Thailand

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A Quality Education for All

WORLD BANK GROUP

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Thailand

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Abbreviation

AGE	Apoyo a la Gestión Escolar (School Management Support)
ASEAN	Association of Southeast Asian Nations
ESA	Educational Service Area
ESCS	Economic, Social and Cultural Status
FY	Fiscal year
GDP	Gross domestic product
IEA	International Energy Agency
Lao PDR	Lao People's Democratic Republic
MOF	Ministry of Finance
NIETS	National Institute of Educational Testing Service
OBEC	Office of the Basic Education Commission
OEC	Office of the Education Council
OECD	Organisation for Economic Co-operation and Development
ONESQA	Office for National Education Standards and Quality Assessment
O-NET	Ordinary National Education Test
PACER	Parent Advocacy Coalition for Educational Rights
PEC	Quality Schools Program
PISA	Programme for International Student Assessment
SBM	School-Based Management
SNED	Sistema Nacional de Evaluación del Desempeño de los Establecimientos Educacionales Subvencionados
TDRI	Thailand Development Research Institute
THB	Thai baht
TIMSS	Trends in International Mathematics and Science Study
TOEFL	Test of English as a Foreign Language
USD	United States dollar

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EXECUTIVE SUMMARY

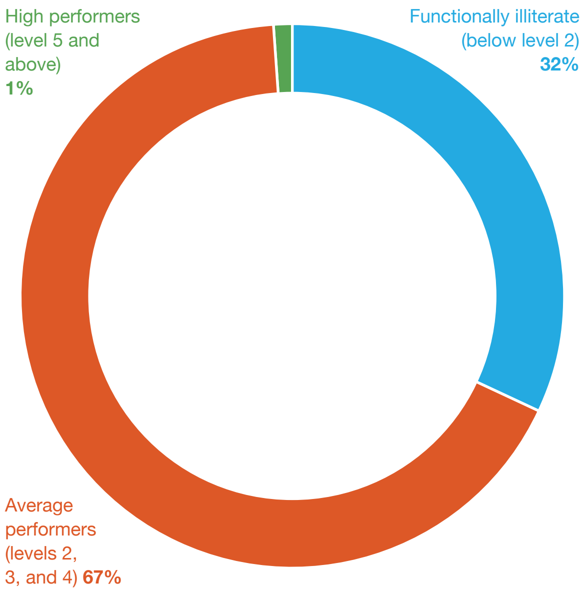
I Introduction

Over the past two and a half decades, Thailand has made great progress in expanding basic education, closing the gap in attendance between socio-economic groups, and putting more focus on the quality of education. Participation in primary education is nearly universal, and secondary school enrolment has risen impressively. Inequality between socio-economic groups in their ability to access schooling has continued to decline. In terms of quality improvement, the 1999 National Education Act (amended in 2002) put long-overdue reforms on the national agenda, with objectives such as decentralizing education administration, establishing educational standards and quality assurance mechanisms, enhancing the quality of teachers and education personnel, and laying the foundation for more creative student-centered teaching and learning processes.

Building on this progress, it appears that even more could be done to maximize the potential of Thailand's students to become productive workforce participants. Closer examination of PISA scores shows that many Thai students still do not have the skills and competencies needed in an increasing number of jobs. For example, in the most recent PISA reading assessment (in 2012), one-third of Thai 15-year-olds knew the alphabet and could read, but they could not locate information or identify the main messages in a text –they were "functionally illiterate," lacking critical skills for skilled jobs (Figure 1). In contrast, the average score for students in lower-income Vietnam was 66 points higher than the average score for Thai students, which implies that, on average, a 15-year-old in Vietnam is approximately 1.5 academic years ahead of the average Thai student.

Functional illiteracy can be seen across the various types of schools in Thailand, indicating that there are still system-wide issues affecting the quality of education. Schools in cities, towns, and villages all produce students who are not functionally literate by the age of 15. The greatest concentration is found in villages, where 47 percent of their 15-year-old students are functionally illiterate. However, three-quarters of the functionally illiterate students in Thailand are found in schools located in cities, towns, or small towns where most of the student population is enrolled. While various factors are at work, three major factors are likely affecting

Figure 1
Distribution of Thailand's 15-year-olds on the 2012 PISA reading assessment



Source: OECD PISA 2012 data.

Table 1
Basic comparison of small schools and all OBEC schools (in 2010 unless otherwise indicated)

	Small schools (less than 120 students)	All OBEC schools
Total number of schools in 2011 (primary and secondary)	14,669	31,211
Average per student subsidy (primary and secondary)	THB 41,551	THB 31,476
Average class size (primary and secondary)	8.8	21.8
Average student-teacher ratio* (primary and secondary)	13.4	21.4
Average number of teachers per class (primary and secondary)	0.73	1.15
Percentage of students who reported being poor**	73.3%	48.8%
Student performance index in the 2010 O-NET exams***	41.3	42.1

* This is the weighted average student-teacher ratio, where the weights are school enrolment size.
** Poor students are those who reported household incomes below THB 40,000 per month.
*** The student performance index (which ranges from 0 to 100) is a weighted index of the 2010 Ordinary National Education Test (O-NET) exams for Grades 6, 9, and 12.
Source: World Bank staff calculations based on OBEC school data 2010.

quality across the education system: i) lack of school autonomy in personnel management which prevents schools from ensuring that they have the highest-quality teaching staff possible; ii) underutilization of information on student learning outcomes (i.e. national standardized test results) to hold teachers, schools, and other actors accountable for performance; and iii) inefficiencies in government education spending, as reflected in chronic teacher shortages despite low student-teacher ratios.

The situation appears to be particularly acute for one group of students: students enrolled in village schools, especially the lowest-performing 40 percent among them. The lowest-performing 40 percent of village students were the furthest behind in 2003, and they continue to fall further behind. In 2003, these 15-year-old students were, on average, 125 "points" behind their peers in large city schools, corresponding to more than three academic years of schooling. That gap widened to 139 points by 2012. In 2012, almost half of those students were functionally illiterate.

Village schools face their own set of challenges that stem from being "remote", small, and getting smaller. As a result of falling birth rates, the total number of primary school students in Thailand fell from 7.45 million in 1982 to just 5 million in 2012. At the same time, the number of teachers barely changed over the same period. Yet over a timespan of just eight years, the number of small schools with less than 120 enrolled students[1] increased dramatically from 10,899 (or 33 percent of OBEC schools) in 2003 to 14,669 (47 percent) in 2011. These small schools, which have very small classes and are much more expensive to operate, predominantly serve the socioeconomically disadvantaged student population (Table 1). Furthermore, under an OBEC program introduced over 20 years ago, many primary schools in rural villages were "upgraded" to secondary schools by adding three more grades (to help fulfill the government's commitment to providing secondary education for all). However, little was done to ensure that these former primary schools could provide a quality secondary school education. In general, village schools are hindered by a lack of

[1] Using the OBEC definition, a small school is a school with less than 120 students enrolled. However, this standard definition could be inappropriate in some contexts. For example, should a school that teaches grades 1 to 4 with 25 students per grade (100 students in total) be considered "smaller" than a school that teaches grades 1 to 9 with 15 students per grade (135 students in total)? The key is to use a measure that is comparable across schools. In the following section of this Executive Summary, a small school is defined as a school with 20 students or less per grade on average. Using OBEC definition, the total number of small schools in 2010 is 14,159. The number of small schools in 2010 increases to 19,864 if the alternative definition is employed.

adequate teachers, material resources, and physical infrastructure.

Improving educational outcomes among these poorer-performing students can have major impacts at the individual level and for Thailand's economic growth prospects. For individuals, being equipped with the necessary skills and competencies to obtain productive employment can help them secure a better future and, for those who are poor, help them break out of the cycle of poverty. Looking at the bigger picture, having a workforce with stronger analytical reasoning and problem solving skills – skills that extend well beyond simply being functionally literate – can help Thailand move up the value-added ladder to a more knowledge-based economy. Therefore, addressing the remaining gaps will enable Thailand to improve its competitiveness, economic growth, and prosperity.

II Strategies to improve performance

Building on the major progress made in improving access to education, Thailand now has the opportunity to improve the quality of education for all and more fully tap the potential of its future workforce. This section highlights some key areas in which reforms could have a significant impact on the quality of education, both for students throughout the education system and more specifically for students in rural village schools.

A Improving the quality of education for all

To help improve the quality of education across Thailand's education system, actions are needed on multiple fronts. This list is by no means comprehensive, but some key priorities include:

- **Increasing school autonomy.** Assessments of implementation of school autonomy and accountability policies in Thailand and elsewhere have shown that increasing school autonomy over personnel management can improve student learning, in particular at better-performing schools. Autonomy could perhaps first be increased for better-performing schools and delayed for other schools until they have a sufficient level of capacity and proper accountability for results.
- **Strengthening the use of information to hold teachers and schools accountable for performance.** Several measures could be considered: i) making school-level results on standardized exams publicly available; ii) in school and teacher evaluations, placing greater emphasis on improvements in student learning outcomes; and iii) requiring publication of school budgets and resource allocations across schools to enable parents and communities to monitor the efficiency of resource usage by their schools.

B Reducing inequities in the education system

The growing inequities in education call for a shift, from focusing on providing schooling access to providing a quality education in Thailand's small village schools, which are at the heart of this problem. The overall objective of this shift would be to bring learning standards everywhere to the same level as Bangkok. Furthermore, in focusing existing resources more strategically so they can be put to optimal use in improving learning outcomes where help is needed most, such reforms have the potential to improve the efficiency of Thailand's education spending tremendously. Some options for consideration include:

- **Utilizing existing resources more effectively.** A detailed mapping of schools shows that the vast majority of schools are small and located within 20 minutes from another school – 16,943 out of 19,864 small schools[2] are non-isolated. With careful planning and support, these schools could be reorganized into fewer but larger and better-resourced schools to provide a higher-quality education. Such reorganization could take the form of:

[2] A small school is defined here as a school with 20 students or less per grade on average.

i) school mergers, which would involve merging two or more schools within the same area to form a bigger school; ii) school networking, which would involve reorganizing classes and the structure of schools within the same area so they can share resources; and/or iii) redefining poorly performing schools to cover fewer and lower grades.

- **Increasing/improving financing.** It is estimated that for every province to bring their learning standards up to Bangkok standards, the share of government expenditure on education would need to increase from 24.0 to 28.8 percent. Furthermore, providing all schools with the level of teacher quality and number of teachers per classroom necessary to achieve Bangkok-level learning standards would require recruiting, training, and deploying 164,000 new teachers – an increase of over 40 percent of the teaching force in Thailand in 2014. Another financing option that could be considered is financing schools based on the number of students they have enrolled rather than on the inputs they employ. This financing approach would incentivize schools to improve quality and attract more students in order to earn larger public subsidies. Schools would also likely become more cost-efficient as teachers and educational personnel are no longer free resources from a school's perspective.

- **Improving teaching resources for small and remote schools.** OBEC could introduce measures to improve training in multi-grade teaching, so schools with severe teacher shortages could then consolidate classrooms and provide multi-grade education more effectively. Building on experience from the health sector, OBEC could also explore options for providing stronger incentives for quality teachers to be deployed in small, remote schools.

- **Increasing awareness and understanding of the small school challenge.** Decisions on the approach to reducing disparities in education could benefit from further research to understand the small school challenge, particularly at the primary school level. And importantly, greater willingness of politicians and government officials to explain and discuss the problem of small schools and the available options to improve quality of learning would help generate a more informed dialogue on this issue.

Summary of recommended actions

Improving the quality of education for all

- Increase school autonomy over personnel management
- Strengthen the use of information to hold teachers and schools accountable for performance

Reducing inequities in the education system

- Utilize existing resources more effectively through school reorganization
- Increase/improve financing for schools
- Improve teaching resources for small and remote schools
- Increase awareness and understanding of the small school challenge

1 Overview

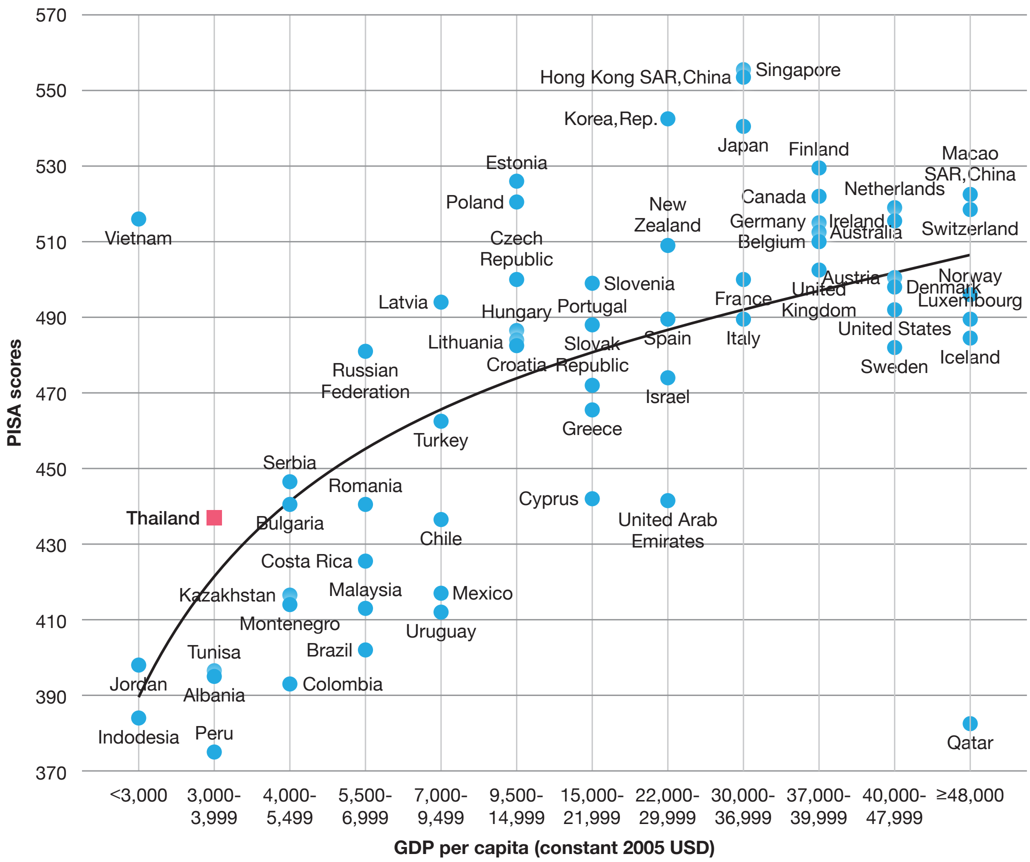
1

Overview

Over the past two and a half decades, Thailand has made great progress in expanding basic education, closing the gap in attendance between socioeconomic groups, and putting more focus on the quality of education. Participation in primary education is nearly universal, and secondary school enrolment has risen impressively. Inequality between socioeconomic groups in their ability to access schooling has continued to decline. In terms of quality improvement, the 1999 National Education Act (amended in 2002) put long-overdue reforms on the national agenda, with objectives such as decentralizing education administration, establishing educational standards and quality assurance mechanisms, enhancing the quality of teachers and education personnel, and laying the foundation for more creative student-centered teaching and learning processes.

These achievements have likely contributed to the steady improvement in Thai students' performance on international assessments over the past decade. On the OECD's Program for International Student Assessment (PISA),[3] Thailand's average score has now reached

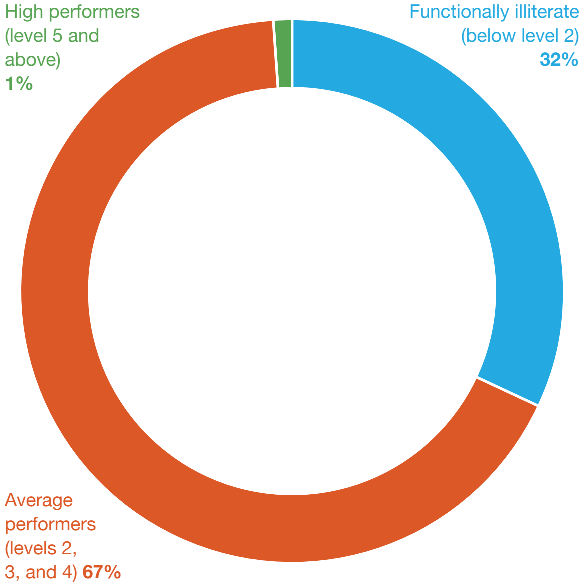
Figure 1.1
Average PISA 2012 Scores vs. GDP Per Capita (constant 2005 USD)



Note: The average of PISA scores in mathematics, science, and reading is used in this graph.
Source: OECD 2012 PISA and World Development Indicators.

[3] The PISA is an international survey that aims to evaluate education systems worldwide by testing the skills and knowledge of 15-year-old students. The tests are designed to assess the extent to which students can apply their knowledge to real-life situations and be prepared for full participation in society. To date, students from more than 70 countries have participated in the assessment, which is conducted every three years (see www.oecd.org/pisa/ for more details).

Figure 1.2
Distribution of Thailand's 15-year-olds on the 2012 PISA reading assessment



Source: OECD PISA 2012 data.

a level slightly above what would be expected for a country at Thailand's level of per capita income (Figure 1.1). With a GDP per capita of USD 3,390 (in constant 2005 USD) and an average PISA score of 437, Thailand's performance is roughly similar to those of Bulgaria, Romania, and Chile and well above those of Malaysia, Brazil, and Mexico, which have higher levels of per capita income. The one outlier is Vietnam with a GDP per capita of USD 986, whose 15-year-old students performed at the level of students in much richer countries such as Australia, Germany, and New Zealand.

Building on this progress, it appears that even more could be done to maximize the potential of Thailand's students to become productive workforce participants. Closer examination of PISA scores shows that many Thai students still do not have the skills and competencies needed in an increasing number of jobs. For example, in the most recent PISA reading assessment (in 2012), one-third of Thai 15-year-olds knew the alphabet and could read, but they could not locate information or identify the main messages in a text – they were "functionally illiterate," lacking critical skills for skilled jobs (Figure 1.2). In contrast, the average score for students in lower-income Vietnam was 66 points higher than the average score for Thai students, which implies that, on average, a 15-year-old in Vietnam is approximately 1.5 academic years ahead of the average Thai student.

Functional illiteracy is not an isolated challenge and can be seen across the various types of schools in Thailand. As Table 1.1, shows, schools in cities, towns, and villages all produce students who are not functionally literate by the age of 15. Most of the functionally illiterate students are where most of the students are enrolled, namely in schools located in a city, town, or small town. Although "only" one-third of their students are assessed as functionally illiterate, they comprise over three-quarters of all functionally illiterate students in Thailand.

The situation appears to be particularly acute for one group of students: students enrolled in village schools, especially the lowest-performing 40 percent among them. As shown in Table 1.1, the lowest-performing 40 percent of village students were the furthest behind in 2003, and they continue to fall further behind. In 2003, these 15-year-old students were, on average, 125 "points" behind their peers in large city schools, corresponding to more than three academic years of schooling. That gap widened to 139 points by 2012. In 2012, almost half of the village students were functionally illiterate. Moreover, the problem is very likely worse than what is captured by the numbers, as many 15-year-olds in villages dropped out earlier and are not even in school. If they had been kept in school and had been tested as part of PISA, the disparities likely would have been even wider since

	% of 15-year-old student population in 2012	PISA 2003 reading score	PISA 2012 reading score	Functionally illiterate in 2012		Point gap with large cities	
				% of functionally illiterate students in location	Breakdown of national level, by location	In 2003	In 2012
Village	16%	394	410	47%	7%	68	73
Lowest-performing 40% in village		337	344			125	139
Highest-performing 60% in village		432	454			30	29
Small town, town, city	77%	422	444	31%	24%	39	39
Large city	7%	461	483	16%	1%	–	–
Thailand	**100%**	**420**	**441**		**32%**		

Source: World Bank staff calculations based on OECD PISA data 2003 and 2012.

Table 1.1
Proportion of functionally illiterate 15-year-olds on the 2012 PISA reading assessment, by type of location

dropouts generally tend to be lower-performing students.

Improving educational outcomes among these poorer-performing students can have major impacts at the individual level and for Thailand's economic growth prospects. For individuals, being equipped with the necessary skills and competencies to obtain productive employment can help them secure a better future and, for those who are poor, help them break out of the cycle of poverty. This is especially important since recent research on Thailand suggests that private returns to higher education as well as the returns to educational quality have been rising consistently over the last couple of decades (Lathapipat, forthcoming). Looking at the bigger picture, having a workforce with stronger analytical reasoning and problem solving skills – skills that extend well beyond simply being functionally literate – can help Thailand move up the value-added ladder to a more knowledge-based economy. Therefore, addressing the remaining gaps will enable Thailand to improve its competitiveness, economic growth, and prosperity.

This report aims to help policymakers identify opportunities to strengthen the quality of education for all Thai students in order to build a more skilled and competitive workforce. The purpose of the study is to answer two overarching questions: 1) How well is Thailand's education system doing in preparing its students to become productive workers? and 2) What more can be done to improve student performance and to close the attainment gap between socioeconomic groups? The rest of the report is structured as follows. Chapter 2 provides an overview of system performance, reviewing the strengths and current challenges in the education system. Chapter 3 takes a closer look at the challenges, examining why student performance may be falling short of desired levels and what factors may be contributing to the growing inequities. Based on this analysis, Chapter 4 provides various options for addressing these challenges and helping Thailand improve the quality of education for students across the country, drawing from experiences both within and outside Thailand.

An assessment of system performance

2

2

An assessment of system performance

As noted in Chapter 1, while Thailand has made impressive progress in improving access to education, challenges persist in helping all students achieve better learning outcomes and reducing inequities in student performance. This chapter provides a brief assessment of the performance of the Thai education system, beginning with a review of recent achievements in expanding access and strengthening the focus on quality. It then describes the remaining challenges being faced in delivering a quality education to all students and addressing inequities in the education system.

The good news: more children are enrolling and staying in school (including poor children), and education quality is similar to other middle-income countries

2.1 Expanded access to education

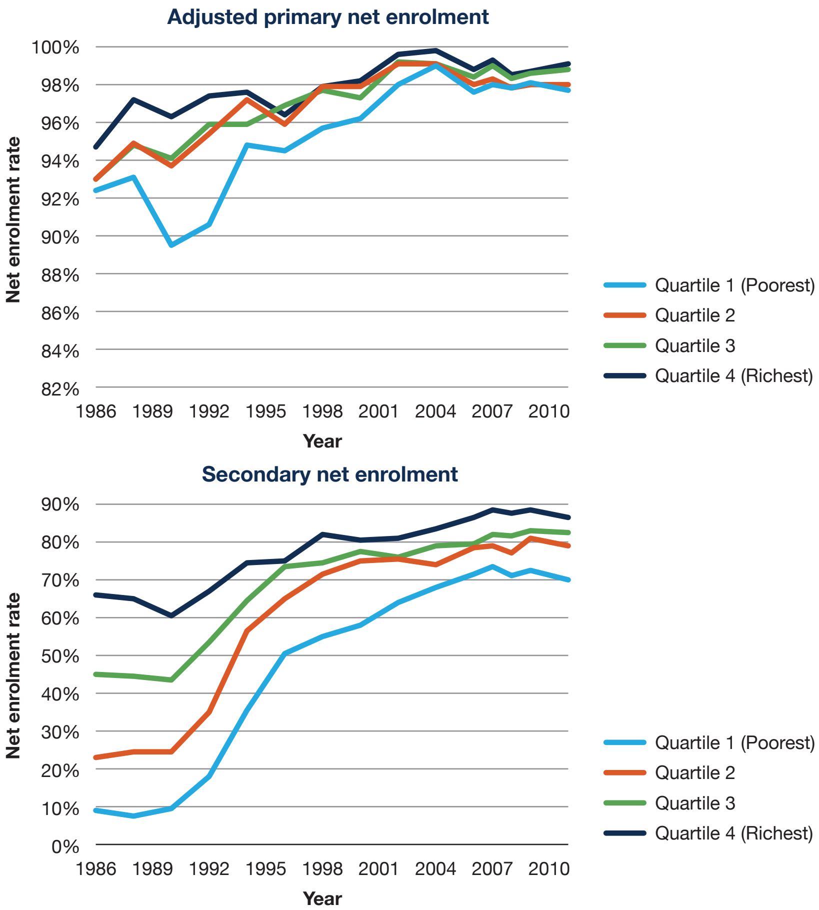
Thailand has made great progress in expanding basic education and narrowing inequities in schooling access between socio-economic groups. As illustrated by Figure 2.1 which presents primary and secondary net enrolment rates by wealth quartile, enrolment inequality between socio-economic groups has declined considerably. The left graph on primary enrolment shows that participation in primary education has become nearly universal for all wealth groups. Moreover, substantial progress has been made in increasing secondary net enrolment, which rose impressively from 31 percent in 1990 to around 78 percent in 2011. Inequality in secondary enrolment between the rich and the poor also narrowed significantly over the past couple of decades.

Throughout this period, gender gaps in primary education enrolment have been virtually non-existent. In fact, the gender gap has reversed at the secondary level, with female enrolment surpassing that of males from 1992 onward. As of 2011, the secondary enrolment rate among females was 82 percent, around 8 percentage points higher than that among males (Figure 2.2).

Thailand's success in achieving near-universal primary education and significantly raising secondary enrolment comes from sustained efforts to expand school coverage and compulsory education. Under the 1977 National Scheme of Education which encompassed three 5-year educational development plans (the Fourth, Fifth, and Sixth National Education Development Plans), the policy agenda began to widen to address poverty and inequality issues (Office of the National Education Commission, 1999). In particular, the Fifth National Education Development Plan aimed to expand compulsory education (6 years of formal schooling) to all sub-districts (tambons) of Thailand in the 1982 academic year (Bhumirat et al., 1987). In 1987, the "Educational Opportunity Expansion School" program[4] was

[4] The "Educational Opportunity Expansion School" program was initiated to help fulfill the government's commitment to providing secondary education for all. However, apart from adding additional grades, little was done to ensure that these former primary schools could provide a quality secondary school education. As discussed in Chapter 3, these rural schools are generally understaffed and are inadequately endowed with material resources (science laboratory equipment, library materials, instructional materials, etc.) and physical infrastructure.

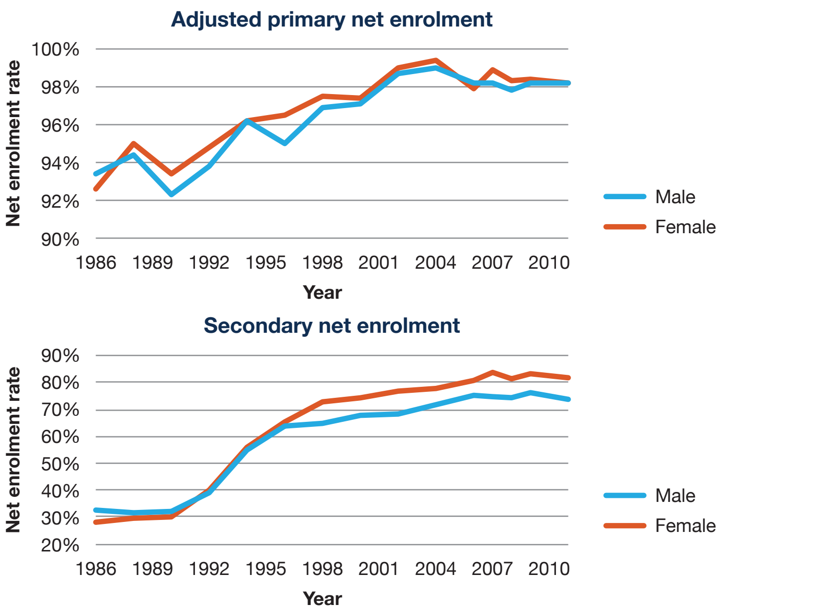
Figure 2.1
Adjusted primary and secondary net enrolment rates – by wealth quartile



Note: Children are divided into four wealth quartiles (the poorest in Quartile 1 and the richest in Quartile 4) according to their family per capita monthly expenditure,[5] expressed in adult-equivalent units.[6]

Source: World Bank staff calculations based on Thailand Household Socioeconomic Survey (various years).

Figure 2.2
Adjusted primary and secondary net enrolment rates – by gender



Source: World Bank staff calculations based on Thailand Household Socioeconomic Survey (various years).

[5] Per capita monthly expenditure was used instead of household income to rank individuals into wealth groups, since expenditure data are generally recorded more accurately than current income in socioeconomic surveys of households. Current spending is also less volatile and is a better proxy for family wealth than income.

[6] The Thai Household Socioeconomic Survey (SES) datasets contain measures of monthly household income and expenditure. In order to compare expenditures across households, it is important to correct for household composition and household size by dividing total consumption expenditure by the number of "adult equivalents" in the household to obtain the per capita monthly expenditure in adult-equivalent scale. Each child under age 15 is treated as equivalent to 0.5 adults. All individuals in each round of the SES dataset are then classified into four wealth quartiles based on their household's per-capita expenditure.

established to add lower secondary classes to existing rural primary schools, without charging tuition fees. Within eight years, the total number of these schools increased to around 6,600, accommodating 21 percent of lower secondary students (Varavan, 2006). A Student Loan Fund was also established in 1995 to provide funds for students from low-income families who continue non-formal education at the lower secondary level and for students in the upper secondary level through undergraduate school. The 1999 National Education Act (amended in 2002) institutionalized compulsory education of nine years and guaranteed the right of all children living in Thailand to receive basic education of quality free of charge for 12 years. As of 2009, mandatory free education was extended further to 15 years, including three years of pre-primary schooling.

2.2 Greater emphasis on education quality

The ambitious 1999 National Education Act (amended in 2002) led to long-overdue, comprehensive reform of the Thai education system. The Act aims to promote the decentralization of education administration to Educational Service Areas (ESAs), educational institutions, and local administration organizations (LAOs). Teachers and institutions are allowed more freedom to set curricula and mobilize resources for the provision of education. Furthermore, the Act lays the foundation for more creative student-centered teaching and learning methods. It also stresses the importance of quality assurance in education and the continuous process of teacher development.

Emphasis was placed on decentralizing administrative responsibilities to the local level. The decentralization process led to the establishment of 175 ESAs in 2003.[7] Each ESA is comprised of a Subcommittee for Teachers and Educational Personnel and an Area Committee for Education, whose office is responsible for approximately 200 educational institutions and a student population of between 300,000 to 500,000. Administration and management relating to academic matters, budgets, personnel, and general affairs are now the responsibility of the educational institutions themselves.[8] Oversight is through a board of 7-15 members consisting of representatives of parents, teachers, community groups, LAOs, alumni, and academicians. In addition, LAOs can provide education services at any or all levels commensurate with their readiness, suitability, and the requirements of the local area[9] (Office of the Education Council, 2007).

At the same time, education planning was consolidated at the central level. In accordance with the 1999 National Education Act, the Ministry of Education is responsible for promoting and overseeing all levels and types of education under the administration of the state. With regard to decentralizing educational administration to LAOs, the Ministry prescribes criteria and procedures for assessing the readiness of the LAOs to provide education services and assists in enhancing their capability in line with the policies and required standards. It also advises on the budgetary allocations provided by LAOs (Office of the Education Council, 2007).

To help improve the quality of education, two major tasks were undertaken to develop education standards and the quality assurance system. The Office of the Education Council (OEC) is responsible for formulating national education standards in cooperation with the offices responsible for basic, vocational, and higher education. The national education standards also serve as the basis for setting assessment standards for internal

7 In 2010, the total number of ESAs increased to 225 (183 for primary and 42 for secondary level).

8 In reality, however, while schools are enjoying more autonomy with regard to curriculum and budget, they still have very little influence over personnel management. This issue is discussed further in Chapter 3.

9 It should be noted that the transfer of educational institutions to be under the jurisdiction of LAOs has progressed very slowly. As of academic year 2013, 1,730 educational institutions (out of 38,010 public and private schools) were under local supervision. This represents an increase of only 795 schools since academic year 2003 (Office of the Permanent Secretary, Ministry of Education, 2003, 2013).

and external quality assurance mechanisms. A continuous process of internal quality assurance was instituted as part of education administration. The Office for National Education Standards and Quality Assessment (ONESQA), established in 2000, has been tasked with overseeing the external assessments of educational institutions, which should receive external quality evaluations at least once every five years (Office of the Education Council, 2007; National Education Act 1999).

In accordance with the new national education standards, schools have been required to shift from a teacher-centered approach to a learner-centered one. To support this transition, the OEC identified 586 individuals as "Master Teachers" who would then train 8,848 teachers in their network. A "Research and Development of Learner-Centered Learning Models" project was conducted by the OEC in collaboration with the Master Teachers and their network teachers to develop and test various teaching-learning techniques that would enhance the thinking processes of their students. Teaching models developed around these techniques were piloted in 90 basic education schools between 2005-2006, with encouragingly positive results. The teaching models were compiled in multimedia form and disseminated to schools across the country, and seminars were organized in the four regions of the country so teachers could participate and learn from each other (Office of the Education Council, 2005-2006, 2007). In addition to developing the basic education curriculum and improving the teaching-learning process, efforts were made to modify the admission system at both the basic and higher levels to avoid placing too much emphasis on examinations that depend mainly on rote learning (Office of the Education Council, 2004).

In order to equip teachers with the skills needed for the new student-centered approach, the Ministry of Education undertook measures in 2002-2003 to reform the teacher education curriculum. Up until the late 1990s, basic education teachers in Thailand generally obtained either a two-year diploma or a bachelor's degree from a variety of teacher colleges and universities (IEA 2009). As part of the education reforms, numerous initiatives were undertaken to improve teacher education. For example, the Rajabhat Universities (formerly Rajabhat Institutes or teacher training colleges) began developing several higher education curricula, including the five-year bachelor's degree curriculum for teaching new teachers for basic education[10] and master's degree programs in teaching and education administration. Two-year bachelor's degree courses were also developed to upgrade in-service teachers and administrators possessing two-year diplomas. The latter were developed in response to the Teachers Council's new professional standards which required teachers to have at least a bachelor's degree in education or a bachelor's degree in other fields, plus completion of a one-year graduate certificate in education (Office of the Education Council, 2004, 2005-2006).

[10] The curriculum includes four years of coursework and a one year of teaching practice at approved schools (IEA, 2009; Office of the Education Council, 2004).

Because teachers are critical to improving the quality of education, considerable efforts have been made to raise the status and standards of the teaching profession. As shown in Figure 2.3, wage differentials between teachers and non-teaching professionals grew from 1988 to 1998 in favor of non-teaching professionals with more work experience.[11] Unsurprisingly, studies conducted around that time found that students entering teacher education generally had low examination scores, and concerns were raised about the quality of the teacher workforce (Fry, 1999). As part of its reform efforts, the government has initiated scholarship and job guarantee programs in order to attract more qualified students into the teaching profession. For example, between 2004-2006, five-year scholarships were provided to 7,500 qualified students who were required to teach in basic education institutions upon graduation (Office of the Education Council, 2004). The teacher salary structure has also been adjusted upward over the past decade. Given the finding from a 1998 survey of 1,000 graduates that low salaries were the greatest deterrent to entering teaching (Fry, 1999) and the fact that wage gaps have narrowed significantly over the last decade (Figure 2.3), there are reasons to be optimistic that the new breed of teachers will be of higher quality.

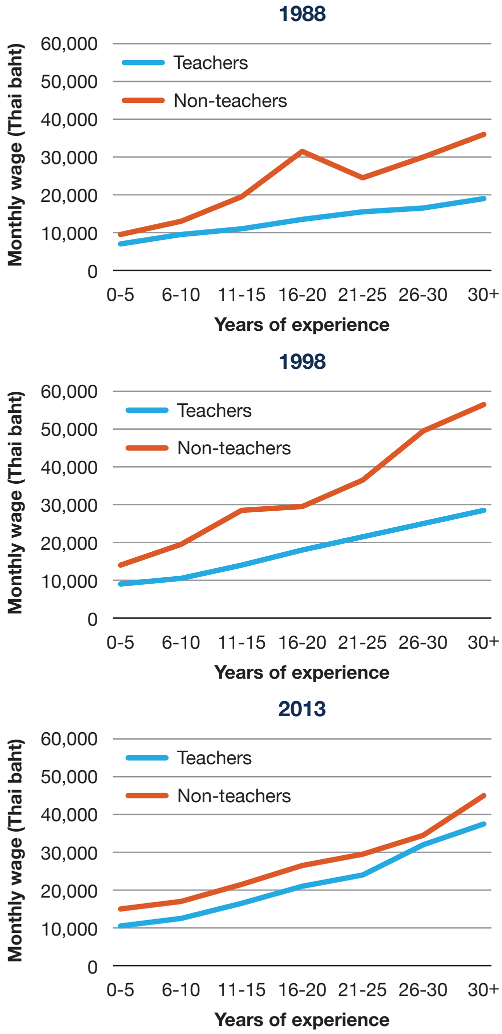


Figure 2.3 Average monthly wages of individuals with bachelor's degree by level of experience – basic education teachers and other occupations (2013 Thai baht)

Source: Thai Labor Force Surveys and World Bank staff calculations.

2.3 Improved learning outcomes (as measured by international assessments)

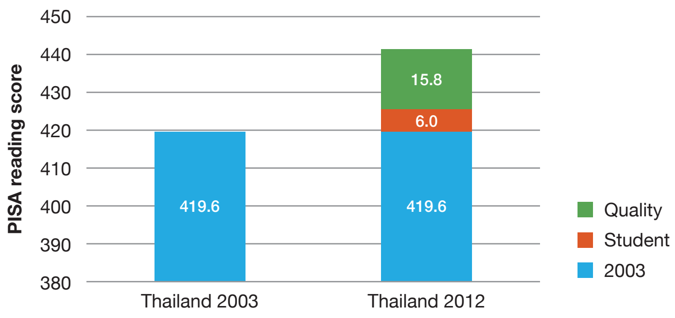
The performance of 15-year-old Thai students in PISA assessments has improved markedly since 2003, apparently thanks in large part to improvements in education quality or effectiveness. In the PISA reading assessment, for example, the average score rose from 419.6 in 2003 to 441.4 in 2012. An analysis was conducted to quantify how much of the increase was attributable to changes in the background characteristics[12] of the student population and how much was attributable to improvements in the "quality" or effectiveness of the Thai education system in transforming students' characteristics into learning outcomes.[13] As shown in Figure 2.4, improvements in education

[11] For Figure 2.3, data from Thai Labor Force Surveys was used to estimate the average monthly wages (including overtime and bonuses) for basic education teachers as well as for non-teaching professionals who had attained bachelor's degree qualification at the time of the surveys. Estimates of monthly wages were made at seven different levels of work experience across three different points in time (1988, 1998, and 2013).

[12] The observable student characteristics used in the analysis include gender, grade level, and the PISA index of economic, social, and cultural status (ESCS). The ESCS index was derived from the following three indices: highest occupational status of parents, highest education level of parents, and home possessions. The index of home possessions comprises all items on the indices of family wealth, cultural possessions, home educational resources, as well as books in the home.

[13] See Annex Section A2.1 for details on the statistical technique used in this study to decompose the change in student test scores over time.

Figure 2.4
Contributions of changes in quality and in student characteristics to changes in PISA reading scores in Thailand from 2003 to 2012



Source: World Bank staff calculations based on OECD PISA 2003 and 2012 data.

quality accounted for 15.8 points of the 21.8-point increase in overall PISA reading scores for Thailand from 2003 to 2012.

On average, learning outcomes are broadly similar to those of other countries at Thailand's level of income. As mentioned in Chapter 1, the performance of Thai students as measured by average PISA 2012 scores in mathematics, reading, and science is now slightly above what would be expected for a country at Thailand's level of per capita income. It also appears that 15-year-old Thai students in large cities are performing at levels similar to their counterparts in much richer economies. For example, the average reading score of 483 for students in large Thai cities is almost identical to the average reading scores achieved by students in Sweden and Iceland. However, this is the case for students in Thailand's large cities, and the situation is very different for students in other locales as discussed below.

The challenges: functional illiteracy is high, and the gaps in learning outcomes are widening

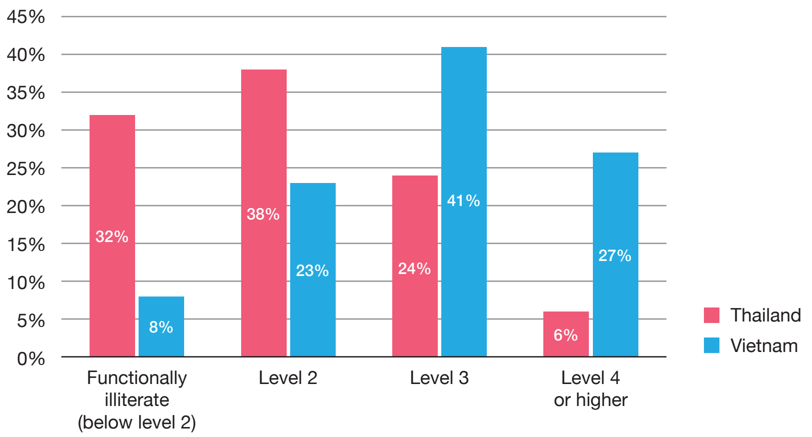
2.4 Functional illiteracy

As mentioned in Chapter 1, test scores indicate that too many Thai students reaching the end of their compulsory education (grade 9) are not well-prepared for further education and/or labor market entry. Figure 2.5 shows the percentages of 15-year-old students in Thailand and Vietnam who attained each level of proficiency in the PISA 2012 reading assessment. Nearly one-third of Thai students scored below level 2,[14] which is regarded as the minimum level for "functional literacy" needed to manage daily living and employment tasks that require reading skills beyond a basic level. In contrast, in neighboring and lower-income Vietnam which participated in the PISA assessments for the first time in 2012, only 8 percent of 15-year-old Vietnamese students failed to reach level 2 proficiency in the reading assessment.

Functional illiteracy can be seen across the various types of schools in Thailand. As illustrated by Figure 2.6, schools in cities, towns, and villages all produce students who are not functionally literate by the age of 15.[15] The greatest concentration is found in Thai villages, where 47 percent of their 15 year-old students are functionally illiterate. However, as Figure 2.6 shows, most of the functionally illiterate students in Thailand are found in schools located in cities, towns, or small towns where most of the student population are enrolled. These students comprise around three-quarters of all functionally illiterate students in Thailand.

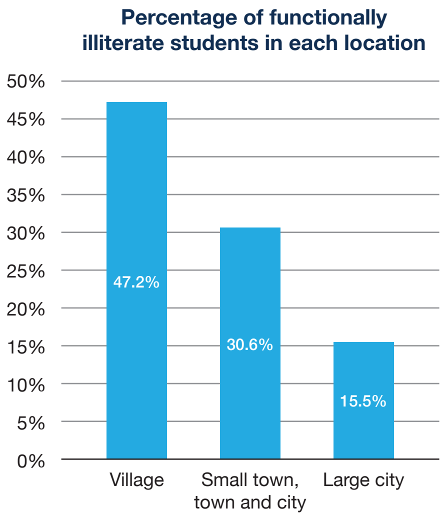
[14] "Some tasks at this level require the reader to locate one or more pieces of information, which may need to be inferred and may need to meet several conditions. Others require recognizing the main idea in a text, understanding relationships, or construing meaning within a limited part of the text when the information is not prominent and the reader must make low level inferences. Tasks at this level may involve comparisons or contrasts based on a single feature in the text. Typical reflective tasks at this level require readers to make a comparison or several connections between the text and outside knowledge, by drawing on personal experience and attitudes" (OECD, 2014).

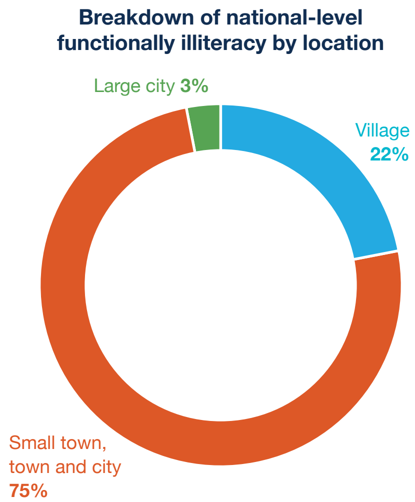
[15] OECD PISA defines a village as a community with less than 3,000 people; a small town has 3,000 to 15,000 people; a town has 15,001 to 100,000 people; a city has 100,001 to 1,000,000 people; and a large city has over 1,000,000 people.



Source: OECD PISA 2012 data.

Figure 2.5
Percentage of 15-year-olds attaining each level of proficiency in the PISA 2012 reading assessment in Thailand and Vietnam





Source: OECD PISA 2012 data.

Figure 2.6
Proportion of functionally illiterate 15-year-olds in 2012 by type of location

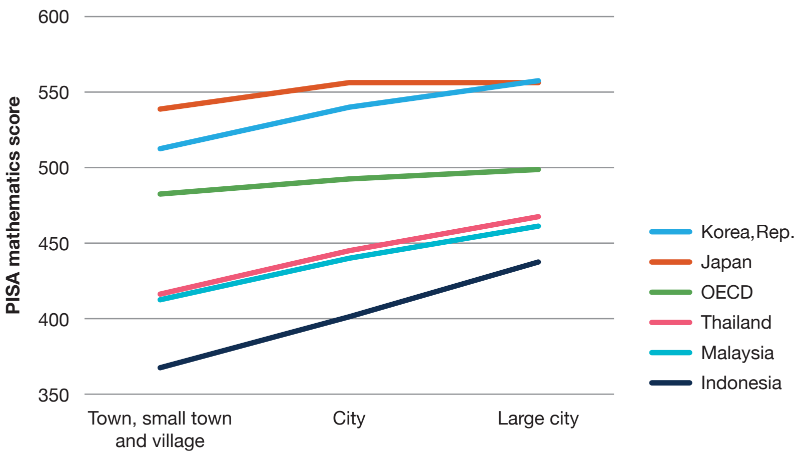
2.5 Widening disparities in student performance

An international comparison shows that compared to high-performing countries, the Thai education system is relatively unequal. Even though positive relationships between socio-economic background and student performance are very common across many countries, Figure 2.7 shows that three low-performing education systems – namely, Thailand, Malaysia, and Indonesia – are relatively more unequal than high-performing systems such as the OECD countries, Korea, and Japan. Significant urban-rural differences in student performance indicate that students outside of a few elite schools in large cities are not acquiring the same level of mastery of key cognitive skills.

An examination of changes in the PISA reading score over time across the test score distribution confirms a significant increase in student performance inequality in Thailand, due largely to changes in education quality. In Figure 2.8, the dotted line shows total changes in PISA reading scores for 15-year-old Thai students across percentiles of the test score distribution. For example, over the 2003-2012 period, the performance of Thai students ranked at the 50th percentile (or the median) improved by 24.1 points. In comparison, the reading score of students ranked at the 20th percentile improved by only 19.4 points. The solid line on the graph shows the portion of the change in test scores that can be attributed to improvements in education quality, and the gap between the "Overall" and "Quality" lines represents the effect of changes in observed student characteristics.[16] The

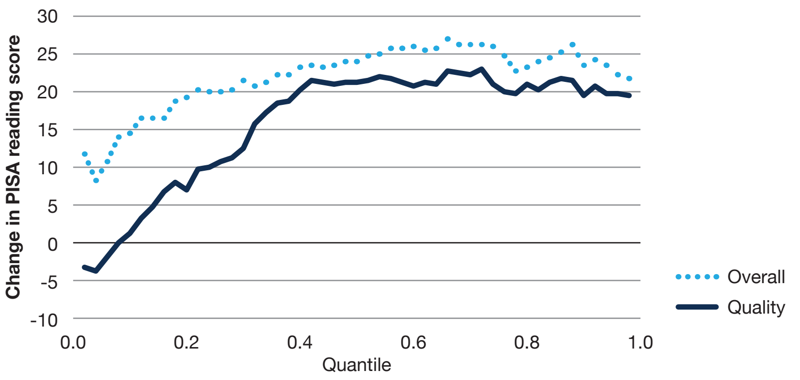
[16] See Annex Section A2.1 at the end of this report for details on the decomposition of the change in student test scores over time. The distribution graphs for the test scores are also presented in Figure A2.1 in the same section.

Figure 2.7
Urban-rural differences in student performance in PISA 2012 mathematics



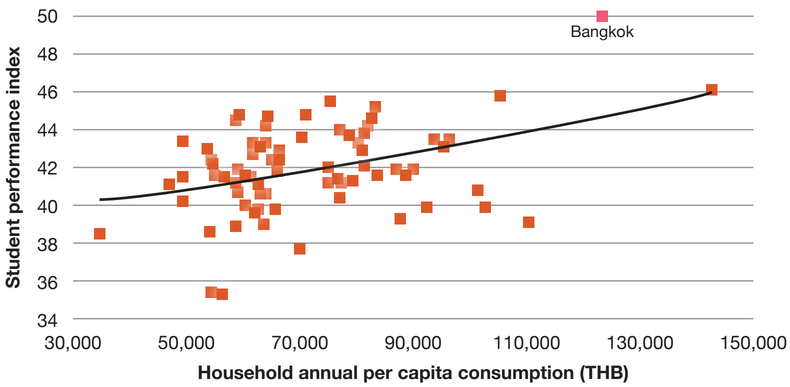
Source: World Bank staff calculations based on OECD PISA 2012.

Figure 2.8
Contributions of changes in quality to changes in PISA reading scores for Thailand from 2003 to 2012 across the test score distribution



Note: The median or 0.5 quantile is equivalent to the 50th percentile, the 0.2 quantile is equivalent to the 20th percentile, and so on.
Source: World Bank staff calculations based on OECD PISA 2003 and 2012 data.

Figure 2.9
Socio-economic inequality in learning outcomes in Thailand – student performance index by average per capita consumption level



Source: World Bank staff calculations based on Thailand Household Socioeconomic Survey 2011 and NIETS 2010.

figure suggests that inequality in test scores was attributable more to changes in education quality than to changes in observed student characteristics.

Closer examination of student performance by socio-economic background indicates that the weaker performers tend to come from more disadvantaged backgrounds. Large disparities in student performance can be seen across schools serving students from diverse socio-economic backgrounds. Figure 2.9 plots provincial average household per capita annual consumption in 2011 against the student performance index for the 2010 Ordinary National Education Test (O-NET) exams.[17] A clear positive and exponential relationship can be seen, with per capita consumption

[17] The student performance index (which ranges from 0 to 100) is a weighted index of the 2010 O-NET exams in mathematics and science for students in Grades 6, 9, and 12. Details on the computation of the index are provided in Section A5.3 in the Technical Appendix to Annex 5 at the end of this report.

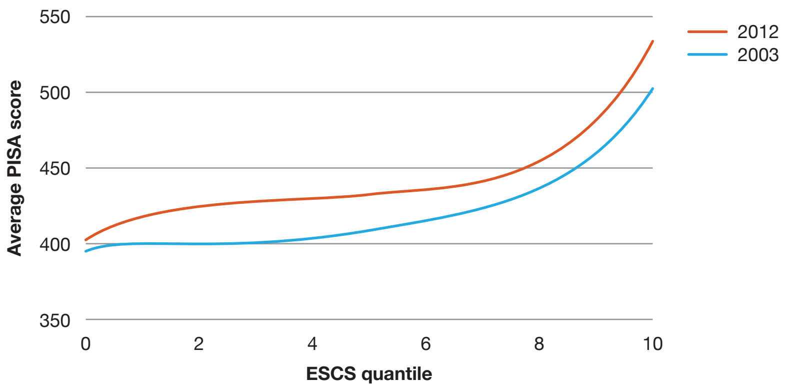


Figure 2.10
Socio-economic-related student performance inequality – average PISA scores by ESCS quantile

Source: World Bank staff calculations based on OECD PISA 2003 and 2012 data.

alone explaining around 16 percent of the total provincial variation in student performance. A similar analysis using school average PISA 2012 test scores in mathematics and science and the PISA index of economic, social, and cultural status (ESCS) of the student body reveals that average ESCS accounts for as much as 49 percent of the total variation in average test scores across schools. These results strongly suggest that the socio-economic background of the student body is one – if not the most important – determinant of school performance in Thailand.

Not only is socio-economic-related student performance inequality high, but it also has been rising over the last decade. Figure 2.10 presents the estimated relationships between household socio-economic status (as measured by the PISA ESCS index) of 15-year-old students in Thailand and their performance on the PISA reading assessments in 2003 and 2012.[18] Unsurprisingly, for both time periods, well-off students generally performed better on the reading assessment than their more disadvantaged peers. Taking the difference between the two lines for 2003 and 2012 at each ESCS quantile indicates the change in the average reading score across the two cohorts at that particular quantile. The results show that while test scores of Thai students have improved significantly over the last decade, the richest students (ranked at the top end of the ESCS distribution) have had the largest improvement in test scores, while the performance of the most disadvantaged students has increased only marginally. In fact, the test scores for the poorest 10 percent of Thai students have improved the least, indicating that student performance inequality between the richest and poorest has been rising sharply over the last decade.

Looking more closely by type of school location, it appears that the disadvantaged, poorer-performing students are concentrated in lagging village schools. Breaking down Thailand's (secondary) school system by location type reveals that performance has been improving at very different rates (Figure 2.11). A large disparity in learning outcomes is apparent, with students in villages having the lowest average performance in any given year. More importantly, the performance gap between students in village schools and those in city and large city schools widened significantly over the period. As represented by the green portion of the bars in Figure 2.11, the widening urban-rural disparity in learning outcomes was driven largely by differences in education quality.

Notably, the analysis also reveals that students in small town schools benefited the most from improvements in education quality over the last decade. As shown in Figure 2.11, the average reading score of students in small towns actually surpassed that of students in town schools in 2012. Important lessons could be learned from investigating the factors that contributed to these impressive gains, which is beyond the scope of this report. Nevertheless, the gap

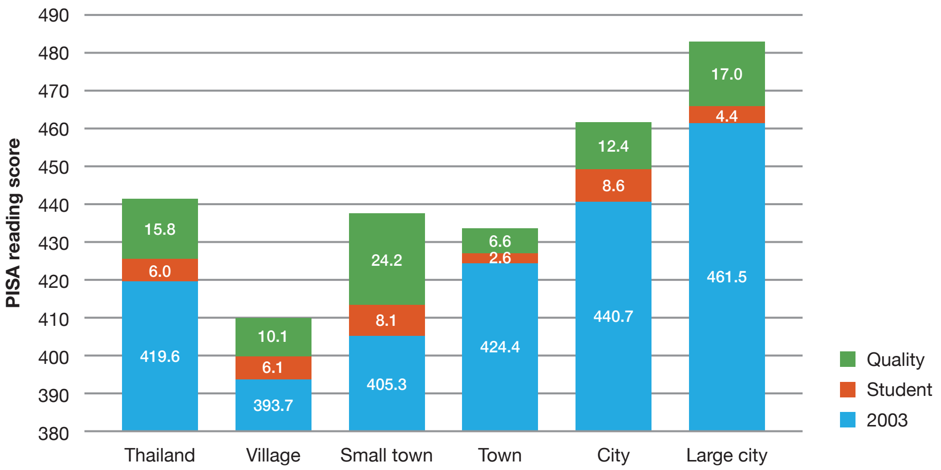
[18] Specifically, for each year of data, the student population was ranked into quantiles according to their family socio-economic status, as measured by the PISA ESCS index. Average PISA reading scores for students were then estimated along the entire socio-economic status distribution.

to students in large city schools remains substantial at 45 points, which corresponds to more than one academic year of schooling.

In contrast, school quality for the lowest-performing students in villages has actually deteriorated over time. The problem of deteriorating education quality is particularly concerning for the poorest-performing children who attend schools in Thai villages. As shown in Figure 2.12, changes in education quality (represented by the solid line) actually had a negative effect on overall test scores (represented by the dotted line) for the lower quantiles. In fact, the quality of schools serving the lowest-performing 40 percent of the village student population declined the most over the period under study.

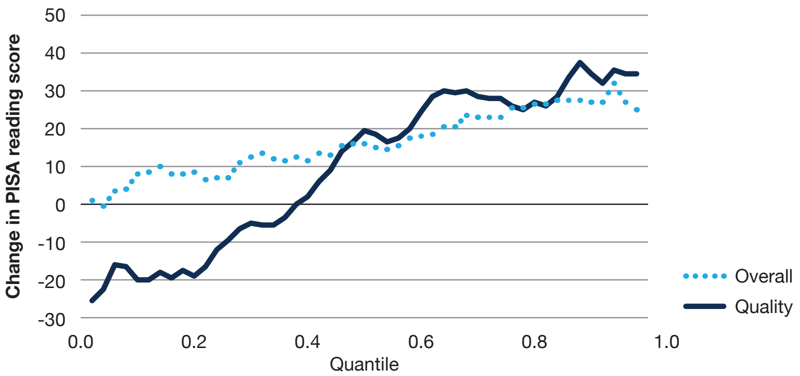
Figure 2.13 below shows that worsening school quality accounted for a 7.8-point decline in the reading score for the lowest-performing 40 percent of the village student population. At the other end of the performance spectrum, students in Thailand's large cities benefited from an increase in education quality, which accounted for a 17-point increase in their performance.

Figure 2.11
Contributions of changes in quality and in student characteristics to changes in PISA reading scores in Thailand from 2003 to 2012, by location



Source: World Bank staff calculations based on OECD PISA 2003 and 2012 data.

Figure 2.12
Contributions of changes in quality to changes in PISA reading scores in Thai villages from 2003 to 2012 across the test score distribution



Note: The median or 0.5 quantile is equivalent to the 50th percentile, the 0.2 quantile is equivalent to the 20th percentile, and so on.

Source: World Bank staff calculations based on OECD PISA 2003 and 2012 data.

Figure 2.13
Contributions of changes in quality and in student characteristics to PISA reading score changes for the lowest-performing 40 percent of village students, students in large cities, and the Thai student population

Source: World Bank staff calculations based on OECD PISA 2003 and 2012 data.

It should be noted that the disparities are likely much greater than what is captured by the above analysis of PISA results, as many 15-year-olds in villages dropped out earlier and are not even in school. While the analyses of educational performance inequality in this chapter were carried out using PISA data on 15-year-old Thai secondary students, it is important to note that some 20 percent of secondary school-age children are not even enrolled in secondary schools. It is probably fair to assume that the majority of these children are socio-economically disadvantaged and/or academically ill-prepared, and they are therefore very likely to be functionally illiterate. Therefore, if the 15-year-olds in villages who dropped out earlier had been kept in school and had been tested as part of PISA, the disparities in results likely would have been even wider since dropouts generally tend to be lower-performing students.

Why is performance falling short of desired levels?

3

3

Why is performance falling short of desired levels?

As a basis for considering the various directions and options for education reform, it is useful to understand the causes behind Thailand's current education challenges. It appears that performance is being held back by two factors: i) remaining system-level issues affecting education quality and ii) particular challenges related to small village schools that are contributing to the growing inequities. This chapter digs deeper into each of these challenges and examines their underlying causes, in order to help identify some appropriate policy options for tackling these issues going forward.

3.1 Remaining system-level issues affecting education quality

While much greater policy emphasis has been placed on education quality in recent years, there are still unfinished system-level reforms that could advance the agenda further. As described in Chapter 2, considerable efforts have been made to develop better teaching techniques, improve teacher education, and raise the status of the teaching profession (through increased salaries to teachers) to attract more qualified individuals. These reforms could be complemented by further progress on system-level reforms that improve teacher management and increase accountability for the quality of education delivered.

Teacher management is still highly centralized, so schools have little influence over personnel choices. While one of the main objectives of the 1999 National Education Act is to promote the decentralization of education administration to Educational Service Areas (ESAs), educational institutions, and local administration organizations, schools have very little influence over personnel management. Teacher management – hiring and firing, disciplining, deployment, and payroll administration – has been decentralized to the ESA level, but only following the regulations set by the Teacher Civil Service Commission which tend to protect job tenure. The selection process is based on compliance with teacher standards requirements (such as completion of a university degree), without provision for more local control. Because the hiring process is bureaucratic rather than selective on the basis of quality, schools have very little room for maneuvering when assigned inadequate teachers. Moreover, since teacher salaries are regulated, there is limited scope for implementing a system of rewards and sanctions that could improve incentives (Arcia and Patrinos, 2013).

Another system-level challenge is that despite having a relatively sophisticated system for assessing student learning outcomes, the information is not being fully utilized. The National Institute of Educational Testing Service (NIETS), established in 2005, has been assessing all 6th, 9th, and 12th graders for nearly a decade using the Ordinary National Educational Test (O-NET). However, Thailand does not utilize this information as much as other countries with a similarly rich assessment culture. Some examples:

- The information has little impact on evaluation of teachers (and their salaries and career prospects). Teacher salaries in Thailand are determined by

two factors: base salary and academic position. The current base salary adjustment guideline from the Office of the Teacher Civil Service Commission does not place any weight on student performance. Regarding the academic position adjustment, student performance in national standardized exams accounts for only 3.3 percent of the total evaluation score. The rest is based on understanding of teaching materials, ability to assess student learning, use of Information and Communications Technology, and understanding of the code of ethics (TDRI, 2013).

- The Office for National Education Standards and Quality Assessment (ONESQA) is tasked with conducting "assessments" of all schools every five years but has done so using criteria that focus mainly on inputs and processes, with very little weight on the student assessment data produced by NIETS. ONESQA follows a policy called "amicable assessment" which emphasizes support for improvement rather than high-stakes accountability. While this is laudable approach, it is unclear whether the results generated are being used to make important operational or policy decisions,[19] and a great amount of effort and resources (on average, approximately USD 1,500 per assessment) is being spent on these amicable assessments (World Bank, 2011).[20]
- Assessment results (whether from NIETS or ONESQA) are not used to hold schools or other actors accountable for their performance. For example, the results do not appear to be used to inform performance discussions among any actors in the system (e.g., between the head of an Education Service Area and a school, or between the head of an ESA and an OBEC official), nor do they seem to be part of any budget discussion with MOF (e.g., justifying more/less spending, changes in spending, or new programs). In addition, while national-level results for standardized exams are publicly available, school-level results are not. This limits the ability of key stakeholders to monitor and evaluate schools effectively.

Another challenge relates to education spending: while a relatively large share of GDP (and government resources) goes to education, those resources could be used more effectively. Illustrating the government's commitment to education, the budget for the education sector remains one of the largest items on the budget. For FY 2015, the budget for education totals THB 531 million (comprising 20.6 percent of the government's overall budget and 4 percent of GDP), of which THB 388 million is for pre-primary, primary, and secondary education (Bureau of the Budget, 2015). However, there are various indications that this funding could be put to more optimal use to improve education quality. One sign of inefficiency is that Thailand has relatively low student-teacher ratios – for example, the student-teacher ratio in primary schools fell from nearly 30:1 in the late 1970s to just 16:1 in 2012—but almost one-third of Thai classrooms face chronic teacher shortages (less than one teacher per classroom) due to ineffective teacher allocation (see Table A3.1 in Annex 3). As discussed below, resources are being spread thinly across schools that are standing half-empty due to dwindling student numbers. Many schools are in dire need of massive capital investments but do not have the funds for upgrading. Thus, there is considerable scope for improving how educational resources are allocated.

[19] According to the manual of ONESQA, the third round of evaluations (2011-2015) will place more weight on O-NET exam results.

[20] World Bank (2011): Thailand Public Finance Management Report Discussion Paper 5: Analysis of Efficiency of Education.

3.2 Factors contributing to the performance gap between schools

3.2.1 The system of educational resource allocation

While public spending appears to be pro-poor, the key question is whether this translates into better educational resources for disadvantaged schools. At first glance, it is encouraging to see that public subsidies for basic education are pro-poor, although the correlation seems rather weak, as shown in Figure 3.1. These subsidies encompass all recurrent public expenditure on schools under the Office of the Basic Education Commission (OBEC), which includes salaries of teachers, administrators, and other education personnel. A key question is: does the observed pro-poor public spending mean that students in socio-economically disadvantaged schools are allocated relatively better educational resources? The rest of this chapter attempts to answer this question through rigorous analysis of the available data.

As a starting point for investigating inequities in public education resource allocation, it is important to look at the adequacy of teacher allocations across schools. As a result of falling birth rates, the total number of primary school students in Thailand fell from 7.45 million in 1982 to just 5 million in 2012. However, the number of teachers barely changed over the same period (Figure 3.2.1). As a result, the student-teacher ratio in primary schools fell from nearly 30:1 in the late 1970s to just 16:1 in 2012 (Figure 3.2.2). Therefore, at the macro level, Thailand certainly has an adequate number of teachers relative to the number of students. Nonetheless, as discussed below, many provinces are facing severe teacher shortages due to ineffective teacher allocation.

The proliferation of small schools, in particular, is putting pressure on public educational resources.[21] Despite declining student numbers, the number of small schools with less than 120 students increased dramatically from 10,899 (or 33 percent of OBEC schools) in 2003 to 14,669 (47 percent) in 2011. These small schools, which have very small classes and are much more expensive to operate, predominantly serve the socioeconomically disadvantaged student population (Table 3.1).[22]

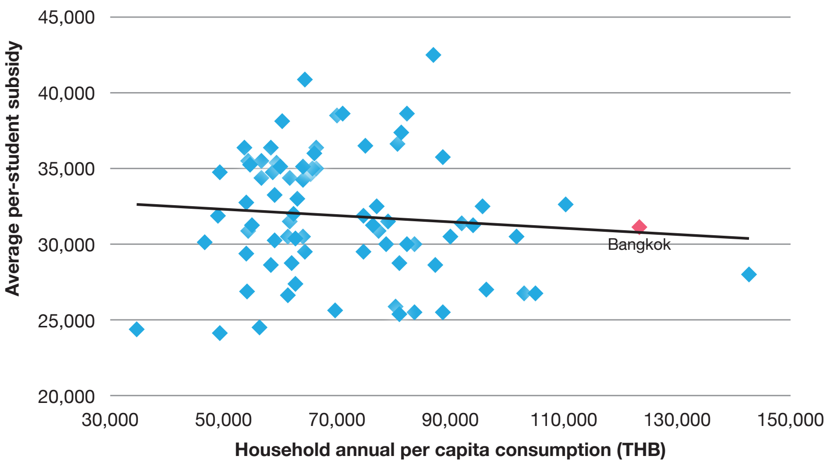


Figure 3.1
Per-student public expenditure (Thai baht per year) – by province

Source: World Bank staff calculations based on Thailand Household Socioeconomic Survey 2011 and OBEC.

[21] Using the OBEC definition, a small school is a school with less than 120 students enrolled. However, this standard definition could be inappropriate in some contexts. For example, should a school that teaches Grades 1 to 4 with 25 students per grade (100 students in total) be considered "smaller" than a school that teaches Grades 1 to 9 with 15 students per grade (135 students in total)? The key is to use a measure that is comparable across schools. In the analysis presented in Chapter 4, a small school is defined as a school with 20 students or less per grade on average.

[22] For a more detailed breakdown of key characteristics by school size, see Table A3.1 in Annex Section A3.

Figure 3.2.1
Number of teachers and students – primary school

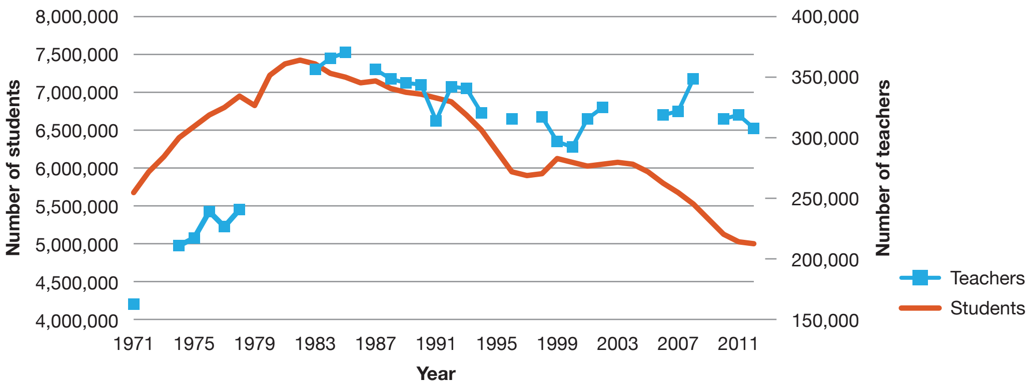
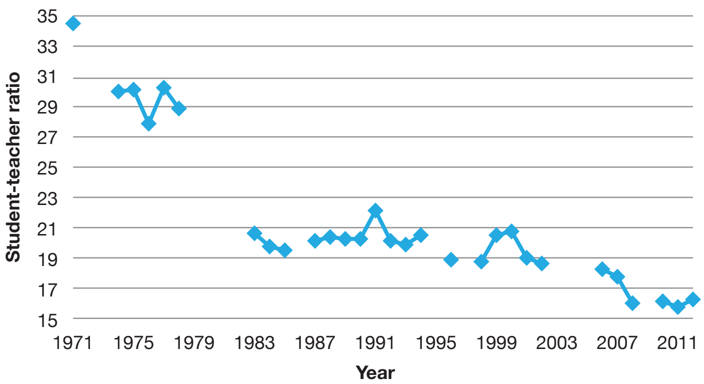


Figure 3.2.2
Student-teacher ratio – primary school



Source: EdStats.

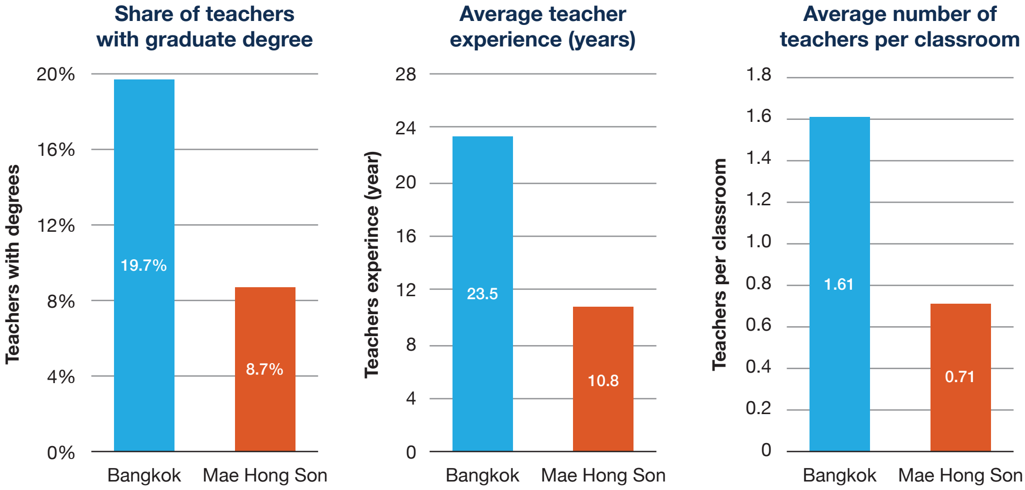
Table 3.1
Basic comparison of small schools and all OBEC schools (in 2010 unless otherwise indicated)

	Small schools (less than 120 students)	All OBEC schools
Total number of schools in 2011 (primary and secondary)	14,669	31,211
Average per student subsidy (primary and secondary)	THB 41,551	THB 31,476
Average class size (primary and secondary)	8.8	21.8
Average student-teacher ratio* (primary and secondary)	13.4	21.4
Average number of teachers per class (primary and secondary)	0.73	1.15
Percentage of students who reported being poor**	73.3%	48.8%
Student performance index in the 2010 O-NET exams***	41.3	42.1

* This is the weighted average student-teacher ratio, where the weights are school enrolment size.
** Poor students are those who reported household incomes below THB 40,000 per month.
*** The student performance index (which ranges from 0 to 100) is a weighted index of the 2010 Ordinary National Education Test (O-NET) exams for Grades 6, 9, and 12.

Source: World Bank staff calculations based on OBEC school data 2010.

While small schools may offer some advantages in certain contexts, Thailand's small village schools are severely under-resourced. While one could argue that small schools offer potential advantages such as a small learning environment and greater teacher-student interaction, the benefits are realized only if the school has sufficient resources to deliver a quality education. Despite small class sizes and low student-teacher ratios, Thailand's village schools do not have adequate numbers of teachers—on average, these small schools are staffed with less than one teacher per classroom (Table 3.1). This means that students across all grades cannot be taught at the same time, unless



Source: World Bank staff calculations based on OBEC school data 2010.

Figure 3.3
Average school characteristics – Bangkok and Mae Hong Son

Box 3.1
Guidelines for teacher allocation for OBEC schools

Schools with 120 enrolled students or less:

• 1 to 20 students:	1 principal	1 teacher
• 21 to 40 students:	1 principal	2 teachers
• 101 to 120 students:	1 principal	6 teachers

Schools with 121 enrolled students or more:

• Pre-primary:	teacher: student ratio = 1:25 student: teacher ratio = 30:1	
• Primary:	teacher: student ratio = 1:25 student: teacher ratio = 40:1	
• 121 to 359 students:	1 principal	
• 360 to 719 students:	1 principal	1 assistant principal
• 720 to 1,079 students:	1 principal	2 assistant principals
• 1,080 to 1,679 students:	1 principal	3 assistant principals
• 1,680 or more students:	1 principal	4 assistant principals

the schools rely on multi-grade teaching and/or teachers cover a much broader range of subjects than in a larger school.

A comparison of Bangkok (where schools, on average, are the largest) and Mae Hong Son province (where schools, on average, are the smallest) illustrates the wide disparities in adequacy and quality of teaching resources.[23] As shown in Figure 3.3, Bangkok enjoys much larger shares of teachers with higher than a bachelor's degree, teachers with more years of experience, and more teachers per classroom. In contrast, schools in Mae Hong Son province – which is located in the northern region bordering Myanmar and is the poorest province in terms of average per capita consumption, and has the lowest population density – are allocated less qualified teachers with the least amount of teaching experience, and their classrooms are severely understaffed, with an average of only 0.71 teachers per classroom.[24]

Considering the current teacher deployment guidelines (presented in Box 3.1), it is not hard to envisage how the allocation process would be problematic for the majority of primary schools with less than 120 enrolled students. For example, under the guidelines, a small primary school with 20 students spread across a few grade levels would be entitled to only one teacher.

[23] For more detailed comparisons of educational resources across all Thai provinces, ranked by student performance, see Figure A3.1 in Annex Section A3.

[24] In Bangkok, average enrolment is 753 students for primary school and 2,298 for secondary school. In Mae Hong Son, average enrolment is 83 students for primary school and 328 students for secondary school.

Figure 3.4.1
Teacher shortage index by selected countries

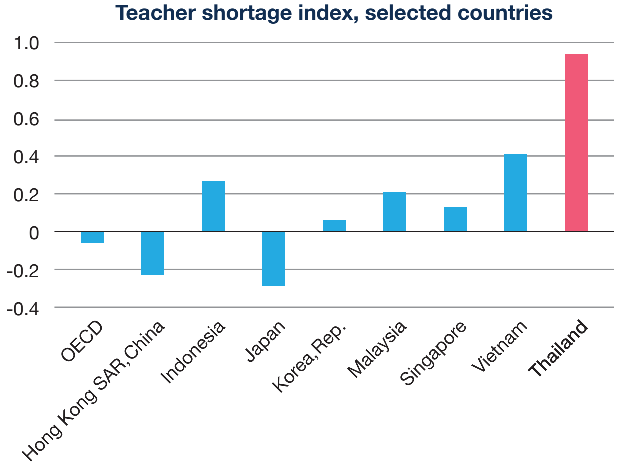
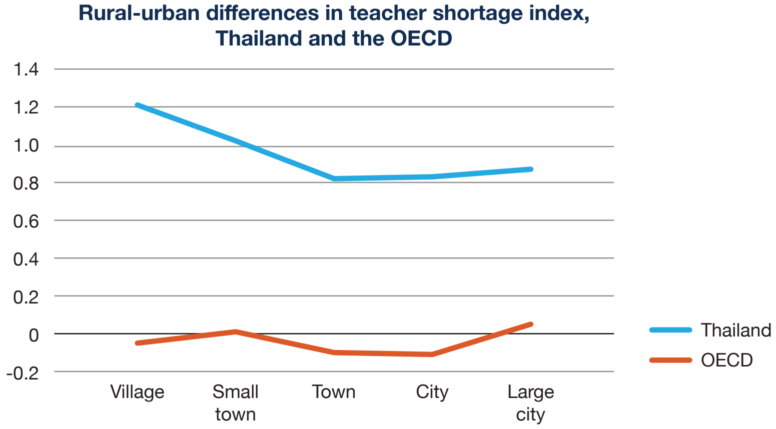


Figure 3.4.2
Teacher shortage index for Thailand and the OECD by type of location



Source: OECD PISA 2012.

Given the severe staffing constraint with the sole teacher being responsible for teaching students in all grades and subjects, it would be unreasonable to expect the school to deliver high-quality education.

The highly centralized teacher management system, as discussed earlier in this chapter, is further compounding the teacher shortage problem for small, remote schools. High-caliber teachers generally do not want to go to remote schools, especially if the schools are tiny since it limits their interaction with and learning from peers. Furthermore, the workload in remote schools may be much higher as the teachers must cover a wider range of subjects and/or grades. Currently, the centralized teacher deployment process allows teachers to be redeployed to any location of their own choosing once they have been in service for over two years, and it does not provide the right incentives to educational personnel to work in remote areas. This results in a disproportionately large share of teachers with relatively few years of experience in remote schools.

Compared to international peers, the Thai school system is severely lacking in qualified teachers, particularly in rural villages. On average, school principals in Thailand reported shortages of teaching staff in key subjects that seriously hindered student learning. Compared to regional peers and the OECD average, Thai schools have the highest PISA teacher shortage index[25] by far (Figure 3.4.1). Figure 3.4.2 which presents the teacher shortage index by location, confirms the earlier finding that schools in rural areas are more severely understaffed than their urban counterparts, and this teacher allocation inequality is much worse than that in OECD countries.

[25] The PISA index on teacher shortage was derived from four items measuring the school principal's perceptions of potential factors hindering instruction at school. The four items indicate shortages of qualified teachers in: i) science, ii) mathematics, iii) the test language within the economy, and iv) other subjects. More positive values on this index indicate higher rates of teacher shortage at a school.

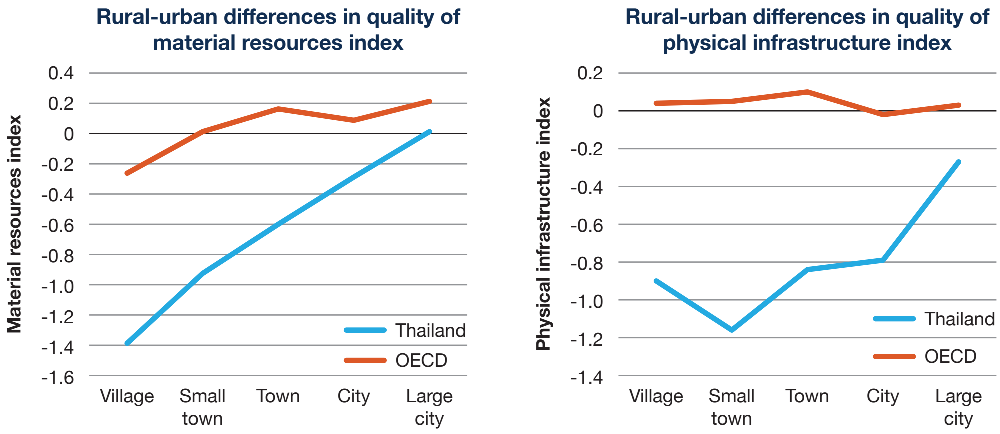


Figure 3.5
Quality of material resources index (left) and quality of physical infrastructure index (right) for Thailand and OECD, by type of location

Source: OECD PISA 2012.

In addition to shortages in human resources, Thai schools are hindered by inadequate material resources and physical infrastructure. School principals in Thailand reported shortages or inadequacy of material resources[26] and physical infrastructure[27] which limited the capacity of schools to provide quality instruction. Compared to international peers, Thai schools are more severely hindered in these dimensions. Once again, schools primarily serving disadvantaged children in rural areas are generally much more lacking in material resources and physical infrastructure than those in urban areas, and this resource allocation inequality is much worse than that in OECD countries (Figure 3.5). This level of under-resourcing means that for Thailand's small village schools which are already expensive to operate (as reflected in high per-student subsidies), closing the performance gap would require a massive outlay that would make those schools even more expensive.

Thus, while public education spending in Thailand may appear to be pro-poor, the small schools serving disadvantaged students face major resource constraints that affect their ability to provide a quality education. As indicated by the above analysis, socioeconomically disadvantaged children in Thailand are provided low-quality education at a relatively high cost. Notably, schools in Bangkok require relatively low per-student subsidies, even though they are endowed with more qualified and more experienced teachers as well as a higher number of teachers per classroom on average (see bar charts in Figure A3.1 in Annex A3). Figure A3.1.6 in Annex A3 shows that the average personnel salary per student for schools in Bangkok is among the lowest in the country. Given that these schools are allocated more and better educational resources, the lower per-student expenditure was achievable only because these schools operate on much larger scales in terms of enrolment and class sizes.

Given Thailand's demographic trends, the number of low-quality small schools will likely increase in the near future, which also means that performance gaps are likely to widen. As shown in Figure 3.6, the declining trend in birth rates means that the number of students is expected to drop to 5.6 million by 2034, while the number of small schools with less than 120 students is projected to continue increasing to 18,291 schools.[28] The growing number of small schools resulting from dwindling numbers of students means that more and more

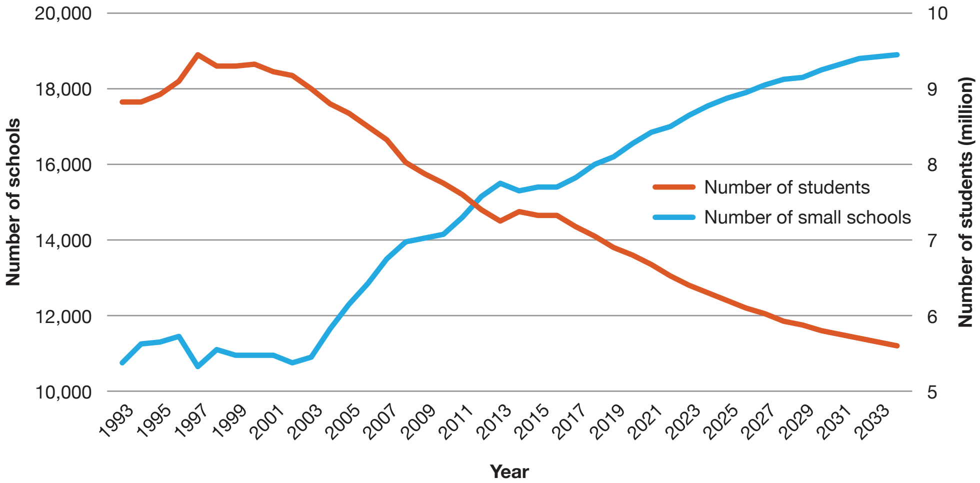
[26] The PISA index on the school's material resources was computed on the basis of six items measuring the school principals' perceptions of potential factors hindering instruction at school. These are shortage or inadequacy of: i) science laboratory equipment, ii) instructional materials, iii) computers for instruction, iv) internet connectivity, v) computer software, and vi) library materials. All items were reversed for scaling so that more positive values on this index indicate higher quality of material resources at a school.

[27] The PISA index on quality of physical infrastructure was computed on the basis of three items measuring the principals' perceptions of potential factors hindering instruction at school. The three items indicate shortages or inadequacy of: i) school buildings and grounds, ii) heating/cooling and lighting systems, and iii) instructional space. Once again, all items were reversed for scaling so that more positive values on this index indicate higher quality of physical infrastructure at a school.

[28] The projection of the total number of small schools is based on the assumption that no school will be closed down as a result of the falling number of students.

schools in Thailand will become chronically understaffed (assuming that the current teacher allocation rule still applies in the future) and poorly equipped. Furthermore, improvements in transportation will enable more and more children in rural areas to be enrolled in larger and better-resourced schools located in urban areas. Those left behind will likely be the most socio-economically disadvantaged children.

Figure 3.6
Number of students and projected number of small schools from year 1993 to 2034 (assuming the current trend continues)



Note: The estimation is based on the enrolment rate provided by International Futures at the Pardee Center (2014) and the number of Thai children aged 3-17 reported by the United Nations, Department of Economic and Social Affairs. This was adjusted with the number of students in OBEC using Statistic of Thailand Education (from the Office of the Education Council, 2013).

Source: Authors' calculations

Strategies to improve the quality of education for all

4

4

Strategies to improve the quality of education for all

Building on the major progress made in improving access to education, Thailand now has the opportunity to improve the quality of education for all and more fully tap the potential of its future workforce. A range of deep and sustained actions aimed at improving the quality of education could help Thailand improve student learning and develop a more competitive workforce. Efforts to bring learning standards throughout the country – including in small and remote villages – to the level of learning standards in Bangkok could also help disadvantaged students improve their future earning opportunities and break out of poverty. Tackling these challenges successfully will enable Thailand to maximize its human capital, reduce inequality, and foster economic growth.

This chapter presents some potential policy options that could help ensure a high-quality education for all Thai students. It highlights some key areas in which reforms could have a significant impact on the quality of education, both for students throughout the education system and more specifically for students in rural village schools. This list is by no means comprehensive but is meant to illustrate the range of reforms that could be undertaken in light of the challenges discussed in the previous chapters. It draws upon experiences from within and outside Thailand as well as more in-depth analysis of particular options and their potential impacts.

A Improving the quality of education for all

1 Increasing school autonomy

An assessment of implementation of school autonomy and accountability policies in Thailand showed that increasing school autonomy over personnel management can improve student learning. The study finds that Thai schools with an average PISA score above 500 points showed higher indicators of personnel management autonomy than schools with PISA scores below 400 points and that PISA scores are significantly affected by personnel autonomy (Arcia and Patrinos, 2013). These findings suggest that greater autonomy in personnel management could improve performance.

However, evidence from within Thailand suggests an important caveat: school autonomy does not make sense everywhere. Increased autonomy can improve learning outcomes in schools, if the schools are already performing well. Analysis of PISA data for Thailand (Lathapipat, 2015) shows that enhanced autonomy, especially regarding personnel management (which encompasses selecting teachers for hire, firing teachers, establishing teachers' starting salaries, and determining teachers' salary increases), significantly improves learning for better-performing schools (those in the top half of the performance distribution), while the opposite seems to be true for schools with weaker performance (bottom half of the performance distribution). The analysis also shows that learning improves the most in a system with strong accountability (using levels of parental monitoring as proxy for accountability).

These findings are consistent with evidence from other countries. Analysis of PISA data for 42 countries found that

Box 4.1
Brazil's experimentation with schools report cards

An example of an effort to generate and disseminate information to improve education service delivery is the experimentation with school report cards in the Brazilian state of Parana between 1999 and 2002. The report card contained school data on test-based performance for 4th and 8th graders and parent opinions about their children's school. It also included student flow data (promotion, retention, and dropout rates), school characteristics (e.g., average class size, share of teachers with college degrees) from the annual school census, student information (e.g., family socioeconomic status) from questionnaires attached to statewide achievement tests, and principals' statement about their management style. Whenever possible, comparative municipal and state averages of key indicators were provided so parents and teachers could compare the performance of their school with that of neighboring schools. Schools were also reported to be performing at, below, or above their expected performance, controlling for the socio-economic background of the students.

The three-page summary of indicators was disseminated to parents and teachers through various local-level workshops, and results were published in the state education secretariat's monthly newsletter and widely disseminated through press releases and press conferences. While no rigorous evaluations of this experiment have been undertaken, anecdotal evidence suggests positive results. Parents engaged in discussions with teachers about how they might improve school performance and, through school councils, increased their voice in policy debates about education.

Source: Burns et al., 2011 and Winkler, 2004.

autonomy affects student achievement negatively in developing and low-performing countries but positively in developed and high-performing countries (Hanushek et al., 2011). Furthermore, recent empirical evidence from Latin America shows very few cases in which school autonomy made a significant difference in learning outcomes – in most of the 30 cases examined, Patrinos (2011) finds that school autonomy was increased through simple mechanisms for increasing parent participation and financial accountability, but with little consequence to educational personnel. The study strongly suggests that giving schools operational autonomy can have a significant impact on learning if it affects teacher motivation. All of these findings indicate that increased autonomy across the board may not be desirable – perhaps autonomy could first be increased for better-performing schools and delayed for other schools until they have a sufficient level of capacity and proper accountability for results.

2 Strengthening the use of information to hold teachers and schools accountable for performance

It would be useful to make data on standardized exams available so teachers and schools can be held accountable. As discussed earlier, while national-level results for standardized exams are publicly available, school-level results are not. Making school-level results publicly available would enable key stakeholders to monitor and evaluate performance effectively. Making assessment results more readily available has helped improve state-level accountability and student achievement in the United States (Hanushek and Raymond, 2005; Carnoy and Loeb, 2002), Brazil (Burns et al., 2011), and Mexico (Alvarez et al., 2007).[29] A particularly inspiring example of an effort to generate and disseminate information to improve education service delivery is the experimentation with school report cards in Brazil conducted between 1999 and 2002 (see Box 4.1).

Strengthening the linkage between teacher/school evaluation and student performance could help incentivize teachers and schools to improve the quality of teaching. In evaluating teachers and schools, greater emphasis could be placed on improvements in learning outcomes, while taking into consideration differences in student background characteristics. Appropriate incentives for education personnel that are directly linked to improvements in student learning could

[29] Using PISA 2012 data, Lathapipat (2015) finds evidence that teacher evaluation and reward mechanisms that are directly linked to student learning outcomes have positive impacts on student performance in Thailand. Achievement data disclosure is also found to have significant positive impacts for schools throughout the entire performance distribution.

Box 4.2
Mexico's reforms to increase parental participation

Mexico's school-based management (SBM) programs grew out of a concern for equity and for poor, rural, and heavily indigenous schools, which led to a large-scale compensatory education program. That program included a small-scale parental participation program, the Support to School Management (or AGE), introduced in 1996. AGE consists of monetary support and training to parent associations. The parent associations can spend the money for the purpose of their choosing, although spending is limited to small civil works and infrastructure improvements. They are not allowed to spend money on wages and salaries for teachers. Despite being a limited version of SBM, the AGEs represent a significant advance in the Mexican education system, where parent associations have tended to play a minor role in school decision-making. The AGE financial support consists of quarterly transfers to APF school accounts, varying from USD 500 to USD 700 per year according to the size of the school.

AGE helps generate significantly higher levels of school participation and communication – both among parents, and with teachers and school principals – because of the projects that parent associations undertake, but more so because of the training they receive and the meetings they undertake. The AGE helps articulate expectations and promotes social participation. Many parents believe that the AGEs put pressure on school principals and teachers to help their children. AGE also motivates parents to follow their children's progress. Rigorous impact evaluations have shown that AGE improves parental participation and improves the school climate (Gertler et al., 2008). It has also been shown that AGE leads to improvements in schooling outcomes such as reduced grade repetition and failure, and better test scores (Shapiro and Moreno, 2004; Lopez-Calva and Espinosa, 2006).

Mexico's successful experience with SBM in rural areas led to the creation of an urban, now nationwide, more advanced program known as the Quality Schools Program (PEC) in 2001 with the goal of expanding autonomy and improving learning in Mexican schools. Participation in PEC entails the following: preparation of a plan by staff and parents of a school that outlines steps for improvement; five-year grants to schools to implement the activities; parental participation in designing and implementing plans; and training of school principals. Several qualitative evaluations find positive effects on test scores, with the largest gains in schools that had the poorest students, and a positive impact on school climate and processes (Loera 2005). PEC also leads to higher accountability and transparency levels (Patrinos and Kagia, 2007). After only a few years of implementation, participation in PEC significantly decreases dropout rates, failure rates, and repetition rates (Skoufias and Shapiro, 2006).

Source: Barrera et al. (2009), quoted in Patrinos et al. (2010).

be explored. Real consequences for poor performance could also be adopted to help ensure that students are being taught by high-caliber, effective teachers. As documented in Vegas (2005), international evidence shows that teachers respond to incentives. International experience also offers lessons on the pitfalls to avoid (e.g., teachers could stop cooperating or could start teaching to the test). Chile's SNED program[30] offers one example: since 1996, monetary bonuses have been offered to schools that show excellent performance in terms of student achievement. Teachers in winning schools receive what has typically amounted to half of one month's salary, or between 5-7 percent of a teacher's annual salary. Although impact evaluations of the SNED are difficult due to the absence of a natural control group, Vegas (2005) provides some preliminary evidence that the incentive has had a cumulative positive effect on student performance for those schools facing relatively good chances of winning the award.

In addition, increasing the transparency of school budgets and allocations would help stakeholders hold schools accountable for resource usage. To improve transparency, schools could be required to publish their budgets, while local authorities could be required to publish the allocation of resources across schools (through a transparent and equitable per-student funding formula, as discussed below). Such transparent per-student allocation formulae are used in a number of countries around the world, including Romania (since 2009), Bulgaria (since 2006), and many others (Sondergaard et al., 2011). This would enable parents and communities to monitor the efficiency of resource usage by their schools. As illustrated by Mexico's reforms to increase parental participation

[30] SNED stands for the *Sistema Nacional de Evaluación del Desempeño de los Establecimientos Educacionales Subvencionados* program.

(Box 4.2), an increased role for parents in holding schools and teachers accountable for performance can have a significant impact on schooling outcomes.

B Reducing inequities in the education system

The growing inequities in education call for a shift from focusing on providing schooling access to focusing on providing a quality education in Thailand's small village schools, which are at the heart of this problem. The overall objective of this shift would be to bring learning standards everywhere to the same level as Bangkok. Furthermore, in focusing existing resources more strategically so they can be put to optimal use in improving learning outcomes where help is needed most, such reforms have the potential to improve the efficiency of Thailand's education spending tremendously.

This shift could build on existing programs such as OBEC's "Educational Opportunity Expansion School" program. As mentioned in Chapter 2, this OBEC program, which was introduced over two decades ago, extends primary schools with three more grades to allow them to offer secondary education. Although this helps expand access to secondary education, these expanded primary schools are most likely the schools that are struggling to provide a quality education. With sufficient staffing and resources, this OBEC program could provide a platform for new initiatives that shift the focus from improving access to education to improving the quality of education provided, not only at these secondary schools but also more broadly for all small and rural primary schools.

Given the large scale and complexity of the challenge and the different circumstances facing each of Thailand's 19,864 small schools,[31] a "one-size-fits-all" and/or a top-down approach is unlikely to work. More promising approaches would place the need of communities at the forefront with OBEC providing overall leadership and direction, providing incentives to ESAs and local communities to identify solutions, anticipate and address bottlenecks, and share best practices on how to use resources more effectively. At the same time, OBEC could also explore some more overarching "structural" options for addressing teacher shortages such as improving the incentives for teachers to work in remote areas and providing more support on how to provide multi-grade teaching effectively. These options are discussed in greater detail below.

1 Utilizing existing resources more effectively

Thailand is in the fortunate position of having the opportunity to improve its resource use without having to go through the difficult transition process faced by other countries in similar situations. As discussed earlier, Thailand's oversized school network no longer fits the current and projected school population. Unlike countries in Eastern Europe which face a similar problem, Thailand fortunately does not face a financial necessity to downsize (in part, because Thailand does not have large and growing social assistance outlays, as is the case in aging Eastern Europe); rather, the impetus for addressing this problem in Thailand is to create optimal learning environments and make the best use of the teacher workforce. Thailand thus has some breathing room to carefully plan for a transition to a smaller network, learn what works, and bring stakeholders on board. Because the Eastern European countries waited until they faced a fiscal crunch, by the time they had to act, they were faced with the difficult challenge of having

[31] Recall that the previous chapters utilized OBEC's definition for a small school, which refers to a school with less than 120 students enrolled. As mentioned earlier, this standard definition can be problematic in certain contexts as it does not allow direct comparisons to be made between schools that offer different numbers of grade levels. This chapter therefore uses a measure that is comparable across schools: a small school is defined here as a school with 20 students or less per grade on average.

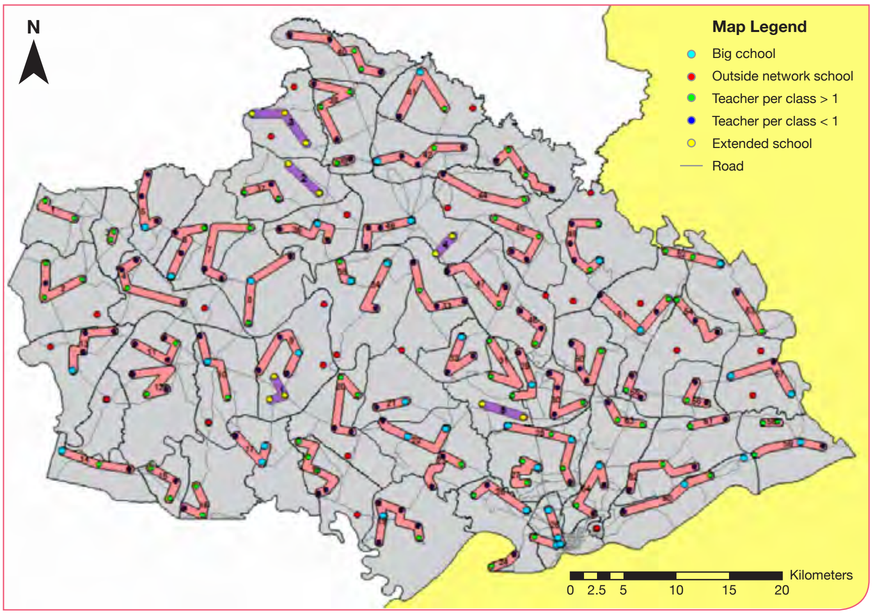


Figure 4.1
Example of school mapping exercise – Ubon Ratchathani province (Education service area 1)

Source: School mapping exercise carried out for this report.

to lay off 10-20 percent of the teacher workforce.[32] In contrast, Thailand could embark on a 10-year journey to consolidate its school network without having to lay off a single worker in the process.

Broadly speaking, Thailand's 10-year journey to improve the use of existing resources and address teacher shortages would likely involve a reorganization of schools through a combination of approaches. These approaches could include school mergers, school networking, and redefining schools. Each of these options is described in greater detail below.

A careful mapping of schools shows that 85 percent of small schools are located in relatively close proximity to other schools and so could be reorganized relatively easily without impairing access to education.[33] The vast majority of small schools are located within 20 minutes from another school (16,943 out of 19,864 small schools[34]). As such, with careful planning and support, these schools could be reorganized into fewer but larger and better resourced-schools (which an analysis of Thailand's assessment data in Annex A4 shows would provide high-quality education[35]). The remaining 15 percent (or 2,921) of small schools are isolated, with no other schools nearby.[36] These schools are unable to share resources with other schools due to their remote locations and should not be merged, since access would be adversely affected. Figure 4.1, which presents a visualization of the school mapping exercise conducted for schools in Education Service Area 1 of Ubon Ratchathani province, illustrates that the majority of small schools are located in close proximity to each other or to other

[32] The challenges faced due to dwindling student numbers in Eastern European countries is well-documented in World Bank public expenditure reviews, see for example World Bank (1998): "Romania Public Expenditure Review," World Bank (2012): "Bulgaria: Public Expenditure for Growth and Competitiveness," and World Bank (2013): "Serbia: Municipal Finance and Expenditure Review."

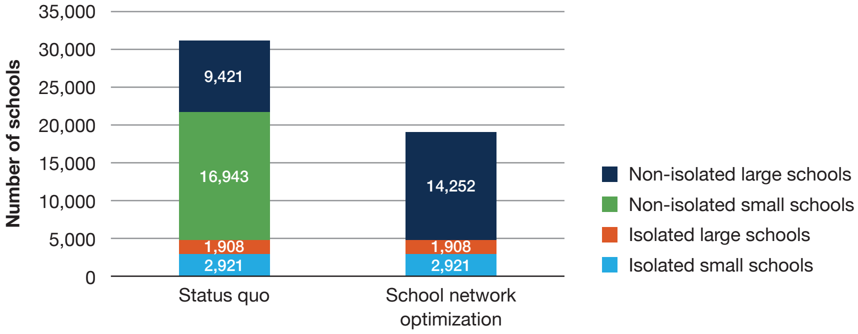
[33] An accompanying study to this report ("Grouping Thailand's Schools into Four Categories") was conducted by the Thailand Development Research Institute Foundation (TDRI) under the guidance and contract with the World Bank Group. The school grouping exercise classified OBEC schools into four distinct categories: 1) isolated small schools, 2) isolated large schools, 3) non-isolated small schools, and 4) non-isolated large schools. "Small schools" were defined as those with 20 students or less per grade.

[34] These numbers exclude 137 schools with no students in 2010.

[35] Annex A4 presents empirical evidence that staffing classrooms in poor schools with adequate numbers of good-quality teachers could have a large impact on student learning.

[36] A school is defined as isolated if there is no school of a similar type (meaning some/all grade levels taught at the schools overlap) located within 20 minutes from it or if the sub-district where the school is situated is more than 500 meters above sea level.

Figure 4.2
Nationwide school network optimization



Source: Authors' calculations based on OBEC school data 2010.

larger schools (as indicated by the pink lines connecting the schools). The paragraphs below discuss how resource sharing could help such schools improve the utilization of resources (particularly teachers) and thus improve student learning.

School mergers

School mergers would involve merging two or more schools within the same area to form a bigger school, with the objective of creating larger, better-resourced schools rather than spreading resources thinly across numerous small schools. The school mapping exercise suggests that at the national level, the 16,943 non-isolated small schools could be merged with each other and/or to the 9,421 non-isolated large schools to create 14,252 large schools (a total reduction of 12,112 schools) without impairing access to education. This represents around 39 percent of total schools under OBEC supervision. The hypothetical reform would reduce teacher shortages substantially, reducing the total number of classrooms staffed with less than one teacher from 110,725 to just 12,600 and reducing the total number of understaffed schools from 14,159 to only 1,739. The reform would also result in a massive increase in the average number of teachers per classroom, from 1.15 to 1.39 (an increase of more than 21 percent) – importantly, without needing to hire an extra teacher.

While school mergers can bring major efficiency gains and are relatively quick to implement, international experience shows that they need to be planned with extreme care and sensitivity to local concerns. Local stakeholders – parents, students, local administration, and local politicians – may understandably be resistant to the idea of merging their local schools with others. In anticipation of this, numerous measures could be adopted to help alleviate such concerns, such as:

- Establish the notion of a "central school" (or "receiving school"), providing additional resources to build their capacity to absorb more students from nearby areas (e.g., through additional support teachers, transport, canteen meals, and semi-boarding facilities). Bulgaria introduced such schools in 2008 as part of an effort to consolidate its school network, and Moldova introduced such schools with the support of a World Bank project starting in 2013.[37]
- Establish the notion of a "protected school" as a school that cannot and should not be consolidated (otherwise access to education would be hurt), using clearly defined and objective data-driven criteria. Once such schools are clearly defined (and distinguished from other small schools), it will be easier to mobilize additional resources in terms of teachers and materials. Again, the Bulgaria experience provides an example of this.
- Provide bussing and/or pay for transportation. For example, ahead of their big attempts at merging schools, Bulgaria and Moldova purchased

[37] For a detailed description of the policy measures adopted by Bulgaria, please see Ministry of Education and Science (2008): National Report on the Development of Education in Bulgaria (available at http://www.ibe.unesco.org/National_Reports/ICE_2008/bulgaria_NR08.pdf). For details on the Moldova project, please see World Bank (2012): Project appraisal document for Moldova Education Reform Project.

minibuses and distributed them to local authorities. This was done as part of a dialogue with local governments about the constraints they faced in consolidating their networks.

- Provide stipends (conditional on attendance) to students involved in school mergers. Providing such conditional stipends might help reduce resistance from parents and also help reduce the risk that children might drop out (as a result of having to move to a different school with a better but also more challenging learning environment).[38]
- Give parents a school choice if their closest school is to be merged with another – they might wish to send their child to the new merged school, or they may prefer a different school.
- Provide additional academic support to students in their new school. Evidence on school mergers in the United States (which is one of only a few places where rigorous analysis has been carried out to document the impact of mergers on students' learning outcomes) suggests that students moved tend to struggle academically during their first year in the new school. Given the large differences in performance between Thai students, such difficulties can be expected in Thailand, as well. As such, it makes sense to have well-designed programs of support ready for students during their first difficult year(s).[39]
- Carefully monitor the attendance and academic performance of children involved in a merger to ensure that no harm is done and to gather information on the impact of the policy efforts.
- Expand boarding facilities at high-performing secondary education schools to ensure that children in remote areas can access these schools – again, doing this as part of a program to designate "central schools," giving certain schools a special status and more resources.

One successful example of a school merger in Thailand is the Jai-Prasan-Jai model in Lopburi province. In this case, OBEC officials selected one school to teach all levels, so the students, teachers, and principals of nearby schools all moved to this school. The school facilities with no students are still maintained for local events and community use.

A rural primary school merger program in China is one of the few for which rigorous evaluation of program impacts on student academic performance has been undertaken. Evidence from the impact evaluation indicates that students' academic performance improved significantly from the transfer to better-resourced schools. However, there are also indications of negative boarding school effects (see Box 4.3).

School networking

School networking would involve reorganizing classes and the structure of schools within the same area so they can share resources without consolidating schools. All stakeholders – including the Ministry of Education, ESA, local authorities, principals, teachers, and parents – would work together to form a network and design the shared education programs. This approach offers the advantage of being less likely to meet resistance compared with school mergers, so it is more likely to be implemented. However, the networking process could take a longer time to implement and could fail as more people are involved in the process.

Several useful examples of school networking and shared education programs can be found within Thailand:

- In the Kangjan model in Loei province, four schools (with a total travel distance of 10 kilometers between schools) agreed on the education years (grades) for which they would like to be responsible. Students are moved to the school that teaches their grades. Prior to the establishment of the network,

[38] Bulgaria provides painful lessons of what can happen if care is not taken to ensure that children affected by a school reorganization stay in school. Schady et al. (2009) conducted an impact evaluation that showed that children affected by a school merger were far more likely to drop out than similar children not affected. See Schady, N., L. Sondergaard, C. Bodewig, T.P. Sohnesen. 2009. "School Closures Impact on Dropout Rates: Main Results and Lessons for the Future." World Bank and the Task Force on Impact Evaluation for more details. See also World Bank (2010): A review of the Bulgaria school autonomy reforms.

[39] The evidence on U.S. school mergers is summarized in PACER (2013): "School closings policy," Issue Brief.

Box 4.3
China's rural primary school merger program

During the late 1990s and early 2000s, China embarked on an ambitious primary school merger program in an effort to improve the overall quality of education and address rural-urban disparities. Students in small rural village schools were transferred to new and larger centralized schools in towns and county seats, and the number of primary schools in rural China fell by 24 percent from 2001 to 2005.

Taking advantage of scale economies, these new schools were equipped with better facilities and higher-quality teachers. Unlike in the small rural schools, teachers in these new larger schools were able to focus on a single grade (and in many cases, on a single course). Furthermore, while the curriculum in small rural schools was often restricted to math and Chinese language due to teacher shortages, the new central schools were able to offer a much richer curriculum. The merger program also entailed building boarding facilities since these new schools were often located far from students' homes. These youngsters were encouraged or sometimes required to leave the comfort of their homes and care of their parents to board at schools during the week.

Mo et al. (2012) conducted an impact evaluation in one of the poorest counties in Shanxi province, which is also one of the poorest in China. The study evaluated all 7th graders in all ten junior high schools in the county at the beginning of the 2009 academic year. It found that transferring from small village primary schools to more centralized town and county schools had large positive and statistically significant impacts on standardized math test results.[40] However, the study also found significant negative effects when students stayed in boarding schools. Nevertheless, in comparing the transfer effect with the boarding effect, the study found that even if students boarded after transfer, they still benefited academically from transferring to new and better-resourced schools. The study suggests that extra attention be given to attenuating the negative boarding school effect so students might be able to take more advantage of the additional resources made available by the program.[41]

Source: Mo et al. (2012)

each of the four schools taught eight classes with three teachers per school, which meant that each teacher needed to teach at least two classes. With the school network, each school now has two classes and three teachers, which means that each class now has at least one teacher. After the intervention, student performance in the standardized O-NET exams improved significantly (Box 4.4).

- In the Tripakeechan 1 model in Janthaburi, each school teaches pre-primary students, but the primary and secondary students and teachers have been merged together in one school.
- In the Ban Yang Noi model in Ubon Ratchathani province, one school in the area teaches core subjects to all students from all small schools in the area three days a week. For the rest of the week, students study at the schools in which they are enrolled.[42] One major limitation of this model is that one of the schools must have the capacity to accommodate all students.

Redefining schools

Another option would be to explore whether some schools can be redefined to cover fewer and lower grades. Some of the schools under the OBEC program described above that are not providing a quality secondary education could perhaps be converted back into a primary school, offering instead to pay for transportation of students in that area to a nearby secondary school. Similarly, another option might be to convert a poorly performing primary school currently offering all six grade levels into a new type of school only offering pre-school and Grades 1 and 2 (and offer to transport children from Grade 3 onward to better schools). The advantage of this approach is that every community would keep some

[40] The test was a 30-minute standardized math test administered by the researchers themselves to ensure that there was no coaching for the test before the survey.

[41] As mentioned in Mo et al. (2012), a number of studies found that when boarding schools in the program were poorly managed, students performed worse in school. Some studies also found that poor nutrition and health in some boarding facilities negatively affected educational performance (Luo et al., 2009 and Shi, 2004).

[42] OBEC and ONESQA (2012).

Box 4.4
The Kangjan case study of school networking

Compared to other merger/networking models in Thailand, the Kangjan networking model is relatively well-documented. Tables B4.1 and B4.2 compare school conditions before and after the networking in terms of number of students, classes, and teachers in each school; number of students who had to travel to other schools after the intervention; and average O-NET scores by subject. The networking started in 2011 with four schools in ESA 1 in Loei province. The four schools, which are located within 10 kilometers of each other, are (1) Bann Namo, (2) Bann Pak Mung Hauy Tab Chang (Pak Mung), (3) Bann Hat Kampee, and (4) Bann Cokwao. Prior to 2011, all four schools taught pre-primary 1 to primary 6.

With the same total number of teachers and students as before, the school networking organized classes much more efficiently. Prior to the establishment of the network, each school had three teachers (excluding the principal) and taught eight classes, so they were critically short of teachers. After the networking intervention, the number of classrooms in each school was reduced to two so each class/grade had 1.5 teachers on average. Table B4.1 also shows that 180 out of 247 students needed to move to other schools after the networking.

Table B4.1 Pre- and post-networking school conditions

	Schools	Number of students in each grade									Number of students transferred to other schools	Number of classes	Number of teachers
		K1	K2	P1	P2	P3	P4	P5	P6	Total			
Before network	Cokwao	3	4	4	1	4	4	7	6	33	25	8	3
	Hat Kampee	11	10	10	8	9	8	16	6	78	56	8	3
	Pak Mung	10	8	6	11	6	9	5	6	61	42	8	3
	Namo	8	8	10	10	10	9	12	8	75	57	8	3
	Total	32	30	30	30	29	30	40	26	247	180	32	12
After network	Cokwao					29	30			59		2	3
	Hat Kampee							40	26	66		2	3
	Pak Mung		30		30					60		2	3
	Namo	32		30						62		2	3

Table B4.2 compares the school average O-NET test results in eight core subjects before and after the networking. The table also shows the corresponding national average scores in 2010 and 2011. As shown in the last column, test scores for students in the network improved substantially more than the national average in all subjects except physical education over the 2010-2011 period.

Table B4.2 Impact on student performance in O-NET exams

Subject	Kangjan			National			Changes in Kangjan model minus changes in the national average
	Year 2010	Year 2011	Changes from 2010 to 2011	Year 2010	Year 2011	Changes from 2010 to 2011	
Thai	29.8	49.2	19.4	31.2	50.0	18.8	0.6
Mathematics	26.5	53.9	27.4	34.9	52.4	17.6	9.9
Science	38.8	43.6	4.8	41.6	40.8	-0.7	5.5
Social science	42.1	47.9	5.8	47.1	52.2	5.2	0.7
Physical education	51.5	51.9	0.5	54.3	58.9	4.6	-4.1
Arts	33.1	44.8	11.7	41.1	46.8	5.7	6.0
Vocational skills	46.6	53.9	7.3	52.5	55.4	2.9	4.4
English	13.9	41.5	27.6	21.0	38.4	17.4	10.2

Source: TDRI (2015).

type of school while initiating a dialogue about how to provide a quality education in the grades where better teachers are needed. Ideally, this option would be pursued as part of a "networking strategy" to ensure that each grade level is filled.

2 Increasing/improving financing

While increasing funding for small schools could help reduce disparities, the key question is whether it is possible to provide the level of resources necessary to bring learning standards to Bangkok levels. Small schools in

Thailand are so underfunded that per student spending for small schools would need to be increased substantially. For example, schools in Mae Hong Son would require at least[43] a 64 percent increase in the average per-student amount in order to provide students in the province with adequate resources to attain the same level of educational outcomes as students in Bangkok.[44]

Calculating the estimated change in the average personnel salary per student[45] necessary for each province to bring their school standards up to Bangkok standards (in terms of teacher quality and number of teachers per classroom[46]) reveals that total recurrent spending on OBEC schools would need to increase by a massive 31 percent. The average per-student public subsidy would rise from THB 31,475 to THB 41,250 per year. Overall, the share of government expenditure on education would increase by nearly 5 percentage points, from 24.0 to 28.8 percent.

Even if financing could be increased significantly, the impact would depend on whether enough qualified teachers could be mobilized, particularly for village schools. Providing all schools with the level of teacher quality and number of teachers per classroom necessary to achieve Bangkok-level learning standards would require the monumental task of recruiting, training, and deploying 164,000 new teachers. This represents an increase of over 40 percent of the teaching force in Thailand in 2014. Therefore, this is not just a fiscal challenge – it is highly unlikely that so many quality teachers could be hired, trained, and would be willing to go to small, remote village schools.

Another financing option that could incentivize schools to become larger and more efficient would be to finance schools based on the number of students they have enrolled rather than on the inputs they employ. By tying money to the number of students enrolled in an ESA (as opposed to how many schools there are and/or how many teachers are employed), OBEC could incentivize local communities to seek ways to create larger schools. This type of “demand side financing” has been the most widely adopted policy change in Eastern Europe, where student numbers have been plummeting for more than two decades.[47] The funding formula[48] could be based on an “adequacy concept,” meaning that the per-student amount allocated should in theory be adequate for all schools to reach a pre-specified “student performance standard” (but not so generous that it fails to provide the proper incentive[49]). This mechanism is more equitable since it creates a direct link between funding and the purpose of the activity funded. However, shifting to such financing would have to be done gradually, since all new formulas would end up with “losers” (i.e. areas and schools that would get less under the proposed formula than what they are getting with the current system) and “winners,” and the only way for “losers” to be able to adjust would be to downsize. Thus, schools and ESAs would need time to prepare for a new formula.

[43] “At least” because the estimate has not taken into account the required incentives (such as salary increases) needed to attract teachers and other education personnel to rural schools.

[44] This is estimated using an educational cost function-based per-student funding formula (see Box A5.1 in Annex 5) which takes into account differences in student performance, school and class sizes, and the school student-body characteristics (poor students, students with disability, etc.). For example, students in small remote schools are poorer and less-prepared academically, so it will take more resources to bring those schools to Bangkok-level learning standards.

[45] Only the salary portion of the per-student subsidy was calculated since the non-salary portion does not vary with teacher quality or the intensity of staffing (see Section A5.2 in Technical Appendix to Annex 5 for details of the non-salary items).

[46] An input-based approach was employed to approximate the increase in the average salary per student amount. Specifically, we used the teacher salary regression equation (Table A5.2 in Technical Appendix to Annex 5) to estimate the change in the provincial average salary per student if schools in the other provinces were to have the same proportion of teachers with higher than bachelor’s degree qualification, teachers with the same average experience, and classrooms staffed with the same number of teachers as the average school in Bangkok.

[47] For example, see Juan Diego Alonso and Alonso Sanchez (2011): Reforming education finance in transition countries” or Sondergaard et al (2011).

[48] An example application of the funding formula is given in Annex 5 (Table 5.1). Interested readers are referred to Technical Appendix to Annex 5 for details of the computation of the “cost function-based” per-student funding formula for Thailand.

[49] See discussion in Box A5.1 in Annex 5.

3 Improving teaching resources for small and remote schools

In order to provide better education to students in severely under-resourced schools, OBEC could introduce measures to improve training in multi-grade teaching. Schools with severe teacher shortages could then consolidate classrooms and provide multi-grade education more effectively. Colombia's "Escuela Nueva" (New School), which is widely recognized as a successful example of rural primary educational innovation, accepts multi-grade teaching as an unavoidable condition in small schools of rural areas. It encourages the development of special materials and teaching methods for multi-grade teaching. Notably, the academic achievement of students in Escuela Nueva is even higher than in urban schools (UNESCO, 2004). After officials from the Ministry of Education in Vietnam visited Colombia, the Ministry launched a version of Escuela Nueva aimed at improving the quality of rural schools in Vietnam.

OBEC could also explore options for providing stronger incentives for quality teachers to be deployed in small, remote schools. As shown in the health sector (and documented in Putthasri et al., 2013), taking an evidence-based approach is more useful than trying to find the perfect solution from international experience that will work in the Thai context. In particular, such an evidence-based approach would entail:

1) Acknowledging that there is a problem;
2) Identifying ways to quantify the problem in order to establish a baseline and track progress;
3) Experimenting with different programs to tackle the problem – for example, in health, there have been experiments with the size of the "financial penalty" for shortening mandatory service and with the way/location where doctors did their clinical training;
4) Evaluating which experiments have worked; and
5) Building on the experiments that worked.

4 Increasing awareness and understanding of the small school challenge

Decisions on the approach to reducing disparities in education could benefit from further research to understand the small school challenge, particularly at the primary school level. Much of the analysis conducted for this report utilized the available information for a small sample from PISA survey data, namely 15-year-olds in secondary schools. Because many students do not even make it to the secondary level, it is important to know what is happening at the primary level. One possible starting point would be to use data from the Trends in International Mathematics and Science Study (TIMSS) results for 4th graders to examine whether the performance gap between village schools and large city schools is already there at grade 4 or whether it only appears later in the school cycle. As noted in Chapter 2, another area for further work is to understand the factors that have contributed to the impressive gains made among small town schools, which could help inform policies aimed at the village level.

The proposed reform options to improve education system performance and address educational attainment inequality could be piloted first in some areas. As discussed above, a few examples of school mergers or school networking can be found in Thailand. However, it appears that none of them have been subjected to rigorous evaluation. The same can be said of financing and school-based management reform experimentation. International experience suggests that it would be a good idea to conduct well-planned pilot studies on the reforms whenever possible so policymakers and local communities can better understand their impacts on students, teachers, schools, communities, and other stakeholders. Well-informed decisions could then be made to scale up the options that have demonstrated favorable impacts.

Thailand's leaders have the opportunity to champion education reform – including effective ways to address the challenges of small schools and improve the quality of learning. A lively public debate can make much difference.

The little public debate that has occurred on small schools usually revolves around drama created around one of the few school closures that has taken place in past years. Furthermore, in policy cycles, the debate tends to focus on what seems impossible to fix—the small, isolated schools and their unique, large challenges – as opposed to the small schools that are not isolated. Greater public awareness and discussion is needed on the poor quality of Thailand's small schools and on the opportunities for offering a better education to the hundreds of thousands of children currently enrolled in such schools. It is hoped that this report can help contribute to such a dialogue.

Such public debate on education could benefit from the type of institutions which have been guiding some of the major reforms undertaken in the health sector in the past 25 years. Specifically, the Health System Research Institute (HSRI) and the Thailand Health Promotion Foundation (Thaihealth) were instrumental agencies to create and sustain a public debate on the need to reform, and underpin reform proposals with relevant evidence. On the education front, the Quality Learning Foundation (QLF) has the potential to become an agency playing the same role as the Thailand Health Promotion Foundation but it has yet to secure a reliable source of funding.[50]

[50] QLF was established in 2010, through the Prime Minister's Office Regulation on Learning Society BE2553. QLF inherits the system approach from the HSRI and the social mobilisation approach to mobilise multi-sectorial and multidisciplinary partners from both domestic and international level from the Thaiheatlh which has been successful in reforming the health sector in the past 25 years. In the past 5 years, QLF has produced a number of promising policy system researches and evidence-based education reform proposals which have potential to scale-up into a national education reform policy in the near future. For instance, the National Education Accounts (NEA), the Area-based education reform programs and the School-based information system for education decentralisation. As of June 2015, a drafted QLF law is waiting for the cabinet consideration to be passed by the National Assembly.

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Annexes

Annex A2

A2.1. Decomposing the Change in the PISA Test Score Over Time

Theoretical Framework

The focus of this part of the study is on analyzing changes in the PISA test score distribution between two points in time, dated $t = 0{,}1$. The method used here is essentially the first stage of the two-stage decomposition procedure proposed by Firpo, Fortin, and Lemieux (2007) – FFL 2007 from hereon. Assume that the test score function[1] depends on some observed and unobserved attributes (X_i, ε_i) of individual student i indexed by $i \in \{1, \dots N\}$, where $N = N_0 + N_1$ is the total number of the combined observations for both time periods, $X_i \in \mathbb{X} \subset \mathbb{R}^K$, and $\varepsilon_i \in \mathbb{R}$. The test score function can thus be expressed as:

$$Y_{ti} = g_t(X_i, \varepsilon_i) \text{ for } t = 0{,}1 \text{ and } i = 1, \dots, N \quad (1)$$

Define the observed test score for student i as $Y_i = Y_{1i}T_i + Y_{0i}(1 - T_i)$, where $T_i = 1$ if the outcome variable Y_i is observed in time period 1, and $T_i = 0$ otherwise. If we view T_i as a treatment indicator, we can only observe $Y_{0i}|T_i = 0$ for untreated units, and $Y_{1i}|T_i = 1$ for treated units, but not both. Their corresponding distribution functions are denoted by $F_Y^0(\cdot)$, and $F_Y^1(\cdot)$ respectively. In effect, we are faced with a missing data problem. However, it is possible to conceive of the counterfactual quantity $Y_{0i}|T_i = 1 \sim F_Y^C(\cdot)$, whose identification requires further assumptions stated below. In words, the counterfactual test score distribution function $F_Y^C(\cdot)$ is the distribution that would have prevailed under the test score function of year 0, but with the observed and unobserved student attributes (X_i, ε_i) jointly distributed as in year 1.

Denote by q_τ the test score at a particular quantile τ, whose change over time we seek to decompose. The "overall change" in q_τ, $\Delta_O^{q_\tau}$, from date 0 to 1 is divided into the "school quality effect", $\Delta_S^{q_\tau}$, and the "student effect", $\Delta_X^{q_\tau}$:

$$\Delta_O^{q_\tau} = \Delta_S^{q_\tau} + \Delta_X^{q_\tau} = \left(q_\tau(F_Y^1) - q_\tau(F_Y^C)\right) + \left(q_\tau(F_Y^C) - q_\tau(F_Y^0)\right) \quad (2)$$

Assume that (i) the distribution of the unobserved characteristics, ε_i, is independent of T_i after conditioning on observed covariates X_i, and (ii) $c < \Pr(T_i = 1|X_i = x) < 1 - c$ for all $x \in \mathbb{X}$ and for some $c > 0$. Assumption (i) is called the "ignorability of treatment" assumption and is written as $\varepsilon_i \perp T_i|X_i = x$ for all $x \in \mathbb{X}$. Assumption (ii) is called the "overlapping support" assumption. Together, these two assumptions are called the "strongly ignorable treatment assignment" assumptions, and are sufficient for the identification of $F_Y^C(\cdot)$, and ensure that the student effect $\Delta_X^{q_\tau}$ only reflects changes in the distribution of observable student attributes X_i (Theorem 2 in FFL (2007)).

[1] In this study, the test score function is viewed as the "Quality" or effectiveness if the Thai education system in transforming its student characteristics (both observed and unobserved) into learning outcome.

To divide the overall change in test score over time into the school quality and student characteristic effects, we employ a reweighting procedure proposed by DiNardo, Fortin, and Lemieux (1996) – DFL (1996) from hereon. Specifically, the test score distribution functions for each time period is non-parametrically identified from observed data, and their empirical distribution counterparts based on a random sample $\{Y_1, \ldots, Y_N\}$ of size N_t are given by:

$$\hat{F}_Y^t(y) = \frac{1}{N_t}\sum_{i \in I_t} 1(Y_i \leq y), \text{ for } t = 0{,}1 \tag{3}$$

where $I_t = \{i: T_i = t\}$ is the index set for observations at time t and $1(\cdot)$ is an indicator function equal to unity if the expression in the parentheses is true. Note also that $F_Y^t(y)$ can be written as:

$$F_Y^t(y) = \int_{\mathbb{X}} F_{Y|X}^t(y|x)dF_X^t(x) \tag{4}$$

where $\mathbb{X} \subset \mathbb{R}^K$ is the support of X and $F_X^t(x)$ is the conditional distribution of $X|T = t$. Assuming the "strongly ignorable treatment assignment" assumptions discussed above and using equation (4), the counterfactual distribution function is well-defined and can be constructed as follows:

$$\begin{aligned} F_Y^C(y) &= \int_{\mathbb{X}} F_{Y|X}^0(y|x)dF_X^1(x) \\ &= \int_{\mathbb{X}} F_{Y|X}^0(y|x)\frac{dF_X^1(x)}{dF_X^0(x)}dF_X^0(x) \\ &= \int_{\mathbb{X}} F_{Y|X}^0(y|x)\psi_X(x)dF_X^0(x) \end{aligned} \tag{5}$$

where $\psi_X(x)$ is the reweighting function. Applying Bayes' rule to the function in the same fashion as DFL (1996), the "inverse probability weighting function" or IPW is expressed as (Theorem 1 in FFL (2007)):

$$\psi_X(x) = \frac{\Pr(T=1|X=x)\Pr(T=0)}{\Pr(T=0|X=x)\Pr(T=1)} = \left(\frac{p(x)}{1-p(x)}\right)\left(\frac{1-p}{p}\right) \tag{6}$$

where $p(x) = \Pr(T = 1|X = x)$ is the propensity score and can be estimated using a flexible logit regression, and $p = \Pr(T = 1)$. The empirical IPW is normalized to sum to unity for convenience:

$$\hat{\omega}_X(X_i) = \frac{\hat{\psi}_X(X_i)}{\sum_{j \in I_0}\hat{\psi}_X(X_j)}, \text{ for } i \in I_0 \tag{7}$$

The empirical counterfactual test score distribution is thus given by:

$$\hat{F}_Y^C(y) = \sum_{i \in I_0}\hat{\omega}_X(X_i)1(Y_i \leq y) \tag{8}$$

Equations (3) and (8) allow us to estimate the sample quantiles of interest; $q_\tau(\hat{F}_Y^0)$, $q_\tau(\hat{F}_Y^1)$, and $q_\tau(\hat{F}_Y^C)$, which can be used to compute the estimated school quality, $\Delta_S^{q_\tau}$, and student effects, $\Delta_X^{q_\tau}$, as per equation (2).

Notice that the methodology discussed in this section is effectively a generalization of the classical Oaxaca-Blinder decomposition to any marginal quantile of interest. Therefore, if we apply the empirical IPW technique to estimate the means of the various distributions, then the resulting decomposition would be equivalent to that obtained using the classical method.

Decomposing the Change in PISA Reading Score from 2003 to 2012

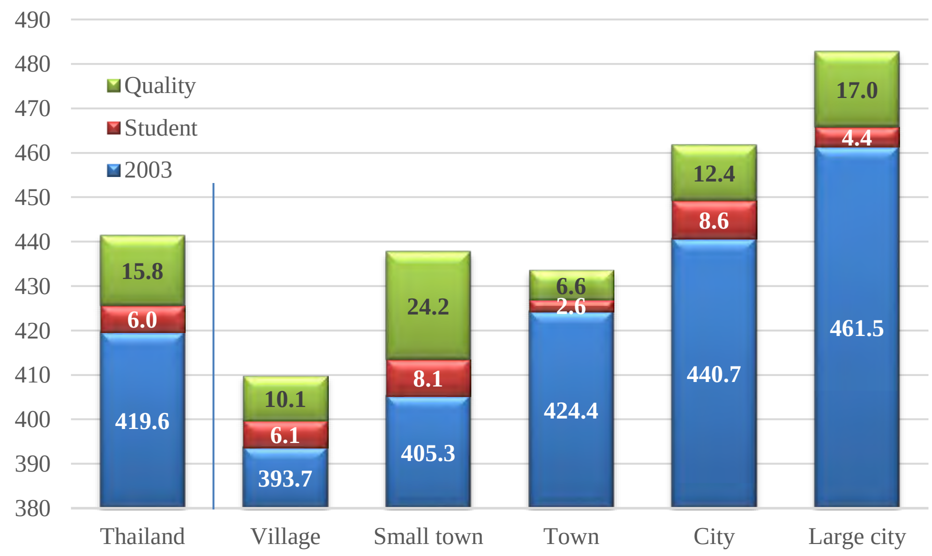
The estimation results from the (flexible) logit regression model are presented in Table A2.1 at the end of this section. The dependent variable is the indicator function which is equal to unity if a student is observed in year 2012 and zero otherwise, while the observable student characteristics (the right hand side variables) used in the analysis include gender, grade level, and the PISA index of economic, social, and cultural status (ESCS). Using the regression coefficients, we are able to estimate the propensity scores and compute the normalized empirical IPW for each individual observation as per equation (7).

First, we demonstrate the IPW technique by applying it to the mean of the test score distribution for 15 year-old Thai students. Specifically, the counterfactual mean test score is computed as follows:

$$\bar{Y}^C = \sum_{i \in I_{2003}} \widehat{\omega}_X(X_i) Y_i$$

This equation is analogous to equation (8) and represents the average test score that would have prevailed under the test score function of year 2003 but with the observed and unobserved student attributes (X_i, ε_i) jointly distributed as in 2012 (sampling weights are also used in the analysis, but are omitted here to simplify notation). The mean test score for each time period is simply $\bar{Y}^t = 1/N_t \sum_{i \in I_t} Y_i$, for $t = 2003{,}2012$.

Figure 2.11. Contributions of Changes in Quality and in Student Characteristics to Changes in PISA Reading Scores in Thailand from 2003 to 2012, by Location



Source: World Bank Staff Calculations based on OECD PISA 2003 and 2012

Analogous to equation (2), the overall change in the average PISA reading scores for Thai students from 2003 to 2012 can be decomposed into the portion attributable to changes in the background characteristics of the student population and the remaining "unexplained" portion, which we interpret as representing improvements over time in the "quality" or effectiveness of the Thai education system in transforming student characteristics into learning outcomes. Specifically,

$$\Delta_O^{\bar{Y}} = \Delta_S^{\bar{Y}} + \Delta_X^{\bar{Y}} = (\bar{Y}^1 - \bar{Y}^C) + (\bar{Y}^C - \bar{Y}^0) \qquad (9)$$

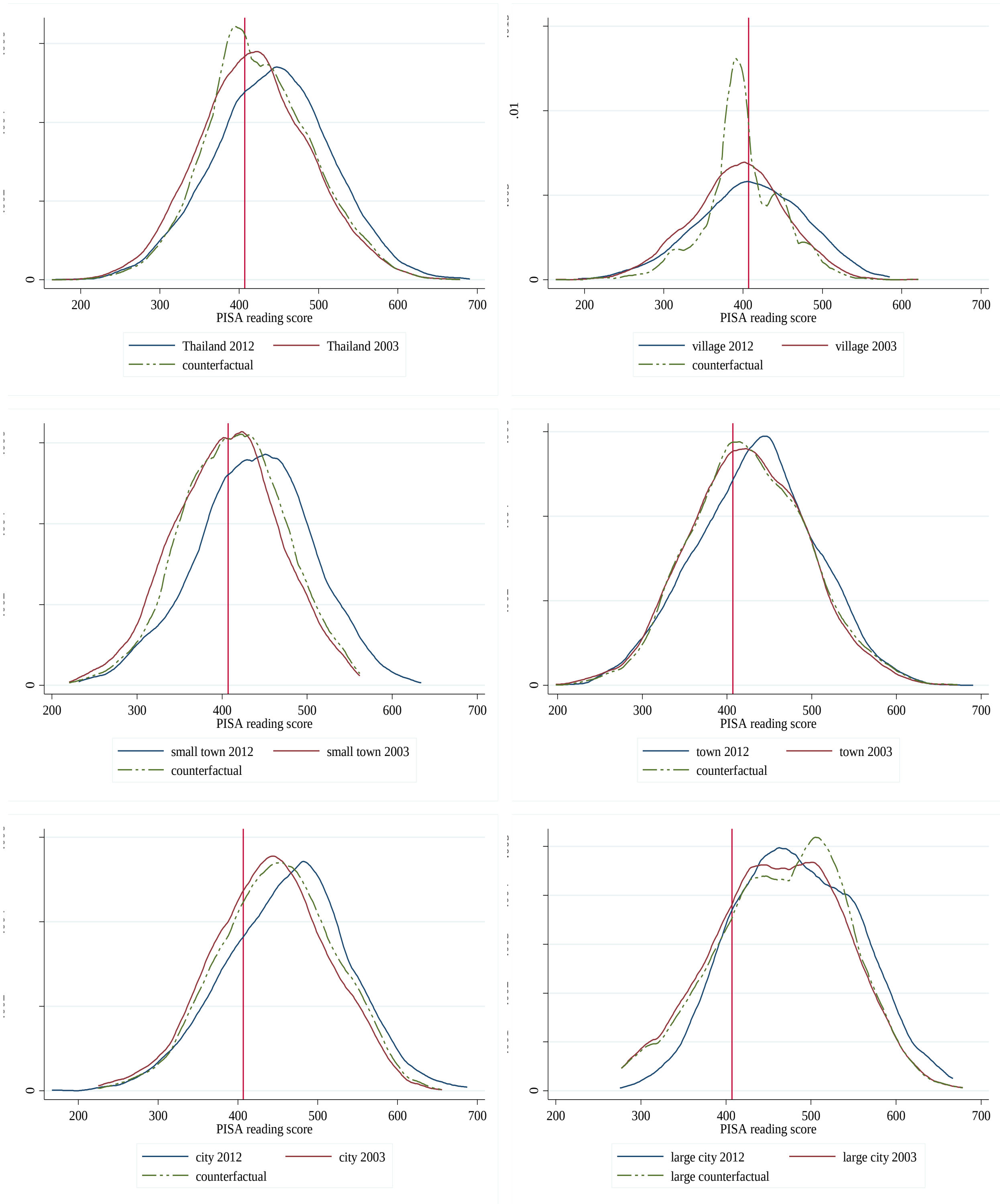
The decomposition results for Thai students on the whole are shown on the left-most bar in Figure 2.11 in Chapter 2, which is reproduced here for ease of exposition. It is estimated that improvements in the observable characteristics of the student population accounted for 6 points of the 21.8-point increase in the overall PISA reading scores for Thailand from 2003 to 2012. This means that the remaining 15.8-point increase can be attributed to an apparent improvement in educational "quality."

The decomposition analysis can also be carried out for subgroups of the Thai student population. Figure 2.11 presents the decomposition results for students attending schools in five distinct locations of the country: villages, small towns, towns, cities, and large cities (see Table A2.2 for the total number of 15-year-old students attending schools by location as well as their average reading test scores in each year). The disaggregated analysis is simply done by applying equation (9) to the student population subgroup of interest.

Much richer analysis can be done if we look beyond the effects at the means. As mentioned earlier, the FFL (2007) decomposition framework allows us to generalize the classical Oaxaca-Blinder decomposition to any marginal quantile of interest. We apply the reweighting procedure to analyze changes at different quantiles of the test score distribution. The resulting distributions of PISA Reading Scores in 2003, 2012, and the counterfactual distributions (produced using equations (4) and (5)) for Thailand and for subgroups of the student population in five different areas are shown in Figure A2.1. Also drawn on each chart in the Figure is a vertical line at the PISA reading score of 407, which is defined as the threshold level of functional literacy.

The decomposition of the overall changes in the test score from 2003 to 2012 into the quality and the student effects across quantiles of the test score distribution are shown graphically in Figure 2.9 in Chapter 2. Notice that for ease of exposition, we have included only the "Overall effect" and the "Quality effect" line graphs in these charts. From equation (2), we can easily see that the gaps between these two line graphs necessarily represent the effects on test scores of changes in the observed student characteristics over time.

Figure A2.1. Distributions of PISA Reading Scores in 2003, 2012, and the Counterfactual Distributions (the vertical lines represent the threshold level of functional literacy)



Source: World Bank Staff Calculations based on OECD PISA 2003 and 2012

Table A2.1. Logit Regression Results

Variables	Dependent variable: Year 2012
Female	-0.050
	(0.045)
Grade level: (reference "G7")	
Grade 8	1.895
	(1.346)
Grade 9	2.878**
	(1.286)
Grade 10	4.002***
	(1.287)
Grade 11	4.633***
	(1.296)
ESCS	0.120
	(0.073)
ESCS2	-0.214***
	(0.045)
ESCS3	-0.094**
	(0.041)
ESCS4	0.020
	(0.014)
Location: (reference "Town")	
Village	-0.296***
	(0.070)
Small town	0.452***
	(0.062)
City	0.804***
	(0.063)
Large city	-0.552***
	(0.085)
Intercept	-3.706***
	(1.286)
Observations	11,776
Pseudo R-squared	0.121

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A2.2. Number of 15-Year-Old Students Attending Schools by Location and Their Average PISA Reading Test Scores

	2003			2012		
	PISA reading	# Students	Student share	PISA reading	# Students	Student share
Village	394	170,356	27%	410	110,148	16%
Small town	405	112,541	18%	438	184,211	26%
Town	424	185,551	29%	433	182,739	26%
City	441	78,432	12%	462	173,700	25%
Large city	461	83,602	13%	483	49,959	7%
Thailand	**420**	**630,481**	**100%**	**441**	**700,757**	**100%**

Source: OECD PISA 2003 and 2012

Annex A3

Table A3.1. Key Characteristics of OBEC Schools – by School Size Category

School Size Category	Primary			Secondary			All		
	Average class size	Total # Schools	Per-student subsidy	Average class size	Total # Schools	Per-student subsidy	Average class size	Total # Schools	Per-student subsidy
Less than 50	**4.6**	**3,785**	**53,504**	**4.4**	**10**	**97,653**	**4.6**	**3,795**	**53,635**
50 to 69	**7.6**	**3,296**	**43,144**	**5.8**	**30**	**63,433**	**7.6**	**3,326**	**43,330**
70 to 89	**10.1**	**3,260**	**39,673**	**8.1**	**72**	**58,635**	**10.0**	**3,332**	**40,089**
90 to 119	**13.0**	**3,489**	**36,768**	**10.4**	**217**	**51,818**	**12.8**	**3,706**	**37,672**
120 to 149	16.6	2,878	34,208	12.7	584	45,828	15.8	3,462	36,199
150 to 199	21.2	2,175	30,400	16.6	1,284	38,486	19.2	3,459	33,454
200 to 279	26.0	1,337	27,329	21.6	2,183	33,230	23.1	3,520	31,026
280 to 499	26.3	874	26,368	26.6	2,720	29,383	26.5	3,594	28,656
500 to 749	30.5	324	25,454	29.7	1,032	28,109	29.9	1,356	27,474
750 to 1149	33.1	166	25,634	34.1	493	28,803	33.9	659	28,008
1150 to 1999	36.6	114	25,444	37.8	386	28,960	37.5	500	28,162
2000 or above	41.9	50	25,275	43.1	434	31,052	43.0	484	30,544
Overall	15.6	21,748	32,489	29.1	9,445	30,843	21.8	31,193	31,476

School Size Category	Primary			Secondary			All		
	Student-teacher ratio	# Teacher per class	Total # Classes	Student-teacher ratio	# Teacher per class	Total # Classes	Student-teacher ratio	# Teacher per class	Total # Classes
Less than 50	**10.3**	**0.52**	**28,010**	**6.3**	**0.95**	**85**	**10.3**	**0.52**	**28,095**
50 to 69	**12.6**	**0.65**	**25,926**	**7.8**	**0.82**	**313**	**12.6**	**0.65**	**26,239**
70 to 89	**13.8**	**0.78**	**25,740**	**9.1**	**0.99**	**728**	**13.7**	**0.78**	**26,468**
90 to 119	**15.0**	**0.92**	**27,717**	**9.8**	**1.14**	**2,206**	**14.7**	**0.93**	**29,923**
120 to 149	15.9	1.09	22,953	10.8	1.23	6,192	15.0	1.12	29,145
150 to 199	18.7	1.18	17,535	13.6	1.26	13,683	16.8	1.22	31,218
200 to 279	22.3	1.23	11,915	17.1	1.32	24,009	19.0	1.29	35,924
280 to 499	23.6	1.17	11,968	21.0	1.33	37,304	21.7	1.29	49,272
500 to 749	26.0	1.25	6,327	23.4	1.34	20,613	24.0	1.32	26,940
750 to 1149	25.9	1.32	4,579	24.8	1.46	13,313	25.1	1.42	17,892
1150 to 1999	28.1	1.38	4,645	26.6	1.50	15,325	26.9	1.47	19,970
2000 or above	27.8	1.55	3,160	26.3	1.69	28,952	26.4	1.67	32,112
Overall	19.4	0.93	190,475	22.7	1.40	162,723	21.4	1.15	353,198

Source: World Bank Staff Calculations based on OBEC

Figure A3.1. Key Characteristics of OBEC Schools – Ranked by Student Performance

Figure A3.1.1. Student Performance Index

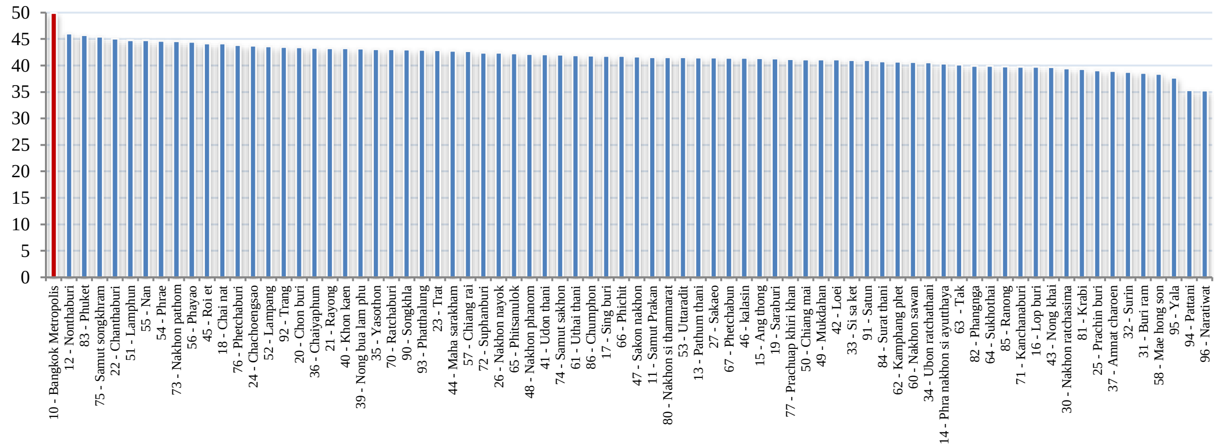


Figure A3.1.2. Share of Teachers with Higher than Bachelor's Degree

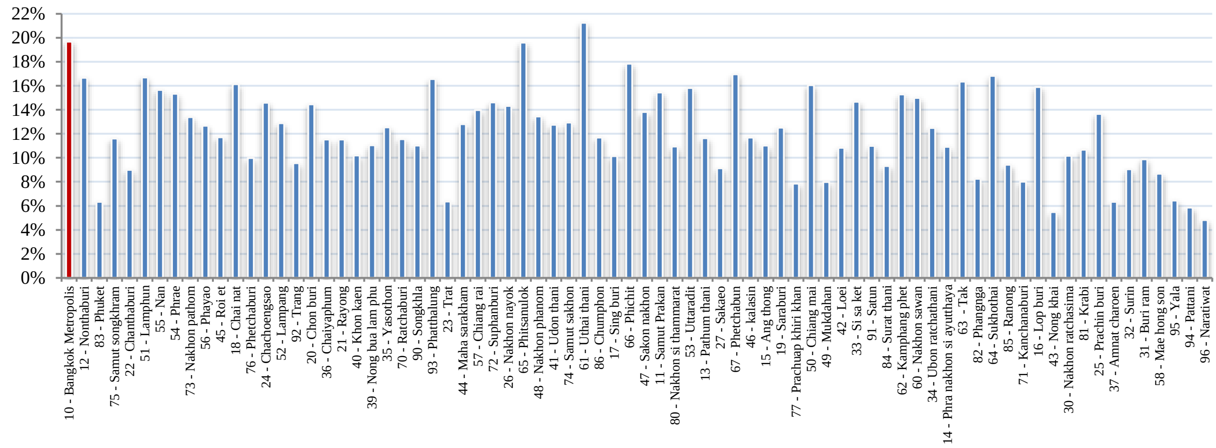


Figure A3.1.3. Average Teacher Experience (Years)

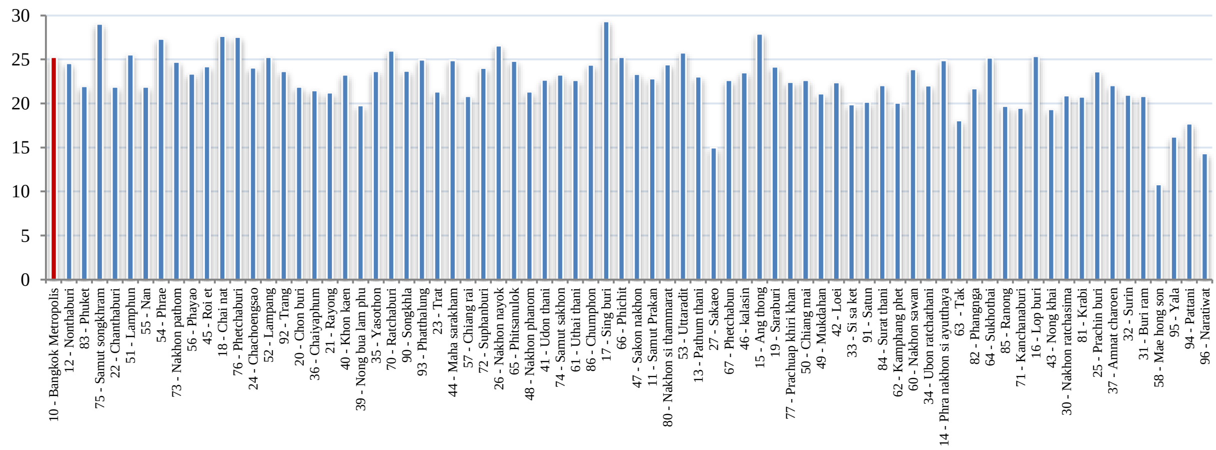


Figure A3.1.4. Average Number of Teachers per Classroom

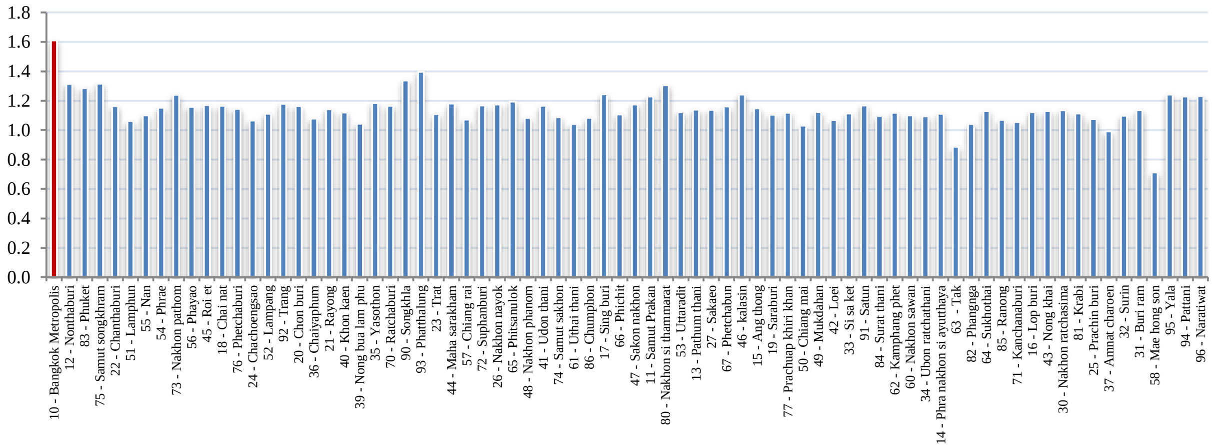


Figure A3.1.5. Average Class Size

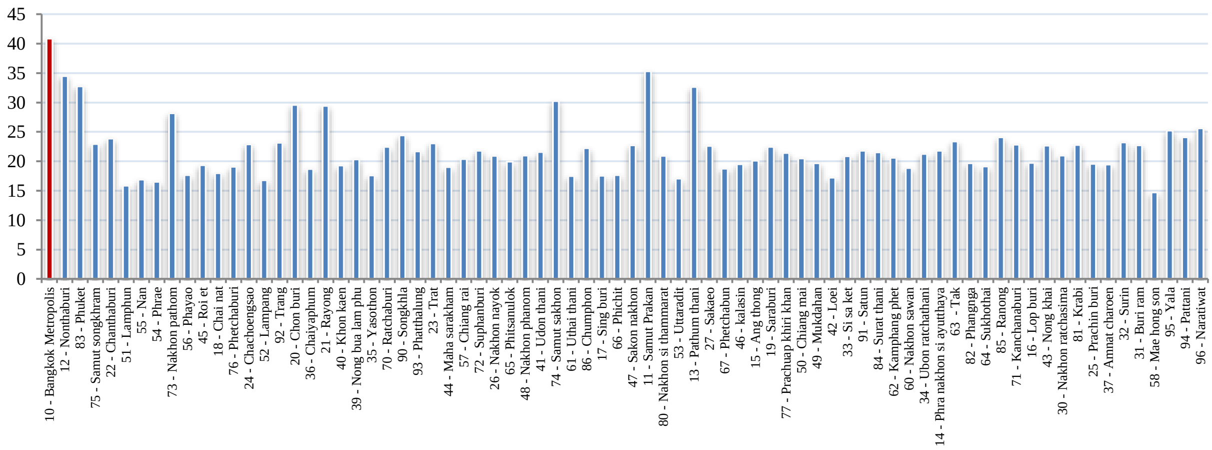
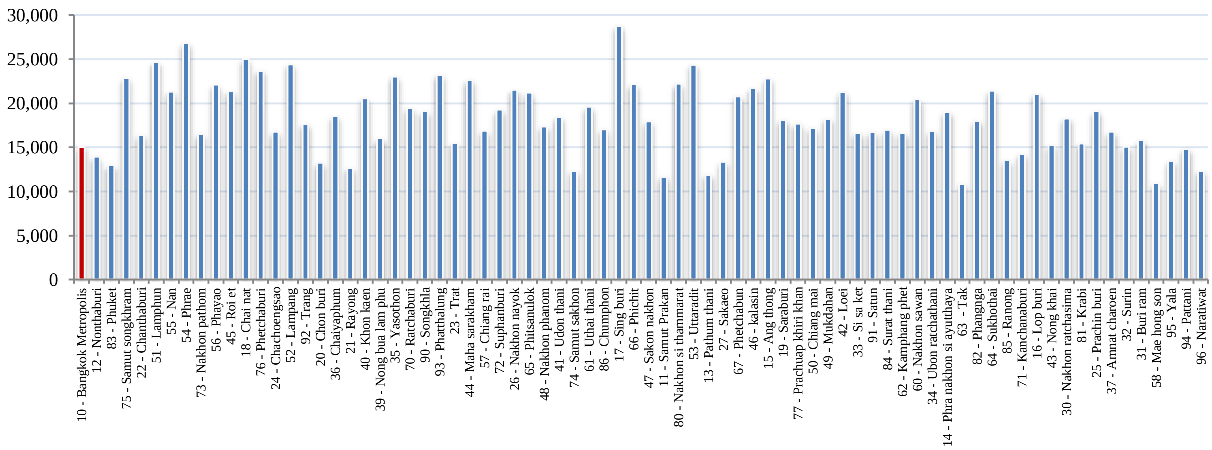


Figure A3.1.6. Average Personnel Salary Per Student



Source: World Bank Staff Calculations based on OBEC and NIETS

Annex A4: What is the evidence that organizing learning with better teachers will improve learning?

This annex presents the empirical evidence that staffing classrooms in poor schools with adequate number of good quality teachers will have a large impact on student learning. Our empirical analysis in this annex employs the concept of an Educational Production Function where it is conceptualized that schools employ some production technology to combine various inputs into producing student learning.[2] Using this framework, we estimate the causal relationships between school-average student achievement[3] and key measures of school quality, namely, the proportion of teachers with higher than bachelor's degree qualification, the teacher workforce average years of teaching experience, the "unobserved teacher quality index",[4] and the average number of teachers per classroom. Due to data limitations, however, we will not be able to evaluate the impacts of material educational resources and physical infrastructure on student learning.[5]

Since the focus of this annex is to evaluate potential interventions that are needed to close the school performance gap, we will be estimating the effects of these school quality variables on the entire distribution of school-level student performance outcome. An estimation method that "goes beyond the mean" will have to be employed for this particular purpose. In this study, we use the "Unconditional Quantile Regression" (UQR) method introduced by Firpo, Fortin, and Lemieux (2009) to estimate the causal impacts of the key measures of school quality on student achievement at different performance quantiles. Issues relating to the estimation of the educational production function model using the UQR technique is described in Technical Appendix to Annex A4, where detailed discussions of the results are also provided. The rest of this annex highlights the key findings.

All four measures of school quality show positive and statistically significant effects on student performance. Our analysis begins with analyzing the effects of measured school quality variables on average student performance outcome at the school level. In particular, it is found that 1) an increase in the unobserved teacher quality index of one standard deviation is associated with an increase of 0.9 percent in student performance, 2) a 10 percentage point increase in the share of teachers with higher than bachelor's degree qualification is expected to raise student performance by 0.27 percent, 3) an increase of 10 years in the average experience of the teacher workforce is estimated to improve student performance outcome by 1 percent, and 4) allocating one more teacher for each classroom is expected to raise performance by as much as 2.6 percent, holding other factors constant.

Gains in student learning from having better quality teachers are found to be much larger for low-performing schools. The estimated causal effects of the three measured teacher quality variables show greater impacts on student achievement for schools ranked at the lower end of the performance

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[2] The empirical study in this chapter uses a 2010 cross-sectional school data collected by the Office of the Basic Education Commission (OBEC), the Ministry of Education in Thailand (see Annex section A4.3).

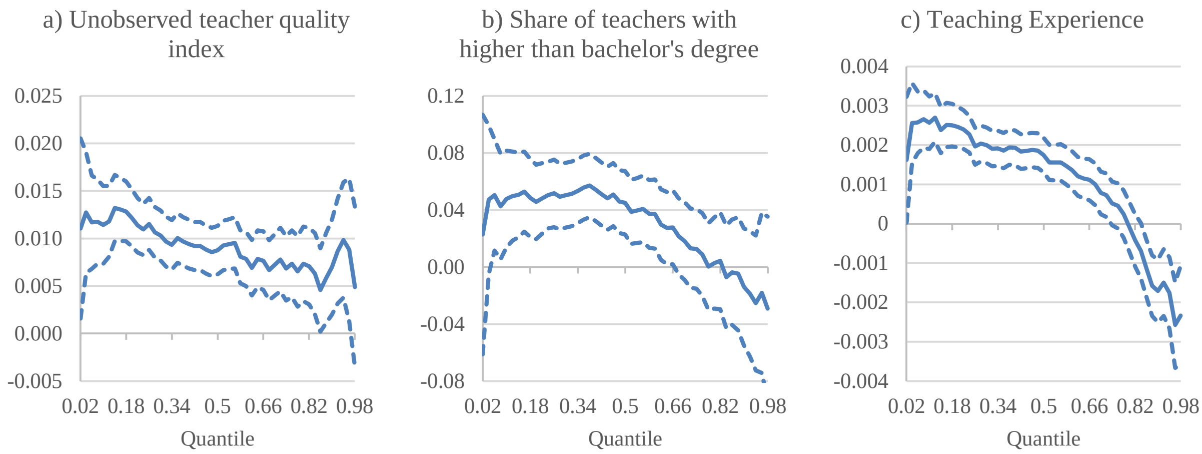
[3] Student achievement is measured by the Student Performance Index, which is a weighted index of mathematics and science scores in the 2010 Ordinary National Education Test (O-NET) exams for Grades 6, 9, and 12. The index is constructed as explained in detail in Section A5.3 in Technical Appendix to Annex A5.

[4] As described in the Annex section A4.3, the "unobserved teacher quality index" approximately captures variations arising from the discretionary wage component (such as performance pay), the average academic ranking of the teacher workforce, and other school average teacher characteristics unobserved by the researcher.

[5] Nevertheless, all is not lost as a rich body of research shows that effective teachers are the most important factor contributing to student learning (see for example Rivkin, Hanushek, and Kain (2005), Hanushek, Kain, and Rivkin (1998), and Nye, Konstantopoulos, and Hedges (2004)).

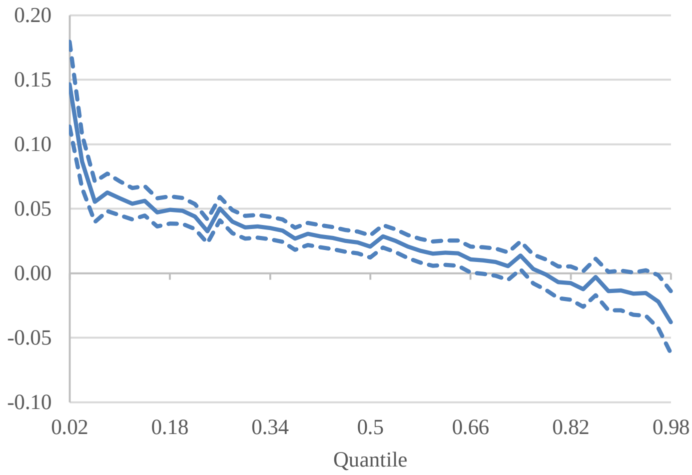
distribution. The three graphs in Figure A4.2 (reproduced from Technical Appendix to Annex A4) show the estimated marginal effects of the three teacher quality variables on the entire distribution of schools, ranked in accordance with their student performance outcome. The dotted lines in the graphs represent the 95 percent confidence band for the estimated effects. Consider low-performing schools that are ranked at the 10th percentile of the performance distribution. The study finds that 1) an increase in the unobserved teacher quality index of one standard deviation is expected to raise student performance by 1.14 percent (Figure A4.2a), 2) a 10 percentage point increase in the share of teachers with higher than bachelor's degree qualification is expected to increase student performance by 0.48 percent (Figure A4.2b), and 3) an increase of 10 years in the average experience of the teacher workforce is estimated to improve student performance outcome by 2.6 percent (Figure A4.2c). The estimated marginal effects of the teacher quality variables on schools ranked at the 10th percentile are therefore much larger than the estimated effects for the average school discussed in the previous paragraph. The marginal effects on other percentiles can analyzed analogously.

Figure A4.2. The Estimated Marginal Effects of Measured Teacher Quality Variables on Student Performance



The study also finds the greatest positive impacts on student learning for the lowest-performing schools from easing severe teacher shortages in their classrooms. Turning now to our measure of the adequacy of teacher quantity, we can see from Figure A4.3 that allocating one more teacher to each classroom is expected to raise performance for schools at the 2nd percentile of the performance distribution by as much as 15.8 percent. The effects are estimated to fall to within a range of 4.8-6.5 percent for schools ranked between the 6th and the 20th percentiles before falling off gradually thereafter. The large and positive effects for schools at the bottom end of the performance distribution should not come as a surprise, considering the fact that teacher shortages are very critical for these schools (see Technical Appendix to Annex A4 for more detailed discussion). The results shown in Figure A4.3 alone are strong evidence that staffing shortages in Thai classrooms are adversely affecting student learning, especially in small schools that primarily serve socioeconomically disadvantaged students.

Figure A4.3. The Estimated Marginal Effects of the Number of Teachers per Classroom on Student Performance



The results from our empirical study in this annex show that eliminating teacher shortages, both in terms of quality and quantity, would result in significant improvements in student achievement and the impacts would be greatest for lower-performing schools. The analyses of the effects of measured teacher quality and the number of teachers per classroom unambiguously suggest that allocating more and better teachers to small and low-performing schools would result in significant improvements in student learning. In light of these findings, we conclude that improving the quality of teachers and addressing the severe teacher shortages, especially for the vast number of small rural schools, should be at the center of Thailand's reform initiatives if the country is serious about tackling the widespread low quality education and the high disparity in educational achievements across socioeconomic groups.

Technical Appendix to Annex A4

A4.1. Using School Level Educational Production Function to Determine the Effects of Measured Teacher and School Characteristics on Student Performance

Our empirical analysis in Annex A4 uses school level data (see Annex A4.3) to estimate the educational production function for schools under the jurisdiction of the Office of the Basic Education Commission (OBEC). Specifically, we conceptualize schools as employing some production technology to combine various inputs into producing student learning. This analytical framework is particularly useful in helping us determine the relationships between measured teacher and school characteristics with student achievement, as indicated by the Student Performance Index in the 2010 O-NET exams.

Complications arise in the model estimation stage, however. Due to data limitations, we do not observe all potentially important family background characteristics of the student body that capture the quality of early education the students received or the home environments that are conducive to learning. These background characteristics are crucial in determining a child's cognitive ability. Furthermore, it is conceivable that these relevant family factors are related to both student

achievement and the selection of schools and teachers by the parents.[6] In other words, the omitted family background characteristics of the student body are confounding our estimates of the school and teacher effects on student achievement.

To mitigate the problem, this study statistically controls for some of this confounding by including as covariates the available variables that capture the socioeconomic status of the student body.[7] Furthermore, a particularly important covariate to include in the model is student achievement in the previous school year. We argue that prior student achievement can be seen as summarizing the effects of the remaining confounding socioeconomic factors. Including the variable as a covariate therefore permits a comparison of student performance across schools.

In our empirical investigation of the educational production function, we are especially interested in the effects of three measures of teacher quality on student achievement. These are; the proportion of teachers with higher than bachelor's degree qualification, the teachers' average years of teaching experience, and the "unobserved teacher quality index".[8] Furthermore, to assess the school effect on student performance, we have decided to include as a covariate the average number of teachers per classroom instead of a more conventional average class size variable. From Table A3.1 in Annex A3, we can see that most small rural schools in Thailand have very small average class sizes. However, instead of reflecting provision of high quality education, the small average classes actually reflects the severity of teacher shortages in small schools. Hence, the number of teachers per classroom variable is a more appropriate variable to include in our model.

Finally, recall that the primary focus of this Annex is to evaluate interventions that are needed to close the performance gap between schools. Since our underlying question of policy interest concerns the entire distribution of student performance across schools, estimation methods that "go beyond the mean" have to be employed. In this study, we use the "Unconditional Quantile Regression" method introduced by Firpo, Fortin, and Lemieux (2009) to estimate the impact of changes in the covariates on the unconditional quantiles of the outcome variable (school performance). The method is briefly described in section A4.2 in this Annex.

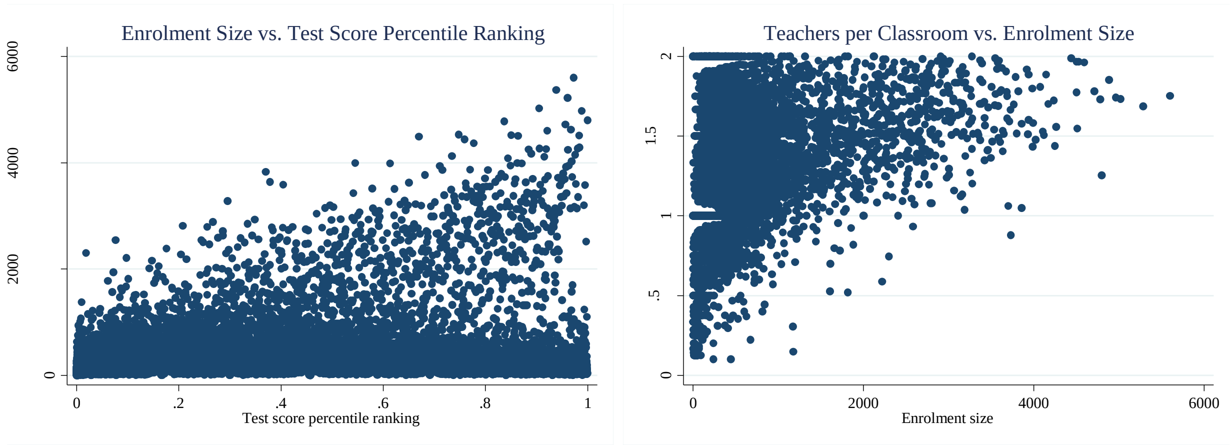
What do the empirical evidences tell us?

Before we go on to analyze the estimation results from the educational production function model, let us first consider simple relationship between enrolment size and student performance. The left-hand graph in Figure A4.1 presents a scatter plot of school enrolment size against the percentile ranking of the school student performance index in 2010. While we can see that many small schools managed to score highly in terms of student achievement, it cannot be denied that the majority of low-performing schools are small schools. Furthermore, the right-hand graph in the same figure shows a scatter plot of the average number of teachers per classroom against enrolment size. Three features of the graph are particularly intriguing. First, teacher shortage is clearly relatively more severe for

[6] For example, highly educated parents are more likely to have prepared their children better since birth to be school ready and to have chosen neighbourhoods with schools that are well-resourced and have high quality teachers.
[7] In fact, from Table A4.3 in this section we can see that we have available to us only two variables that could potentially capture the socioeconomic status of the school student body. These are: 1) the share of students that are poor and 2) the distance from the school to the nearest city.
[8] As described in the Annex A4.3, the "unobserved teacher quality index" approximately captures variations arising from the discretionary wage component (such as performance pay), the average academic ranking of the teacher workforce, and other school average teacher characteristics unobserved by the researcher.

smaller schools. Second, many small schools are seen to be staffed with relatively high number of teachers per classroom. Third, a lot of the schools that are not classified as "small" by OBEC definition (having 120 enrolled students or less) also face serious teacher shortage problem. Notice that it is the variations in key variables such as these that enable us to estimate the effects of measured teacher and school characteristics on student performance.

Figure A4.1. Enrolment vs. Student Achievement (Left) and Teacher per Classroom vs. Enrolment (Right)



Source: World Bank Staff Calculations based on OBEC and NIETS

The functional form for the educational production function used in this study can be seen from Table A4.2 in this section. Also reported in the Table are the coefficient estimates from the unconditional quantile regression model (UQR) for some selected quantiles of the school performance distribution, as well as the coefficient estimates obtained using conventional ordinary least squares (OLS) regression.

Let us first analyze the estimation results from the OLS regression model which is reported in the final column of Table A4.2. All of the coefficients can be seen to have the expected signs and are mostly significant at conventional statistical levels. However, since two of the four variables of interest enter the model in quadratic form, they are not straight forward to interpret. Therefore, to ease exposition, we also report in Table A4.1 the estimated average marginal effects of the four measured teacher and school characteristics on (log) student performance.

The final column of Table A4.1 shows that an increase in the unobserved teacher quality index of one standard deviation is associated with an increase of 0.9 percent in the student performance index for an average school, ceteris paribus. Similarly, a 10 percentage point increase in the share of teachers with higher than bachelor's degree qualification is expected to raise student performance by 0.27 percent. An increase of 10 years in the average experience of the teacher workforce is estimated to improve student performance outcome by 1 percent. Lastly, we find that allocating one more teacher for each classroom is expected to raise performance by as much as 2.6 percent, holding other factors constant. Notice that the estimated marginal effects are all statistically significant at the 1 percent significance level.

Table A4.1. Average Marginal Effects of Selected Variables from the Educational Production Function Model – OLS and Unconditional Quantile Regression

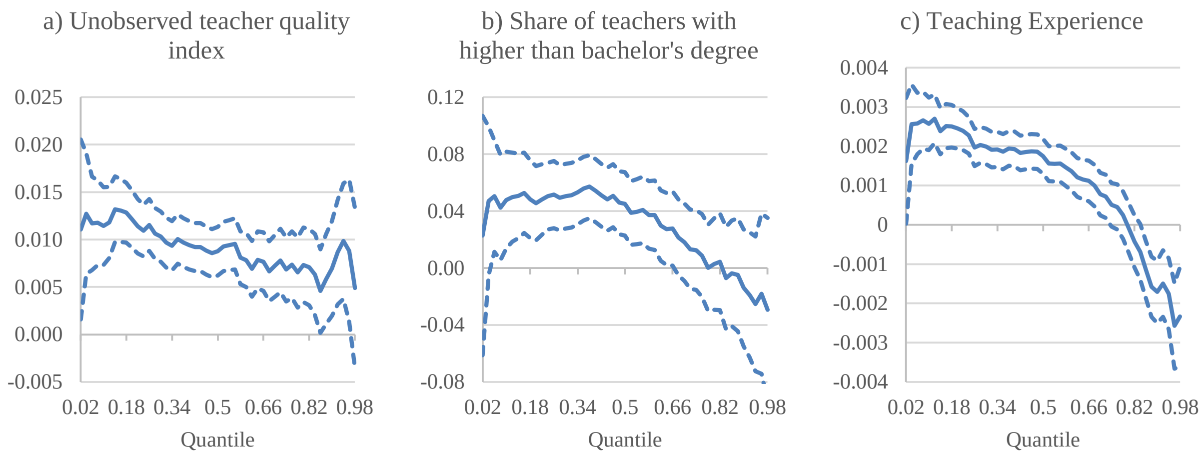
	Q10	Q30	Q50	Q70	Q90	OLS
Unobserved teacher quality index	0.011***	0.010***	0.009***	0.007***	0.007***	0.009***
	(0.002)	(0.001)	(0.001)	(0.002)	(0.003)	(0.001)
Share of teachers with more than bachelor's degree	0.048***	0.050***	0.045***	0.018	-0.014	0.027***
	(0.017)	(0.012)	(0.011)	(0.014)	(0.021)	(0.010)
Average years of teaching experience	0.003***	0.002***	0.002***	0.001***	-0.002***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Average number of teachers per class	0.058***	0.036***	0.021***	0.009	-0.013*	0.026***
	(0.007)	(0.005)	(0.004)	(0.005)	(0.008)	(0.004)

Delta method standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

While OLS can be used to estimate the partial effects of the covariates on the performance outcome for an average school, the narrow focus on the mean outcome obscures the effects of the teacher and school characteristics on other important features of the school performance distribution that are of policy relevance. Much richer analysis can be carried out using UQR as is illustrated in the first five columns of Table A4.1, where the estimated marginal effects of the key variables on school performance are presented for schools ranked at the 10th, 30th, 50th, 70th, and 90th performance percentiles.

Alternatively, the UQR marginal effects can be presented graphically as shown in Figure A4.2 for the three variables on measured teacher quality, and in Figure A4.3 for the number of teachers per classroom variable (see Figure A4.4 in this Annex for all the graphs of the UQR coefficient estimates). Figure A4.2a shows the estimated marginal effects of the unobserved teacher quality index on the entire distribution of schools, ranked in accordance with their student performance outcome index in 2010. The dotted lines in the graph represent the 95 percent confidence band for the estimated effects. Immediately apparent are the larger effects of a one standard deviation increase in the unobserved teacher quality index on student performance for schools ranked towards the lower end of the performance distribution.

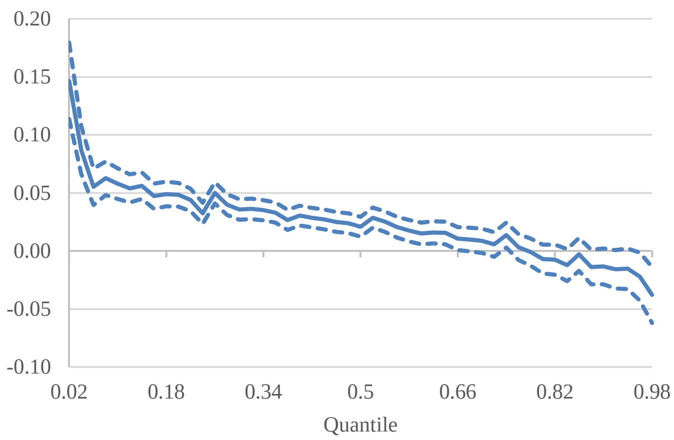
Figure A4.2. Unconditional Quantile Marginal Effects – Teacher Quality Variables



Similarly, we can see from Figure A4.2b that the effects on student performance from increasing the share of teachers with higher than bachelor's degree qualification are largest for schools that performed below the median in the performance distribution. For schools that are ranked higher than the 82nd percentile, the effects of increasing the share of highly qualified teachers turn out to be negative. However, it can be inferred from the width of the 95 percent confidence band that the estimated effects are not significantly different from zero.

The final measured teacher characteristic of interest is the average years of experience of the teacher workforce. Once again, Figure A4.2c shows the estimated effects of allocating more experienced teachers to lower-performing schools to be very high. For instance, an increase of 10 years in the average teacher experience is estimated to improve student performance outcome for schools at the 12th percentile by as much as 2.7 percent. This is much greater than the 1 percent impact estimated for the average school using OLS. Finally, it is not obvious why the marginal effects of average teacher experience should turn negative and statistically significant for schools which are ranked above the 82nd percentile.

Figure A4.3. Unconditional Quantile Marginal Effects – Teachers per Classroom



Turning now to our measure of the adequacy of teacher quantity, we can see from Figure A4.3 that allocating one more teacher for each classroom is expected to raise performance for schools at the 2nd percentile of the performance distribution by as much as 15.8 percent (or 0.147 log points), other factors held constant. The effects drop down to within a range of 4.8-6.5 percent for schools between the 6th and the 20th percentiles before falling off gradually thereafter. The large and positive effects for schools at the bottom end of the performance distribution is not surprising considering the fact that teacher shortages are very severe for these schools.[9]

[9] For schools ranked at or below the 2nd percentile of the performance distribution, the average number of teachers per classroom is 0.79. For schools ranked between the 2nd and 4th percentiles, the figure improves slightly to 0.93. The figure improves further to 1.0 for schools ranked between the 4th and 6th percentiles, and to 1.06 for schools ranked between the 6th and 20th percentiles. For those schools that are ranked above the 20th percentile, the average number of teachers per classroom rises to 1.18. These figures once again confirm that teacher shortage is a very serious problem constraining Thai schools.

Table A4.2. OLS and Unconditional Quantile Regression Results for the Educational Production Function Model

Dependent variable: Log student performance index in 2010	Q10	Q30	Q50	Q70	Q90	OLS
Log student performance index in 2009	0.286***	0.291***	0.354***	0.446***	0.517***	0.377***
	(0.009)	(0.006)	(0.005)	(0.007)	(0.013)	(0.005)
Unobserved teacher quality index	0.011***	0.012***	0.009***	0.007***	0.007***	0.009***
	(0.002)	(0.002)	(0.001)	(0.002)	(0.003)	(0.001)
Share of primary students	-0.018	-0.028	-0.038**	-0.056**	-0.057*	-0.040**
	(0.029)	(0.022)	(0.019)	(0.023)	(0.034)	(0.017)
Share of lower secondary students	0.050*	-0.052**	-0.136***	-0.172***	-0.163***	-0.103***
	(0.026)	(0.021)	(0.018)	(0.021)	(0.031)	(0.015)
Share of upper secondary students	0.022	0.052**	0.000	-0.025	-0.065*	-0.001
	(0.031)	(0.025)	(0.021)	(0.025)	(0.035)	(0.017)
Average number of teachers per class	0.222***	0.164***	0.039***	-0.016	-0.082***	0.070***
	(0.022)	(0.017)	(0.013)	(0.016)	(0.022)	(0.012)
Average number of teachers per class^2	-0.079***	-0.056***	-0.009	0.012*	0.033***	-0.021***
	(0.009)	(0.007)	(0.005)	(0.007)	(0.009)	(0.005)
Share of students poor	-0.036***	-0.031***	-0.007*	0.012**	0.033***	-0.005
	(0.006)	(0.005)	(0.004)	(0.005)	(0.007)	(0.003)
Share of teachers with more than bachelor's degree	0.048***	0.046***	0.045***	0.018	-0.014	0.027***
	(0.017)	(0.013)	(0.011)	(0.014)	(0.021)	(0.010)
Average years of teaching experience	0.014***	0.010***	0.004***	0.003***	0.005***	0.007***
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Average years of teaching experience^2	-0.000***	-0.000***	-0.000**	-0.000**	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Distance in km to the nearest city	-0.001***	-0.001***	-0.001***	-0.000**	0.000	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Intercept	2.113***	2.274***	2.336***	2.159***	2.120***	2.222***
	(0.044)	(0.032)	(0.025)	(0.032)	(0.053)	(0.025)
Observations	30,120	30,120	30,120	30,120	30,120	30,120
R-squared	0.078	0.104	0.147	0.144	0.090	0.212

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A4.3. Summary Statistics (at the school level)

	Mean	S.D.	Min	Max
Log student performance index in 2010	3.690	0.207	2.303	4.554
Log student performance index in 2009	3.664	0.233	2.708	4.474
Unobserved teacher quality index	0.003	0.993	-17.232	15.985
Share of primary students	0.651	0.225	0	1
Share of lower secondary students	0.118	0.196	0	1
Share of upper secondary students	0.031	0.109	0	1
Average number of teachers per class	1.038	0.384	0.100	4.000
Share of students poor	0.662	0.319	0	1
Share of teachers with more than bachelor's degree	0.120	0.117	0	1
Average years of teaching experience	22.747	7.273	0.000	39.417
Distance in km to the nearest city	12.201	11.000	0	136
Number of schools		30,120		

Figure A4.4. Unconditional Quantile Regression Coefficient Estimates

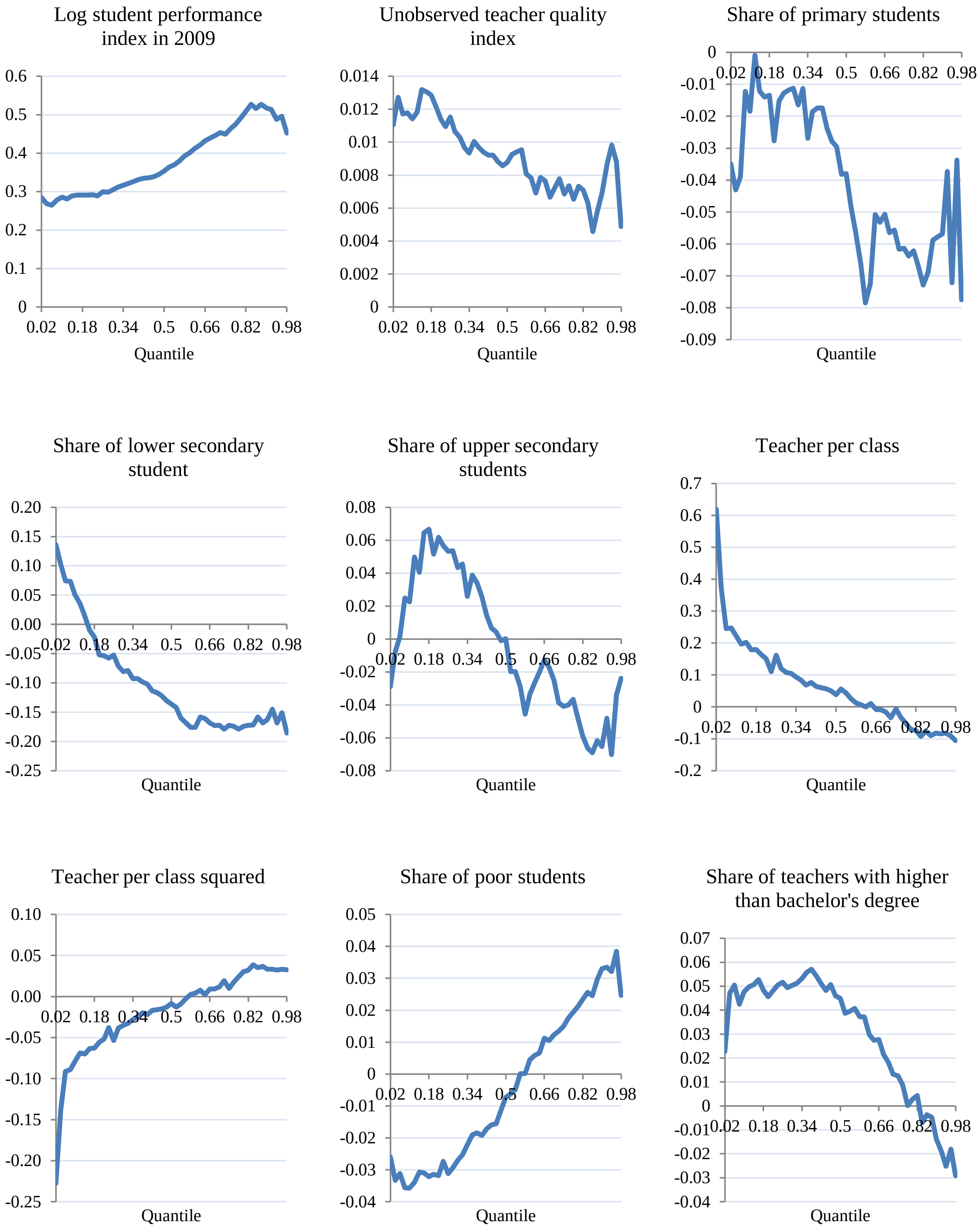
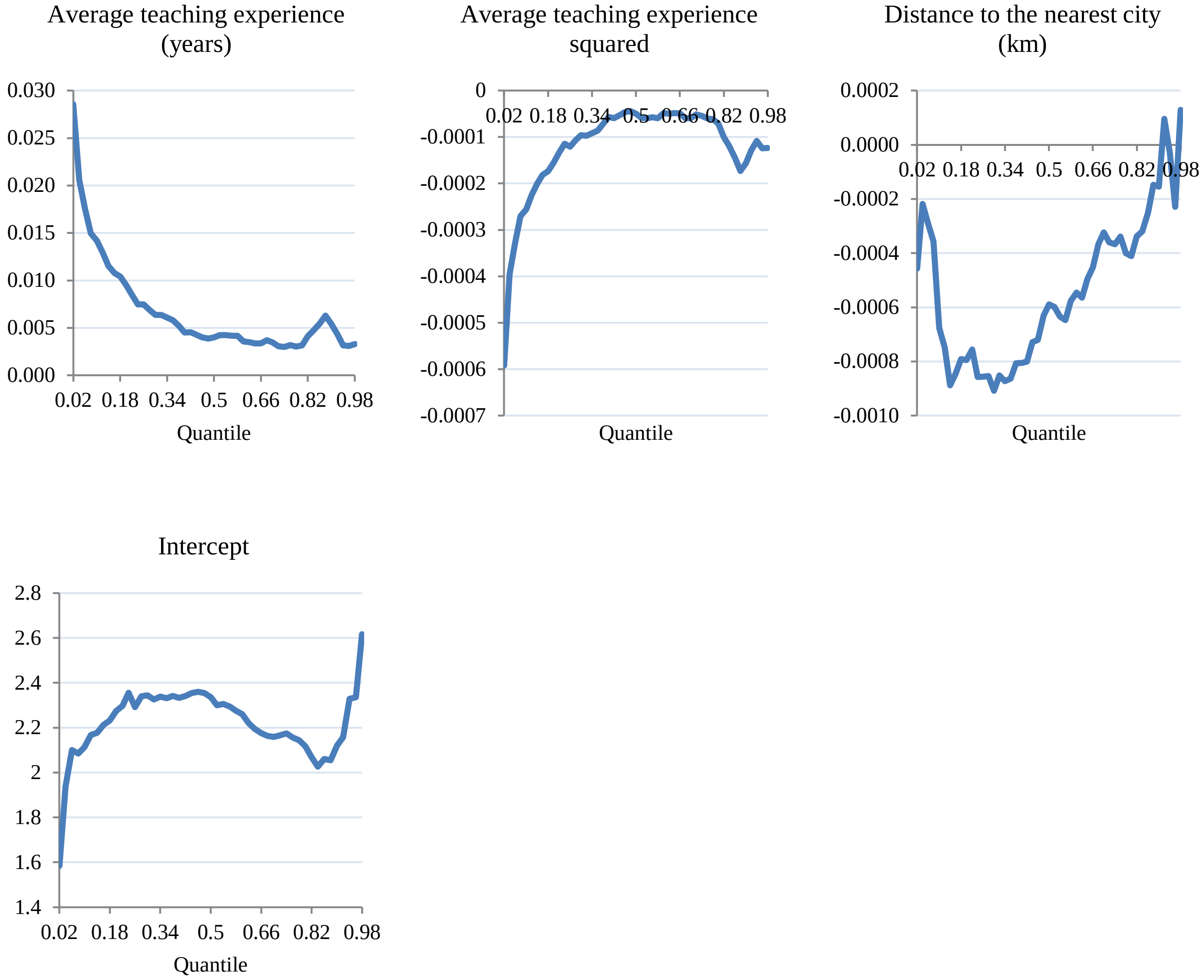


Figure A4.4. Unconditional Quantile Regression Coefficient Estimates (continued)



A4.2. Unconditional Quantile Regression

This section describes the unconditional quantile regression method introduced by Firpo, Fortin, and Lemieux (2009) – FFL from hereon. The method enables an evaluation of the impact of changing the distribution of explanatory variables X on the quantiles of the "unconditional" (or marginal) distribution of the outcome variable Y using a familiar regression framework.

Consider a real-valued statistical functional $\nu(F_Y)$, where F_Y is an underlying distribution function for (any) random variable Y. The influence function $IF(y;\nu,F_Y)$ introduced by Hampel (1968, 1974) is a widely used tool in studies on local robustness properties of functionals, and is defined as,

$$IF(y;\nu,F_Y) = \left.\frac{\partial\nu\left(F_{Y,\epsilon.\delta_y}\right)}{\partial\epsilon}\right|_{\epsilon=0} = \lim_{\epsilon\downarrow 0}\frac{\nu\left(F_Y+\epsilon\left(\delta_y-F_Y\right)\right)-\nu(F_Y)}{\epsilon}, \quad 0<\epsilon<1 \qquad (1)$$

if this limit is defined for every point $y \in \mathbb{R}$, and δ_y denotes the probability measure that puts the mass 1 at the value y. If a statistical functional (von Mises functional due to Mises (1947)) is Gâteaux differentiable at F_Y, FFL show that the following approximation holds for some distribution function G_Y close to F_Y,

$$\nu(G_Y) = \nu(F_Y) + \int_{\mathbb{R}} IF(y;\nu,F_Y)d(G_Y - F_Y)(y) + r \qquad (2)$$

where r is a remainder term. Noting that $\int_{\mathbb{R}} IF(y;\nu,F_Y)dF_Y(y) = 0$ by definition, we have $\nu(G_Y) = \nu(F_Y) + \int_{\mathbb{R}} IF(y;\nu,F_Y)dG_Y(y) + r$. For a particular case that G_Y=δ_y, FFL call this first order approximation term the "Recentered Influence Function,"

$$RIF(y;\nu,F_Y) = \nu(F_Y) + \int_{\mathbb{R}} IF(s;\nu,F_Y)d\delta_y(s)$$

$$= \nu(F_Y) + IF(y;\nu,F_Y) \qquad (3)$$

FFL recognise several interesting properties of the $RIF(y;\nu,F_Y)$, the most important of which is that it integrates up to the functional of interest $\nu(F_Y)$; that is, $\int_{\mathbb{R}} RIF(y;\nu,F_Y)dF_y(y) = E[RIF(y;\nu,F_Y)] = \nu(F_Y)$. Applying the law of iterated expectation to this expression yields,

$$E_{\mathbb{X}}\left[E[RIF(y;\nu,F_Y)|X)]\right] = E_{\mathbb{X}}[m^{\nu}(X)] = \nu(F_Y) \qquad (4)$$

where $E_{\mathbb{X}}[\cdot]$ makes explicit that the expectation is taken over the support of X, and $m^{\nu}(X)$ denotes the RIF regression model with regard to the statistical functional ν.

As mentioned at the outset, this study applies the RIF Regression method to a whole range of quantiles of the dependent variable Y, which are generically denoted by $q_\tau(F_Y)$ for any quantile $\tau \in (0,1)$ of interest. The influence function for a quantile is given by:

$$IF(y;q_\tau,F_Y) = \frac{\tau-\mathbf{1}(Y\leq q_\tau)}{f_Y(q_\tau)} \qquad (5)$$

where $\mathbf{1}(\cdot)$ denotes an indicator function, equal to 1 if the expression in the parentheses is true and 0 otherwise.

Using the definition of RIF given in (3) for the τ^{th} quantile of the marginal distribution of Y, the feasible version of the $RIF(y; q_\tau, F_Y)$ can be expressed as:

$$\widehat{RIF}\left(Y; \hat{q}_\tau, \hat{F}_Y\right) = \frac{\mathbf{1}(Y > \hat{q}_\tau)}{\hat{f}_Y(\hat{q}_\tau)} + \hat{q}_\tau - \frac{(1-\tau)}{\hat{f}_Y(\hat{q}_\tau)} \quad (6)$$

Note that the estimator of the τ^{th} population quantile of the marginal distribution of Y, $\hat{q}_\tau$, is nonparametrically identified from observed sample. Furthermore, the empirical density of Y is estimated using the kernel density procedure as follows:

$$\hat{f}_Y(y) = \frac{1}{Nh} \sum_{i=1}^{N} \omega_i K\left(\frac{y - Y_i}{h}\right) \quad (7)$$

where $K(\cdot)$ is the kernel density function, h is the kernel bandwidth,[10] ω is the sampling weight,[11] and N is the total sample size. The empirical density function is evaluated at $\hat{q}_\tau$.

A4.3. Data

This study employs a 2010 cross-sectional school data collected by the Office of the Basic Education Commission (OBEC), the Ministry of Education in Thailand. A rich set of information from 31,330 schools were collected on teacher and personnel salaries, number of students in each education level, number of poor students (students whose household incomes are below 40,000 Baht per month), number of classes, number of teachers by their educational qualification, their average years of teaching experience, etc. Hence, the data are aggregated at the school level by nature.

Using the raw data, we were able to construct school-level variables needed in estimating the educational production function. The constructed variables that serve as inputs into the production function capture the average student body, teacher, and school attributes. Particularly, these are: the shares of students by broad schooling level (pre-primary, primary, lower secondary, and upper secondary), the share of students that are poor, the proportion of teachers with higher than bachelor's degree qualification, the teachers' average years of teaching experience, the "unobserved teacher quality index", the average number of teachers per classroom, and the distance in kilometers from the school to the nearest city (Amphur).

The "unobserved teacher quality index" is constructed from the "composition-adjusted teacher salary" variable which is computed as explained in Section A5.4. As discussed at length in section A5.4, the variation in the composition-adjusted teacher salary encompasses variations arising from teacher "price" differences across geographical areas, the discretionary wage component (such as performance pay), the average academic ranking of the teacher workforce, and other school average teacher characteristics unobserved by the researcher. The unobserved teacher quality index is then computed by normalizing the composition-adjusted teacher salary to have zero mean and unit

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[10] The Gaussian kernel is used in this study, where $K(u) = \frac{1}{\sqrt{2\pi}} e^{-u^2/2}$

[11] Notice that the sampling weight is normalized to sum to N. That is, $\sum_{i=1}^{N} \omega_i = N$

variance. Notice that since the index also encompasses teacher's wage variation arising from teacher prices, we therefore regard it as an approximate measure of unobserved teacher quality.

The final key input variable in the educational production function is the school level "student performance index in 2009", which is a weighted index of mathematics and science scores in the 2009 Ordinary National Education Test (O-NET) exams for Grades 6, 9, and 12. The index is constructed as explained in great detail in A5.3.

The output variable for the educational production function is the (log) student performance index in 2010.

The summary statistics for the variables used in estimating the educational production function model are presented in Table A4.3. Notice that a small percentage of the observations were dropped due to the presence of missing data on one or more variables. Furthermore, the 137 schools that had no students were discarded. The final sample size is 30,120 schools.

Annex A5: Per-Student Funding Formula based on an Educational Cost Function Approach

Table 5.1. Funding Formula Example Application

School Characteristics		
Shares by level	Baseline	Simulation
Pre-school	13.4%	30.0%
Primary	45.5%	50.0%
Lower secondary	27.6%	20.0%
Upper secondary	13.5%	0.0%
School level composition index (1)	**1**	**0.875**
Enrolment size	Baseline	Simulation
less than 50	0	0
50 to 69	0	0
70 to 89	0	0
90 to 119	0	0
120 to 149	0	1
150 to 199	0	0
200 to 279	0	0
280 to 499	0	0
500 to 749	1	0
750 to 1149	0	0
1150 to 1999	0	0
2000 or above	0	0
Enrolment size index (2)	**1**	**1.268**
Class size	Baseline	Simulation
less than 10	0	0
10 to 19	0	1
20 to 29	1	0
30 to 34	0	0
35 to 39	0	0
40 to 44	0	0
45 or above	0	0
Average class size index (3)	**1**	**1.103**

Student Body Characteristics		
	Base case	Simulation
Share of students who are poor	48.9%	60.0%
Student poverty index (4)	**1**	**1.001**
	Base case	Simulation
Share of disabled students	0.2%	0.0%
Student disability index (5)	**1**	**0.999**

Table 5.1 Funding Formula Example Application (continued)

Provincial Labor Market Characteristics		
	Base case	Simulation
Teacher wage index	26,816	26,816
Input price index (6)	**1**	**1.000**

	Base case	Simulation
Overall cost index (7)*	**1**	**1.225**
Per student spending	***33,506***	***41,035***
Student performance index		*50*

**Note (7)=(1)x(2)x(3)x(4)x(5)x(6)

Box A5.1. Predicting the Per-Student Cost of Meeting Student Performance Standard

This section applies the cost function model to predicting the per-student cost for a hypothetical "baseline school" that is adequate for supporting students in attaining some educational performance outcome standard. The estimated regression coefficients from the cost function model (see column "Frontier IV" in Table A5.4) are then used to construct cost indices for each school in the estimation sample. These cost indices reflect differences relative to the baseline school of **key student body and school characteristics that are outside the control of the school or local community in question**. An overall cost index is then computed by multiplying together the various component indices. This overall index is effectively a measure of relative variation in per-student cost for the school compared to the baseline school. For example, a cost index of 1.5 indicates that the school in question will require 50% more spending per student than the baseline school to achieve the same average student performance outcome. The manner in which the cost indices are estimated is completely transparent and the indices can be easily applied to predicting the required per-student spending for any school in the country.

We begin with using the estimated per-student cost function to generate the predicted subsidy required for each school to reach some average student performance outcome. This is made possible because the cost function specification directly ties spending to performance, while accounting for differences in school and student-body characteristics. In this study, we set the required Student Performance Index[12] at 50 (referred to as the performance standard from hereon), or at around the 84th percentile in the student performance outcome distribution. Then, we estimate the per-student cost of reaching this performance standard for a hypothetical "baseline school" which has as its characteristics the mean shares of students by the three broad schooling levels (pre-primary, primary, lower secondary, and upper-secondary), the mean shares of poor and disabled students, and the national average teacher salary index (see Annex Section A5.4). Furthermore, we set the enrolment size of the baseline school at between 500 to 749 students and an average class size at between 20 to 29 students. Finally, we allow the baseline school to have an average level of cost inefficiency (see equation (12) in Section

[12] The computation of the Student Performance Index is explained in Section...

A5.1). Using equations (9), (10), and (11) from Section A5.1; the predicted log per-student cost of the baseline school can thus be written as:

$$\widehat{\ln(E^b)} = \hat{\beta}_0 + \hat{\beta}_1 \ln(\overline{p}) + \hat{\beta}_2 \ln(50) + \sum_{j=3}^{K} w_j^{b\prime}\hat{\beta}_j + \overline{u}$$

where $\overline{p}$ is the provincial average composition-adjusted teacher salary, w^b is a vector of the baseline school characteristics set at values as stated in the previous paragraph, $\overline{u}$ is the average level of cost inefficiency, and the $\hat{\beta}$'s are the estimated marginal effects.

We use equation (14) from Section A5.1 to convert the predicted log per-student cost of the baseline school into the predicted cost in level term. The per-student cost of this hypothetical baseline school to meet the required performance standard is predicted to be 33,506 Baht per annum (see Table 5.1).

The adequate per-student cost for each school to meet the performance standard based on the estimated marginal effects is the predicted cost of the baseline school multiplied by an "overall cost index" for the school. The overall cost index is in turn a product of different component indices pertaining to schooling level composition of the student body, enrolment size, average class size, student poverty, and the share of students who are disabled.

For example, consider estimating the schooling level composition index for school k which is composed of shr_pri^k share of primary-level students, $shr\_lowersec^k$ share of lower-secondary students, and $shr\_uppersec^k$ share of upper-secondary students. Notice that the respective shares for the baseline school are 0.455, 0.276, and 0.135 respectively. The schooling level composition index for school k can be computed using the formula:

$$\exp\{(shr\_pri^k - 0.455)\hat{\beta}_{shr\_pri} + (shr\_lowersec^k - 0.276)\hat{\beta}_{shr\_lowersec} + (shr\_uppersec^k - 0.135)\hat{\beta}_{shr\_uppersec}\}$$

where $\hat{\beta}_{shr\_pri}$, $\hat{\beta}_{shr\_lowersec}$ and $\hat{\beta}_{shr\_uppersec}$ are the estimated Frontier IV marginal effects for the "Share of primary students", "Share of lower secondary students", and , "Share of upper secondary students" variables respectively.

Conducting the preceding exercise for all schools in the data set, it is predicted that the average per student public expenditure adequate for achieving the stated student performance standard is 36,331 Baht per annum – a 15.4 percent increase from the actual average per-student subsidy of 31,475 Baht per annum. In order to see the required change in per-student public expenditure at a more disaggregated level, we average the required per-student subsidies for all provinces in Thailand. The required change in the average per-student amount by province is plotted against the provincial average annual per capita consumption and the provincial average student performance index in Figures BA5.1 and BA5.2 respectively.

The broad patterns of the two figures indicate that poorer provinces with lower educational outcomes would require larger increases in per-student public expenditures in order to raise their students' average educational performance to the required performance standard. In other words, public expenditure would need to be even more progressive than it currently is (recall Figure 3.1 in Chapter

3). Notice also that there will be losers from implementing the funding formula as four provinces would see their average per student public allocation decline. On the other hand, the network of small schools in Mae Hong Son (the poorest province in Thailand in terms of per capita consumption expenditure) would need a massive increase of 64 percent in per student financing.

Figure BA5.1 Required Change in Per Student Subsidies vs. Per Capita Consumption – by Province

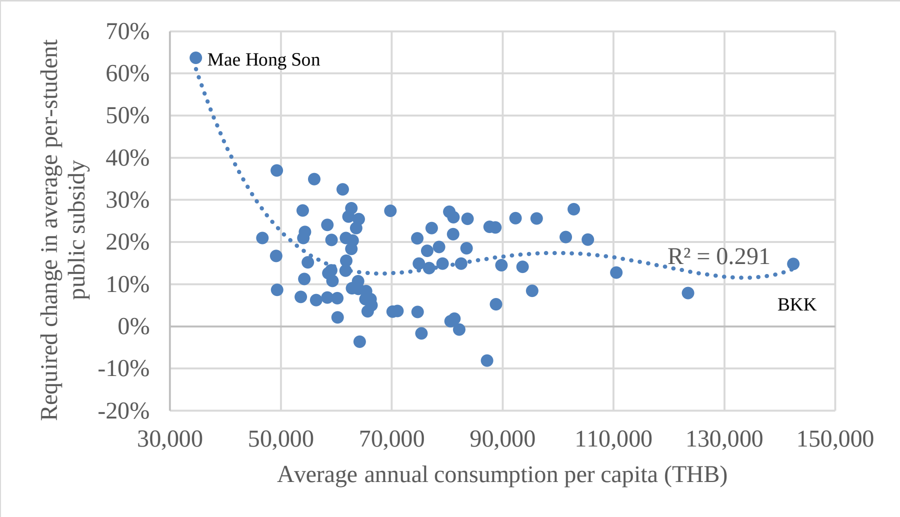
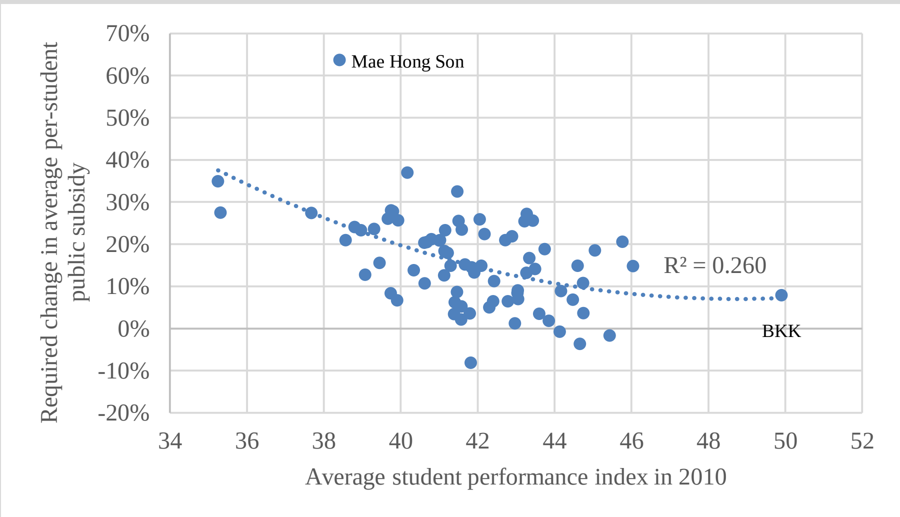


Figure BA5.2 Required Change in Per Student Subsidies vs. Average Student Performance Index – by Province

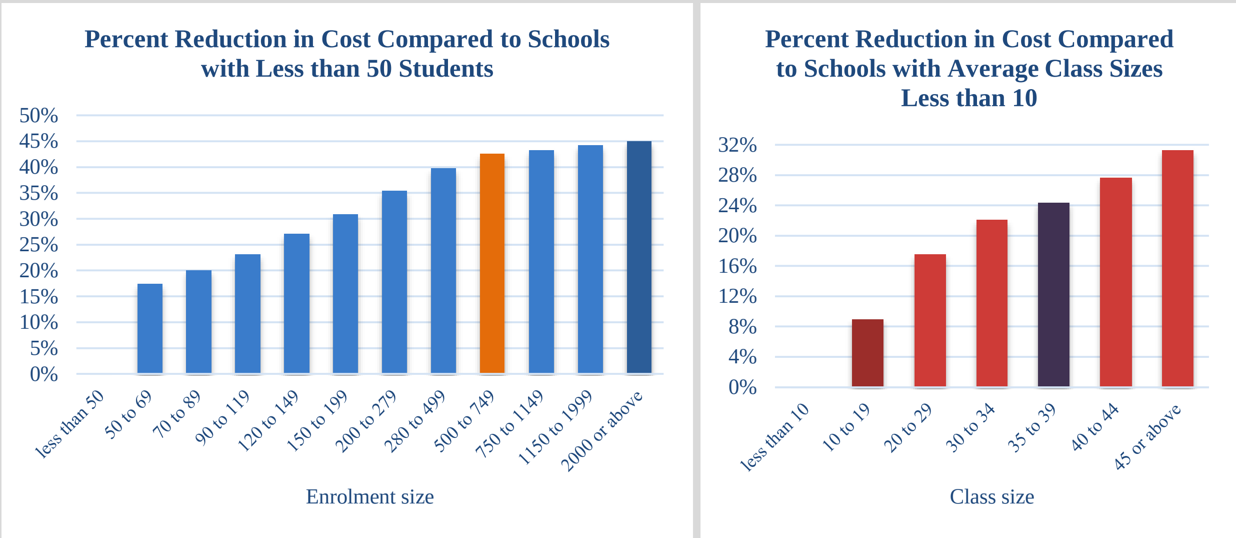


Source: World Bank staff calculations based on Thailand Household Socioeconomic Survey 2011, OBEC 2010, and NIETS 2010.

Distinguishing between factors that are and are not under the control of the school and/or local community

Recall that the funding formula gives schools funding premiums for factors that are outside the control of the school or the local community, such as the share of students by level of schooling in the area, the shares of students who are poor or disabled, and the local price level of educational inputs. However, as we have seen from the analysis given in Chapter 4, most small schools need not be small since they are located in close proximity to other schools. Therefore, these non-isolated schools may not be regarded as small and may not receive the same funding premium that a similarly-sized isolated school would receive. The importance of the scale effects of enrolment and class sizes is clearly depicted in the bar charts shown in Figure BA5.3. Consider the left bar chart which shows the reduction in required per-student subsidy as the schools gets larger. The required per-student subsidy for a school with an enrolment size between 500 to 749 students is a massive 43 percent lower than that for a school with less than 50 enrolled students, other things held constant. The scale effect of average class size can be analyzed analogously.[13]

Figure BA5.3. Estimated Scale Effects of Enrolment and Average Class Size



Source: World Bank staff calculations based on OBEC 2010.

For the reasons given in the previous paragraph, it is crucial that a school mapping exercise be conducted prior to determining the required per-student subsidies. We calculate the amount of subsidies for all 19,081 schools that would remain after the hypothetical school consolidation reform. The national average amount of required funding for all schools to achieve a score of 50 on the Student Performance Index is estimated at 33,863 Baht per student. This amount is 7.6 percent higher than the actual average per-student subsidy of 31,475 Baht, which is considerably lower than the 36,331 Baht needed prior to the hypothetical school network rationalization reform. However, in order for Thailand to realize these efficiency gains, more than 12,000 schools will need to be consolidated. The strategies that Thailand could follow to realize this vision is discussed in Chapter 4.

[13] The scale effects are calculated based on the estimated coefficients of the cost function model shown in Table A5.4.

The required change in the average per-student amount by province post-school consolidation reform is again plotted against the provincial average annual per capita consumption and the provincial average student performance index in Figures BA5.4 and BA5.5. We can see that the broad patterns where poorer provinces with lower educational outcomes would require larger increases in per-student public expenditures remain unchanged. However, there will be more losers as 23 provinces would now face reductions in the allocation of per-student public subsidies.

Figure BA5.4 Required Change in Per Student Subsidies vs. Per Capita Consumption – by Province (Post School Network Rationalization)

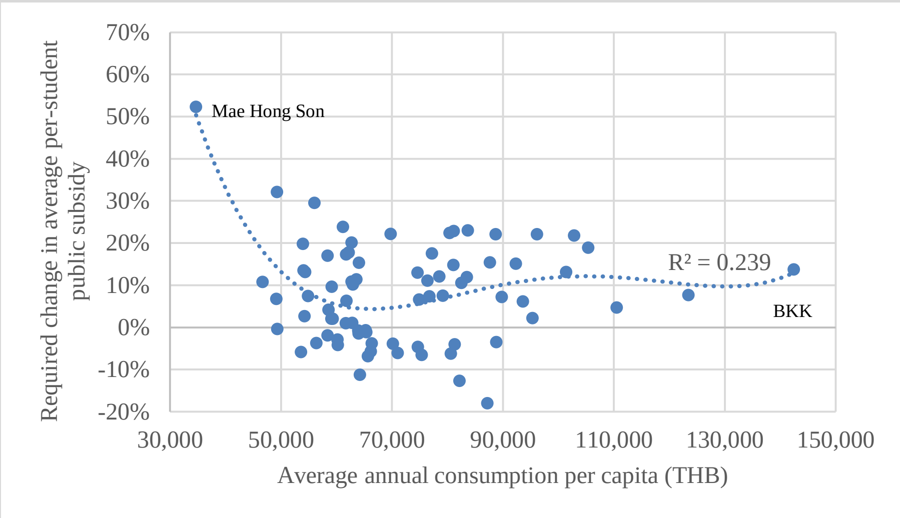
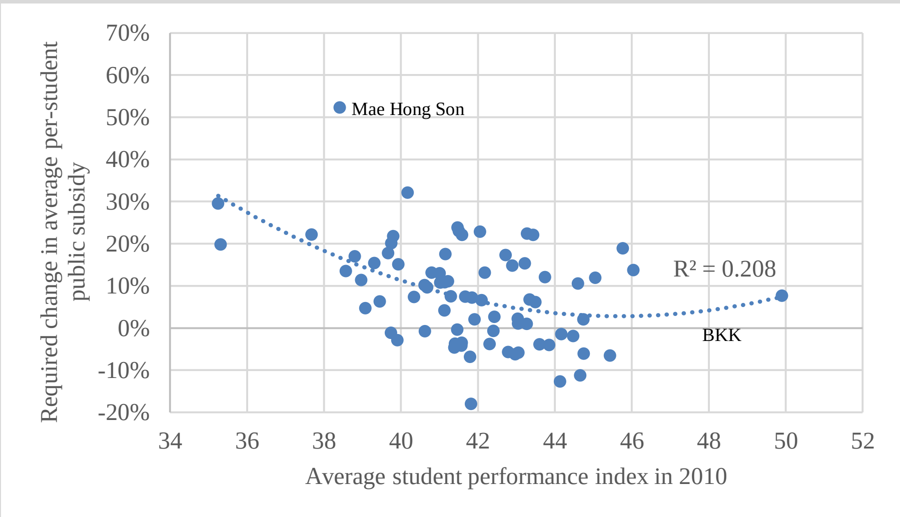


Figure BA5.5 Required Change in Per Student Subsidies vs. Average Student Performance Index – by Province (Post School Network Rationalization)



Source: World Bank staff calculations based on Thailand Household Socioeconomic Survey 2011, OBEC 2010, and NIETS 2010.

Technical Appendix to Annex A5

A5.1. Educational Cost Function

This study uses a Cobb-Douglas per-student cost function specification. Specifically,

$$c(p_i, q_i, w_i; \beta) = \exp(\beta_0) p_i^{\beta_1} q_i^{\beta_2} \exp\left(\sum_{j=3}^{K} w'_{ij}\beta_j\right) \quad (1)$$

where p_i denotes teacher salary which is a proxy for the prices of school educational resources, q_i is the level of output (student performance), w_i is a vector of variables that controls for possible variation in resource needs due to differences in school and student body background characteristics that affect their performance, and the β's are parameters to be estimated. Taking logarithm of equation (1) yields a log-linear model of the form:

$$\ln(c_i) = \beta_0 + \beta_1 \ln(p_i) + \beta_2 \ln(q_i) + \sum_{j=3}^{K} w'_{ij}\beta_j \quad (2)$$

However, as pointed out in Duncombe and Yinger (2005) and Duncombe (2007), the observed data are per-student spending, not cost, which is defined as the minimum expenditure required to achieve a certain performance outcome given school and student body characteristics. To estimate the cost of education requires taking into account differences in school efficiency in resource utilization. A school may have higher per-student spending compared to another school with similar student performance level, school and student background characteristics, and input prices they face because of inefficient use of resources. It is becoming increasingly common in recent literature to attempt to directly control for variables that are related to these inefficiencies in the right hand side of equation (2). For example; Duncombe and Yinger (2005) and Duncombe (2007) use "efficiency related measures", which are broadly categorized as fiscal capacity, competition, and factors affecting voter involvement in monitoring the government. Imazeki (2008) focuses instead on local competition by using the Herfindahl Index (HHI) as a proxy for local competition in school districts. As argued in Costrell, Hanushek, and Loeb (2008), finding a set of observed and measurable factors that determined efficiency in schools is clearly difficult. As a result, existing "efficiency controls" are rarely convincing measures of the full range of efficiency and do little to explain variations in education spending.

This study employs a Stochastic Frontier Analysis (SFA) approach introduced by Aigner, Lovell, and Schmidt (1977) and Meeusen and van den Broeck (1977) to identify the points at or near the bottom of the observed spending patterns. This statistical method has been used by a number of studies to convert an expenditure equation to a cost function (see for example Duncombe, Ruggiero, and Yinger, 1996; Gronberg, Jansen, Taylor, and Booker, 2004, 2005; Chakraborty and Poggio, 2008). In particular, consider per-student expenditure, E_i, incurred by school i. By definition, it must be the case that

$$E_i \geq c(p_i, q_i, w_i; \beta) \quad (3)$$

because $c(p_i, q_i, w_i; \beta)$ is an education cost function. To incorporate the fact that per-student expenditure may be subject to random shocks outside the control of the school, rewrite equation (3) as

$$E_i \geq c(p_i, q_i, w_i; \beta)\exp\{v_i\} \quad (4)$$

where $\exp\{v_i\}$ captures the effects of random shocks on each school and $c(p_i, q_i, w_i; \beta)\exp\{v_i\}$ is the stochastic cost frontier. The remaining excess of expenditure over the minimum attainable cost is attributed to a degree of inefficiency, $\exp\{u_i\}$. Specifically,

$$E_i = c(p_i, q_i, w_i; \beta)\exp\{u_i\}\exp\{v_i\} \tag{5}$$

An appropriate measure of cost efficiency (Kumbhakar and Lovell, 2000) in a stochastic frontier setting is given by:

$$CE_i = \frac{c(p_i,q_i,w_i;\beta)\exp\{v_i\}}{E_i} = \exp\{-u_i\} \tag{6}$$

which is the ratio of minimum cost attainable to observed expenditure. From equations (4) and (5), it follows that $CE_i \leq 1$, with $CE_i = 1$ if and only if E_i attains its minimum feasible value.

Assuming that the cost frontier takes the log-linear Cobb-Douglas functional form given in equation (2), the stochastic frontier model in equation (5) can now be written as:

$$\ln(E_i) = \beta_0 + \beta_1 \ln(p_i) + \beta_2 \ln(q_i) + \sum_{j=3}^{K} w'_{ij}\beta_j + u_i + v_i \tag{7}$$

where $u_i \geq 0$ is a one-sided error term representing cost inefficiency and v_i is a two-sided error term. The two error components of the asymmetric "composed error" term $e_i = u_i + v_i$ are assumed to be independently distributed from each other. This study follows Meeusen and van den Broeck (1977) and makes the following distributional assumptions:

$$v_i \sim N(0, \sigma_v^2)$$

$$u_i \sim i.i.d.\ exponential$$

That is, the two-sided errors v_i's are assumed to be i.i.d. normally distributed and the one-sided errors u_i's are assumed to have i.i.d. exponential distribution.[14] Furthermore, when the two error components are also independently distributed from the regressors in equation (7), then maximum likelihood will consistently estimate the β parameters along with the distribution parameters σ_v and σ_u. The log-likelihood function for a sample of N schools can be shown to take the following form (see Meeusen and van den Broeck, 1977):

$$\ln L(\beta, \lambda, \sigma^2) = \sum_{i=1}^{N} \left\{ -\ln \sigma_u + \frac{\sigma_v^2}{2\sigma_u^2} + \ln \Phi\left(\frac{e_i - \frac{\sigma_v^2}{\sigma_u}}{\sigma_v}\right) - \frac{e_i}{\sigma_u} \right\} \tag{8}$$

where $\Phi(\cdot)$ is the standard normal cumulative distribution function, and e_i is the composed error.

Dealing with Endogenous Explanatory Variables

The assumption that the error components are independently distributed from the explanatory variables in equation (7) is problematic. Karakaplan and Katlu (2013) argue that increasing cost

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[14] Other distributional assumptions have been proposed for the non-negative inefficiency term, such as the half normal (Aigner, Lovell, and Schmidt, 1977), the truncated normal (Stevenson, 1980), and the Gamma distribution (Greene, 2003).

efficiency may release additional resources that can be reallocated to enhance student performance. As a result, school output may be correlated with the inefficiency component. Costrell, Hanushek, and Loeb (2008) assert that some school districts are composed of citizens that are more education-oriented than others and this characteristic is not captured by observable variables. These districts may therefore tend to spend more and have more highly performing students. This statistical association would clearly cause an upward bias in the relationship between spending and performance. Furthermore, since the cost function is derived under the assumption of perfectly competitive market, it is implicitly assumed that schools are "price-takers." This assumption is unlikely to be tenable as variation in teacher salaries likely includes some discretionary variation which may be correlated with student performance and per-pupil spending. The presence of endogenous teacher salaries and student performance variables would result in inconsistent parameter estimates if conventional maximum likelihood estimation of stochastic frontier model is performed. A proper instrumental variable (IV) framework is needed to deal with the endogeneity issue in the SFA setting.

One of only a few studies trying to address the endogeneity problem in SFA is Guan, Kumbhakar, Myers, and Lansink (2009). The authors propose a two-step procedure to handle endogenous explanatory variables. In the first step, consistent estimates of the slope parameters are obtained using instrumental variable regression. Notice that the estimated intercept term from the first step is, however, inconsistent for the cost frontier intercept. In the second step, they use the residuals from the first stage as the dependent variable to get the maximum likelihood estimates of the stochastic frontier distributional parameters and a "shift parameter" for the first stage-intercept. Specifically, in the first step estimate equation (7) using instrumental variable regression to obtain

$$\ln(E_i) = \hat{\beta}_{0,IV} + \hat{\beta}_{1,IV}\ln(p_i) + \hat{\beta}_{2,IV}\ln(q_i) + \textstyle\sum_{j=3}^{K} w'_{ij}\hat{\beta}_{j,IV} + \hat{\varepsilon}_i \tag{9}$$

In the second step, take the residuals $\hat{\varepsilon}_i$'s from the first stage and use them as the dependent variable in the following stochastic cost frontier model with only an intercept term

$$\hat{\varepsilon}_i = \alpha_0 + u_i + v_i \tag{10}$$

The model in equation (10) is estimated using maximum likelihood as per equation (8) to obtain consistent estimates of $\sigma^2 = \sigma_u^2 + \sigma_v^2$, $\lambda = \sigma_u/\sigma_v$, and the shift parameter α_0. Finally, a consistent estimate of the stochastic cost frontier intercept from equation (7) is constructed by

$$\hat{\beta}_0 = \hat{\beta}_{0,IV} + \hat{\alpha}_0 \tag{11}$$

Cost efficiency estimates for each school can be obtained using equation (6). However, this study uses an alternative point estimator for CE_i proposed by Battese and Coelli (1988):

$$CE_i = E[\exp\{-u_i\}|e_i] = \left[\frac{1-\Phi(\sigma_* - \mu_{*i}/\sigma_*)}{1-\Phi(-\mu_{*i}/\sigma_*)}\right]\exp\left\{-\mu_{*i} + \frac{1}{2}\sigma_*^2\right\} \tag{12}$$

where $\mu_{*i} = e_i - \sigma_v^2/\sigma_u$ and $\sigma_* = \sigma_v$ for the normal-exponential model.

Predicting the Per-Student Cost in Level

Using equations (9), (10), and (11); the predicted log per-student expenditure of a particular school can be written as:

$$\widehat{\ln(E)} = \hat{\beta}_0 + \hat{\beta}_1 \ln(\overline{p}) + \hat{\beta}_2 \ln(q) + \sum_{j=3}^{K} w_j{}'\hat{\beta}_j + \overline{u} \quad (13)$$

where $\overline{p}$ is the provincial average composition-adjusted teacher salary, q is the level of output (student performance index), w is a vector of school and student body characteristics, $\overline{u}$ is the national average level of cost inefficiency, and the $\hat{\beta}$'s are the estimated regression coefficients. Notice that we have omitted the i subscript to simplify notation.

To convert the predicted log per-student expenditure of the school into the predicted cost in level term (in Thai Baht unit), we apply the following formula:

$$\hat{E} = \exp\{\widehat{\ln(E)}\}\exp\{\hat{\sigma}_v^2/2\} \quad (14)$$

where $\hat{\sigma}_v^2$ is the variance of the predicted two-sided residuals.

A5.2. Data

The education cost function described in the previous section of this report is estimated based on 2010 cross-sectional school data collected by the Office of the Basic Education Commission (OBEC), the Ministry of Education in Thailand. A rich set of information for 31,330 schools were collected on teacher and personnel salaries, number of students in each education level, number of disabled students, number of classes, number of teachers by their educational qualification, personnel teaching experience, etc. However, a small percentage of observations were dropped due to the presence of missing data on one or more of the variables summarized in Table A5.1.

The per student cost summarized in the same Table is calculated from the sum of subsidies schools received under the government's "15-Year Free Basic Education Program" and the total expenditure on education personnel, divided by the number of students enrolled in that school. The subsidies under the 15-year free basic education program can be classified into five categories as follows; direct per student tuition subsidy, uniforms, learning materials, textbooks, and other activities which promote quality improvements among students. The expenditure for education personnel covers salaries of school administrators, teachers, and other educational staffs. All calculations are based on an annual basis.

Also included in Table A5.1 are the summary statistics of the variables used in estimating the cost function model. All the variables are categorized into four major groups as follows; 1) teacher characteristics, 2) cost variables, 3) Student body characteristics, and 4) School characteristics.

A5.3. Student Performance Outcome

The student performance outcome measure used in this report is a weighted index of mathematics and science scores in the 2010 Ordinary National Education Test (O-NET) exams for Grades 6, 9, and 12. These tests are centrally administered by the National Institute of Educational Testing Service (NIETS) and all students in these respective grades are required to sit the exams. The rest of this subsection describes the procedure used in constructing the overall school outcome measure needed for our cost function estimation.

For each school, we have information on the total number of students who took the exams by grade and subject. Also reported are the number of students that falls into each of the twelve test

score intervals ranging from; (0), (0.01-10), (10.01-20), (20.01-30),…, (80.01-90), (90.01-99.99), and (100). Histograms representing densities of the 2010 O-NET scores in mathematics and science for the three grade levels are presented in Figure A5.1.

To calculate the average test score for each exam, we first assign students within each test score interval the upper bound score for that particular interval (see table below). The school average test score for each exam is then simply calculated as a weighted average of the assigned scores, where the weights are the number of students in the test score intervals. The school average O-NET score for each grade level is in turn a weighted average of the mathematics and science test scores, where the weights are the total number of students who took the exams. The resulting empirical cumulative distribution and density functions for the student performance measures in the three grade levels are depicted in Figure A5.2.

Assigning 2010 O-NET Scores to Students in each Test Score Interval

Test score interval	0.01-10	10.01-20	20.01-30	30.01-40	40.01-50	50.01-60	60.01-70	70.01-80	80.01-90	90.01-100
Assigned score	10	20	30	40	50	60	70	80	90	100

Notice that the distributions of the average test scores in the three grade levels are quite different from each other. The challenge here is to find a way to appropriately combine the average scores for the three different grades into a single measure of student performance outcome for each school. This study uses the distribution of the Grade 6 O-NET scores (G6 scores from hereon) as the reference distribution, where the scores from the other two grade levels are projected onto. Specifically, we first compute the empirical cumulative distribution function (ECDF) for the G6 scores using the formula:

$$\hat{F}_{G6}(q) \equiv \widehat{Pr}\left(Q^{G6} \leq q\right) = \sum_i \omega_i^{G6} I\left(Q_i^{G6} \leq q\right) \quad (15)$$

where $\hat{F}_{G6}(\cdot)$ is the ECDF of the G6 scores, Q^{G6} is the random variable representing the school mean G6 score, $\widehat{Pr}(\cdot)$ denotes probability, and $I(\cdot)$ is an indicator function equal to unity if the expression in the parentheses is true. Each school s is assigned a weight $\omega_s^{G6} = n_s^{G6} / \sum_i n_i^{G6}$, where n_s^{G6} is the total number of students in school s who took the G6 O-NET exams. Equation (15) is evaluated at some school average test score q.

In the next step, we similarly compute the ECDF's for the test scores in the other two grade levels and then apply the inverse of the reference ECDF (also known as the quantile function), $\hat{F}_{G6}^{-1}(\cdot)$, to the values of the ECDF's of the other test scores to obtain the rescaled scores. For example, consider the school average G9 score at the τ^{th} quantile (q_{G9}^{τ}), where $\tau \in (0,1)$. The rescaled G9 score at the τ^{th} quantile $\left(q_{G9\_rs}^{\tau}\right)$ is computed as follows:

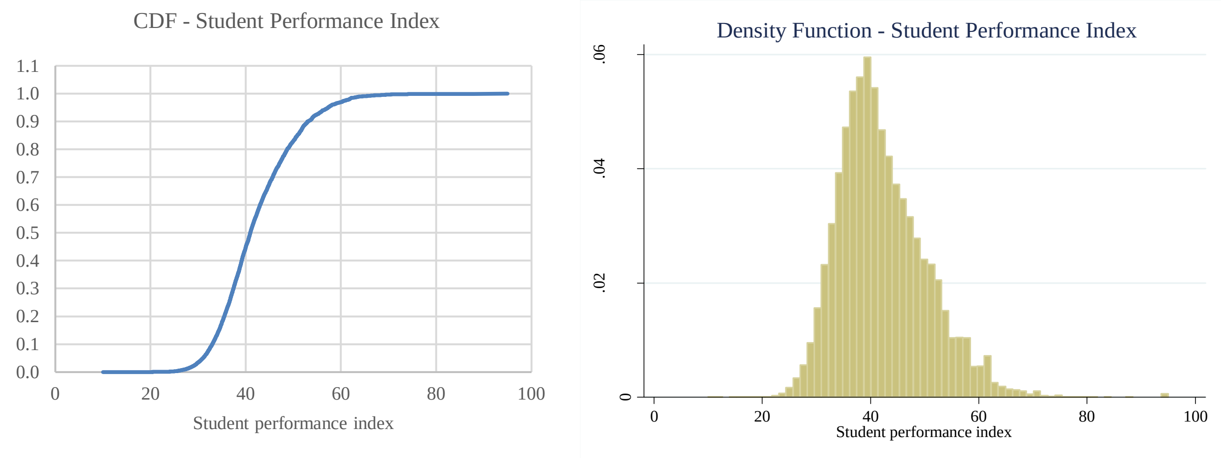
$$\hat{F}_{G6}^{-1}\left(\hat{F}_{G9}(q_{G9}^{\tau})\right) = q_{G9\_rs}^{\tau} \quad (16)$$

In the final step the student performance index is computed as a weighted average of the rescaled test scores from the three standardized exams. Specifically, for any school s we compute the student performance outcome index, q_s, using the formula:

$$q_s = \frac{n_s^{G6} q_{G6} + n_s^{G9} q_{G9\_rs} + n_s^{G12} q_{G12\_rs}}{n_s^{G6} + n_s^{G9} + n_s^{G12}} \quad (17)$$

The empirical cumulative distribution and density function for the constructed student performance index are presented in Figure A5.3.

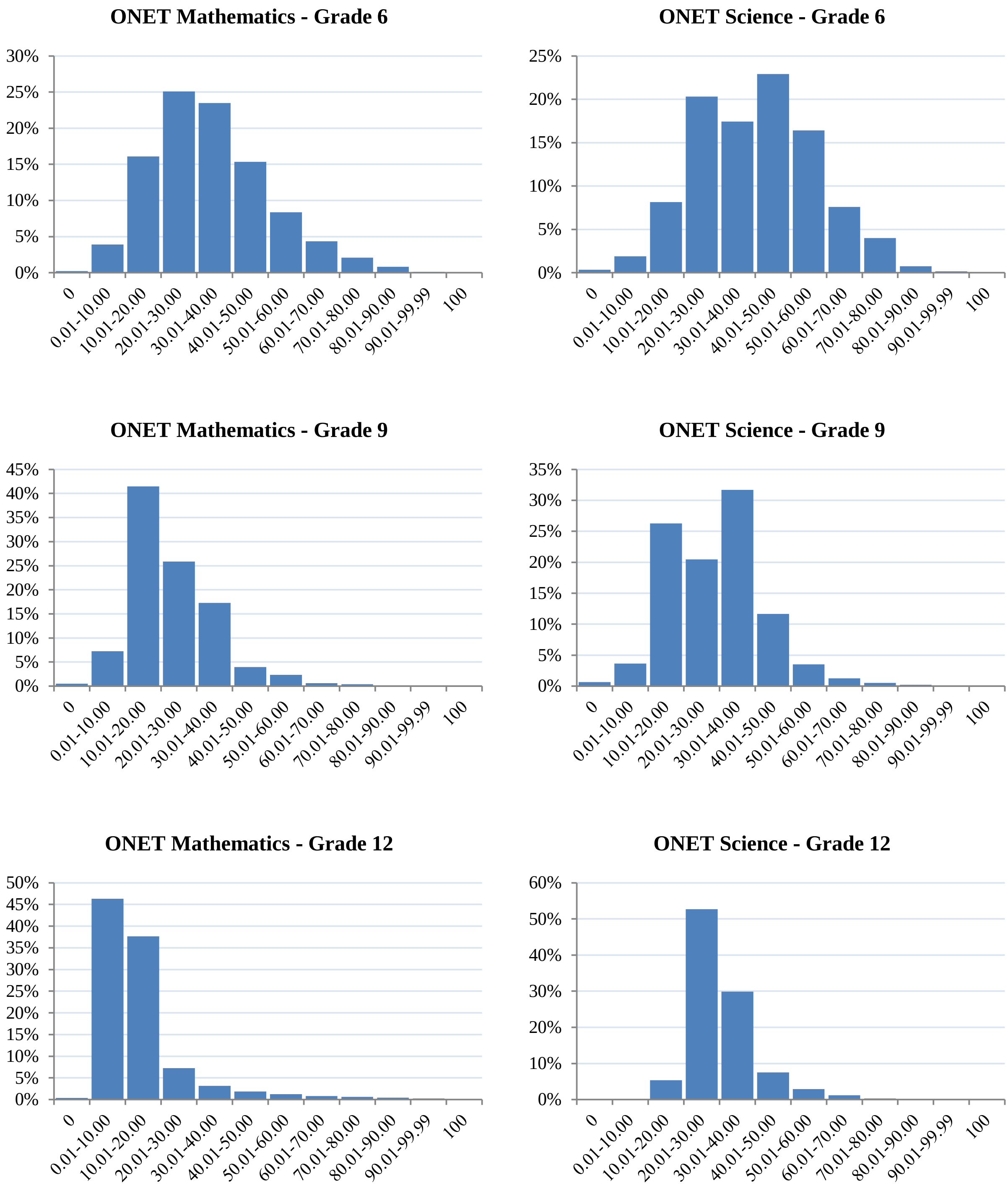
Figure A5.3: Cumulative Distribution and Density Functions for the Student Performance Index



Source: World Bank staff calculations based on OBEC and NIETS.

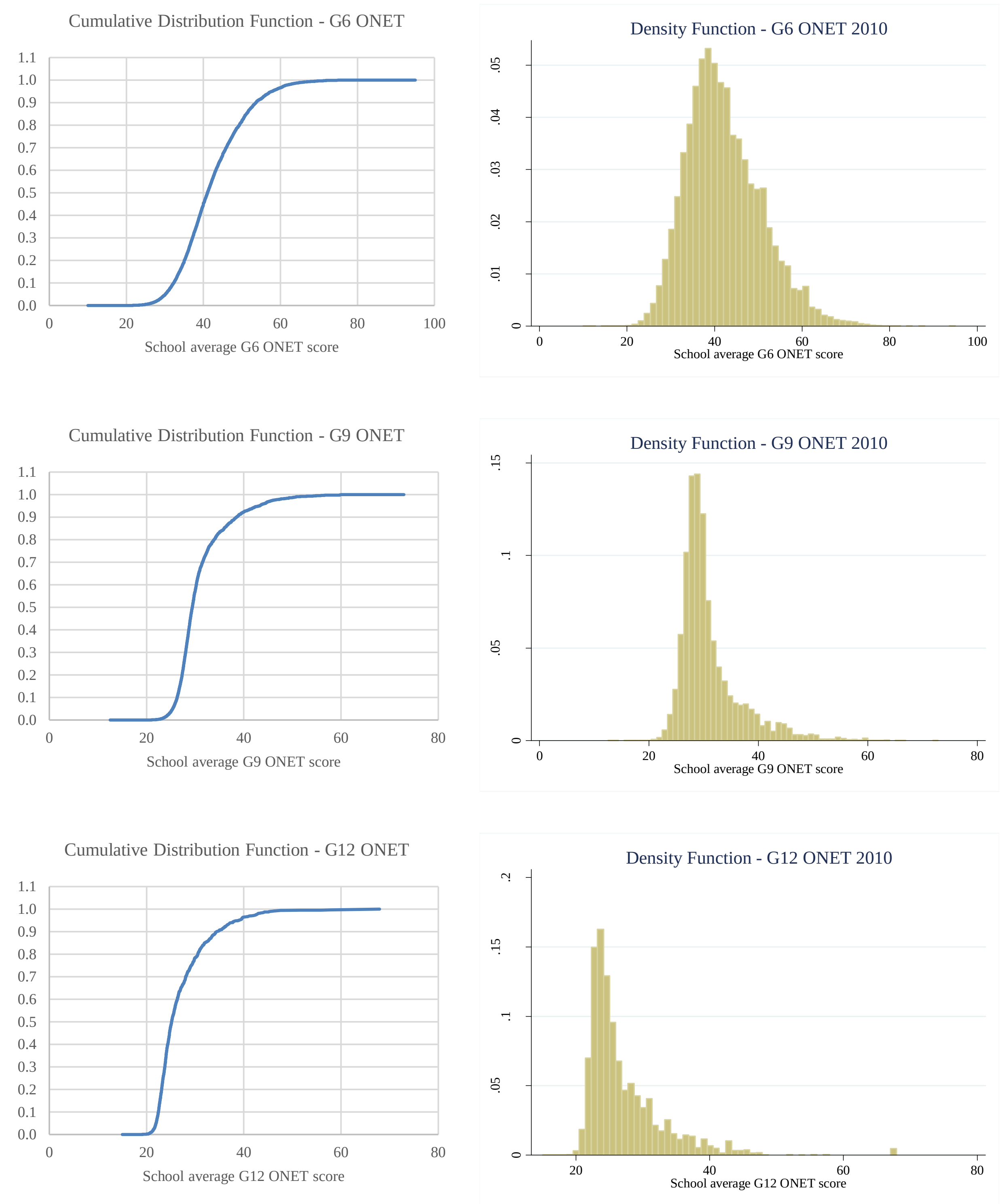
It is decided that the student performance index of 50 represents the required standard of proficiency used in this report. This is equivalent to the 84th percentile of the national student performance outcome distribution. In other words, 84 percent of students in Thailand performed at or below this level in the 2010 O-NET exams in mathematics and science.

Figure A5.1. Distribution of O-NET Scores in Mathematics and Science by Grade Level (2010)



Source: World Bank staff calculations based on OBEC and NIETS.

Figure A5.2: Cumulative Distribution and Density Functions for the 2010 O-NET Scores

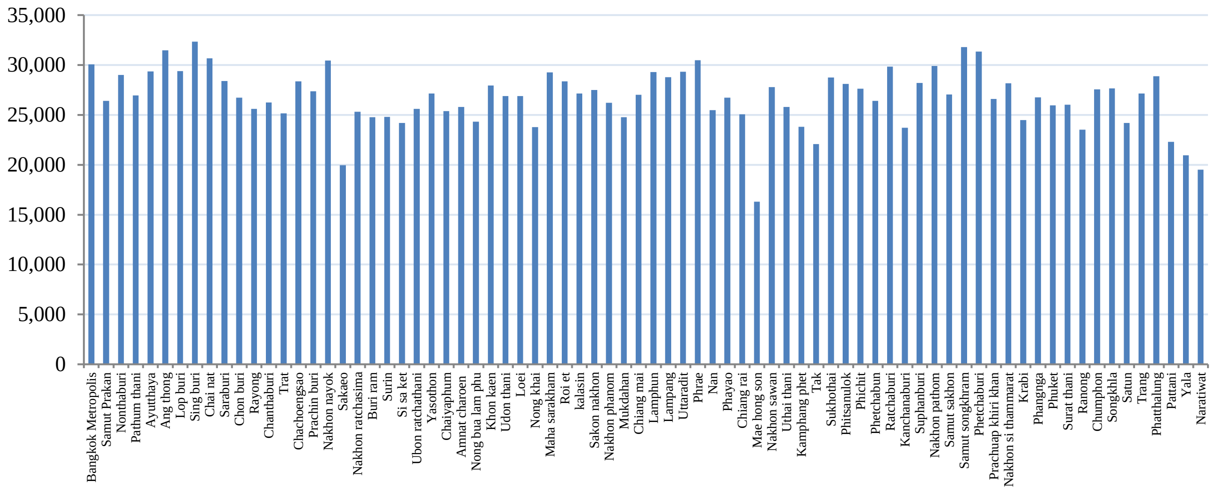


Source: World Bank staff calculations based on OBEC and NIETS.

A5.4. Composition-Adjusted Teacher Salaries

From the summary statistics shown in Table A5.1, it can be inferred that total salary expenditure makes up 57 percent of total per-student public subsidy in Thai schools. Furthermore, teacher salary accounts for most (around 94 percent) of total salary expenditure per student. It is therefore very clear that teacher salary is the most important resource price to include in the cost function model. Moreover, it also serves as a proxy for the market prices for other school educational resources such as non-teaching staff. However, while data on school average salary of teachers are readily available, they do not only contain variation in the "prices" of teachers across schools. For instance, average teacher salaries can also vary across schools due to differences in teacher educational qualification, years of teaching experience, past performance assessment, as well as academic standing allowance and position allowance of teacher civil service.

Figure A5.4: Unadjusted Average Teacher Salary (THB per month)



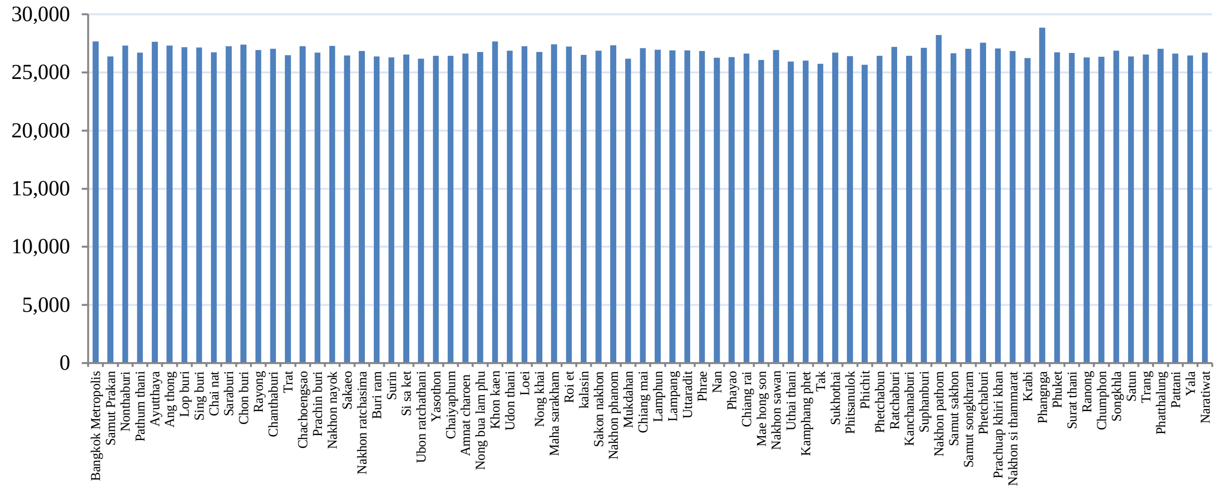
Source: World Bank staff calculations based on OBEC 2010.

Figure A5.4 presents the raw or "unadjusted average teacher salaries" in OBEC schools across 76 provinces in Thailand. We can immediately see the large provincial differences in average teacher salaries. In order to measure teacher prices more accurately, we need to measure average salaries for teachers of comparable average characteristics across schools. This can be done by adjusting average teacher salaries using regression. It is important to note that for each school we observe only the shares of teachers by educational qualification and the average years of teaching experience in our dataset. We do not, however, observe other teacher quality measures such as past performance assessment and teacher academic standing which are clearly associated with salaries. Therefore, in addition to pure differences in the price of teachers, the resulting "composition-adjusted average teacher salaries" will also inevitably contain variations arising from differences in the unobserved teacher characteristics.

To construct the composition-adjusted average teacher salaries, we first regress the log of average teacher salary on the shares of teachers in the school with doctorate, master's, bachelor's, and lower than bachelor's degree, and a quartic in the average years of teaching experience. The regression results presented below in Table A5.2 indicate that teacher educational qualification and experience

explain as much as 96 percent of the total variation in average salaries across schools. In the second step, we then predict what the logarithm of average teacher salary would be for each school if teacher education and experience are at the country average levels. It is important to note that we need to add the regression residuals from the first step to the predicted log average salary in this second step. The variation in the adjusted average teacher salaries is therefore due to the residuals of the log salaries from the first step alone. The residual wage variation therefore encompasses variations arising from teacher price differences, the discretionary wage component, and other teacher characteristics unobserved by the researcher.

Figure A5.5: Composition-Adjusted Average Teacher Salary (THB per month)



Source: World Bank staff calculations based on OBEC 2010.

In the final step, we simply exponentiate the predicted log average salaries to obtain the predicted average salaries in level terms across schools. The results for provincial average adjusted salaries presented in Figure A5.5 clearly show relatively little variation across provinces compared to the unadjusted salaries in Figure A5.4.

A5.5. Instrumental Variables

As discussed at length in the previous section, it is highly likely that the student performance variable is endogenous in the cost equation and instruments are needed in order to consistently estimate the model parameters. This study follows a similar approach taken by Duncombe and Yinger (2005) and Gronberg, Jansen, Taylor, and Booker (2005) and uses as instrument the median student performance of schools in the same province, but not in the same district as the school in question. Since there is only a single instrument for each endogenous variable, it is not possible to test the validity of the instrument using an overidentifying restriction test. However, the instrument does pass the necessary rank condition test as can be seen from the results from the first stage regressions shown in Table A5.3 where the instruments enter the equations highly significantly with a p-values of less than 0.01.

Table A5.1. Descriptive Statistics

Variables	Observations	Mean	S.D.	Min	Max
Student performance index	30,366	42.13	7.97	10	95
Cost variables					
Per-student expenditure	30,366	31,470	8,388	12,197	833,013
Salary expenditure per student	30,366	17,840	8,659	902	820,494
Teacher salary per student	30,366	16,792	8,349	902	816,312
Non-salary expenditure per student	30,366	13,631	2,359	10,497	18,389
Teacher characteristics					
Teacher salary	30,852	26,673	5,677	2,647	47,113
Share of teachers with doctorate degree	30,852	0.001	0.006	0.000	0.250
Share of teachers with master's degree	30,852	0.124	0.099	0.000	1.000
Share of teachers with bachelor's degree	30,852	0.835	0.123	0.000	1.000
Share of teachers with lower than bachelor's degree	30,852	0.041	0.088	0.000	1.000
Years of potential experience	30,852	22.610	6.654	0.000	39.917
Student body characteristics					
Share of pre-primary students	30,366	0.134	0.109	0.000	0.642
Share of primary students	30,366	0.455	0.334	0.000	1.000
Share of lower secondary students	30,366	0.276	0.255	0.000	1.000
Share of upper secondary students	30,366	0.135	0.201	0.000	1.000
Share of poor students	30,366	0.489	0.362	0.000	1.000
Share of disabled students	30,366	0.002	0.011	0.000	0.297
School characteristics					
Enrolment size:					
Less than 50 students	30,366	0.107	0.309	0.000	1.000
50 to 74 students	30,366	0.107	0.309	0.000	1.000
75 to 119 students	30,366	0.108	0.311	0.000	1.000
120 to 159 students	30,366	0.121	0.326	0.000	1.000
160 to 199 students	30,366	0.113	0.317	0.000	1.000
200 to 299 students	30,366	0.113	0.317	0.000	1.000
300 to 499 students	30,366	0.115	0.319	0.000	1.000
500 to 699 students	30,366	0.118	0.322	0.000	1.000
700 to 899 students	30,366	0.044	0.206	0.000	1.000
900 to 1499 students	30,366	0.022	0.145	0.000	1.000
1500 to 2499 students	30,366	0.016	0.126	0.000	1.000
2500 students or above	30,366	0.016	0.124	0.000	1.000
Class size:					
Less than 10 students	30,366	0.265	0.441	0.000	1.000
10 to 19 students	30,366	0.376	0.484	0.000	1.000
20 to 29 students	30,366	0.252	0.434	0.000	1.000
30 to 34 students	30,366	0.060	0.238	0.000	1.000
35 to 39 students	30,366	0.028	0.166	0.000	1.000
40 to 44 students	30,366	0.013	0.114	0.000	1.000
45 students or above	30,366	0.006	0.076	0.000	1.000

Table A5.2. Teacher Salary Regression Results

Variables	Log teacher salary
Teacher qualification: (Share of teachers with lower than bachelor's degree)	
Share of teachers with doctorate degree	0.295***
	(0.087)
Share of teachers with master's degree	0.090***
	(0.007)
Share of teachers with bachelor's degree	0.029***
	(0.006)
Average years of teaching experience	0.094***
	(0.003)
Average years of teaching experience^2	-0.003***
	(0.000)
Average years of teaching experience^3 /100	0.008***
	(0.001)
Average years of teaching experience^4 /1000	-0.001***
	(0.000)
Intercept	8.950***
	(0.013)
Observations	30,852
R-squared	0.958

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A5.3. First Stage Regression Results

Variables	Log teacher salary	Log student performance
Log teacher salary instrument	0.719***	0.055
	(0.025)	(0.105)
Log student performance instrument	0.017***	0.611***
	(0.006)	(0.028)
Share of primary students	0.007	0.005
	(0.006)	(0.024)
Share of lower secondary students	0.012**	-0.176***
	(0.005)	(0.024)
Share of upper secondary students	0.038***	0.073*
	(0.007)	(0.038)
School enrolment size: (Less than 50 students)		
50 to 69 students	0.000	0.027***
	(0.002)	(0.006)
70 to 89 students	0.004*	0.040***
	(0.002)	(0.007)
90 to 119 students	0.005**	0.054***
	(0.003)	(0.009)
120 to 149 students	0.008***	0.060***
	(0.003)	(0.009)
150 to 199 students	0.007**	0.063***
	(0.003)	(0.010)
200 to 279 students	0.008***	0.068***
	(0.003)	(0.011)
280 to 499 students	0.009***	0.065***
	(0.003)	(0.012)
500 to 749 students	0.011***	0.059***
	(0.003)	(0.012)
750 to 1149 students	0.014***	0.083***
	(0.003)	(0.013)
1150 to 1999 students	0.012***	0.123***
	(0.004)	(0.015)
2000 students or above	0.019***	0.206***
	(0.004)	(0.019)
Class size: (Less than 10 students)		
10 to 19 students	-0.003	0.006
	(0.002)	(0.007)
20 to 29 students	-0.002	-0.006
	(0.002)	(0.009)
30 to 34 students	-0.003	-0.025**
	(0.003)	(0.010)
35 to 39 students	0	-0.037***
	(0.003)	(0.014)
40 to 44 students	0.001	-0.014
	(0.004)	(0.019)
45 students or above	0.001	0.056**
	(0.004)	(0.022)

Table A5.3. First Stage Regression Results (continued)

Variables	Log teacher salary	Log student performance
Share of students poor	-0.004***	-0.034***
	(0.001)	(0.005)
Share of students disabled	0.003	-0.300*
	(0.034)	(0.161)
Intercept	2.794***	0.867
	(0.254)	(1.056)
Observations	30,366	30,366
R-squared	0.165	0.207

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A5.4. Results from the Cost Function Model

Variables	Frontier IV	OLS
Log teacher salary	0.788***	0.611***
	(0.159)	(0.034)
Log student performance	0.699***	0.188***
	(0.044)	(0.008)
Share of primary students	0.708***	0.713***
	(0.030)	(0.028)
Share of lower secondary students	0.966***	0.892***
	(0.029)	(0.025)
Share of upper secondary students	0.681***	0.724***
	(0.036)	(0.029)
School enrolment size: (Less than 50 students)		
50 to 69 students	-0.191***	-0.179***
	(0.009)	(0.008)
70 to 89 students	-0.224***	-0.204***
	(0.010)	(0.009)
90 to 119 students	-0.262***	-0.237***
	(0.013)	(0.011)
120 to 149 students	-0.316***	-0.287***
	(0.013)	(0.011)
150 to 199 students	-0.369***	-0.340***
	(0.013)	(0.012)
200 to 279 students	-0.437***	-0.406***
	(0.014)	(0.013)
280 to 499 students	-0.507***	-0.478***
	(0.015)	(0.013)
500 to 749 students	-0.553***	-0.527***
	(0.016)	(0.014)
750 to 1149 students	-0.566***	-0.524***
	(0.018)	(0.016)
1150 to 1999 students	-0.583***	-0.521***
	(0.020)	(0.018)
2000 students or above	-0.596***	-0.484***
	(0.022)	(0.019)
Class size: (Less than 10 students)		
10 to 19 students	-0.094***	-0.092***
	(0.010)	(0.009)
20 to 29 students	-0.192***	-0.199***
	(0.012)	(0.011)
30 to 34 students	-0.250***	-0.268***
	(0.014)	(0.013)
35 to 39 students	-0.279***	-0.303***
	(0.017)	(0.014)
40 to 44 students	-0.324***	-0.339***
	(0.020)	(0.017)
45 students or above	-0.375***	-0.348***
	(0.022)	(0.018)

Table A5.4. Results from the Cost Function Model (continued)

Variables	Frontier IV	OLS
Share of students poor	0.010*	-0.013**
	(0.006)	(0.005)
Share of students disabled	0.287**	0.196
	(0.142)	(0.185)
Intercept	-0.344	3.377***
	(1.565)	(0.344)
$\ln(\sigma_v^2)$	-3.279***	
	(0.037)	
$\ln(\sigma_u^2)$	-6.544***	
	(0.830)	
Observations	30,366	30,366
R-squared		0.458

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

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