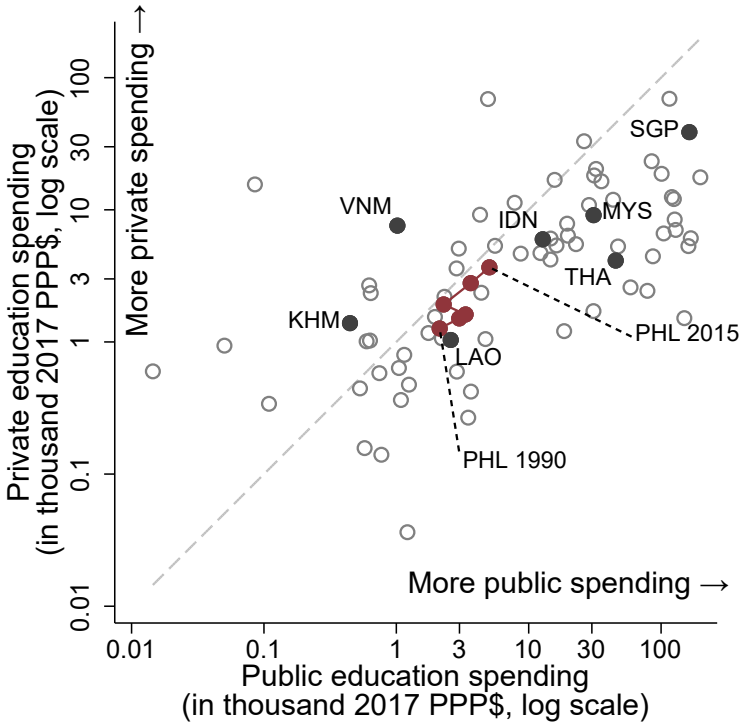
[12] A related measure is the education component in WB's human capital index that measures the expected number of years of schooling a child would complete by age 18 given the cross-sectional age pattern of school enrollment adjusted for education quality, as measured by harmonized test scores (WB, 2021b).

Figure 2. Basic education consumption as share of labor income



Source: Author's calculations based on recent NTA data from www.ntaccounts.org. Number in labels represent coverage year of NTA estimate. Labelled Asia and the Pacific countries are as follows: IDN – Indonesia; JPN – Japan; MYS – Malaysia; KOR – South Korea; PHL – Philippines; SGP – Singapore; THA – Thailand; and VNM – Vietnam.

Figure 3. Cumulative public and private basic education consumption



Source: Author's calculations based on recent NTA data from www.ntaccounts.org. Note: Values are the simple sum of per capita education consumption up to age 16. Number in labels represent coverage year of NTA estimate. Labelled countries are as follows: IDN – Indonesia; KHM – Cambodia; MYS – Malaysia; PHL – Philippines; SGP – Singapore; THA – Thailand; and VNM – Vietnam.

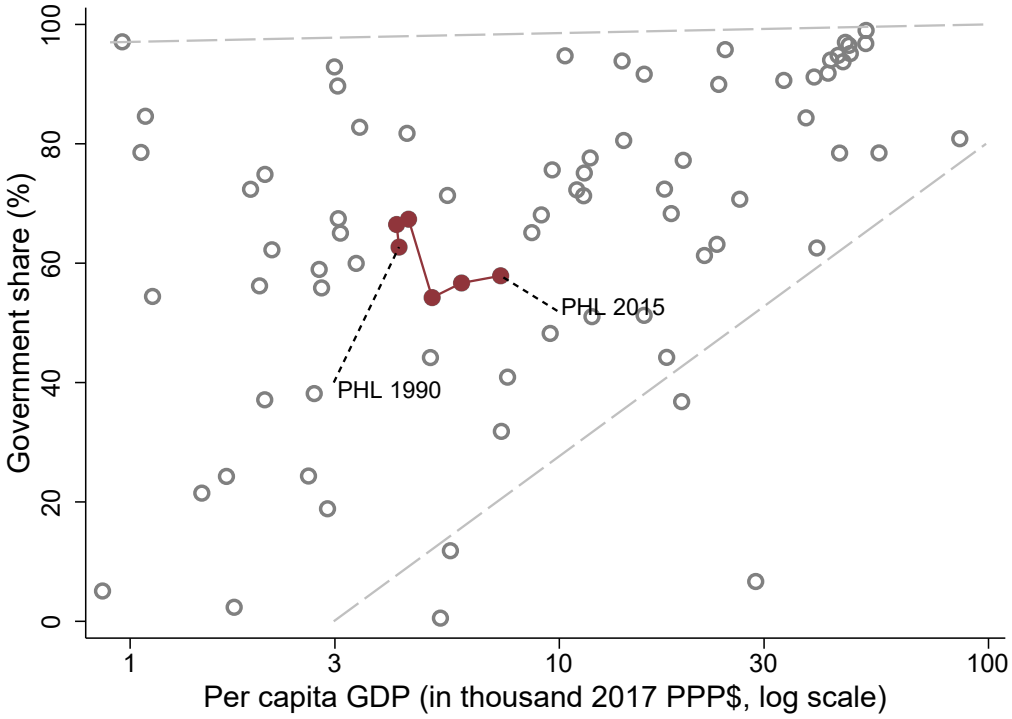
Over a span of 25 years, the Philippines' cumulative basic education consumption almost trebled, although much of the growth happened more recently. Between 1990 and 2010, cumulative basic education consumption increased from PPP$3,390 to PPP$6,430, or about 3.3% per year. In the next five years, the measure would grow by 6.3% per annum to PPP$8,720 by 2015. It is noteworthy that these rates are significantly larger than the annual growth in per capita GDP, which registered at 1.7% between 1990 and 2010 and 4.3% between 2010 and 2015. The Philippines' private and public sectors spend about equal shares to finance basic education over the course of this period.

Similar to insights from Figure 2, Cambodia and Vietnam still both rely more on the private sector, unlike other countries in the region, using the synthetic cohort measure of basic education consumption in Figure 3. But in addition, and more importantly, Figure 3 also shows that public spending appears to not crowd-out private spending on basic education, with private spending increasing by about 0.4% for every percent increase in public spending.[13] Further, the figure also shows a higher tendency towards greater public share in basic education financing as an economy develops.

This tendency may be better visualized in Figure 4, which shows a scatter plot of the share of the public sector in per capita cumulative basic education consumption against per capita GDP.

[13] This pertains to education financing only, which covers private spending in public school systems, among others. Indeed, evidence from the Philippines suggest that expansion of the public education system crowds out private school enrollment, at least at the secondary level (e.g. Jimenez and Sawada, 2001).

Figure 4. Government share in cumulative basic education consumption



Source: Author's calculations based on recent NTA data from www.ntaccounts.org, and per capita GDP data from WB (2021a). Note: The government shares in cumulative basic education consumption are based on the simple sum of per capita public and private education consumption up to age 16. PHL – Philippines.

The government share in cumulative basic education consumption varies considerably among lower-income countries, spanning almost the whole 0 to 100 percent. However, the span of the distribution narrows and the average share increases with higher per capita GDP. Similar observations of such "financing transition" have been observed, for example, in health spending (e.g. Fan and Savedoff, 2014), in human capital investments (e.g. Abrigo, et. al., 2018), and in consumption in general (Peacock and Wiseman, 1961).

3. What drives education spending?

Unless there is widespread child labor or capital markets allow loans to children, basic education consumption is primarily financed through government tax-transfer systems or through *inter vivos* transfers by older generations, especially family members. Motivations for such inter-generational transfers have been well studied.[14] Earlier theoretical work were based on parents deriving satisfaction from their children's consumption (e.g. Becker, 1974; Barro, 1974), which were later expanded to allow other possible motivations for inter-generational transfers, including for parents benefitting from investments on their children (e.g. Becker and Murphy, 1988; Becker, 1991), among others.

Two important empirical studies in the Philippines exemplify these lines of thought. Estudillo, et. al. (2001a, 2001b) documented sex-differentiated giving norms in agrarian settings, with

[14] See Arrondel and Masson (2006), and Laferre and Wolff (2006) for a comprehensive discussion.

male children usually inheriting land while female children being compensated by greater education investments. Yamauchi and Tiongco (2013), on the other hand, showed that greater propensity of parents getting future financial support from their female children may be a possible alternative driver of differential education investments on children.

Although it may not be possible to disentangle these competing motivations using estimates of representative populations based on NTA, we show in Figure 5 that (log) cumulative basic education consumption increases with (log) per capita income (Pearson's correlation coefficient, ρ=0.96), and decreases with (log) fertility rate (ρ=0.88). These observations are in line with predictions of Becker's (1960) classic child quality-quantity tradeoff theory, and supported by household-level empirical evidences, such as in the Philippines (e.g. Orbeta, 2009; Yamauchi and Tiongco, 2013). It is interesting to note that public and private cumulative basic education consumption separately have lower correlation coefficients when compared against per capita income and fertility rate.

Between 1990 and 2015, the Philippines appear to be spending at about the cumulative basic education consumption of the average country for the specified per capita income. However, for its fertility rate the Philippines is spending significantly below the average country, especially in more recent years. In 2015, for instance, the Philippines spends at the rate of only about half of the expected cumulative basic education consumption of PPP$18,350 (standard error = PPP$1,860) for a country with a total fertility rate of about 2.8 births per woman.

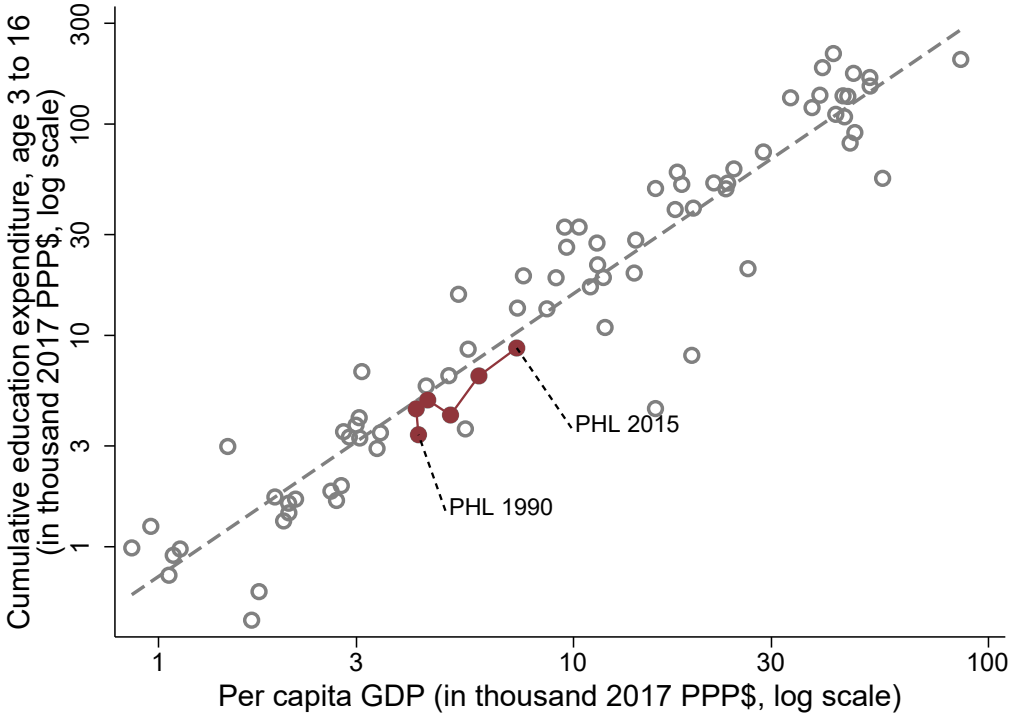
4. Does spending level matter?

Greater education spending does not automatically lead to better schooling outcomes. A series of papers by Hanushek (1981, 1986, 1989), for instance, found no strong relationship between expenditures and student achievements, although more recent studies suggest some positive associations not only with schooling outcomes, but also in some later-life welfare measures (e.g. Card and Kreuger, 1992; Gupta, et. al., 2002; Baldacci, et. al., 2003; Huang, et. al., 2021). Other factors have been found to be also important in explaining schooling success, including family background (e.g. Plug and Vijverberg, 2003) and rent-seeking in government (e.g. Suryadarma, 2012), among others.

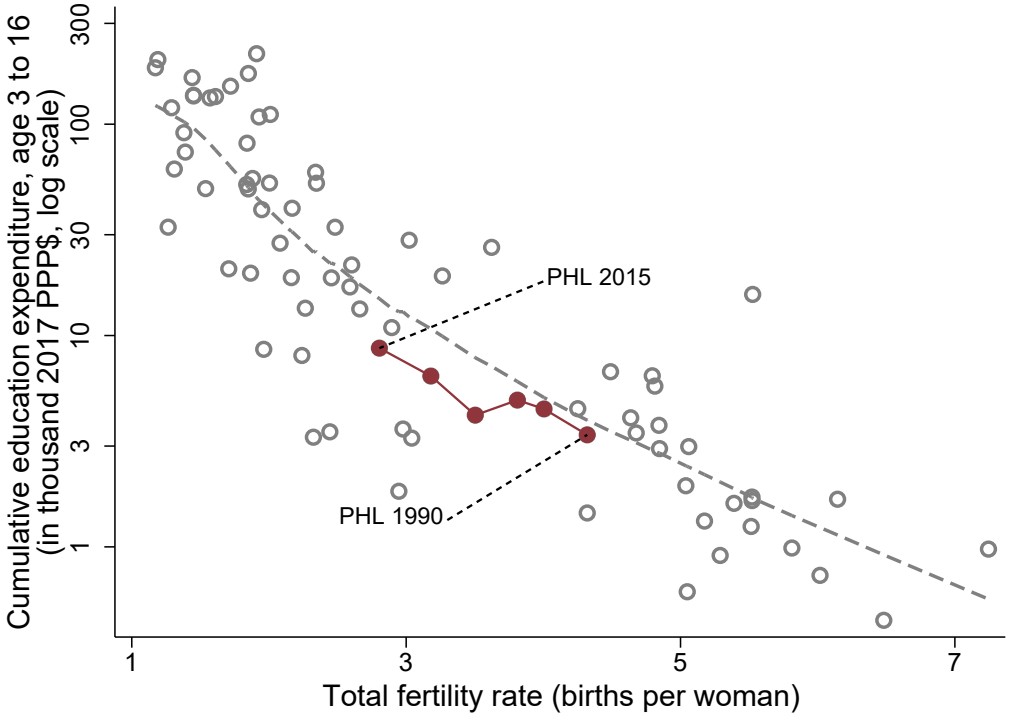
Figure 6 presents scatter plots of cumulative basic education consumption up to age 15 and corresponding country-average scores in the 2018 Program for International Assessment (PISA) by the Organization for Economic Co-operation (OECD, 2019). PISA is an international standardized test that evaluates the performance of 15-year old students in science, mathematics, and reading. The presented cumulative basic education consumption are modelled estimates using per capita GDP, total fertility rate, and government share in final consumption expenditure as predictors. This allows us to use all 77 economies in the 2018 PISA, instead of the 33 that have overlap with NTA country estimates. The results are qualitatively similar using either the 33 or the 77 data points.

Figure 5. Correlates of cumulative basic education consumption

A. Per capita income



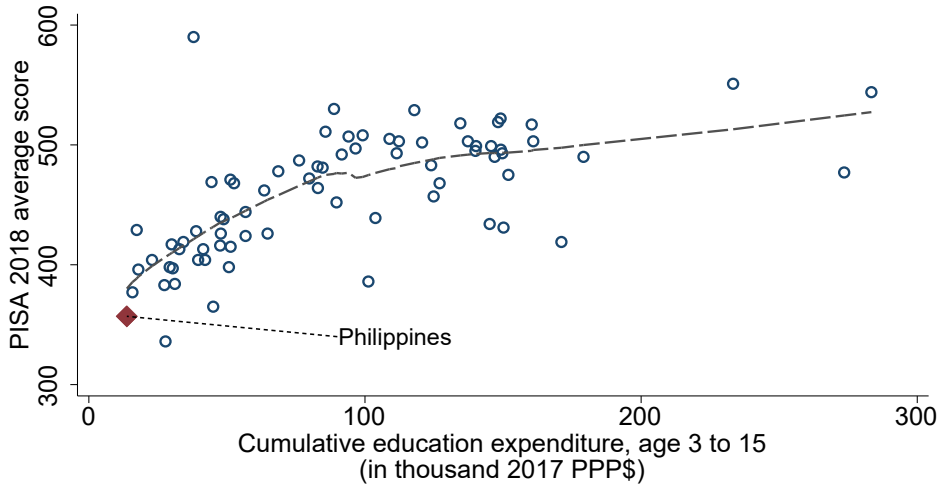
B. Fertility rate



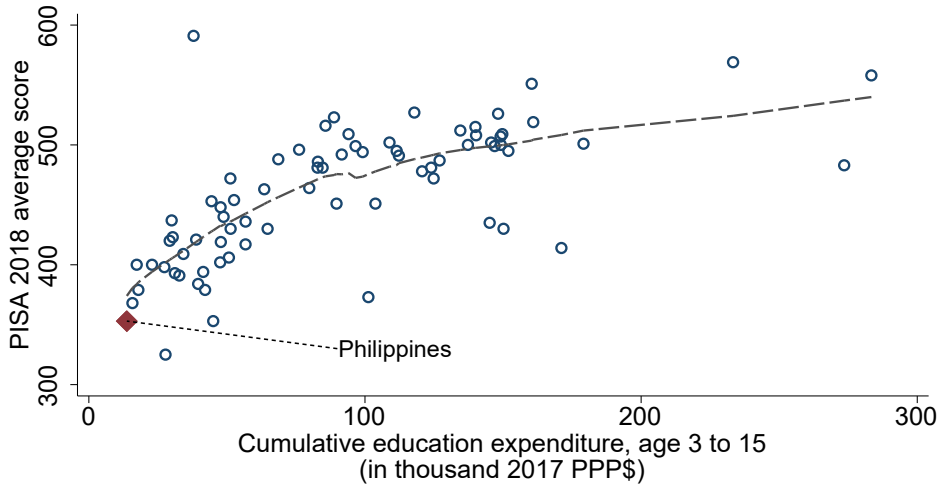
Source: Author's calculations based on recent NTA data from www.ntaccounts.org, and per capita GDP and total fertility rate data from WB (2021a). Note: Cumulative basic education consumption values are based on the simple sum of per capita public and private education consumption up to age 16. PHL – Philippines.

Figure 6. Education quality and cumulative basic education consumption

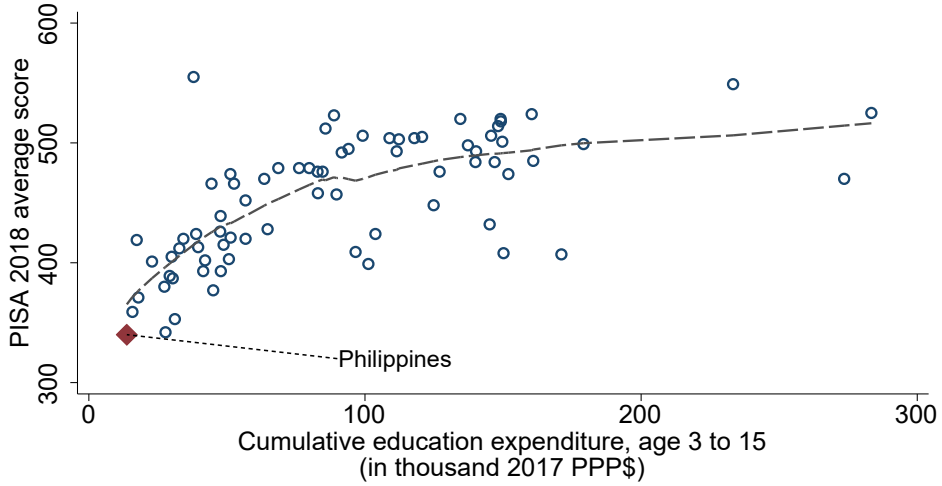
A. Science



B. Mathematics



C. Reading



Source: Author's calculations based on recent NTA data from www.ntaccounts.org, and OECD (2019).
Note: Cumulative basic education consumption values are based on the simple sum of per capita public and private education consumption up to age 15. Presented values are modelled estimates using per capita GDP, total fertility rate and government share in consumption as predictors.

Similar to findings by Schleicher (2019), who used a different approach, Figure 6 shows that average schooling quality increases with cumulative basic education consumption. The rate of change is much larger at lower levels of spending, and gradually flattens with higher expenditures.[15] This observation is true for the science, mathematics, and reading scores. While this association may not be interpreted as causal, it is suggestive that greater resources may be needed to raise schooling quality, especially in resource-poor settings.

The figure also shows that better schooling quality may be achieved using the same level of resources. For example, Belarus, and Bosnia and Herzegovina both spend about PPP$50 thousand in cumulative education consumption up to age 15, but their average PISA scores differ by about 70 points. This suggests that some education systems may be better at converting education inputs into outputs.

We formalize this idea in Figure 7 that shows the estimated technical efficiency (TE) scores among different education systems in the 2018 PISA. The TE scores are estimated using a multi-output, in this case PISA scores by subject, stochastic frontier model (Aigner, et. al., 1977; Meeusen and Van den Broeck, 1977) with cumulative education consumption up to age 15 as the only input.[16] The TE scores compares the distance of a country from a theoretical frontier based on a specified education production function. A TE score of 100% indicates that a country is at the frontier, while lower TE scores imply some inefficiency in converting inputs to outputs relative to the production possibility frontier. We provide two sets of estimates, wherein we exclude China, represented by Beijing, Shanghai, Jiangsu and Zhejiang, from the estimation sample in one set to assess robustness against outliers.

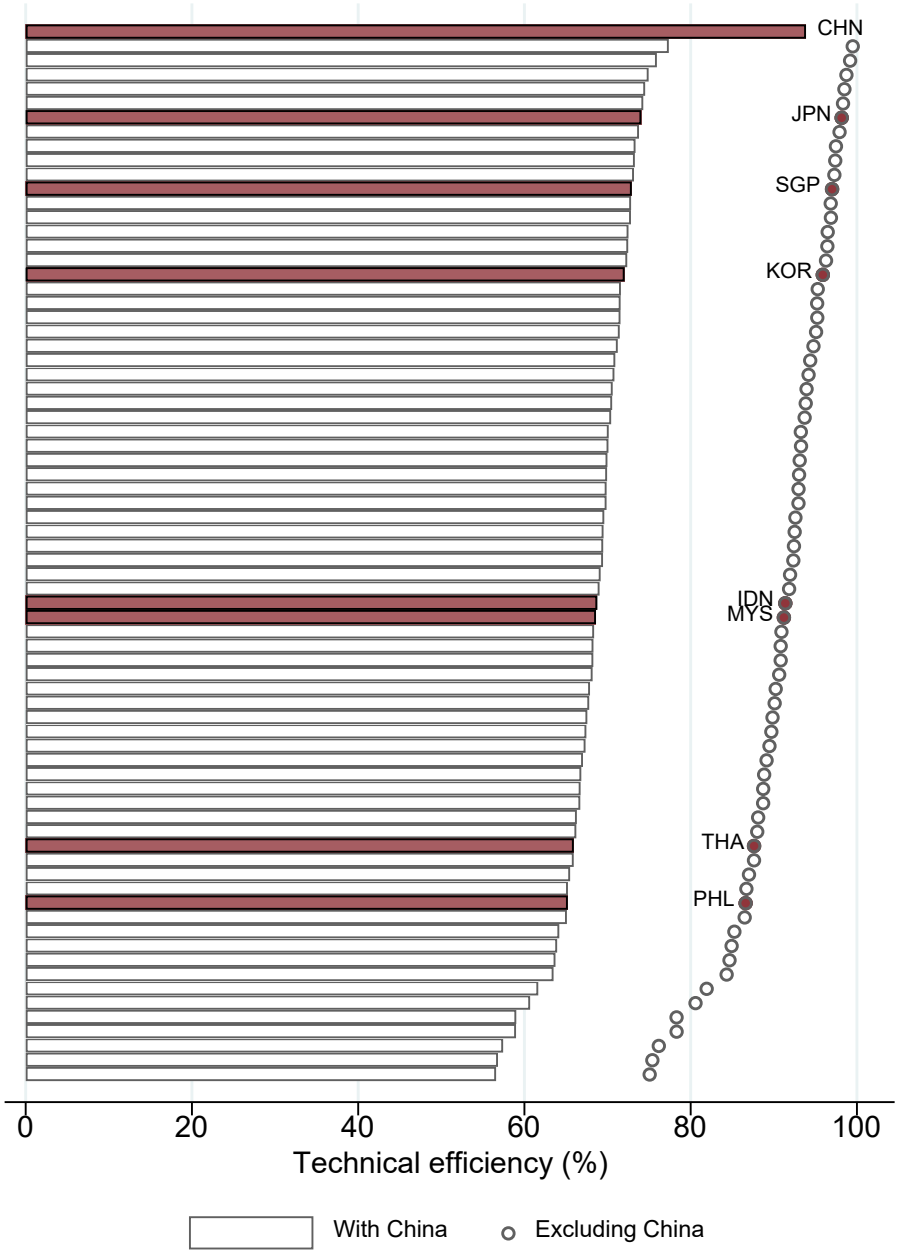
TE scores vary widely among the 77 PISA countries. With China in the estimation sample, TE scores range between 56.6% and 93.9%. Excluding China, on the other hand, leads to upward revisions in TE scores across countries, with TE scores now ranging between 75.0% and 99.4%. The Philippines scores behind other East and South-east Asia countries included in the 2018 PISA, although its TE score in the no-China set is at a more acceptable value of 86.5%. If the Philippines have fully maximized the use of its inputs it should have scored closer to 400 points in each of the test subjects, instead of the 340 to 360 observed range.

5. Policy implications

The analyses we have presented highlights important trends in Philippine education financing. First, using a synthetic measure of basic education consumption, we have uncovered that education spending per person in the country has grown robustly over the past 25 years, even growing faster than recorded GDP per person over the same period. Second, the private sector contributes about as much as government to finance basic education. Third, while the Philippines is spending at the average level for its per capita GDP, it is spending substantially less for its level of fertility. Fourth, despite the robust growth in spending per person, its basic education spending level still lags behind its regional and aspirational peers, which contributes to its poor performance in international standardized student assessments. Finally, while the Philippines lag behind in education spending per capita there may be opportunities to improve schooling quality by optimizing the translation of inputs to outputs.

[15] Using the 33 countries with NTA data overlap, the fitted line is positively sloped until about PPP$80 thousand, then flattens thereafter. The output elasticities are around 0.12 for each of the test subjects.
[16] See methodological annex for details.

Figure 7. Technical efficiency estimates



Source: Author's calculations based on recent NTA data from www.ntaccounts.org, and OECD (2019).
Note: Cumulative basic education consumption values are based on the simple sum of per capita public and private education consumption up to age 15. Presented values are modelled estimates using per capita GDP, total fertility rate and government share in consumption as predictors. The technical efficiency scores are estimated using a multi-output stochastic frontier model with total cumulative education consumption up to age 15 as the only input.

Although increasing resources available for education may be desirable to improve schooling quality, our cross-country comparison shows that this may be difficult to achieve as per capita education spending is intimately linked with an economy's particular economic development and fertility levels. Raising education spending per capita may therefore entail more than rallying resources for the education sector, but also ensuring that robust economic opportunities

are available to improve average household incomes, as well as assisting households to achieve their desired fertility levels.

Poor schooling quality need not be the necessary and only outcome of subpar education spending levels. A more important and arguably more urgent challenge for government is to identify and to scale cost-effective education interventions that better translate resource inputs to desired education outcomes.

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Annex A. Stochastic frontier estimation

Stochastic frontier models (Aigner, et. al., 1977; Meeusen and Van den Broeck, 1977) are used to estimate and analyze technical (in)efficiency based on firm production theory. A firm, in this case countries, are assumed to produce a set of outputs, in this case PISA test scores, using a common technology given some production inputs, in this case cumulative basic education consumption. A firm is perfectly efficient when it produces the maximum possible output for the input it uses, i.e. when it is at the production possibility frontier.

We estimate a multi-output, single input stochastic frontier model using the following linearized production function

$$\ln(y_i) = \ln(c_i) \cdot \beta + \gamma + (v_i - e_i)$$

where y_i is the column vector of PISA scores by test subject for country $i = 1,2, \dots, 77$, and c_i is its cumulative basic education consumption up to age 15, a scalar. The conformable vector β are production elasticities that relate a unit of input c_i to output y_i. The vector γ is a subject-specific shifter that captures differences in production technology across test subjects. The model residual is composed of two parts. The country- and test-specific vector v_i is assumed to follow a normal distribution with zero mean and variance σ_v^2, and captures idiosyncratic shocks on production. In the general case, the country-specific vector e_i is assumed to follow some non-negative random distribution, which when exponentiated ranges between zero and one and provides an estimate of production efficiency, with a value of one indicating production at the frontier. In our estimation, we assume e_i to be distributed as half-normal $N^+(\mu_v, \sigma_v^2)$, and common across test subjects for a given country.

There is significant under-coverage in countries with both PISA scores and NTA estimates. In order to expand our sample, we modelled cumulative basic education consumption up to age 15 using per capita GDP, total fertility rate, and government share in final consumption expenditure as predictors. This allows us to use all 77 economies in the 2018 PISA, instead of the 33 that have overlap with NTA country estimates. The results are qualitatively similar using either the 33 or the 77 data points. Estimates are available from the author upon request.

We estimated two sets of models based on the above specification. We include all countries in our baseline model. In a second model, we remove data for China to assess the robustness of our estimates to outliers. As shown in Figure 7, the statistical ordering of technical efficiency scores across countries although magnitudes differ between specifications. Table A1 provides a summary of the parameters of our estimated stochastic frontier models.

We also did an alternative stochastic frontier model using corrected ordinary least squares (COLS), where we did not assume any parametric distribution for e_i. Instead, we estimated a country fixed-effects model, with the estimated fixed-effects u_i^* split into two components: $e_i \geq 0$ capturing technical efficiency, and u_i capturing the contribution of other country-specific test-invariant characteristics

$$\ln(y_i) = \ln(c_i) \cdot \beta + \gamma + (v_i + u_i^*)$$
$$u_i^* = u_i - e_i$$
$$e_i = \max(u_i^*) - u_i^* \geq 0$$

The results are qualitatively the same as the models presented in Table A1 and in Figure 7, although magnitudes differ. In COLS, the most efficient firm is assigned a technical efficiency of 100% following the applied correction above.

Table A1. Stochastic frontier model: PISA test scores

	Model 1		Model 2	
$\ln(c_i)$	0.116	***	0.115	***
	(0.013)		(0.011)	
Test-subject				
Math (= 1)	-0.061	**	-0.062	**
	(0.027)		(0.027)	
Reading (= 1)	-0.045	*	-0.041	
	(0.027)		(0.027)	
Test-subject x $\ln(c_i)$				
Math (= 1) x $\ln(c_i)$	0.014	**	0.015	**
	(0.006)		(0.006)	
Reading (= 1) x $\ln(c_i)$	0.008		0.007	
	(0.006)		(0.006)	
Constant	6.001	***	5.719	***
	(1.247)		(0.044)	
σ_v^2	0.001		0.001	
	(0.000)		(0.000)	
σ_e^2	0.006		0.010	
	(0.001)		(0.005)	
μ_e	0.375		0.044	
	(1.246)		(0.059)	
With China	Yes		No	
N	222		219	
BIC	-696		-713	

Source: Author's calculations based on recent NTA data from www.ntaccounts.org, and OECD (2019).
Note: Cumulative basic education consumption values, c_i, are based on the simple sum of per capita public and private education consumption up to age 15 modelled using per capita GDP, total fertility rate and government share in consumption as predictors. N – Number of observations; BIC – Bayesian information criterion