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EQUITY-BASED BUDGETING IN EDUCATION:

SCHOOL FUNDING FORMULA

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ABSTRACT

Equity is a fundamental value and guiding principle of education policy at the national and international levels. In the last decades, government have put forward various strategies to promote equity in education, particularly using school funding formulae. In this study,we review the potential role and capacity of per-student funding (PSF) and other variants of needs-based funding formulae at promoting equity in education. Being multidimensional and involving multiple components of the education system, we first discuss how educational equity is defined in the context especially of education financing and how it could be measured at various stages of the education process. We examine the main characteristics of formula funding and identify key components to promote equity through allocation of additional resources to disadvantaged pupils and schools serving these students. We examine categories of student-needs and school characteristics identified in international practices of school funding formulae to ensure the pursuit of equal opportunity of education quality. We also discuss various input-oriented and output-oriented methods to measure costs within school funding formulae. Equity in teachers' allocation is also examined and the importance of including personnel expenditures in funding formulae. The study also presents applications of formula funding models in the case of five countries and formulates some recommendations.

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[1]
INTRODUCTION

Equity is a fundamental value and guiding principles of education policy at the national and international levels. The right to education for all has been recognized by the Universal Declaration of human rights of 1948 and equity in education is also a specific target of the Sustainable Development Goals (SDG) set by the United Nations in 2015 (United Nations, 2015; OECD, 2018a).[1]

While overall educational attainment has been rising during the last decades, educational inequity within countries persists overtime. Out of school children and youth still represent a significant share of youth around the world [2] and for those in schools, educational quality and learning outcomes are often related to socio-economic status.[3] Furthermore, difference in likelihood of completing secondary and tertiary education between individuals with highly educated parents and those with low-educated parents, is very significant across countries (OECD, 2019a).

Unequal access to quality education for all can severely limit opportunities for disadvantaged children to escape poverty and to enable socioeconomic mobility. More inclusive education, providing equitable education opportunities for all, can be seen as a basis for inclusive growth (UNICEF, 2015). National education policies that focus on equity can play an essential role in ensuring access to quality education for all and be among the most potent levers to foster upward social mobility over the long term, including through proper funding which is a necessary condition for education success (OECD, 2018a; Baker, 2018).

However, the distribution of government educational resources within countries around the world is often highly inequitable. In most countries, public education expenditures tend to disproportionately benefit the richest income groups[4] and only a few countries have succeeded in aligning the quality of resources with challenges of disadvantages students and schools (OECD, 2017a, p.157).

[1] SDG's targets 4.1 and 4.5, call on countries to "ensure that all boys and girls complete free, equitable and quality primary and secondary education …" and to "…eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable , including persons with disabilities, indigenous peoples, and children in vulnerable situations" (United Nations, 2015).

[2] In 2016, 263 million primary and secondary school age children were out of school representing about one fifth of the children of that age group, of which 39 % are in Asia (UNESCO, 2018a, p. 5).

[3] For instance, in all countries and economies that participated in PISA 2018, social economic status has a large influence on students' performance in science, reading and mathematics, with the average gap between disadvantaged and advantaged students representing the equivalent of about 3 full years of schooling (OECD, 2019a).

[4]Analyzing 31 low and lower middle-income countries using benefit incidents analysis, Ilie and Rose (2018) find that government education expenditures disproportionately benefit the richest income groups. Out of the 31 countries in Sub-Saharan Africa and South-Asia examined, all were skedded in favor of the richest household with only 4 countries (Bangladesh, Comoros, Namibia and Nepal) with a share of government expenditure benefiting children among the poorest 10 percent of household. At the other extreme, in Congo, Liberia, Malawi and Guinea, children among the poorest decile receive less than 10$ for each $100 spent on children among the 10% richest households.

In the last decades, government have put forward various strategies to promote equity in education.[5] In particular, several countries have adopted allocation mechanisms seeking to ensure a basic level of resources for all using per-student funding (PSF) and other variants of needs-based funding formulae. These formal funding mechanisms for schools and districts have been developed in many different forms to pursue various objectives, some explicitly recognizing equity objectives that some students need more support than others.

In this study, we review the potential role and capacity of PSF and other variants of needs-based funding at promoting equity in education.[6] We examine the main characteristics of formula funding and identify key components to promote equity through allocation of additional resources to disadvantaged pupils and schools serving these students. We examine costing methodologies and the potential inclusion of personnel resources within school funding formulae. We also examine the application of formula funding models in five countries.

The study is organized as follows. Section 2 describes the evolution of the concepts and definitions of equity in education, in particular as they relate to education financing. Section 3 identifies how equity could be measured at various stages of the education process, including inputs, process and outcomes. Section 4 examines the use of formula funding and mechanisms to pursue equity and discusses some design considerations relating to equity. It also discusses various inputoriented and output-oriented methods to measure costs within a school funding formula and evaluation of funding formulae. Section 5 discusses equity in teachers' allocation and examines the potential of including personnel in funding formulae. Section 6 reviews applications of formula funding models in the case of five countries. Section 7 presents concluding remarks and recommendations. A draft equity diagnostic checklist is presented in the Appendix.

[5]In addition to how public resources are allocated, these strategies include, (i) the design of education systems – in particular the sorting of students according to attainment the socio-economic structure of education systems tend to increase inequalities among students and across schools; early tracking and streaming and postpone academic selection; reduce parental school choice so as to contain the risks to equity; and (ii) practices in and out of school, which include how systematic is the help to those who fall behind at school and to reduce year repetition; the strength of the links between school and home to help disadvantaged parents help their children to learn.; the response to diversity and the successful inclusion of migrants and minorities within mainstream education (OECD, 2008).

[6] The importance of identifying weather and how formula-base policies are able to support equity objectives is underlined by the thematic SDG indicator 4.5.3 which explicitly aims at measuring the extent to which "explicit formula based policies reallocate education resources to disadvantaged populations" (Makarova, 2016; UNESCO, 2018b).

[2]

EQUITY IN EDUCATION : DEFINITIONS,OBJECTS, PRINCIPLES AND EXPECTED EFFECTS

The concepts of equity in education have evolved over time and have specific applications as they relate to education financing.

2.1 Definitions of equity in education

Equity is a normative concept based on individual or society's conception of what is fair or just. In education, equity has been defined as encompassing two dimensions: inclusion and fairness (OECD 2019b).

Inclusion refers to: "the objective of ensuring that all students, particularly those from disadvantaged backgrounds or from traditionally marginalized groups, have access to highquality education and attain a minimum level of skills". Fairness refers to: "the goal of fully realising every student's potential by removing obstacles over which individual students have no control, such as unequal access to educational resources and school environments." (OECD, 2019b, p.42).

These equity dimensions are based on the equal opportunity principle, an equity criterion widely applied in national laws and international conventions based on the concept of equal opportunity in inputs and outcomes of the educational process (UNESCO, 2018b, p. 18; Roemer, 1998). Equal opportunity means that "everyone should have the same opportunity to thrive, regardless of variations in the circumstances in which they are born" (UNESCO, 2018b, p.17).[7] That individual performance "…should not depend on personal circumstances that stem from the randomness of birth, but to individual effort" (Roemer and Trannoy, 2016).

On the input side, equity in education means that schools and education systems provide equal learning opportunities to all students, and that quality education should not be function of one's socioeconomic, geographic of personal circumstances (OECD, 2018a, p.22).

On the output side, equal opportunity corresponds to children with different starting points having the same access to the education system in terms of achievement levels and is ensured through reducing gaps in student achievement levels across communities (Berne and Stiefel, 1984; BenDavid-Hadar 2016).

[7] Different viewpoints on how to achieve fairness in school financing policy have been proposed. See for instance UNESCO (2018b) for a review of measurement of educational equity as well as Berne and Stiefel (1984, 1994) for a review of different concepts of school finance equity. See BenDavid-Hadar (2016) for an application of the equal opportunity concept to Israel.

As a result, student of different socio-economic status, gender or immigrant and family backgrounds would tend to achieve similar levels of academic performance and levels of social well-being and integration. Equity does not mean that all students achieve the same results, but that every student has been given an equal opportunity to realize his or her potential and has acquired the skills he or she needs to participate fully in society. Indeed, inequality in outcome is not necessarily unfair, as differences in student outcomes might be due to differences in students' efforts, interest, talents or even luck (OECD, 2018b, p.54). While some degree of inequality in education outcomes is to be expected in any school system, equity means that whatever inequality exists between students in the school system, it is not related to students' socioeconomic status or determined by other factors outside of one's control (Roemer, 1998).

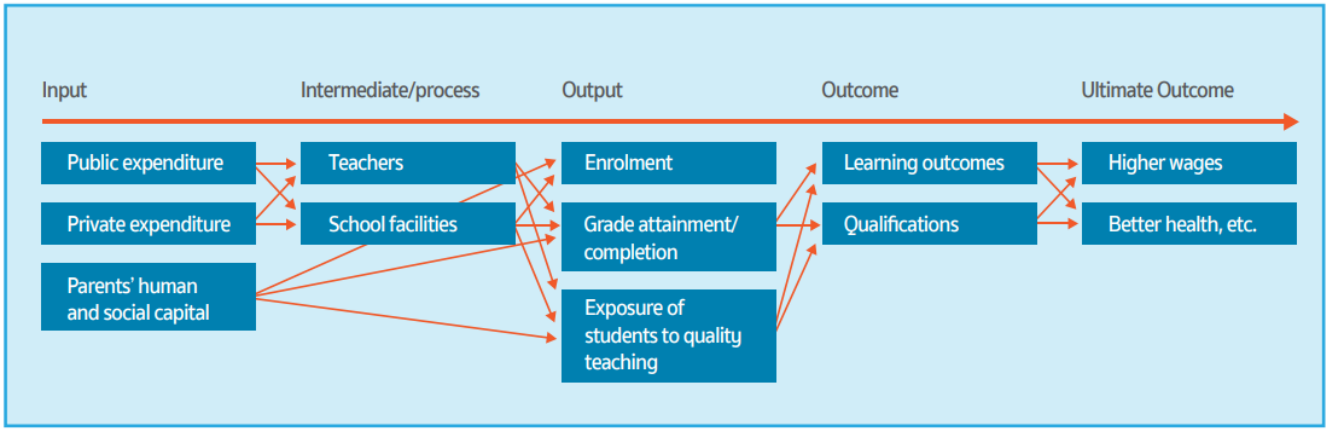
Equity in education also means that students from different backgrounds are equally likely to earn postsecondary education degrees. Ultimately, the goal of educational equity is to promote social mobility and reduced inequalities in employment and income (OECD, 2018a, p.22).

2.2 What is the object of equity? What should be made equitable?

Equity in education concerns all components of an education system, from inputs to ultimate outcomes in the educational process.

Figure 1 presents a simple model which identifies the various stages of the education system.

Figure 1: A model of the education system



Source: UNESCO (2018b, p. 35)

Within the education system, inputs relate to the level of expenditures and services provided for students consisting of actual expenditures per pupil (from public and private sources) and overall quality of the process of education put forward (including intermediate inputs, such as teacher quantity (pupil-teacher ratio) and quality, and index of school quality).

Outputs include student achievement and graduation rates (grade attainment and completion) while outcomes include learning levels (using standardized assessment) and qualificationws. Ultimate outcomes relate to satisfaction, incomes, earnings potentials and overall well-being. For each of these components, the main objective of the education system is to make an efficient use of the resources (inputs and intermediate inputs/process) in order to achieve desired (or at least adequate) level of outcomes and an equitable distribution of outcomes (and other measures of outputs).

2.3 Equity in funding principle

On the input side, education funding is the key factor that purchases other inputs, such as teachers and staff services, infrastructure, material and equipment. Funding level per pupil is hence on the input side, the objective to be made equitable for children; it is then object that should be distributed fairly. Since the inputs put forward are a means to an end, equity should involve fair competition and lead to equal opportunities to attain school objectives and life chances (Brimley et al, 2020, p.68)

With regard to education funding, three main principles have traditionally guided the examination of equity in education finance: horizontal equity, vertical equity, and wealth neutrality. Horizontal equity refers to the equal treatment of equals, that is that similar children in similar school should receive equal funding and be provided, more generally, with equal education quality.

However, as a goal, equal treatment of equal is just a starting point, as all children are not alike and, therefore, require different treatments and funding (Odden and Picus, 2019). Hence, the principle of vertical equity requires unequal treatment of unequals. Vertical equity acknowledges that "one size does not fit all" children. Some require more funding to have the same access to quality education and reach similar outcomes (Brimley et al., 2020, p. 67). However, the main issue in an equitable education policy is to determine what legitimate and relevant differences should be taken into account in the distribution of funding and departures from strict equality?

As for the wealth neutrality principle, it states that there should be no relationship between the wealth characteristics of a student and the school budget allocated for his/her education (Berne and Stiefel, 1984). Hence, the quality of a child's education should not be a function of wealth other than the wealth of the state as a whole.[8] This is generally ensured through greater allocation of public resources toward poorer communities to reduce disparities in total educational resources per student (given potentially unequal private education contributions).

In recent decades, as emphasized by Baker (2018), various shortcomings of separating the concepts of horizontal and vertical equity, have come to light. First, horizontal equity itself does not rule out vertical equity, that is equal treatment of equals does not leave aside the need for differentiated treatment for some (non-equals). Second, vertical equity requires value judgment that leads to categorical determination of who is unequal and how unequal their treatment must be in order for the educational system to be "equitable". The difficulty for the policymaker is to establish these categories of different treatment.[9]

The equal opportunity principle has been seen as providing a unifying approach at the basis of educational funding equity. The equitable treatment of all children that this criterion seeks to achieve and that needs to be considered is to be focused on the outcome – seeing the inputs (financing) as a means: "It is not the inputs of the child receives but the outcomes that are expected of all children under state standards and accountability systems. In this sense, all children within an education system are similarly situated and similarly expected to achieve the common outcome standards. Thus, the obligation of the state is to ensure that all children, regardless of their background and where the attends school, have equal opportunity to achieve those common outcomes standards." (Baker, 2018, p.22).

[8] These education equity principles could be traced back to seminal work by Berne and Stiefel (1984) in their seminal study, "The measurement of equity in school finance". They proposed a framework for evaluating equity in state school finance systems in the United States so that state school finance system should be based on fair treatment of taxpayers and yields fair treatment of students. Drawing on literature from tax policy, they adopted the definition of fairness that provided for both "equal treatment of equals" (horizontal equity) and "unequal treatment of unequals" (vertical equity). That is, if two taxpayers are equally situated, their tax treatment should be similar. Likewise, if two students have similar needs, their access to additional programming services or financial inputs should be similar. But if two taxpayers are differently situated (homeowner vs commercial), then differential taxation might be permissible; and if two students have substantially different educational needs requiring different programs and services, then different financial inputs might be needed to achieve equity. As for wealth or fiscal neutrality: "a child's education must not be affected by the wealth of his or her parents or neighbors, except by the wealth of the state as a whole (Brimley et al., 2020).

[9] However, "Differences in individual students and population needs don't always fall into neat boxes; rather they run along continua" (Baker, 2018, p. 22).

[10] As emphasized by Baker (2018, p. 23): "The conception of equal opportunity to achieve common outcome goals has thus largely replaced vertical equity into vernacular of k-12 equity analysis."

Hence, the input and process differentiation of program and services, including additional supports, i.e. vertical equity, is toward the goal of equal treatment for all, in which equal treatment is understood as toward common outcome goals.[10]

2.4 Linkage between educational funding and equity

To be concerned with equity in funding requires first to recognize that educational resources indeed play a role in educational outcomes. This question has occupied the education finance and economics literature for quite some time. What is the actual relationship between expenditures and quality of education, and does money matters ultimately in terms of learning results? (Brimley et al., 2020, p.23).

Various early studies had raised doubts about the relationship between resources and educational outcomes. Early studies by Coleman et al (1966), as well as Jenks et al (1972), indicated that expenditures (as measured by salaries and facilities) have only a minor effect on student achievement compared to much larger effects of family and peers. Hanushek (1986, 1993) also put forward that there is no strong or systematic relationship between education expenditure and student performance.

Despite the difficulty in identifying a specific resource effect in this multidimensional relationship,[11] more recent studies based on improved measurement and statistical methods overtime, have allowed to unravel the causality relationship between resources and outcomes, supporting the hypothesis "that money does matter after all".[12]

In particular, rigorous longitudinal studies testing the relationships between school finance reforms and student outcomes found significant causal effects. For instance, Lafortune, Rotstein and Whitmore (2018) found that overtime "states that that changed their funding system after 1990 in response to lawsuit compared two states that did not and that send more money to their lowest income school districts saw more academic improvement in those districts and states that don't".[13] Reviewing available research evidence on the issue of whether money matters in leading to higher student learning outcomes, Baker (2018,p.38) concludes: "a large body of evidence from rigorous empirical research indicates that money does make a difference for school outcomes".

[10] As emphasized by Baker (2018, p. 23): "The conception of equal opportunity to achieve common outcome goals has thus largely replaced vertical equity into vernacular of k-12 equity analysis."

[11] A 15 year analysis of studies done by the National Institute of education found that schools makes a difference if it has : "instructional leadership from the principal, a safe and secure environment, high expectations of students, a good monitoring system and commitment to basic skills instruction. Leadership, money, teacher attributes, pedagogy, climate, research methodology are all important when attempting to unravel the variables in scientific research as it relates to cost-quality relationship" (Brimley et al 2020, p. 26)

[12] For instance, Verstegen and King (1998) reviewing a large body of research following Coleman's results concluded that : "a large and growing body of research -- that has taken advantage of improvement in technology better databases and advances in methodologies and measurements -- provides further evidence that school inputs can and do make a difference in education and are positively associated with both enhanced student achievement and labor market earnings". (Baker, 2018). Various other studies have supported the significance of the relationships between cost and quality. For instance, Knoeppel, Verstegen and Rinehart (2007) found that schooling resources are powerful predictors of multiple student outcomes, including performance on standardized exams, graduation rates, higher education participation and citizenship (voting).

[13] Also, using individual panel study data, Jackson, Johnson and Persico (2015) examining the long term effect of increased funding to local public school districts through school finance reforms in the 70s and 80s, reported significant increase in wages, a drop in the incidence of adult poverty and additional months of schooling.

[3]

HOW DO WE MEASURE EQUITY?

Being multidimensional and involving multiple components of the education system, how could educational equity be measured? We review here some of the main measures used to assess equity at various stages of the education process, examining first equity in inputs, then in outcomes and in process.

3.1 Inputs

While the ultimate goal of equitable education are equitable outcomes for individuals, the means by which fair outcomes could be achieved are through equitable access to quality education for all. As mentioned, this involves horizontal, vertical equity and wealth neutrality with regard to public financing.

The best way to evaluate the equity of a school finance system is to examine the patterns of resources generated by its funding mechanisms toward schools. However, in some contexts, the main education systems are segmented, financed by various sources and allocated through various programs and mechanisms. The main allocation formula may constitute a relatively small part of the overall distribution of school funding. Among particularly problematic categories of aid provisions that need to be accounted for and that could play significant dis-equalizing roles are teacher allocation, as well as local and private contributions to schools. So ideally, the measure of per pupil funding that should be used in measuring equity should involve all central and local education expenditures, including wages and potentially private contributions.[14]

Horizontal equity

With regard first to the criteria of horizontal equity, which requires equal treatment of equals, one generally assumes that all students across schools or regions are similar. However, horizontal equity is best applied on subgroups of students (e.g. primary level students in regular programs). For such purpose, legitimate subgroups of students for which homogeneity claims are valid need first to be determined (Odden and Picus, 2019, p. 59).

Measuring horizontal equity entails measuring inequality or dispersion in the distribution of expenditure per pupil. Several statistics to measure the degree to which finances are equitable have been identified by Berne and Stiefel (1984)'s seminal work in education finance. Among the main statistics proposed are: (see Table 1 of the different input equity indicators) Restricted range, which is the difference between an observation close to the top of the distribution of expenditures per pupil and an observation close to the bottom of the distribution (for instance, the difference between the 5th and 95th percentile of expenditure per pupil).

[14] Still, comparing school-level (or district level) per pupil spending is a challenge. Comparison should focus only current expenditures, ignoring capital expenditures which are lumpy. Comparison need to control for teacher experience and enrolment. Schools with more experienced teachers and salaries will produce greater per-pupil costs, while class size affects per pupil value of teacher salary. Also, some schools are much more expensive to maintain than others or with higher energy cost and repairs which makes per-pupil comparisons difficult (Brimley et al, 2020, p. 76).

Coefficient of variation (CV), which is the standard deviation of the expenditure per pupil distribution divided by the mean.[15] Its value usually varies between zero and one with zero corresponding to a uniform distribution among all children. Determining a standard for the CV is a value judgment. Normally a standard of about 10% for the CV is generally used as a cutoff point separating equitable from inequitable resource distribution.

Gini coefficient is a relative measure of inequality in the expenditure per pupil distribution. It is measured as the area between the Lorenz curve and a 45 degree line. A value close to 0 suggests equality. A value of less than 0.05 could be seen as desirable.

Mcloone index is a statistics which provides a measure of the dispersion in the bottom half of a distribution, indicating the degree of equality along only observations below the 50th percentile.[16] It ranges from 0 to 1 with 1 indicating perfect equality. A value higher than 0.95 is seen as desirable (Odden and Picus, 2019, p. 61).

Vertical equality

As mentioned, vertical equality specifically recognizes differences among children and seek to address the fact that some students need more services than others. Various categories of characteristics have generally been identified, in particular those relating to children, local school districts, and to specific programs.

There are two main ways of measuring vertical equality. The first starts by assigning "pupil-needs weights" to all students requiring extra services, that is coefficients adjusting for the additional costs required to provide equal educational services to special needs students, and then conducting an horizontal equity analysis using the number of weighted pupils as the pupil measure (see section 4). This approach combines vertical and horizontal equity in a joint analysis. (Vertical equity is reflected in the weights recognizing factors that can lead to needs of different resource levels and made appropriate adjustments).

Alternatively, the analysis is conducted only for the general revenues or educational expenditure for the regular programs, with specific expenditures for extra services and programs deduced from the total expenditures. (Note that this approach essentially assesses the degree of equality in the distribution of the base program for all students, leaving aside analysis of vertical equity.)

Wealth neutrality

As mentioned, this principle states that education expenditures per pupil should not vary with household income or another index of students' socio-economic status. Contrary to the other two criteria which involve univariate analysis, assessing the degree of wealth neutrality entails analyzing the relationship between two variables. Generally, current education expenditure per pupil and a measure of wealth per pupil (such as an index of socioeconomic level) is used.

Two main measures of degree of wealth neutrality are generally used: the coefficient of correlation and the elasticity (calculated from a single one-variable regression).[17] The elasticity indicates the magnitude or policy importance of that relationship.[18] A correlation of less than 0.5 and elasticity of less than 0.1 are sometimes used as a standard to determine whether a system meets the fiscal neutrality standard (Odden and Picus, 2019, p.58).

[15] It could be expressed in decimal or percentage form.
[16] Technically, it is the ratio of the sum of the value of observations below the 50th percentile (the median) to the sum of these observations if they all had the value of the median.

A variant of this wealth neutrality measure was implemented in the context of US states by Baker et al (2018). In the by-annual review of states school finances, Is School Funding Fair?, states are classified as equitable (or progressive) if they allocate funding so that low-wealth districts and students with greater needs get more, with the expectation that they can reach an adequate level of educational opportunities and outcomes. More precisely, a state is classified as equitable (or progressive), if high-poverty districts receive at least 5% more funding than low-poverty districts (adjusted for cost variations and district size and sparsity of population); regressive if it allocates 5% less to high poverty districts, and flat if it falls in between (Baker et al., 2018).

Table 1: Input equity indicators

Equity dimension	Indicator	Definition	Technical details	Interpretation
Horizontal equity	Restricted range	Gap in expenditures per pupil	Difference in expenditures per pupil between an observation (or group) close to the top and bottom of the distribution, for instance between the 5th and 95th percentiles	A wide gap indicates inequity
	Coefficient of variation	Standardized measure of dispersion of the distribution of expenditures per pupil	Standard deviation divided by the mean. Expressed in decimal or %.	Varies usually between 0 and 1. 0 corresponds to a uniform distribution among all children.
	Gini coefficient	Relative measure of inequality measuring the dispersion in the distribution of expenditures per pupil	Measured as the area between the Lorenz curve and a 45 degree line	Varies between 0 and 1 0 indicates perfect equality and 1 perfect inequality Value less than 0.05 seen as desirable
	McLoone inde	Measure of the dispersion in the bottom half of a distribution of expenditures per pupil	Ratio of the sum of the value of observations below the 50th percentile (median) to the sum of these observations if they all had the value of the median	Range from 0 to 1 1 indicates perfect equality A value higher than 0.95 is seen as desirable
Vertical equity	Weighting coefficient	Comparison of expenditures per pupil across schools weighted by student needs units (structural costs)	Weight coefficients represent the additional costs required to provide equal educational services to special need students. Comparison of equal weighted per student expenditure is then realized	Depends of the horizontal equity measure used on the weighted per pupil expenditures
	Restricted	Comparison of expenditures per pupil across schools restricted to general programs	Expenditures for extra services and programs are deduced from the total expenditures and the analysis is conducted only for the general educational expenditures for regular programs	Corresponds to a horizontal equity analysis
Wealth neutrality	Correlation coefficient	Degree to which there is a statistical relationship between per pupil expenditures and student socio-economic status (income or wealth)	Linear relationship between per pupil expenditures and an income index	Ranges between -1 and 1 Correlation of less than 0.5 sometimes used as a standard to determine whether a system meets the fiscal neutrality standard
	Elasticity coefficient	Magnitude of the relationship between expenditures per pupil and socio-economic status (income or wealth index)	Coefficient of the bivariate regression between expenditures per pupil and an income index	Percentage change in expenditure per pupil relative to the percentage change in the income index. Elasticity of less than 0.1 is sometimes used as a standard to determine whether a system meets the fiscal neutrality standard

[17] The correlation coefficient indicates the degree to which there is a linear relationship between two variables. It ranges between -1 and 1.
[18] Technically, it indicates the percentage change in one variable (e.g. expenditure per pupil) relative to the percentage change in the income index for instance.

3.2 Outcomes

With regard to outcomes, as discussed, equity in education means that education systems should provide equal quality learning opportunities to all along two dimensions, inclusion and fairness. This corresponds to a situation where all students have access to quality education and that differences in students' outcome are unrelated to their background or to economic and social circumstances over which the students have no control. Hence, equitable school systems are those that provide accessibility to quality education to all and that are able to weaken the link between individual circumstances and education outcomes (OECD 2019a, p.42). Table 2 below presents the different equity indicators in outcomes, as well as in process.

Various indicators of educational outcome equity are found in the literature. In particular, the UN's global indicator framework makes use of the Program for International Student Assessment (PISA) data and indicators to monitor progress towards the SDG for education (UNESCO, 2018b). With regard to equity, PISA 2018 presents a set of indicators of inequalities in learning outcomes assessing the inclusiveness and fairness of education systems focusing on 15-year old students. For that purpose, PISA 2018 assesses two main components of the education systems 1) Access to schooling (inclusiveness) and 2) student performance (fairness).[19]

1)Access to schooling

As emphasized by OECD (2019 vol II, p. 43), "Access to schooling can be seen as a precondition for children to benefit from education". Access is reflected in school enrolment rates and could be measured at various grade levels and using various indicator sources. PISA 2018 assesses the enrolment of children in formal education for secondary age students at age 15. The indicator, called "Coverage Index 3", is based on verified rather than reported enrolment.

Examining PISA 2018 results, the proportion of 15-year-olds enrolled in schools in countries covered by the PISA sample ranged from over 98% in Germany and Hong Kong, to under 50% in Baku (Azerbaijan). The coverage in Thailand is 72 %, quite below the OECD average of 88%. Indicators of school enrolment could be interestingly decomposed further by sub-groups, for instance by socio-economic groups, gender, and immigrant status, as well as by regions, for different grade levels, to highlight potential inequities in grade attainment. However, PISA does not report such decomposition.

2)Student performance

With regard to fairness, PISA 2018 considers three individual circumstances that could contribute to shaping academic achievement on which equal opportunity is to be assessed: i) socio-economic status; gender; and immigrant background. These dimensions were chosen given that they have been shown to be strong predictors of academic achievement and education outcomes in several countries. Equity in education would correspond to a situation where students of different socioeconomic status, gender or immigrant and family backgrounds achieve similar levels of academic performance and levels of social well-being and integration (OECD, 2019b, p.43).

[19] PISA also assesses other measurable dimensions of education outcomes, particularly i) student attitudes and beliefs; and ii) student expectations for their future. i) Schools are not only places where students acquire academic skills; they are also where children develop many of the social and emotional skills they need to thrive (OCDE 2019b).

As mentioned earlier, equity in education outcomes does not mean that student obtain equal learning results but that learning results are not explained by characteristics in which they have no control (such as socio-economic levels, gender, etc.). Variations in learning results related to students' individual characteristics provide a measure of equity in education. The weaker the relationship between student personal background and student performance, the more equitable the school system.

Socio-economic status

PISA 2018 includes an indicator called "Strength" which assesses the share of the student performance explained by its socio-economic status. It is measured as the percentage of the variance in reading (sciences and mathematics) performance explained by an index of Economic Social and Cultural Status (ESCS).[20] When the relationship between socio-economic status and performance is strong, socio-economic status is a good predictor of performance, and equity is low.[21]

Examining PISA2018 results, on average across OECD countries, students' socio-economic status accounted for a significant share of the variation in their performance in the core PISA subjects (reading, mathematics and science). In reading, it accounted for 12% of the variation on average and even more in mathematics and science, about 13.8% on average. In Hong Kong and Macao, socio-economic status explained less than 6% of the variation in performance. In Thailand, the share was close to OECD average at 12%.

Another indicator of equity in student learning is the gap in results (in absolute score or percentage) between socio-economic groups. PISA uses an indicator of the gap as the "difference between advantaged and disadvantaged students in reading (science and mathematics)."[22] The indicator is measured as the gap between the average test score of the 1st quartile of student (advantaged) and the 4th quartile of students (disadvantaged) of the ESCS distribution.[23]

[20] The ESCS index is built as a composite score of three indicators, using principal component analysis, including parents' highest level of education, occupational status, and home possessions as a proxy for family wealth (OECD 2020 vol V, Appendix 1).
[21] The strength of the economic gradient between performance and ESCS, or how well socio-economic status predicts performance, corresponds to the percentage of variance (R2) in test score performance explained by the ESCS. For a detailed discussion, see (OECD, 2016).
[22] A socio-economically advantaged (disadvantaged) student is defined as a student in the top (bottom) quarter of ESCS distribution in his or her own country.
[23] This indicator could be repored as an absolute gap, in percentage points, or converted in terms of equivalent years of schooling.

Table 2: Outcome and Process Equity indicators

Stage/Equity dimension	Category	Indicator	Definition	Technical details	Interpretation
Outcome					
Inclusion	**Access to schooling**	PISA coverage Index 3	Proportion of 15-year-olds enrolled in schools	Based on verified rather than reported enrolment	
		Other student age categories (and sub-groups)	Pre-primary: proportion of (4) 5 yearolds enrolled in pre-school		
Fairness	**Student performance**				
	Socio economic status	Strength of socio-economic status (ESCS)	Share of the student performance in reading (mathematics, science) explained by its socio-economic status (ESCS)	Percentage of variance (R2) in test score in reading (mathematics, science) explained by ESCS	High score indicates that the socio-economic status explains strongly student performance and equity is low.
		Gap in results between socio economic groups	Difference in test scores in reading (science and mathematics) between advantaged and disadvantaged students	Gap between the average test score of the 1st quartile of student and the 4thquartile of students of the ESCS distribution	-Absolute gap or % score -Gap (%) could be analyzed between different quartiles
		Socio-economic parity index in minimum achievement	Disparities in minimum achievement between disadvantaged and advantaged students in reading (mathematics, science)	Ratio of the share of students who reached at least level 2 performance in the test score for disadvantaged students compared to advantaged students	Score below 1 indicate a disparity in favor of advantaged students
	Gender	Gender disparities in minimum achievement"	Disparities in minimum achievement by comparing the share of students scoring above minimum levels between girls and boys in reading (mathematics, science)	Ratio of the share of girls who reached at least Level 2 performance in the test score compared to boys	
	Immigrant status	Immigrant status disparities in minimum achievement"	Disparities in minimum achievement by comparing the share of students scoring above minimum levels between immigrants and non-immigrants in reading (mathematics, science)	Ratio of the share of immigrant students who reached at least Level 2 performance in the test score compared to nonimmigrant students	
Process					
Equal opportunity	Sorting across schools	Between school variation in student test scores	Percentage of the total variation in average performance across schools explained by between-school variations in reading (mathematics, science)	Share of the total variation in average performance across schools explained by between-school variations by opposition to withinschool share	High score indicates high level of academic stratification across schools
	Social segregation across schools and sectors	No social diversity index	Extent to which social diversity, as observed at the country level is mirrored at the school level	Index can be decomposed into three distinct components: the social segregation observed between public and private schools; the social segregation across public schools, and the social segregation across private schools,	Score of 0 corresponds to an even distribution of students across schools, regardless of their socio-economic status, to 1 if schools don't enroll students of diverse socio-economic status

Indicator source: PISA 2018 For details: See OECD (2019b) PISA 2018 Results (Volume II): Where All Students Can Succeed

Examining PISA 2018 results, in all countries part of the assessment, average test score performance (in reading, math and science) improved with each successive quartile of students' socio-economic status (OECD 2019b, vol II, p. 56). However, in some countries, differences in performance were more marked at the bottom of the socio-economic status distribution, as disadvantaged students scored much lower than students in the three higher quarters of socioeconomic status. This was the case for instance in Hong Kong, Macao and Norway, where most of the gap came from difference between the bottom quarter and the next-highest quarter.

In some countries, including Thailand, socio-economic disparities in performance were observed mainly at the top of the distribution as advantaged students outperformed students in the three lower quarters of socio-economic status by a wide margin (OECD 2019b, vol II p.56). In that regard, a closer analysis of these specific patterns in Thailand may prove useful for designing policies aimed to tackle both education underperformance and inequity.

Also, socio-economic inequalities could be assessed in terms of differences in students reaching an adequate or minimum level of proficiency in different core subjects. For that purpose, PISA 2018 contains a "Socio-economic disparities in minimum achievement" which assesses disparities in minimum achievement which compares the share of students scoring above minimum levels between disadvantaged and advantaged students.

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The socio-economic parity index in minimum achievement is measured as the ratio of the share of 15-year-old students who reached at least level 2 performance in the test score for disadvantaged students compared to advantaged students.[24] Values of the parity index equal to 1 indicate that the share of 15-year-old students scoring above minimum level (level 2) is the same for both groups (no disparity). A score below 1 indicates a disparity in favor of socio-economically advantaged students.[25]

Examining PISA 2018 results, socio-economic disparities are shown to be systematic across subjects in most countries. On average across OECD countries for instance, there were only about seven socio-economically disadvantaged students who scored above the minimum proficiency level in reading or mathematics for every 10 advantaged students who scored above that level. The countries showing the lowest disparities in above-minimum proficiency related to socioeconomic status include Estonia, Hong Kong and Macao with index about 0.9 and above. By contrast, disparities were wider in several low- and middle- income countries, including Cambodia, the Philippines and Zambia, with index at about 0.2 and below.

Thailand socio-economic minimum proficiency was 0.41 and 0.54 in reading and mathematics respectively, indicating that less than half of the socio-economically disadvantaged students scored above the minimum proficiency level compared to the advantaged students.

Gender

To monitor disparities with respect to gender, a similar parity index could be used to monitor differences in students reaching an adequate or minimum level of proficiency in different core subjects.

PISA contains a gender disparity index in minimum proficiency. The indicator, called "Gender disparities in minimum achievement" assesses disparities in minimum achievement by comparing the share of students scoring above minimum levels between girls and boys. The gender disparity index in minimum achievement is measured as the ratio of the share of girls who reached at least Level 2 performance in the test score compared to boys.

Examining PISA 2018 results, it is observed that gender disparities in minimum proficiency are in most countries in favor of girls in reading (as indicated by values of the parity index above 1) and of boys in mathematics. In both subjects, these disparities tend to be limited, as indicated by parity indices between 0.85 and 1.15. In Thailand, there are actually more girls than boys scoring above the minimum level of proficiency in both reading and mathematics (scores of 1.38 and 1.16 respectively). PISA 2018 also examines these indicators with respect to immigrant's status (see OECD, 2019b Vol II, chap 9 for details).

[24] The four levels (1-4) in PISA test scores correspond to quartiles in student test scores distribution.
[25] The parity index varies between 0 and 2. For example, if the share of disadvantaged students scoring above Level 2 is 40%, and the share of advantaged students is 50%, the socioeconomic parity index is 0.8 (40%/50%). Conversely, if the share of disadvantaged students is 50% and the share of advantaged students is 40%, the parity index is 1.2 (i.e. 2 – 40%/50%). See OECD (2019b, p. 148) for details.

3.3 Process

Equity in education is also related with the specific institutional arrangement governing the educational system, including especially the segmentation of students between the public and private sector and various rules and practices influencing stratification and sorting of students across schools (OECD, 2008).

Indeed, equity in education is related with sorting of students across schools of different quality with regard to their socio-economic status and ability. The social mix in schools is an important component in the design of policies aiming to tackle both education underperformance and inequity (OECD, 2019a). High levels of social and ability stratification between schools has been observed as having an impact on the learning opportunities available to students and thus on education outcomes (Reardon and Owens, 2014). In particular, with regard to resources and financing, the socio-economic composition of a school often determines the availability of certain resources that matter for student learning, such as the quality and quantity of teachers (OECD 2019b, vol II).

Furthermore, socio economic sorting affects the "peer-effect". As emphasized by OECD (2019b, p.84), limited social and ethnic diversity in schools implies that disadvantaged students are more likely to be enrolled in schools that have disproportionately large concentrations of low achievers – which also affects their performance. Indeed, one of the factor contributing to the negative effect of student sorting relates to the "peer effects" at school, that is "the extent to which the performance of one student is affected by that of his or her classmates" (Sacerdote, 2011). A relative consensus has emerged across various studies about the detrimental effect on a student's performance of being among struggling classmates (Hanushek et al., 2003; Burke and Sass, 2013).

The impact of such sorting is that, unless disadvantaged schools are allocated sufficient resources,[26] (in particular high quality teachers) to compensate for their shortfalls, social and academic segregation between schools may thus widen the gaps in outcomes related to socioeconomic status. (OECD 2019b, vol II, p84)

PISA 2018 measures the level of academic stratification across schools. It contains an indicator of between and within-school variation in student performance. The between school variation in student test scores measures the percentage of the total variation in average performance across schools explained by between-school variations.

Examining PISA 2018 results, 29% of the OECD average variation in reading performance was observed as being explained by between school variation.[27] The extent of between-school variation in reading performance differed widely across school systems. In Canada, Denmark, Finland, Norway for instance, between-school differences accounted for less than 15% of the total variation in performance. By contrast, in Germany, Lebanon, the Netherlands, differences between schools accounted for more than 50% of the total variation.In Thailand, about 27% of the disparities in average student scores are explained by differences between school, slightly below the OECD average.

PISA 2018 also contains a social diversity index within schools. The index measures the extent to which social diversity, as observed at the country level, is mirrored at the school level. It ranges from 0, which corresponds to an even distribution of students across schools, regardless of their socio-economic status, to 1, which would be observed if schools in a country never enrolled students of diverse socio-economic status (OECD 2019b, Vol II, p. 94)

[26] Disadvantaged schools are defined by OECD (2019a) as those with average student classified within the bottom quarter of the distribution of socio-economic index and advantaged schools as those with average student classified within the top quarter of the distribution of socio-economic index.
[27] See OECD (2019,vol II) Figure II.4.1

Examining the PISA 2018 results, the highest levels of social school segregation according to this indicator (i.e. the lowest degree of social diversity within schools) were observed in Albania, Argentina, Brazil, Chile, Colombia, Indonesia and Mexico.[28] In these countries, the index was at least twice as high as the level of school segregation that prevails in Canada, Croatia, Finland, Ireland, Korea and Taipei, for instance. Also a bivariate relationship could be examined between the index of social diversity[29] and the percentage of the variations in student test scores explained by students' socio-economic status.

A high degree of social segregation across schools means that children are less likely to be with peers from diverse backgrounds. As discussed above, students, especially those from disadvantaged families, may be especially affected by a lack of social and academic diversity in schools. As disadvantaged students are often over-represented amongst low achievers, schools that concentrate a large proportion of disadvantaged students generally also have high concentrations of struggling students, and this may have additional detrimental effects on academic achievement (OECD 2019b Vol II). Social segregation is thus likely to reinforce the link between socio-economic disadvantage and poor academic achievement.

Examining the results of PISA 2018, countries where schools were less socially diverse also tended to have the strongest relationship between socio-economic status and performance.[30] Peru, which had one of the highest levels of social segregation across schools is one of the countries where the association between students' socio-economic status and performance is the strongest. By contrast, Canada, Croatia, Korea and Norway showed low levels of segregation, and the association between performance in PISA and socio-economic status was weak.

As for Thailand, the indicator shows above average segregation by socio-economic status across schools and higher than average level of inequity associated with socio-economic status explaining learning results (OECD 2019b, Vol II, p.98). Having reviewed some of the main measures of equity in inputs, outcomes and process in education, we now turn to examining how education finance system could be structured toward promoting equity.

[28] See OECD (2019b, vol II) Table II.B1.4.10.
[29] The no social diversity index could be further decomposed into three distinct components: the social segregation observed between public and private schools; the social segregation across public schools, weighted by the share of students in public schools; and the social segregation across private schools, weighted by the share of students in private schools. See OECD 2019b Vol II, for further details.
[30] See OECD (2019b, Vol II) Figure II.4.9.

[4]

THE PURSUIT OF EQUITY IN EDUCATION FUNDING

As mentioned, equity in school finance seeks at ensuring equal opportunity to quality education to all, leading to adequate and similar learning outcomes. Fair financing of education funding as we saw is fundamental for that endeavor. Education funding allows to buy the various inputs in education, in particular teachers and support staff and school management, as well as instructional material and facilities, and hence contribute to provide the various programs and services required to provide quality education for all.

We examine in this section the use of funding formula, in particular per-student funding rules and variants including needs-based components to pursue objectives of educational equity. These funding mechanisms vary in their capacity and quest to pursue basic horizontal equity, through equal per student allocation, and pursuing vertical equity, through consideration given to students' special needs and school characteristics, using needs-based funding rules.

We start by examining the various types of education grants before discussing allocation mechanisms, distinguishing especially formula funding from other mechanisms to distribute funds. We discuss in particular per-student and needs-based school formulae, including weightedstudent formulae.

4.1 Education grants

Allocation systems and expenditure levels in education vary substantially across countries. These choices are path dependent and conditioned by countries' development level and government priorities, political and administrative environment, responsibility sharing between levels of government, and relative roles in the economy of the public and private sectors (North, 2005; OECD, 2017).

Historically, financial support to education from central or state governments toward regional, districts or local authorities in financing schools took the form of general purpose aid intended to encourage basic schooling and, in decentralized or federal systems, as a relief to local school authorities and tax payers (Brimley et al. 2020, p. 89). These education grants were usually flat grants, delivered in uniform amount to school authorities or districts (either on a per teacher or per pupil basis). Progressively, some of these grants started to incorporate equity considerations and were allocated using some equalization principle to somewhat "level the playing field" across jurisdictions.[31]

[31] In countries relying on local property tax especially, such as the USA, equalization principles became an important consideration starting in the early 20th century to remove some disparities in school revenues and expenditure given unequal wealth, income and ultimately injustice and unequal opportunities (Brimley et al 2020, p. 89).

Over time, these non-restrictive general purpose grants also became categorical, that is, they started to include conditions that were tied to the receipt and the use of the funds by schools or local authorities. Today, categorical (conditional) grants to education is the funding mechanism of choice used by several governments to try to ensure the pursuit of specific programs or targets (Odden and Picus, 2019). Governments also use block grants[32] to transfer resources toward decentralized level of government, authorities or schools.

4.1 Education grants

Different mechanisms are used by administrative authorities (e.g. ministry of education) to allocate these various types of education grants toward local/regional authorities and schools. European Commission (2014) classifies these mechanisms into two models: (1) those relying on budgetary approval or discretion and, (2) those using a funding formula.

Within the first, more traditional, model, three main mechanisms could be distinguished: i) administrative discretion; ii) historical allocation, and iii) bidding/competitive process (Levacic 2008; OECD, 2017a).

Administrative discretion is an approach more frequently used in centralized funding systems, in which local/regional authorities or schools receive resources based on administrative assessment by the funding agency of the education resource needed by each district or school. These allocation choices are not guided by unique or know (objective) rules. Historical expenditure, or incrementalism, is an approach in which funding allocation is based on the previous year(s) budget or historic level of certain variables (potentially accounting for modification for student number or input prices).
.
Bidding and bargaining is an awarding process by the central authority involving competition among local authorities/districts or schools for additional funding and making a case for additional resources through the participation of specific programs. For instance, many state systems in the United States use competitive processes to award funding for categorical grant programs allocation based on demonstrated needs or merit by schools or districts (Levacic, 2008).

These more traditional allocation mechanisms as emphasized by OECD (2017), present various shortcomings. Administrative discretion leaves little space for predictability, transparency and equity as allocation choices are not linked to unique or objective criteria applied to all, and is generally associated with low level of budget transparency (Levacic and Ross, 1999). The distribution of resources on a historical/incremental or discretionary basis is also rarely efficient or equitable. Funds allocated on an incremental basis to support existing staff and infrastructure, year after year, may actually support structural or historical inequities across regions or type of schools and, as for discretion, there could be no clear relationship between needs of a region or specific school an actual resources allocated (Levacic, 2008). Furthermore, under these mechanisms, districts and school have no incentives to reduce expenditures or increase their efficiency or the quality of their provision (European Commission, 2000). As for allowing schools to bid and bargain for resources for specific programs, it tends to reward more entrepreneurial principals or districts, with little relationship to the needs of the students (Caldwell et al, 1999).

[32] Block grants generally involve broader spending categories and greater discretion than categorical aid for the recipient.

Formula funding, by opposition, involves the use of objective criteria and universally applied rule to determine the amount of resources that each school authorities, district or school is entitled to. Compared to the more traditional methods, formula funding systems could directly be structured to promote efficiency or equity objectives. The use of a consistent and known rule has also been viewed as allowing to advance other goals, such as predictability, transparency and accountability at low administrative costs (Fazekas, 2012). In a budget management perspective, it is also viewed at improving forecasting of public expenditures when adequately linked to the number of students (OECD, 2017a, p. 121).

In the last decades, funding formulae have been put in place in many countries for distributing large categories of expenditures to districts or schools. We examine in the next section the main characteristics of funding formulae and in particular per-student rules and variants accounting for specific student and school needs, which seek to advance equity objectives.

4.3 Formula funding

According to the OECD (2017a, p. 22), formula funding is a mechanism involving: "the use of objective criteria with a universally applied rule to establish the amount of resources each school is entitled to". Formula funding could further be defined as: "methods, principles and rules of any description, however expressed. It does not have to be expressed in purely algebraic form, but it must apply a consistent set of criteria for distributing resources" (Department of Education and science, 1998).

As such, a funding formula determines the level of public funds allocated, based on a set of predetermined criteria which are impartially applied to each recipient (e.g. sub-central authority or school). These predetermined criteria in most cases are input-, output- or performanceoriented (OECD, 2017a).[33]

In its most simple form, a funding formula is expressed as a per capita allocation scheme that a school or education authority is entitled to receive, but most formulae are more complicated incorporating additional types of variables, such as pupils in each grade, area of school, poverty level, to advance resource equity objectives (Fazekas, 2012).

History

According to Caldwell et al. (1999), formula funding for schools have a long history, having been a feature of educational management since the formation of systems of public education, especially within western countries.

However, historically, funding formula were generally simple "conversion rules", used to make various "in kind" resource entitlements allocations to schools or districts (e.g. rules to convert the number of students in each grade to the number of teachers required given the regulation on student-teacher ratio and teacher workload) (Ross and Levacic, 1999, p.251).[34] These "first generation" funding formulae -- using simple staffing ratios and allowances per pupil or other simple per capita allocations – were implicitly assuming that all pupils, in a school or at a given grade level, were identical and had the same educational needs, and hence cost the same to educate (Caldwell et al., 1999, p. 20).

[33] We leave aside here the discussion of formulae based on output and performance. See Levacic (2008) and Fazekas (2012) for a discussion on these approaches.
[34] Other resources such as supplies and equipment may also be allocated by conversion rules related to the infrastructure of the school, its condition, type of students or location (World Bank, 2011, p. 285)

In an equity perspective, as emphasized by Ilie et al. (2018), these initial formulae based on the principle of equality of funding per pupil were highly regressive. Indeed, they were not factoringin the different needs of providing education to different characteristics of students and differentiating between the backgrounds of students in the different locations, including harder to reach groups more likely to be out of school.

The "second generation" of funding formulae were developed precisely to integrate equity objectives, by taking into account differences in learning needs and recognizing that some students cost more to educate. Starting in the late 1960s, various OECD countries in particular introduced funding formulae containing a number of variables to account for specific student needs. Australia, Britain, France and the USA among others developed funding formulae to allocate additional resources to schools serving disadvantaged communities, recognizing the relationship between economic disadvantaged and educational attainment (Caldwell et al. 1999).

These early attempts at formula funding of schools with an equity component were usually targeted at special subgroup of schools and confined to relatively small proportion of the total budget (Ross and Hallak, 1999). Furthermore, equity allocations were not based on proper assessment of the costs of these supplementary programs, but simply function of available budgets and priorities.

In light of these limitations, Caldwell et al (1999, p.21) identify "third generation" funding formulae as having three main characteristics: Comprehensiveness, that is, including all the costs of educating students incurred at school level; cost based, that is, derived from an analysis of the costs of providing students with a specified educational program and differentiated according to students' supplementary educational needs; and incentive appropriate, that is, the formula encourages schools to act in ways which are consistent with agreed educational policy objectives.

Ongoing development in education financing is also leading, according to Caldwell et al. (1999) to a fourth generation of funding formulae, characterized as a needs-based formula designed in an education outcome equity perspective , that is, "derived from an explicit analysis of what schools need to spend in order to provide a specified quality of education for all their students" (Caldwell et al., 1999, p. 10). These ongoing education financing advances seek to improve equity by ensuring that similar students and similar schools are funded the same, while those which justifiably incur higher costs are funded accordingly. Given sufficiently good quality information about the links between resource costs and learning outcomes, instead of having an input focus these formulae seek to link resource inputs to learning outcomes based on specific per pupil costs per learning outcome, and not simply overall cost per pupil (Caldwell et al., 1999, p.22).

Historically, the development of formula funding often took place in the context of the introduction of a decentralized school management approach, which gave more freedom for school authorities to spend their allocated budgets. This was the case for instance in countries such as Australia, New Zealand, United Kingdom and the USA which started to implement decentralized models of authority, responsibility and accounting in the 1990s which generated a demand for formula funding (Ross and Levacic, 1999).

However, funding formula has been applied also to more centralized education systems, the key being the mechanisms of allocation rather than how the money is spent. Still, as emphasized by Fazekas (2012, p.8), decentralized school management is more frequent in the presence of formula funding, and the combination of centralized school management and formula funding tend to be rare.

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4.3.1 Basic design considerations

Before examining more specifically how educational equity could be advanced through formula funding, we examine some basic design considerations in school formulae, including with regard to coverage of the funding allocation mechanism, its reach, complexity and the choice of funding units.

Coverage/comprehensiveness

Funding formulae differ with respect of the share and specific components of the education budget they allocate. Most formula are used to allocate recurrent expenditures. Only a few include capital expenditure. Levacic and Ross (1999, p. 37) argue that expenditures that have an uneven incidence over time, such as major capital projects, are not usually suited to allocation by formula to individual schools. Doing so would require making adjustments that would complicate funding, for temporary and often changing expenses, which would tend to be impractical. With regard to current expenditures, for which formulae tend to be mainly designed, a key question concerns which resources, programs or services for special students or schools, would benefit at being funded through the main school formula. Conversely, which part should be retained under the control of the funding authority and allocated outside the main formula, for instance through specific targeted programs using discretion or budgetary awards?

Indeed, in practice countries' education funding systems tend to mix different budget allocation methods, and reliance on school formula funding sometimes is limited to specific programs or budget share.[35] For instance, a per student formula could be used to allocate cash funding for learning material, while supplementary costs for special needs student could be covered by conditional programs using a budgetary award mechanisms.

Furthermore, teachers and other staff could be allocated in-kind through a conversion rule by the central or local authorities, and operational costs and capital investments be determined through administrative discretion (Levacic, 2008).

A wide variety of experiences regarding formula funding are observed across countries. Despite that there is no single best practice with regard to the design of school funding formula (OECD 2017), among the key principles generally recommended is for the funding formula to have as wide coverage of the budget as possible. A comprehensive formula -- including especially wages given the importance of personnel resources in the school budget -- allows to promote predictability of school allocation, transparency in funding, and accountability of overall education spending at the district and school level.

[35] For instance, in ECA countries before the economic and political transition, the education finance approach corresponded to a combination of historic funding, discretion and bargaining (World Bank, 2011, p. 4). The allocation system, referred to as an input-based (or normative budgeting) system, included norms covering space, equipment and staffing, norms for allocating teaching resources by number of classes, or specific number of lessons stipulated by curriculum. Such budget planning process was viewed as encouraging schools to minimize class size in order to maximize the number of teachers and teaching aid and wasted space... (World Bank, 2011, p. 3).

Targeted educational programs outside of the main formula are often observed to allocate funding to priority areas or to address emerging priorities within the school system. However, the multiplicity of targeted funding tend to reduce predictability and transparency and to increase transaction costs, including potentially greater reporting and administrative burden for schools (OECD, 2017, p. 144). Comprehensive formulae allocating wide segment of a school current expenditure allows greater consistency, predictability and transparency of funding and could improve accountability (Levacic, 2008).

Reach

Another key consideration in the design of a formula relates to the responsibilities of delegated authorities involved in resource flow, in particular whether resources are transferred to local education authorities or directly to schools. In some countries, the central government allocates funding to local authorities which in turn chose the specific allocation of individual schools or exercise some discretion on its allocation. In other countries, the central/state government use the funding formula to determine the budget of individual schools, which is then either provided for all schools to the relevant local education authority, or directly to the individual schools.Such configuration decision affects the potential flexibility of the formula application across schools and could have repercussions on the incentive for efficiency of spending improvements (World Bank, 2011, p.288).

There is a wide variety of international practices with regard to role and responsibilities in the funding flow, which are conditioned by countries' specific institutional arrangements. Still, a guiding principle recommended by OECD (2017) is for allocation formula mechanisms and responsibilities to be aligned with the incentives of the final user of resources, to ensure that the funds are allocated and used as targeted. This could entail specific accountability systems or consultation mechanisms.

Units of funding

Another major consideration in designing a school formula concerns the unit of funding to be used. A formula can be based on a single unit of funding, for instance the number of students, but can also contain a number of different units of funding (e.g.a teaching group or a class, a school, or the school site).

If the student is the unit of funding of the whole formula, the number of students is the input (as measured by numbers of students on the school roll for instance) used to determine the resources to be transferred (as a funding amount or in-kind), to the school or local authority. In such student-based budgeting context,[36] a Per Student Funding (PSF) formula provides schools an amount of resources based on the number of students enrolled in each school.

A needs-based variant of the PSF that has arisen as a strategy for addressing equity concerns is known as the Weighted Student Funding (WSF) formula, also called the per-pupil weighting formula. Under WSF, resources are allocated to schools (or school districts) based on the numbers and types of students enrolled in each school (Miles and Roza, 2006).

Weights are attached to students based on their individual needs, the type of educational program or other pertinent cost factors. The weights are set as the costs adjustments above (or below) the level of basic allocation to compensate for the additional cost of education of some students given their special needs, the types of education or programs they pursue or other relevant cost factors associated with students or specific schools (for instance small schools or low density areas).

[36] Alternatively, in a funding formula using staff-based budgeting, funding is attached to staffing positions.

Hence, in a WSF, each student receives initially a base weighting of 1.0 which represents a foundation monetary amount. Then adjustments or weights are established for groups of students who have special educational needs or taught in more costly schools. For instance, if the cost for a special program is 50% more (0.5), than for the general education program, then that students has a total program cost of 1.5 for funding purposes in Weighted Pupils Unit (WPUs).[37]

A WSF approach implies identifying factors that most thoroughly address differences in educational costs across schools and districts, and to determine the magnitude of the adjustment (or weight) for each cost factor that should be accounted for in the school funding formula. The WSF approach has been adopted by a number of jurisdictions and is a popular strategy for addressing equity concerns. One of the longest used WSF approach was developed in the Edmonton school district in Alberta, Canada, which implemented a school-based management and student-based funding reform, named the "Weighted Student Formula" in the early 1970s (Archer, 2005). In the United States, several urban school districts implemented student-based funding policies starting in the late 1990s[38](Chambers et al., 2010).

A funding formula could also be mixed with regard to the units of funding, containing for example both student and school site as units of funding, depending on the cost elements that are addressed among the various components of a formula. Such mixed formula was used for instance in Lithuania during a school reform period between 2008-2012.[39]

Complexity

Another key design decision in needs-based formula is reflected in the choice of the specific cost components that will be accounted for to pursue vertical equity objectives. In needs-based formula using weights or other mechanisms to account for cost differentials, cost categories and weights associated with the different components of the formula need to reflect adequately the different cost per students. This implies the introduction of various adjustment components.

[37] More generally, the WSF formula is as follows:

$$\text{School Grant} = \text{Foundation} \times \sum_{i=1}^{C} N_i W_i$$

[38] A variant of the WSF is referred to as the "school-level" WSF, also known as "student-centered funding" or "back-pack funding", in which funding is intended to follow children directly to the school he or she enrolls, in the context especially of voucher systems and school choices (Barnard, 2019). Such approach includes two key components: (a) the distribution of money to schools based on student specific needs and, (b) an increase in autonomy at the school level over how these amounts are to be used.

[39] In the context of a weighed student funding formula based only on student enrolment, small and rural schools with limited enrolment were resolving to multi-grade teaching in presence of limited per student funding, leading to lower education quality. In such context, school as a unit of funding was added to support small schools. However, because of budget considerations, the hybrid form was only used until 2012. The formula mixing student and school as funding units was as follows:

$$School\ Grant = (student\ Foundation \times \sum_{i=1}^{C} N_i W_i) + (school\ Foundation \times \sum_{j=1}^{Q} W_j)$$

Where Wj are weights for categories of school structural cost factors, j =1, …Q.

Among the key principles generally emphasized as guiding principles of a needs-based funding formula is that the formula has to adequately reflect the differences in student costs of providing education (Ross and Levacic, 1999; Levacic, 2008; OECD ,2017a).In international practices, school funding formulae show considerable variations in their design with regard to accommodating various cost structure of schools. As a guiding principle, OECD (2017) emphasizes that a balance has to be found between a simple and a sophisticated formula, which may capture the school needs with more complete accuracy, but may be also more difficult to understand for the various stakeholders and to revise.

Indeed, there are tradeoffs in formula design between complexity of a formula, which encompasses multiple elements differentiating costs of students or schools, and easiness of implementation with regard to efficiency, effectiveness and transparency objectives (OECD, 2017a, p.142)

4.3.2 The pursuit of equity objectives through formula funding

The pursuit of equity defined as equal educational opportunity for all, through education financing, lies in the capacity of a funding formula to take into account the differences in learning needs of students and legitimate school cost differentials, in order to equalize education quality and opportunities to learn for students across schools.

For such purpose, formulae need to combine horizontal equity objectives – that is treating all students with similar needs in the same way and to fund the same type of schools at the same level – with vertical equity objectives, that is to treat students with different learning needs differently and schools facing different legitimate unit costs, in such a way that students are able to have access to equal education quality and to achieve similar educational outcomes. This involves funding schools of different types catering for different categories of students (for example, general programs and technical-professional programs) differently – according to their differing needs and the specific characteristics of their student bodies for legitimate differences in unit costs which are beyond the control of the individual or schools (Baker, 2018).

Taking into account vertical equity within a formula hence requires two main steps. The first step directly concerns equitable education outcomes for all. It involves identifying groups and categories of learners with access and achievement gaps, defined as differences in school enrolment and achievement results which are beyond control of individual, associated with student characteristics (e.g. disabilities, socio-economic status) or with school characteristics beyond their control (e.g. small school, group size, incomplete school). This corresponds to identifying cost factors or categories of student with special needs and learning difficulties, as well as schools and district characteristics, that justify cost differential categories.

Identifying these access and achievement gap categories that will justify costly intervention reflected in the funding formula support is country specific, as well as potentially region and district specific. It evolves over time, influenced among other things by results of the interventions. Identification of achievement gaps depends on the choice of indicators and criteria used to determine the existence of such gaps.[40]

[40] Formula design requires determining the threshold for which the relative difference between the (overall) average achievement and the student category's average achievement is considered sufficient to require an intervention.

Remind that equitable education goal requires equal access to quality education and equal opportunity for all in the education process to achieve relatively similar outcome levels across categories of students. Given existing access and outcome gaps to fill among categories of students, additional inputs, programs and support have to be put forward (including through mechanisms to include out of school children and potentially through lower student teacher ratio and additional teachers in small schools), which represent additional costs in order to reduce gaps in access and achievement levels.

One consistent finding across country is the importance of early childhood education on a child development and on inequality. Inequality in education starts early (Heckman, 2016). Studies show that the most critical years in a child development are in its very early age and that disadvantaged children benefit most from early childhood education programs (Elango et al., 2016; Darling-Hammond, 2019). However, they are much less likely to be enrolled in quality preschool programs (CGECCD, 2016). Identification of these access gaps to quality preschool education for children with greater learning needs, such as from low-income families, children with disabilities and immigrant, and mechanisms to equalize learning opportunities during early childhood is a fundamental step for greater improvements in educational equity over the child overall education years.

The second step in integrating vertical equity into the formula is about equal opportunity of education quality, and involves identifying the interventions and costing these additional inputs and support. It requires determining the nature and level of the interventions (i.e. special programs and support) needed to fill up the identified outcome gaps and include out-of-school children. It also requires estimating the costs of these interventions and school conditions to be accounted for in the formula to fill the gaps in outcomes.

Ultimately, integrating vertical equity into the formula involves a value judgement of determining the categories of who is considered unequal, and how unequal their treatment should be to be equitable (Baker, 2018).[41] There are also various other considerations are at play in the determination by policy-makers of the magnitude of these adjustments -- the level of assistance provided to help disadvantaged students gain access to school and fill the gap in outcomes as well as other structural factors such as school size and remoteness -- that will be factored in the funding formulae. Given resource constraints, there is a tradeoff between general education program and special-needs program funding. The choice could potentially have an impact on overall student achievement level and on the dispersion of results (achievement gaps) among students. There could be also potential implementation constraints in terms of availability of resources, and school and district capacity to implement special programs.

We first examine practices regarding the first step of vertical equity consideration of identifying cost categories of students with achievement gaps and school structural factors, and discuss the main components generally found in needs-based formulae. We then examine the second step and review methods to estimate the costs of these needs-based interventions to level the playing field of educational quality and outcomes (section 4.3.4).

Cost factors and components in a funding formula With regard to the first elements of identifying the cost factors, a needs-based funding formula (such as a WSF) has, in principle, to reflect adequately the cost differentials in education due to various student and school characteristics. These include generally student, school and district factors: Student supplementary educational needs. A major equity issue to tackle in funding formulae is the allocation of additional funds for students with supplementary educational needs that are manifested in various forms of learning impairment, disadvantages or difficulties (e.g. disabilities, income, language).

[41] Determination has also to be made about which inequities are prioritized in terms of intervention and the criteria used to determine these choices of priorities.

School site cost differentials. Another equity consideration is to ensure that the formula adequately compensates schools for differences in their unit costs which are due to specific characteristics of the school and which are beyond its control. Such cost differences arise due to factors such as small size, isolation, or buildings which are more costly than average to operate and maintain.

Regional cost variations. The costs of school inputs can vary across regions within the school system. Identifying best practice in providing funding for specific student needs or individual school still constitutes an ongoing objective of education financing evaluation (Baker, 2018; OCDE 2017). Given the idiosyncrasies of countries' institutional arrangements and wide diversity of experiences and approaches across countries regarding the selection of cost categories and cost adjustments, this quest is especially complex. (Fazekas, 2012).

Nevertheless, while each country's use of funding formula tends to differ, there are typically some basic patterns that are observed in their configuration. Indeed, most are made of some main components and recognize a core set of cost factors that contribute to differences in educational costs (Kolbe et al, 2019, p. 7).

Following the categorization of Ross and Levacic (1999), four main components or group of variables are generally present in school funding formulae: (A) a basic allocation; (B) a curriculum or educational program enhancement allocation; (C) student needs allocation; (D) school needs allocation.[42]

Component A: Basic allocation. School funding formulae are generally composed of an initial allocated amount (for instance, based on each student enrolled), and subsequently incorporates adjustment factors in the other components of the formula, either based on school or student characteristics.

The basic allocation reflects the costs of educating students with 'normal' educational needs. It represents the cost of minimally adequate educational services (and/or of achieving adequate educational outcomes), either in the school or district with lowest cost, or for the child with no specialized needs.[43] It generally includes year-level coefficients which accounts for difference of grade level cost differentials, or stage of schooling (e.g. primary, lower secondary). The basic allocation may be provided on a per-student basis, or alternatively per teaching group, or a base allocation per school defined in terms of student size categories. [44]

Component B: Curriculum enhancement. The allocation adjusts for the cost of providing a specific educational profile (e.g. vocational, art, sport) and only applies to selected school or students. It could also be associated with an adjusted curriculum designed to meet specific education needs of specific student groups.

[42] The FEP funding formula in Thailand is structured along these 4 components in the spirit of Ross and Levacic (1999) with the following elements: School grants = A + B + C + D where A: Basic allocation. The basic per-student allocation covers school operating costs associated with teaching and learning activities, including schoolbooks, learning materials and student uniforms. Common to all schools, the subsidy seeks to promote horizontal equity and represents the largest share of school budget allocation. B: Additional curriculum allocation to enhance education quality. The additional allocation aims at improving student access to IT as well as outside classroom activities. C: Supplementary allocation for poor students. This supplementary component for disadvantage students, poor and handicapped aims at promoting vertical equity. D: Supplementary allocation for small and needy schools. This additional allocation aims at supporting operating costs for small and isolated schools facing lack of scale economy and also aims at promoting vertical equity (Gauthier and Punyasavatsut, 2019).

[43] Alternatively, the foundation level could be set to represent the cost of educational services (and/or of achieving adequate educational outcomes) in the average educational setting for a district or school facing average cost pressures and serving an average student population (Baker, 2018, p. 106)

[44] When instead of a per student unit, the teaching group is the unit of funding, the formula will also specify the class size threshold before an extra student demands the creation of an additional class and its associated requirement of teacher time costs

Component C: Student needs: The allocation aims to adjust for different student characteristics which require additional resources to ensure the same level of access of the required curriculum and quality education. This is the major component to support equity function within a formula. It involves the identification of students expected to benefit from funds directed towards responding to supplementary educational needs and the linkage between inputs and outcomes is of particular importance in designing the component.

Component D: School needs: The allocations seeks to adjust for structural differences in school site operation costs beyond the schools management controls (e.g. located in rural or remote areas with lower class sizes, or schools with higher maintenance cost linked to economic factors, such as specialized equipment needs). Some formulas also include with in this component factors associated with differences in resource costs across schools or districts due to their location. Some formulae tend to account for these differences of costs and sometimes differences in recruitment incentives for schools in remote areas, and a price-of-education index is sometimes developed and used in the formula to adjust the value of funding across areas (Kolbe et al, 2019). Each of these components relate to a main policy goal pursued through the formula. Their relative importance in terms of total school allocation reflects the emphasis given to equity relative to other objectives in a formula. Hence, in a per student funding formula emphasizing efficiency, funding would mainly be allocated through component A, the basic per student allocation. This basic allocation per capita allocates funding equally according to the number of student enrolled in a school (potentially differentiated by age or grade). This would tend to create incentives for competition among schools through financial incentive to recruit students, providing incentives for efficiency through economies of scale.

Conversely, in a formula emphasizing equity, higher share of funding would be allocated through the other components, especially component C accounting for specific student needs, reflecting a desire to promote vertical equity by accounting for various structural factors outside of students, schools or district controls.

International practices regarding the selection of variables within a formula which serve as needbased cost categories and adjustments to pursue equity objectives vary widely. Baker (2018) and Kolbe et al. (2019) reviewed the cost categories in practice in the United States among the 50 states. All US states rely on school formula funding for at least part of their school current expenditures, allowing to gain some insights on the variety of categories of costs but also patterns observed. Box 1 presents an overview of the main cost categories observed among US states based on Baker (2018) and Kolbe et al. (2019) review.

Box 1: Patterns of need-based cost category components in use in US states

Baker (2018) and Kolbe et al. (2019) reviewed the cost categories and adjustments for students and school needs in the 50 US states. We briefly summarize some of their main findings.

Student Needs: With regard to student specific needs, the main adjustments for differences in the cost of educating students with higher levels of needs among US states generally include, disabilities, socio-economic disadvantage, language, and gifted and talented students

Disabilities/Special education: Adjustments to the basic per student allocation account for extra costs to provide equitable educational opportunity for those requiring special education because of disability status, hence recognizing the need of required additional resources, specialized staff or instructional material. In twenty-two states, some form of supplemental funding to pay for portion of the additional cost of providing special education and related services to students with disabilities (SWD).[45].

[45] Weights vary widely across states in the US. For example, Utah Oregon use a single weight to fund special education programs Iowa provides three weights. Alternatively, some states use cost reimbursement to support special education.

Socio-economic disadvantage: Nearly all states consider differences in student disadvantage, and the resulting increase in educational costs for poor students or who have been identified as at-risk for academic failure.[46] The most commonly-used indicator for the extent of student need in a school district is the share of students who receive or who are eligible to receive nutrition benefits through federal and state school lunch programs.[47]

Non-native language learners: All but two US states provide additional funding to educate students who are unable to communicate fluently or learn effectively in English and support services provided for them to meet the curriculum.[48]

Low performance students: Some states provide additional funding for students based on standardized test scores or provide local assistance for students at risk of dropping out of school. [49]

Gifted and talented students : Thirty-five US states implement policies that provide school districts with additional funding for programs targeted at gifted and talented students. However, there is no commonly accepted approach across states to identify the number or share of gifted and talented students.

Schools' location and scale : Several states recognize size, sparsity or small schools or districts among cost categories in their funding formulae. Small size: Consideration is given in several state formulae to the need to help finance small, often rural schools which face higher education per pupil costs because of diseconomies of scale. States use different thresholds to determine small size threshold to qualify for additional assistance, using generally student enrollment as an indicator for size.[50] A few states also identify small districts and schools using staff-based criteria.

Geographic necessity: Most states condition the qualification to small scale districts or schools out of geographic necessity. That is, small districts and schools may be necessary because they are located in sparsely populated areas or are geographically bounded in ways that make consolidation with other entities impracticable.[51]

High density factor: Some states recognize that large school districts where the density factors is high could be overburdened by larger groups of disadvantage children presenting additional cost; it also accounts for increased administrative costs, higher salaries or personal costs resulting from unions in large urban areas.

Resource Prices: Some states recognize that schools and districts could face differences in input prices due to their location and some also account for differences in recruitment incentives.[52]

[46] As of AY 2018, three states (Alaska, Delaware, and South Dakota) did not provide additional state funding for economically disadvantaged students.
[47] A smaller number of states use average levels of student achievement in a school district to identify districts that require additional resources. To identify differences in costs among school districts, some states also use the concentration, or density, of economically-disadvantaged or at-risk students and allocate additional funds to districts
[48] As was the case for economically-disadvantaged and at-risk students, most states adjust for either the number or share of English Language Learner (ELL) students served by a school district.
[49] For instance, South Carolina provides funding for students in need of academic assistance based on test score and for students in poverty.
[50] Thirty-three states recognize that small districts and schools and those located in sparsely-populated areas face higher per-pupil educational costs. In some states, enrollment thresholds is set by the number of students in a grade or average class size in a school.
[51] For example, Michigan defines a sparsely populated school district as having fewer than 4.5 students per square mile, whereas Wisconsin identifies districts with less than 10 students per square mile. In addition to population density, some state policies also incorporate criteria based on a school district's physical geography and the distance between neighboring districts and schools. Also, some states further condition aid on the driving distance between districts or schools.
[52] Eleven states adjust for differences in the price school districts must pay to hire similarly qualified teachers. States use 3 different approaches to adjust for resource cost: (1) Comparable Wage Index (CWI) (2) Comparable Living Index (CLI), and (3) Hedonic Wage Index.

4.3.3 Mechanism to compensate for costs differentials in a formula

In addition to the variety of costs differential categories that tend to be considered in international practices of needs-based school formula funding, there are also many methods used in formula funding to adjust for these additional costs.

According to Brimley et al. (2020, p. 73), the main methods through which additional school funding is made available within funding formula include:

i) Resource-based allocation

Under resource-based allocation, schools or districts receive resources (either cash amounts or in-kind) according to specific criteria of resource needs. Under an in-kind resource-based allocation model, tangible resources (e.g. teacher and paraprofessional time) are allocated based on thresholds of students with certain characteristics. When monetary resources are transferred, the amount of additional revenues a district or school receives is based on the additional costs of purchasing these specific resources, as determined by the central authority (Kolbe et al, 2019).[53]

ii) Cost reimbursement:

Under cost reimbursement, instead of providing an additional predetermined amount or level of resources, the funding formula reimburses districts or schools based on actual expenditures for the additional costs incurred with providing educational services and supports to certain categories of students or specific school structural cots.[54]

iii) Student weights

Finally, another approach to allocate school funding and adjust for differences in costs to ensure equitable distribution of resources in a formula, is through the use of adjustment weights attached to each category of students. As mentioned earlier, weights within WSF formula correspond to the financial amounts that are tied to different levels of needs to account for the differences of educational costs. Weights associated with various components of the formula need to reflect adequately the different costs per students.This leads us to the issue of costing.

4.3.4 Cost analysis in funding formula

Once the categories of student-needs and school characteristics identified in a school funding formula in order to pursue vertical equity, the second step is to estimate the cost of these additional resources to provide for these specific needs to be factored in the formula.

[53] For instance, several US states, including Vermont, Tennessee provides districts using a formula with supplemental funding equal to the cost of one fulltime equivalent teaching position for every 20 ELL students and a fulltime equivalent interpreter position for every 200 ELL students (Kolbe et al, 2019).
[54] In the US state of Vermont for instance, the funding formula provides school districts with supplemental state aid to educate students with disabilities based on a reimbursement system. The state reimburses school districts for up to 60% of allowable costs. Alternatively, in Illinois, districts are reimbursed for the additional costs of educating English language learner students that are over-and-above a district's average per pupil expenditure for a student of comparable age and who does not receive special education or related services (Kolbe et al 2019).

This costing exercise includes estimating the monetary value attached to the base level of funding per pupil (foundation), representing the education cost for a child with no specialized needs.[55] In addition, costs must be estimated for adjustments in the formula related to student needs and school characteristics,[56] required to provide all student with reasonably equal quality educational programs to achieve adequate education outcomes.

This costing exercise is difficult and often controversial given the difficulty in identifying the additional costs of providing specific services. This is magnified in an equity lens focusing on equal opportunity of learning outcomes as we still do not know enough about how school outcomes are produced in different conditions to objectively calculate costs of delivering specific student outcomes (Fazekas, 2012, Hanushek, 2003).

Two main categories of costing approaches have been developed: i) input-oriented analysis and ii) outcome-oriented analysis. The first cost method category works forward, starting with inputs toward actual or desired outcomes. The second approach works backward, from outcomes achieved toward the costing the various resources required to produce such outcomes (Baker, 2018).

i) Input-oriented analysis: Sometimes called Resource Costs Models (RCM), ingredient methods or activity-led funding model, these methodologies consist at identifying the various resources, required to deliver a given educational program and costing them out (Odden and Picus, 2019). Three basic steps are involved: first identifying the various resources or ingredients necessary to implement a set of educational programs and services, that is identifying the teaching and learning activities that are to be included for particular student in specific school context; second, determining the input price for those resources, i.e. determining the cost of these activities; and finally, combining the necessary resource quantities with their corresponding prices to calculate the total cost estimate to be included in the funding formula for schools.

The RCM approach based on actual outcome goals estimate the costs of resources based on actual practices using financial data at central, district or school levels for students in specified grade levels and contexts and facing particular needs.[57] For instance, the per student funding formula in Estonia and Lithuania employs the activity-based approach. An illustration of the application in Lithuania is presented in Box 2 in section 6.

The fact that this costing method is grounded on actual spending and organization of resources of various schools or districts is seen by Baker (2018, p. 196) as a strength for this approach. Also, such activity-led funding is seen as potentially both cost effective, when funding is set at per student average costs, as well as equitable, because students with the same programs and learning needs are funded the same amount (Abu-Duhou et al., 1999).[58]

When instead of current practices, hypothetical outcome goals or desired practices are considered, two other main variants of costing are found under the RCM approach, the professional judgment approach and the evidence-based approach (Baker 2018: 190).

[55] The base level represents the cost of minimally adequate educational services (and/or of achieving adequate educational outcomes), either in the school or district with lowest cost, or for the child with no specialized needs. Alternatively, the foundation level could be set to represent the cost of educational services (and/or of achieving adequate educational outcomes) in the average educational setting for a district or school facing average cost pressures and serving an average student population (Baker, 2018, p. 106)

[56] as well as other accepted variations, such as input price across districts to acknowledge the additional costs that some students and schools.

[57] In practice, it starts with assumptions about class size number of hours students are taught per week or year, and additional curriculum support resources, such as book material and equipment. Once the mapping of these specific resources required is identified, the quantification and costing of these staff and non-staff resources is done (AbuDuhou et al 1999, p. 61)

[58]] However, the fact that it could be generally difficult to identify the various specific resources required for special needs across settings and children is seen as a shortcoming of the approach. Indeed, it requires to "…thoroughly quantify those inputs, determine their prices and sum their costs. In order to ensure the findings are generalizable, we must explore how input prices for both personnel (e.g. teacher compensation) and non-personnel (e.g. materials and supplies) vary across other sites where the programs and services might be implemented and consider whether context (economy of scale, grade ranges) affects how inputs are organized in ways consequential to cost estimates." (Baker 2018, p. 190)

Professional judgment approach: With this method, resources or various elements necessary to meet educational objectives or standards are identified by service providers, professionals or focus groups and then priced and summed.[59] For Brimley et al (2020, p. 44), one of the advantages of this approach is that it is relatively easy to understand and transparent. The disadvantages are that it does not rely on current spending and is based on current practice, so it has to be complemented by research to ensure that resources and strategies are able to produce the desired results.

Evidence based (or state of the art) approach. This approach uses research evidence to identify effective strategies to reach specific targets and attaches cost to each. However, generally, not all elements costed are based on research (Brimley et al,p. 46)

ii) Outcome oriented methods: The category of methods using top-down approaches starts with assessing student outcomes of specific programs and then examines aggregate spending of those programs yielding specific outcomes. Two main methods are observed 1.) Successful school analysis, and 2.) Education cost function.

1.Successful school analysis. This method consists at identifying successful schools or benchmarks that meet program targets and objectives and determine their expenditure. The average expenditure of those schools or districts are then used as overall estimates. This sampling approach of actual past expenditures has been criticized on a variety of fronts. The way success is defined varies with the methodology used (e.g. average test scores vs proficiency test score), resulting in different cost estimates. Also, successful schools or districts identified tend to be more affluent with few high-need students, which makes adjustments for schools with greater diversity resting on weak hypothesis.[60]

2.Education cost function: The cost function (CF) approach makes use of econometric techniques to estimate costs based on detailed expenditure and output data. It seeks at evaluating statistically the relationship between aggregate spending and outcomes controlling for the conditions under which they are produced.

These statistical models which have been more extensively used especially since the late 1990s, date back from the 1970s and are now the dominant modeling approach in recent peer-reviewed literature (Kolbe et al 2019). Minimum average costs per unit are estimated by associating school-level (or district) spending (total or on specific services), with predetermined pupil outcomes, such as test scores, controlling for various student and school characteristics.[61]

The main strength of cost function analysis is seen as its reliance on estimate of the statistical relationship between actual outcomes and actual spending and that it evaluates distribution across potentially all schools or districts, not just samples.[62] However, these statistical techniques requires high quality fiscal and outcome data. Also, a limitation is that they focus only on limited measured outcomes and cannot offer deep insight into internal resource use or allocation underlying cost estimates (Brimley et al., 2020).[63] An illustration of the application of the CF approach in the case of the weighted-student school formula for the state of Vermont, USA is presented in Box 3 in the Appendix.

[59] It seeks at providing an estimated average cost of a defined set of resources in an average school or district needed to achieve a certain standard.
[60] For Baker (2018), "this method determines what "successful" districts are spending and specifies an amount to maintain that spending, not what a struggling school needs to reach high outcome and maintain them" which for him discount the usefulness of such approach:, " the method is little more than a cost function without any controls for student characteristics, context, or input price variation and devoid of any sufficient controls for inefficiency or missing these controls altogether. Thus, in its usual application, Successful School analysis is of negligible use for determining costs." Baker (2018, p. 195)
[61] Costs are defined as the minimum amount that would need to be spent per student to achieve a specific level of outcomes, giving the student characteristics and other contextual constraints. Costs could be understood at connecting spending with outcomes (in the absence of inefficiency). As for efficiency, it could be defined in education spending as the least spending needed to achieve a given level of student output or outcomes. The margin of difference in spending above cost is inefficiency, with Spending = Cost + Inefficiency (Baker, 2018).
[62] Adequately devised cost function models tend to consider spending as a function of outcomes, student characteristics, school characteristics (e.g. economy of scale, population sparsity, etc.), regional variation in the price of inputs, as well as factors affecting spending that are unassociated with outcomes (i.e. inefficiencies).
[63] While the realm of feasibility of identifying the perfectly efficient school (or district) or the absolute minimum that might possibly be spent to achieve a given level of outcomes is not currently in sight, empirical cost functions attempt to focus on understand average efficiency by which existing schools and districts produce outcomes, and deviations around these averages, which could support evidence-based costing (Baker, 2018).

Overall, international practices with regard to costing methods to estimate monetary values or coefficients to attach to each variable of a funding formula vary substantially from a country to another. Econometric study exercises tend to be predominantly used especially in the USA (Hanushek, 2006a; Fazekas, 2012). In other countries, activity-led costing and historical costs (as well as simply political bargains), are often the main mechanisms defining the crucial costing details of the applied formulas.

Before examining how real world formula have integrated equity considerations in the case of five countries (section 6), we briefly discuss how funding formulae could be evaluated (section 4.3.5) and the question of integrating personnel in funding formulae (section 5)

4.3.5 Evaluating Funding formula

Evaluating funding formulae is problematic for various reasons. First, it is generally difficult to assess the net effect of a formula given that it is difficult to assess what would have happened in the absence of formula funding. This problem of the absence of counterfactual could be circumvented when the formula is implemented only in some regions and potential comparison could be realized (Fazekas, 2012). Or alternatively, randomizing the implementation of formula reforms could allow measuring causal relations between funding reforms and resulting inputs and outcomes. However, such comparisons or randomization have not been yet implemented rigorously, to the best of our knowledge.

Other reasons for difficulties in carrying out evaluation arise from the fact that countries' education funding systems often tend to mix different budget allocation mechanisms, with school formula funding sometimes limited to specific programs and sometimes multiple funding formulae operating simultaneously. Hence, the presence of targeted conditional grants outside of the main funding formula, the multiplicity of formulae and potentially limited coverage of the main formula in terms of total expenditures on schools, reduce accountability and traceability of results. Furthermore, the presence of various demand and supply sides transfer programs and interventions in the education system managed by different line ministries, complexifies assessment of formula results and identification of distinct effects. Furthermore, country's education systems are often segmented, between public and private sectors and managed by different ministries or offices, which introduces equity issues across students enrolled within different systems with varying equity financing support and mechanisms.[64]

More generally, data availability at the school and student level is another key limitation. Detailed information on differences in per student funding across districts and school (to evaluate horizontal equity) as well as across student and school characteristics, programs and achievements (to evaluate vertical equity over time), are often unavailable. Furthermore, information on accountability and enforcement mechanisms in place to ensure that the funding received by local governments or schools, reaches the targeted students or schools is generally limited.

[64] For instance, in Thailand, public schools are in majority managed by the Education Service Areas Office (ESAO) under the jurisdiction of the Ministry of Education (MOE), but also by the Local Administrative Organizations (LAO) under the Ministry of Interior's jurisdiction, while private schools are managed through the MoE's Office of Private Education Commission (OPEC). Such situation, in addition to equity consideration between students enrolled in the different sub-systems, could also introduce competition of financing at the decentralized level from local authorities for instance which face trade-off supporting various public schools systems.

Hence, while needs-based formulae are frequently used and popular recommendations to address educational inequities, there is relatively little rigorous evidence supporting their results in the literature.[65] In the absence of rigorous impact evaluation, studies evaluating the results of funding formulae with some details have mainly proceeded using descriptive statistical methods at the national level or international comparative studies (World Bank, 2011; Levacic, 2008b, Li, 2008; Chambers et al. 2010; OCDE 2016). Various econometric techniques have also been used to assess the equity and adequacy criteria through formula funding but without claiming causal associations (e.g. Imazeki, 2007, Duncombe, 2006, Kolbe et al 2019). Overall, results are difficult to compare given the specificities of the formulae design and scope, and national policy environments and institutional contexts (Levacic, 2008b; Fazekas, 2012).

Still, examining some of these studies, we find that the examination of horizontal equity that is comparing the distribution of per student funding across similar students or schools is more frequently realized. The application of a uniform funding formula, with the same indictors and coefficients determining the school budget of all schools, in principle satisfies the criterion of horizontal equity (i.e. equal funding of similarly situated students and schools) (Levacic, 2008b; Fazekas, 2012). However, one needs to assume that schools and students compared are homogeneous, and legitimate claim in that regard are necessary. Furthermore, the per pupil allocation examined needs either to encompass all recurrent expenditures, or to focus on certain allocation components in the formula to observe their equity effect.

Significantly different per capita funding of comparable students or schools in different regions or districts would be considered horizontally inequitable, unless the difference in funding is responding to vertical equity considerations (that is, addressing structural inequalities among areas such as variability in cost that results from a region geographic location, density or size) (World Bank, 2011, p. 6). In Poland, for instance, Levacic (2011) observed a wide variation in per student allocation at the municipal level, which was not associated with structural factors (i.e. vertical equity adjustments), but instead was found related with local income levels per capita.[66] She concluded that per student funding system violated the wealth neutrality principle and has not achieved horizontal equity.[67]

The criteria of vertical equity is more difficult to verify, as well as to implement in a formula. Dissimilar categories of students and schools should be treated differently according to vertical equity to equalize school quality and opportunity to pupils, but what should be the optimal level of program support and funding for what categories of students or schools is debatable. Many countries make efforts to allocate additional funds to special education students or low-income pupils, but there is no consensus on the specific interventions or levels at which these funding should be. Indeed, no one has determined exactly "how unequally" those students with "unequal needs" should be treated, and how progressive the formula should be (Brimley and Garfield, 2005).

Econometric methods (described in the previous sub-section) examining the relationship between historic spending, school characteristics and student outcomes could eventually lead to more precise measurement of required supplemental resources' unit costs and improved understanding of the relationship between spending and student outcomes. However, such analysis depends on the existence of detailed longitudinal school-level and student-level data, allowing to link funding at the student and program level, as well as learning outcomes over time, which are seldom available.

[65] Instead, previous research more frequently cites examples of regressive or unsuccessful mechanisms. Dalrymple (2016, p. 22) for instance cites cases in Sudan, Zambia and Georgia where need based evidence of inequitable and poorly administered allocation mechanisms. She emphasizes that there is little discussion in the literature on the actual
outcomes that funding formula mechanisms produce or the direct effects they have on poor and marginalized children, on learning outcomes, school enrollment rates and drop out levels. "Rather, outcomes and impacts discussed in the literature are often broad and generalized."
[66] Using regressions controlling for structural factors (i.e. school size, students-teacher ratio, population density, size of the municipality), Levacic (2011) found that variation in per student expenditure in Poland is explained by the difference in municipalities own revenues per capita.
[67] Also in Hungary, important local contribution to schools was observed leading to horizontally inequitable total per pupil funding in the context of a non-equalizing per student formula (Fazekas, 2012).

Empirical evidence on the achievement of vertical equity through formula funding is relatively scarce (Fazekas, 2012). Kolbe et al (2019) for instance use empirical models based on various units of analysis (districts and schools) and data sources to simulate optimal weights and funding levels across categories of students and outcomes in several US states, but do not realize ex-post result evaluation.Among studies that have analyzed actual results of formula using comparative statistics, Li (2008) has examined the relative vertical equity effort of two provinces in Canada, Alberta and Ontario. He focuses on three main categories of student needs differentially supported by the provincial formulae: low income students, non-native language learners, and special education students. Without attempting to empirically estimate how optimally students within each of these categories should have been funded to reach equal education quality and opportunity, the author simply compares the level of progressivity of the provincial formulae by assessing the nominal allocation per pupil for each of these characteristics above the basic allocation (foundation) level for all students. Li (2008) observes that Alberta provides more basic allocation (foundation grant) than Ontario --in line with horizonal equity criteria, while Ontario provides greater support for special needs students -- in line with the vertical equity criteria. Furthermore, Alberta showing higher average achievement level in standardized international assessments than Ontario, but greater variance in the distribution, the author makes the inference that it may be linked to a trtade-off between overall performance and equity of the distribution of results, but without trying to test this hypothesis.

Future rigorous evaluation of formula funding and verification of such hypothesis is dependent on the availability of adequate longitudinal measurement of student and school characteristics, education input, process and outcome. We provide in the Appendix a draft checklist of support currently provided in the system and progress toward the pursuit of educational inclusion and fairness. The draft equity checklist could help benchmarking where schools and districts currently stand with regard to equity goals to inform stakeholders on needs for additional interventions and priorities.

In the future, developing rigorous evidence-based research – and as a precondition, the collection of detailed measurement of student and school characteristics, education input, process and outcome over time -- would help improve understanding of the relationship between formula funding systems, school spending and student outcomes.

[5]

PERSONNEL ALLOCATION

A fundamental component of schooling quality relates to teachers and other school personnel. In this section, we briefly examine the potential inclusion of personnel resources within school funding formulae focusing on equity considerations.

5.1 The importance of human resources in education

Teacher salaries and overall teacher distribution are major components of resource allocation to schools. Personnel budget represents the main share of education spending. Including teachers and other personnel school staff compensations, staffing costs represent between 70% to 80% of education current operating expenses in most countries, with current expenditures representing more than 90% of total education expenditures (OECD, 2019c).

Adequate personnel funding is essential given that the school quality depends in large part on the availability and quality of teachers, support staff, administrators and other personnel to provide reasonable class sizes, relevant programs and services (Baker, 2018, p. 55). Teachers' quality in particular relates positively to student performance (Darling-Hammond, 2013) and is one of the main inputs explaining overall education outcomes (OECD, 2020, vol V, p.97).

However, in most countries human resources tend to be inequitably allocated across schools and regions. International evidence show that schools located in remote areas and with higher concentration of socio-economically disadvantaged students tend to be endowed with fewer and less experienced teachers (OECD, 2019c).[68] More qualified teachers are often physically concentrated in the classrooms of more advantage and wealthy children therefore reinforcing unequal access to quality education for children from different socioeconomic backgrounds (OECD, 2016 p. 9).

Several national studies show that, compared to more advantaged schools, disadvantaged schools[69] have teachers who tend to have weaker academic credentials, and are less qualified and certified.[70] In particular, multi-country evidence show that in more than 1/3 of countries and economies participating in the OECD's PISA 2015 assessment, teachers in the most disadvantaged schools were less qualified or experience than those in the most advantage schools (OECD, 2019b p. 193).

[68] In Brazil for instance, schools with higher number of disadvantaged children, in addition to having worse infrastructure are also characterized as having less qualified teachers and fewer teaching hours (UNESCO, 2018b) Some countries have had success in addressing inequity in education including the Netherlands where a school funding formula is in place since 1985 accounting for weights in favor of disadvantaged children. Dutch primary school with large number of disadvantaged children have on average 58% more teachers per student as well as more support staff (ladd and Fiske 2010; UNESCO, 2018b, p. 115)

[69] As mentioned, disadvantaged schools are defined by OECD (2019a) as those with average student classified within the bottom quarter of the distribution of socio-economic index and advantaged schools as those with average student classified within the top quarter of the distribution of socio-economic index.

[70] Darling-Hammond (2004)

Important differences in teacher resources and quality that are related to student disadvantage are observed in the most recent analysis of multi-country assessment. PISA 2018 for instance finds that principals from socio-economically disadvantaged areas are more likely than principals of advantaged schools to report that lack of teaching staff is hindering their school's capacity to provide instruction.[71]

In particular, using detailed information on teacher demographics, PISA 2018 evaluated the sorting of teachers across schools based on their qualifications and found that in most countries, teachers with more years of experience tend to work in schools that have lower concentrations of disadvantaged students (OECD, 2019a, p. 84). Specifically, the proportion of teachers with less than five years of experience was larger in disadvantaged schools than in advantaged schools.[72]

With regard to Thailand, evidence from PISA 2018 indicates that similar situation of inequitable teacher allocation and quality associated to student disadvantage is also observed. Principals in socio-economically disadvantaged Thai schools report significantly greater shortages of educational staff, as well as material, than advantaged schools. Also, teacher allocation inequality is much worse in Thailand than in OECD countries (see figure II.5.5 in the Appendix).[73] Furthermore, Thai secondary schools present the highest PISA teacher shortage index compared to regional peers.

Also, schools in rural areas were more severely understaffed than their urban counterparts. As emphasized by World Bank (2015, p. 27), this inequitable staff allocation across areas and types of schools is observed despite overall adequate number of teachers relative to the number of students within the country.[74] According to national evidence, many provinces are facing severe teacher shortages created by ineffective teacher allocation practices. Overall, almost one-third of Thai classrooms are reported to face chronic teacher shortages (less than one teacher per classroom) due to ineffective teacher allocation (World Bank, 2015, p. 24). The inequitable allocation affects especially small village schools serving predominantly the socioeconomically disadvantaged population which are severely under-resourced.[75]

5.2 The negative impacts of inequitable personnel distribution on student achievement

As emphasized by OECD (2012, p.130), effective teachers are especially important for disadvantaged schools. Employing mainly less-experienced teachers in schools with high concentrations of disadvantaged students may compound the academic difficulties these students face because novice teachers tend to be less effective than teachers with several years of experience (OECD, 2019b vol II, p.112; Rivkin et al. 2005). Furthermore, highly competent teachers can have especially large positive effects on student performance and may help low performing students to catch up and improve.

[71] PISA 2018 reports that only 19% of students in advantaged schools attended a school whose principal so reported, while these proportions ranged from 28% amongst students who attended schools in the second quarter of socioeconomic status, to 34% amongst students who in disadvantaged schools significantly more experienced than those in advantaged schools (OECD, 2019 Table II.B1.5.16)
[72] Only in Malaysia and the United Arab Emirates were teachers in disadvantaged schools significantly more experienced than those in advantaged schools (see OECD, 2019b, Figure II.5.3).
[73] Figure II.5.5 presents the differences in these two indices between advantaged and disadvantaged schools. A negative value in this difference indicates that disadvantaged schools are worse off with respect to shortages of staff or material.
[74] Student-teacher ratio of 16:1 in 2012 (World Bank, 2015).
[75] For instance, World Bank (2015 p. 28) reports that schools in Mae Hong Son province—the poorest province in terms of per capita consumption and the lowest density – are allocated much less qualified teachers with the least amount of teaching experience, and that their classrooms are severely understaffed than wealthier area schools. Indeed, Bangkok compared to Mae Hong Son province enjoys much larger shares of teachers with higher than a bachelor's degree (19.7% vs 8.7%), teachers with more years of experience (23.5 years vs 10.8 years), and more teachers per classroom (1.61 vs 0.71).

Formulating policies and designing mechanisms to help allocate qualified teachers to high needs schools is essential. Indeed, according to OECD (OECD, 2012, p.128), mechanisms to attract competent and qualified teachers to disadvantaged schools are a fundamental element within a high performing and equitable systems, such as Finland and Korea, which have been able to ensure excellent teachers for all students.

5.3 Personnel budget allocation mechanisms

In most OECD countries, personnel resources allocation is integrated within the main school funding formula (Ilie and Rose, 2018). Among a vast majority of European countries in particular, a recent review of school financing systems found that the level of resources for school staff is based on formulae defined by central/top level authorities (European Commission, 2016).[76]

In a majority of European countries reviewed, the criteria used for determining the level of staff resources, or the amounts transferred which contribute to the costs of staff, in addition to the number of pupils or existing staff, also consider a broader range of input-based criteria enabling a more thorough assessment of school needs and allowing for the provision of differentiated funding, especially toward small school and remote areas (European Commission, 2016, p.34).[77]

Contrary to OECD countries, in low and middle-income countries were funding formulas are in place, teacher salaries are frequently not part of the formulae used to allocate recurrent expenditures. This exclusion from formulae calculation of schools' fundamental resources greatly limit the redistributive impact of funding formulae (Ilie and Rose, 2018).

In South Africa, for instance, the funding formula meant to distribute more funds to disadvantage children is limited to non-wage expenditures representing less than 10% of school budgets. Furthermore, the distribution process of qualified teachers is skewed toward wealthier school, neglecting townships and rural areas (Mestry and Ndjlovu, 2014). In Sri Lanka also, the school funding formula excludes teacher salaries and covers less than 2% of the total education recurring budget (UNESCO, 2018b).

5.4 Solutions to inequities in teaching staff distribution

Solving inequities in teaching staff distribution is a complex and multidimensional issue (OECD, 2018c, p.130). Indeed, the issue of personnel inequity is not only one of staff recruitment and allocation to schools (or local school authorities) resulting in staff shortage, but also involve the additional problem of reallocation of teachers through self-sorting from high needs disadvantaged schools after their initial assignment, driving inequalities in teacher quality and experience.

Working conditions, level of isolation as well as salary differentials influence teachers self-sorting across school and districts away from disadvantaged areas. Furthermore, teachers tend to prefer working with higher-achieving students, as reported in recent research (Pop-Eleches and Urquiola, 2013), rendering recruitment and retention of staff in remote locations and socioeconomically challenged areas much harder (Baker, 2018 p.66).

[76] In cases where the intermediate authorities determine the amount of funds allocated to cover staff costs in schools (through block grants or other grants earmarked for staff), a set of criteria established by the central/top level ministry is frequently used (European Commission, 2016)
[77] Around two thirds of countries examined in the review consider disparities between schools or areas when establishing the amount of staff resources. In around ten countries, central/top level authorities take geographical or demographic disparities into account when determining the level of resource for staff (including grants earmarked for staff costs and block grants/lump sums intended to cover staff costs in full or in part (European Commission 2016).

In countries with highly centralized teacher management system,[78] there is generally little leverage at the school (or district/ESA) level to address issues of personnel choices and teaching quality. Also, since teacher salaries in such systems tend to be regulated, there is limited scope for implementing a system of rewards and sanctions that could improve incentives (Arcia and Patrinos, 2013). In Thailand for instance, the centralized teacher deployment process allows teachers to be redeployed to any 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 (World Bank, 2015, p. 23). Furthermore, the incentives for educational personnel to work in remote areas is not sufficient leading to a disproportionately large share of teachers with relatively few years of experience in remote schools (World Bank 2015, p. 27).[79]

In countries with centralized teacher management systems, the approach of restricting redeployment rules to reduce inequitable reallocation of staff through self-sorting of teachers appears fundamental, as well as requirement of teacher mobility. In Japan for instance, teachers are expected to periodically change schools throughout their career to ensure that all schools have access to effective teachers and a balance of experienced and young teachers. In Korea, teachers are required to move to a different school every five years (UNESCO, 2017)

In countries with decentralized market-allocation mechanisms for staff -- where schools compete with each other to attract the best teachers -- but also in countries with centralized teacher allocation and compensation mechanisms, policies should be implemented to improve the working conditions and incentive to work in disadvantaged schools. Targeted financial incentives for teachers – salary increases and other types of financial additional payments – are also often cited as necessary to compensate for unattractive working conditions (OECD, 2018c p. 34).[80]

Several countries have put in place incentives to encourage teachers and other education personnel for working in remote and rural locations or in less socio-economically advantaged areas.[81] In Korea, for instance, various incentives are offered to attract teachers to high-needs schools (e.g. additional salary, smaller classes, less instructional time, additional credit towards future promotion to administrative positions, and the ability to choose the next school where one works) (OECD, 2012).

In Vietnam, financial provisions to assist disadvantaged population groups to access education services include incentives to teachers to live and work in mountainous and remote locations (UNESCO, 2017, p. 54). In Japan, a policy provides special allowances to teachers working in public primary and lower-secondary schools in remote areas, with the allowance amount increasing with the level of remoteness. (Asia pacific 2017,p. 54).[82]

[78] According to a World Bank 2015 assessment, Thailand is perceived to be part of this group. Despite that teacher management – hiring and firing, disciplining, deployment, and payroll administration – has been decentralized to the ESA level since 1999, it is viewed as remaining highly centralized given the role of the Teacher Civil Service Commission regulations on selection process and tenure (World Bank, 2015)

[79] Evidence suggest that in countries with decentralized teacher management systems -- where schools have greater autonomy over the hiring of teachers and over establishing their salaries -- the quality of teachers seems to be better aligned to meet the needs of students and schools (OECD 2018 p. 4). As emphasized by OECD (2018), this does not mean that increasing school autonomy will necessarily improve equity in teacher allocation. But it suggest that school systems with more flexible work organization placing greater responsibility at the frontline could support establishing conditions that better align resources with needs.p4 Furthermore, it suggest also that countries with more centralized systems of teacher selection and recruitment should consider increasing the level of school responsibility to improve both efficiency and equity (World Bank, 2015). Capacity building of school leaders to manage human resources being not created overnight and uniformly, a gradual evidence-based pilot approach may be an interesting option to explore.

[80] Studies that have evaluated such schemes have found positive effects in some contexts but not in others, suggesting that similar incentives might work differently, depending on the institutional environment and context of teacher employment and career progression, and on the size of the incentive (OECD, 2018c, p. 34)

[81] Several countries with centralized as well as decentralized teacher management systems, such as Australia, England, France, Germany, Sweden and the United States, have introduced policies that award financial bonuses to teachers in high poverty or remote schools (OECD, 2018c, p. 85). For instance,

[82] For instance, in Hokkaido Prefecture, which presents the highest number of remote area schools, teachers in the most remote areas receive a 25 per cent higher salary than other teachers (Asia pacific 2017, p.5v4)

In addition to financial incentives, offering formal training and mentoring, or more informal support, might help disadvantaged schools attract and develop talented teachers (OECD, 2018c, p.118). Another form of in-kind allocation that could be considered is the provision of professional development opportunities for staff (European Commission/EACEA/Eurydice, 2016). The Danish government for instance offers specific professional development support for teachers working in schools with disadvantaged student populations (OECD 2018c, p.128)

Summary

Most countries face a dual problem of teacher allocation inequities between socio economically disadvantaged and advantaged schools, consisting of (1) shortage of teachers due to inadequate allocation rules and 2) lower quality and experienced teachers, often due to self-sorting of teachers, observed in both centralized and decentralized staff allocation systems.

Ultimately, for countries with centralized allocation systems like Thailand, potential solutions could involve integrating teacher costs withing the overall school formula in a way to more directly take into account the equity effect of overall resource allocation at the schools and regional levels; modifying the redeployment clause by extending job assignment requirement in order to reduce excessive turnover and inequitable sorting, and considering mandatory rotation schemes such as in Japan and Korea. Also, exploring options for providing stronger financial and Ultimately, for countries with centralized allocation systems like Thailand, potential solutions could involve integrating teacher costs withing the overall school formula in a way to more directly take into account the equity effect of overall resource allocation at the schools and regional levels; modifying the redeployment clause by extending job assignment requirement in order to reduce excessive turnover and inequitable sorting, and considering mandatory rotation schemes such as in Japan and Korea. Also, exploring options for providing stronger financial and career incentives for quality teachers to be deployed in small, remote schools and, in presence of shortage, ways to consolidate classrooms and provide multi-grade education more effectively (World Bank, 2015, p.4). Furthermore, as emphasized by the 2015 World Bank assessment, solutions also lie in modifying the input-based allocation criteria to ensure higher teacher ratio per classes through lower minimal class thresholds for remote and small schools.

[6]

CASE STUDIES

We now examine the application of formula funding models and equity considerations in five countries. While a choice of countries with starting points comparable to Thailand would have been especially insightful, data limitation on allocation mechanisms in middle-income countries using needs-based allocation formulas rendered the task difficult, leading to more pragmatic choices.[83] We focus on countries for which relatively detailed information on their school allocation mechanisms was available, demonstrating relative success at promoting equity and student achievement performance, and representing a variety of school financing models.

Two of the countries examined, Estonia and Lithuania, are small transition countries that went through major governance reforms in the early 1990s and where per capita financing emerged as an approach to funding education in the context of significant demographic changes and financing constraints. The other three countries, Canada, England and the United States, are high income countries in which needs-based education formulae have been implemented also in the 1990s, in the context of decentralized provincial and state models in the north American cases and of a centralized model in the English case.

The variety of school formula models covered in these case studies is quite diverse. In Estonia and Lithuania, pure per student formulae accounting for some students needs and school factors are in place using weighting factors. In the three states examined in the USA and in England as well, weighted per student formula are in place. In the province of Ontario, Canada, a set of formulae is in place to provide 14 different school grants, some of which are allocated on a per student basis with weighting factors, while other are school based.

In all the cases examined, teacher wages were included in the main school funding formula. All the countries also provided special support to small schools, but the two transition countries did not provide extra support to socioeconomically disadvantaged students. In all the countries, school funding was allocated through the local authorities but with various degree of discretion over the ultimate transfer toward schools. In Lithuania for instance, while the education grant is allocated as a lump sum to Local Authorities (Las), they have very little discretion over the allocation as the central level per student formula specifies the exact allocation of teaching costs to be transferred to each school, of which only 5% could be reallocated. Furthermore, despite that the cost of school maintenance and operation is covered by Las, most of the school funding comes from intergovernmental transfer, reducing potential variation in local revenue which could have affected equity (wealth neutrality).

[83] It would be especially useful in future analysis to examine if there are patterns or clusters of approaches with regard to funding formulae adopted for instance in South-East Asian countries, and if the context of governance affects these choices.

Table 3 presents several of the PISA indicators discussed in section 3 for the five countries examined, as well as for Thailand (and Indonesia).

PISA indicators illustrate the significant performance of Estonia and Canada especially with regard to both education achievement and equity relative to the other countries examined and countries part of these standardized assessments.

Of course, given that school finance formulae are only one among a variety of factors affecting educational equity dimensions over time, these descriptive statistics examinations of outcome equity remain simply illustrative. Rigorous evidence-based analysis at the student and school level would be required to analyze the relationship over time between a school finance reform and education equity components.

Table 3: PISA equity indicators 2018, selected countries

	Outcomes :	**Inclusion**		**Fairness**					**Process**		**Inputs**	
Countries	Mean performance in reading	Access Coverage of the national 15 year old population PISA coverage index 3	Percentage of students performing below level 2 in reading	**Strength of the relationship between perfor-mance and SEC**[1]	**Socio-economic disparities in minimum achievement (Parity index[2] for disadvantaged students, compared to advantaged students[3])**		**Gender disparities in minimum achievement (Parity index[2] for girls, compared to boys)**		Between-school variation	No social diversity index	Index of shortage of educatio n staff	Index of shortage of education al material
				Reading (2018)[4]	Reading (2018)[4]	Mathematics (2018)[4]	Reading (2018)[4]	Mathematics (2018)[4]				
	Mean score	Index	%	%	Parity index	Parity index	Parity index[1]	Parity index	%	Mean index	Mean index	Mean index
Canada	520.6	86.3	13.8	6.7	0.85	0.81	1.09	1.00	12.8	0.09	-0.6	-0.4
Estonia	522.5	93.1	11.1	6.2	0.90	0.88	1.07	1.00	16.8	0.14	-0.2	-0.1
Lithuania	475.9	90.3	24.4	13.2	0.68	0.65	1.18	1.05	31.6	0.17	0.3	0.3
United Kingdom	503.9	84.8	17.3	9.3	0.81	0.76	1.07	0.97	18.4	0.14	-0.6	-0.5
United States	505.4	86.1	19.3	12.0	0.76	0.62	1.09	0.98	19.7	0.14	0.7	-0.2
OECD average	488.8	88.2	22.6	18.0	0.72	0.68	1.12	0.99	29.0	0.14	-0.4	-0.4
Cambodia	..	..	..	..	0.22	0.19	1.31	0.84	22.0	0.16	-0.4	-0.3
Indonesia	371.0	84.9	69.9	7.8	0.39	0.37	1.31	1.13	24.8	0.20	-0.7	-1.1
Thailand	395.5	72.4	59.5	12.0	0.41	0.54	1.38	1.16	26.2	0.18	-0.9	-1.4
Vietnam	505	69.5	9.5	..	..	..	..	..	..	..	-0.6	-0,3

1. Strength: proportion of the variance in students' reading scores explained by social, educational and cultural index (SEC)
2. Values of the parity index below 1 indicate a disparity in favor of the second group (boys, or advantaged students). Values of the parity index above 1 indicate a disparity in favor of the first group (girls, or disadvantaged students). Values equal to 1 indicate equal shares of both groups.
3. Socio-economically disadvantaged students are students in the bottom quarter of the PISA index of economic, social and cultural status . Socio-economically advantaged students are students in the top quarter of the PISA index of economic, social and cultural status (ESCS) in their own (ESCS) in their own country/economy.
4. Source: OECD (2019), PISA 2018 Database,

ESTONIA

Background/Context

Estonia is a small country of 1.33 million people by the Baltic Sea with GDP per capita pf 23 650 US$ (2019). Education spending represents 4.4% of GDP (of which 1.4 % primary and 1.4 % secondary in 2016) (OECD, 2019, p.286)

The Estonian basic education system provides 9 years of compulsory education, starting at the age of 7 (grades 10 to 12 being optional). With the exception of pre-primary education, there are no fees in public schools. Privately-run schools receive public funding on the same terms as public schools and can also charge tuition fees (OECD, 2016, p.110).

Following independence in 1991 and the end of the Soviet era, Estonia, as other transition countries in the region, gradually reformed its governance structure by decentralizing power toward local governments (municipalities), including for education. Though the Basic Schools and Upper Secondary Schools (BSUSS) Act local governments are responsible for general education, under the overall responsibility of the Ministry of Education and Research is responsible for the national education policy and the overall strategy for the education system (Levacic, 2011, p. 33)

Education grants and composition

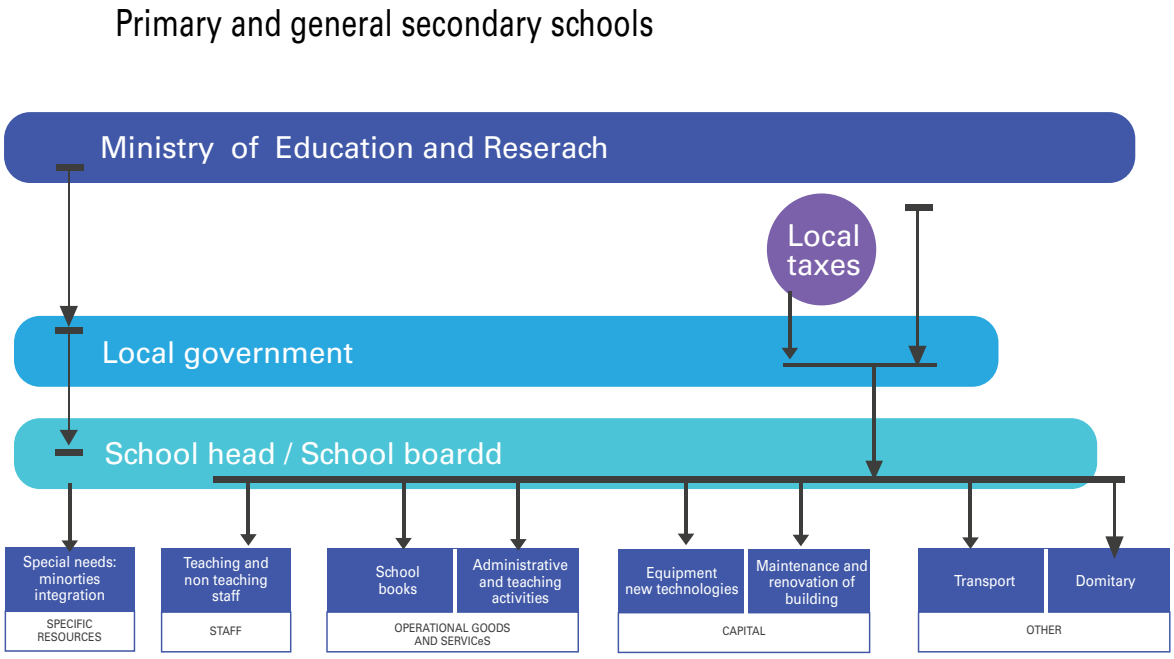
The main source of funds for elementary and secondary education in Estonia comes from the central government with earmarked grants from the national government accounting for about 55% of all municipal spending on primary and secondary education in 2012 (OECD, 2016, p.111).

The education grants received by municipalities to fund the recurrent costs of primary and secondary education (including special education) are built around four earmarked components: the most important one is for salaries of both teachers and school leaders, and smaller components for textbooks, one professional development of both teachers and school leaders and for school lunches.

Figure 2 shows the flow of funding from the central state to primary and secondary schools via municipalities and the resources that the funding stream are intended to purchase (OECD 2016, p.115).

The central government grant for education is not a general purpose grant, being earmarked to be spent on education. Despite that central government makes explicit which types of expenditures the grant for general education is intended to support, other than the subsidy for school lunches, municipalities are not required to spend the sub-grants, into which total education grant is subdivided, in exactly the same amounts as they are calculated by the formula for distribution purposes. (Levacic, 2011, p.38).

Figure 2: Flow of funding from the state to primary and secondary schools through municipalities



Formula funding

Earmarked education grants from central government are allocated through funding formulae calculated on a per student basis. In the context of governance reforms and demographic transition, per capita financing emerged as an approach to support decentralization of power and promote rationalization of the education system (OECD, 2016). Per student funding was intended to replace the 'soviet era system of norms' for the determination of funding to support municipal education spending. There was, in addition, a desire to promote internal efficiency by inducing municipalities to reduce the number of small schools that had multiplied at the municipal level since 1991 despite the important decline in student population. The government also wanted to promote competition between public schools and between public schools and private schools, whose growth would be encouraged by a per student state subsidy (Levacic, 2011, p.37).

The first per student formula implemented in September 1998 was relatively simple. The base amount apportioned for each student enrolled. Initially, the formula allocated money for teacher salaries and textbooks. In 2003, small grants for academic subjects and extracurricular activities were added. A per student allocation for capital investments was introduced in 2005, and in 2007 a grant for workbooks was included (OECD 2016). The per student formula contains eight (initially six) coefficients adjusting per student payments on the basis of whether the municipality is urban or rural, and also on its demographic size.

Tables 4 and 5 present the amounts allocated for each type of sub-grant within the general education grant for municipal and private schools, as well as the different coefficients applied to these per student amounts depending on the size of the municipality are presented (Levacic, 2011, p.39).

Table 4: General Education Grant: 2003 to 2007

Genneral Education Grant ("000s Estonian kroons)	2003	2004	2005	2006	2007
Per student for regular general education students					
Salaries funding per student	7,805	9,171	10,547	11,390	13,670
Textbox funding per student	265	265	265	265	282
Workbook funding per student	0	0	0	0	458
Investment per student	0	0	1,270	1,270	1,385

Source: Levacic, 2011, p. 39

The higher per student costs of rural municipality and island schools is reflected in per student weights according to the size of the municipality in terms of student numbers and island locations. The formula also contains coefficients designed to provide smaller municipalities with additional funding to protect small schools while also pressuring them to consolidate school networks.

In addition, municipalities received a contribution from the state budget for providing school lunches for all students, as required by law for students in grades 1 to 9.

Table 5: Per student coefficients in the funding formula in 2007

Municipality criteria	Coefficient
Cities with over 5,000 pupils	0.89
Cities with 701-5000 pupils	0.9
Rural municipalities with over 700 pupils	1.0
Local governments with 501 - 700 pupils	1.0
Local governments with 351 - 500 pupils	1.1
Local governments with 251 - 350 pupils	1.2
Local governments with 181 - 250 pupils	1.3
Local governments with 121 - 180 pupils	1.4
Local governments with under 120 pupils	1.5
Weights for schools on islands (these are added to the municipal weight)	
Prangli,Ruhun and Vormsi islands	1.2
Kihnu island	0.7

Source: Levacic, 2011, p. 40

Special needs

There are a number of programs designed to support specific needs of students. These include programs to provide additional support for immigrant students to learn Estonian and to follow individualized curricula; the Language Immersion program; and program that provide housing and travel allowances to VE and other commuting students based on socio-economic need (OECD 2016, p 120). With regard to students with disabilities, taught in special schools (about 56% of the 6000 students in 2013), the coefficients in the formula are designed to reflect the severity of the disability and the type of curriculum the student is being taught (OECD 2016, p.119).

It should be noted that the formula does not account for student socioeconomic status, except for vocational school students —a fundamental element into improving vertical equity. The various weights in the formula for the different categories of student are shown in Table 6.

Table 6: Additional factors in the per student funding formula

Special factors	**2003**	**2004**	**2005**	**2006**	**2007**
Distance learning or evening courses	0.8	0.8	0.8	0.8	0.8
Prison education	1.6	1.6	1.6	1.6	1.6
Special classes					
Supplementart learning class (with minor mental disorders)	1.9	1.9	2.2	2.2	2.2
Classes for children with severe and profound learning disabilities	3.5	3.5	3.8	3.8	3.8
Students with behavioral problems (including minor mental disorders)	1.6	1.6	2.2	2.2	2.2
Childrens with speech impairments,sensory and physical disabilities	2.3	2.3	2.6	2.6	2.6
Sanatorium school	1.2	1.2	1.2	1.2	1.2
Opportunity class (learning difficulties)	1.3	1.3	1.4	1.4	1.4
Students with various types of special provision					
Remedial classes	0.2	0.2	0.2	0.2	0.2
Home teaching	4.4	4.4	4	4	4
Psychiatry	1.3	1.3	1.3	1.3	1.3
Hospirals	0.6	0.6	0.6	0.6	0.6
Language integration				0.2	0.2
Students learning a simplified curriculum regular classes	0	0	0	1.2	1.2
Students learning the curriculum for those with moderate or severe learning difficulties regular classes	0	0	0	2.8	2.8

Source: Levacic, 2011, p. 41

The different weights in the formula are multiplicative. Per student allocation expected at the student level are calculated as follows. For instance, the allocations for students in special classes are obtained by multiplying the number of students in each category by the coefficient (weight) for that category and then multiplying by the basic per student amount for a regular student (Levacic, 2011, p. 40).

Cost calculation

The base amount of the formula is derived from an activity-led model of the costs of teaching and learning. However, adjustment coefficients are derived not from an activity-led costing model of schools but from analyzing the actual expenditures of municipalities, that is on actual per student costs of municipalities and the ratios of these unit costs when comparing different types of local governments (Levacic, 2011, p. 38).

More specifically for the basic amount of teaching cost per student, the activity-led costing approach is based on assumptions about the number of full-time staff necessary to teach the programmatic hours of the national curricula at different year levels. Normative class sizes are used to determine the number of teaching positions to which municipalities with different student populations are entitled accounting for smaller size school protection.

[84] Once the total number of teaching hours (i.e. full-time equivalent positions) are determined for the municipality, this figure is then multiplied by a national salary for teachers (including training and social insurances) to determine a teacher salary budget for the municipality (Levacic, 2011, p. 116).

Results

According to OECD (2016), the intergovernmental formula funding system in Estonia has provided local governments with adequate, predictable, and relatively equitable education funding despite not accounting explicitly for socio-economic structural factors.

With regard to efficiency, student results in international assessments taken in conjunction with international comparisons of education spending per student as a proportion of per capita GDP indicate that the Estonian education system is comparatively efficient. Indeed, the Estonian education at lower secondary level shows high performance in a context where public investment on education relative to national resources is only around the OECD average, and despite the burden of financing high cost small schools. Estonian secondary students show steady improvement on the 2006 to 2018 PISA surveys across all measures and in the PISA 2018, Estonian students are ranked among the best in Europe (and the world) in math (4th and 11th), reading (4th and 11th) and science (1st and 4th).

With regard to equity, Levacic (2011, p.77) examined the relationship between education spending per student and local government wealth (as measured by tax revenue per capita). Controlling for structural costs (population density, and size of municipality in terms of student numbers and area), it found a significant positive association between wealth and education spending. The school finance system overall was hence not horizontally equitable with the amount spent on a student's education dependent on local income levels.

Such result illustrates the difficulty in achieving horizontal equity at the school and local government levels in the context of highly decentralized system where local entities have considerable jurisdiction and funding flexibility over school finances.Still, examining equity in outcome, despite not accounting explicitly for socio-economic structural factors in its formula, Estonia performs well in terms of equity, on standardized tests (See Table 3. In PISA 2018, Estonia present relatively low share of students not reaching minimum level of achievement in reading (11.1%), low between school variance (16.8%) and a relatively small proportion of the variance in students' reading scores explained by social, educational and cultural index (6.2%). Furthermore, the number of students repeating years has fallen to less than 1% and only 4% of students do not continue their studies after completing Grade 9 (OECD, 2016).

[84] For example, at the basic education level, the formula used in 2015 allocated teachers' salaries on the assumption that the average class could have three possible values: 24 students for municipalities with a student-teacher ratio equal or above 15; 21 students for municipalities with a student-teacher ratio between 7.8 and 14.9; and 10 students for municipalities with a student-teacher ratio of 7.7 or below (OECD 2016).

LITHUANIA

Background/Context

Lithuania is a small Baltic country of 2.79 million people with GDP per capita of 19 455 US$ (2019). Education spending represents 3.4 % of GDP (of which 0.8 % primary and 1.6 % secondary in 2016). (OECD 2019: 286). There are no fees in public schools. Privately-run schools, which share is relatively negligible, receive public funding on the same terms as schools owned by local or central government and can also charge tuition fees.Following independence in 1990 and transition toward a democracy and market reforms, education reforms were slow and were introduced only in 2002 with decentralized grants toward local governments (municipalities).

Education grants and composition

Central government funding to schools support resources directly related to the teaching process, including teacher staff salaries and teaching supplies, while local governments support school maintenance costs.Central government education funding is allocated as a lump sum to the local governments with detailed information on amounts to be received by each school on its territory. Capital investments grants are provided by central government as distinct grants on a need basis, supplemented by local government funding.

Figure 3 shows the flow of funding from the central state to primary and secondary schools via municipalities and the resources that the funding stream are intended to purchase (European Commission, 2016).

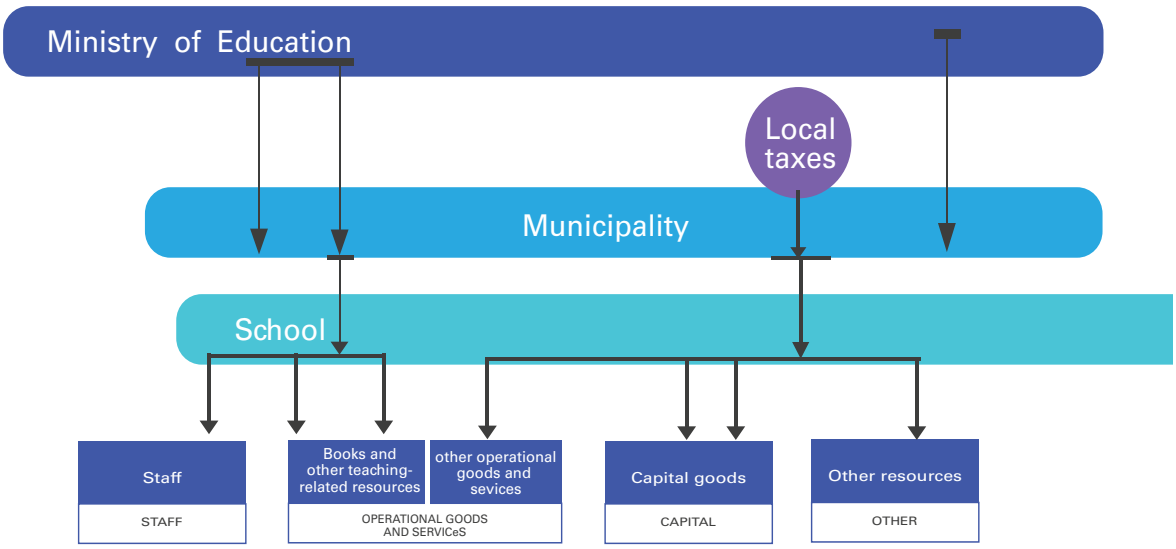
Formula funding

In the context of transition toward a market economy and decentralized structure of government, the Lithuanian government implemented an education finance reform in 2001 supported by the World Bank. The reform based on a per-student central government formula funding sought to pursue several goals, including:

- to create a transparent and fair scheme for allocating resources, with a particular emphasis on eliminating rural-urban disparities
- to strengthen the financial independence of schools and increase the responsibility of school leaders
- to promote the optimization of local school networks and constant adjustment to the decreasing number of students
- to enhance parental school choice, school competition and the development of the non-governmental school sector
- to reduce the number of children who are not attending school (Shewbridge 2016, p. 94; Herczynski, 2011)

Figure 3: Flow of funding from the state to primary and secondary schools through municipalities

Primary and general secondary schools



Source: European Commission/EACEA/Eurydice

The Lithuanian model of per-student formula is quite different from other such financing arrangements as it distinguishes between the "teaching process" which relate to education quality and those related with the "teaching environment" which relates to the operation and maintenance of the service provider facilities. The teaching process which covers all education direct cost related to education quality, is financed by the central government formula, while the teaching environment component is left to the discretion of the municipalities (OECD 2016).

The per student amount, called the Student Basket, which finances the teaching process is calculated according to a formula adjusted every year through a decision of the Cabinet of Ministers. The Student Basket comprised teacher salaries, as well as salaries for the other professional support staff (e.g. psychologists, librarians), school management and administration, textbooks for students and some school materials, teacher in-service training, and some other specific education functions. The Student Basket is calculated by the Ministry of education for each school separately. Local governments which receive the school specific allocation are allowed to redistribute 5 percent of the funds allocated by the funding formula among its school network (Shewbridge et al, 2016).

The smaller portion of the school budget is supported by local government funding for "school maintenance costs". This covers salaries of the maintenance staff, communal and communication expenses (heating, electricity, telephone and Internet), student transportation (school buses) and expenditures of materials and repair works used for the maintenance of school facilities (Herczynski 2011, p.95). There are no national norms for this other segment of the school budget allocated by the municipalities and for which they have discretion.

The per-student approach used in Lithuania could be viewed as a variant of a student voucher approach where funding follows the student, which was among the explicit goals of the reform to promote competition among schools with the aim of improving education quality. However, the scheme differs from a pure voucher funding given that instead of being transferred to schools, the per student grant is transferred to local governments which are entitled to redistribute a certain share of the funding across schools. Also, the grant takes into account school size acknowledge the legitimately higher costs of smaller schools which have lower enrolment rates due to their rural location.

The funding model could be viewed as supporting decentralized school management as the school has the responsibility for preparing and managing the school budgets, which are then approved by the municipalities (i.e. owner of the school). To promote efficiency and equity, within the school budget, expenses funded by the Student Basket funds and school maintenance expenditures are kept separate and not fungible (Shewbridge et al, 2016).

The basic component of the Student Basket is calculated as the standard per student amount for the teaching process for a student of grades 5 to 8 in an urban general secondary school, with an assumed class size of 25. Students in other school types or grade levels receive a higher or lower allocation based on allocation coefficients. The total funding for a school is then determined based on enrolment figures on the number of "equivalent students", that is, a weighted sum of students taking into account various elements related to cost differences in teaching different students (Herczynski, 2011).

Special needs

The funding scheme acknowledges some teaching cost differences and allocates more funding for certain types of students and schools with justifiably higher costs. This is done through weighting factors assigned to these types of students. As it is the case for weighted per student formula, the weighting for the reference student is 1, while students who are more (less) expensive to teach are assigned a weighting factor greater (less) than 1. Among the main student characteristics considered are school year the student is enrolled in, special education needs (SEN) which is assigned an extra weight (1.35), migrant status (1.30) and students following instruction in a national minority language (1.20).

In addition, the size, location and type of the school also affect weights while lower weighting is allocated to pre-school and kindergarten education. Table 7 presents the weights by school size and year, together with the expected class size for each category. Note that the school type also defines the weighting, as the number of school years can vary in different school types.

As observed, the funding formula favors small and rural schools to some extent. The degree of the preferential treatment of small rural schools was modified several times since the introduction of the reform, reflecting constant debates about the adequacy of funding for these schools (Shewbridge et al, 2016, p.98).

Table 7: Student basket weighting coefficients by school size, type, location and year

School type,location and size	Enrolment	Expected class size	Years 1 to 4	Years 5 to 8	Years 9 to 10	Years 11 to 12
Primary school						
Extra small, rural area	<40	10	1.9177	..	..	..
Small, rural area	41-50	12	1.5644	..	..	..
Medium, rural area	51-80	15	1.2435	..	..	..
Large, rural area	81+	20	0.9963	..	..	..
Urban area		22	0.9963	..	..	..
Basic school, pre-gymnasium						
Extra small, rural area	<80	10	1.8264	2.2644	2.7438	..
Small, rural area	81-120	12	1.5644	1.9095	2.4028	
Medium, rural area	121-200	15	1.2435	1.5276	1.9222	..
Medium/large, rural area	201-300	15 (Years 1-8) 18 (Years 9-10)	1.2435	1.5276	1.6018	..
Large, rural area	301+	20 (Years 1-4) 22 (Years 5-10)	0.9792	1.2685	1.4206	
Urban area		22 (Years 1-4) 25 (Years 5-10)	0.9461	1.2064	1.4077	
Secondary school,gymnasium						
Samll, rural area	<300	15 (Years 1-8) 18 (Years 9-12)	1.2435	1.5276	1.6018	1.6661
Medium, rural area	301-500	20 (Years 1-4) 22 (Years 5-12)	0.9792	1.2685	1.4206	1.4735
Large, rural area	501+	20 (Years 1-4) 25 (Years 5-12)	0.9792	1.2064	1.4077	1.4345
Urban area		22 (Years 1-4) 25 (Years 5-10)	0.9461	1.1274	1.4077	1.4345

Source: Government of the Republic of Lithuania (2014), Del Mokinio Krepselio Lesu Apskaiciavimo Ir Paskirstymometodikos Patvirtinimo - Nauja Metodikos Ir Jos Priedu Redakcija Nuo 2014-01-01,Nr. 790,2013-08-28,Zin.,2013,Nr.94-4699 (On The Approval of the Methodology of Calculation and Distribution of Funds of the Student basket - New Methodology and Annexes Version 01/01/2014), www3.lrs.lt/pls/inter3/dokpaieska.showdoc_l? p_id=480354.

Source: European Commission/EACEA/Eurydice

Cost calculation

The student basket is calculated using the activity-led method. The methodology is presented in Annex A. The main idea of the activity-led cost calculation of the basic student amount is to estimate the teaching cost of a standard reference student who has no distinctive status (i.e. special education needs (SEN), migrant status and national minority-language status),for a standard class size of 25 and teaching hours.

The calculation is based on the number of students' teaching hours set by the Lithuanian curriculum (equal to the grade 1-10 average) and on teachers' teaching hours of full-time teachers according to teacher employment and salary regulation, and average teacher salary in the public sector for 12 months. This amount is divided by the number of students in a presumed class size of 25, leading to the standard salary amount per student (Herczynski (2011, p. 182). Box 3 details the steps in the activity-led costing of the various components within the per-student school formula.

The non-teaching Student Basket elements are estimated in a comparable way and built in the formula through the use of coefficients of items responsible for specific non-teaching functions of the schools. Table 8 provides the values of coefficients for all those functions between 2002 and 2007, together with their sum.

Table 8. Non-Teaching Student Basket Coefficient: 2002 to 2007

Coefficient purpose	Symbol	2002	2003	2004	2005	2006	2007
Textbooks	TB	0.0083	0.0167	0.025	0.0300	0.0345	0.0449
Teaching aids	TA	0.0017	0.0033	0.005	0.0060	0.0069	0.0090
Pedag. psych. services	PPT				0.0052	0.0079	0.0095
Cognitive development	CD					0.0027	0.0053
Vocational guidance	VG						0.0027
Libraries	L						0.0053
Total non-teaching		0.01	0.02	0.03	0.041	0.0520	0.0767

Source: Source: Herczynski (2011, p. 184)

Analysis

While simple in theory, the Student Basket is arithmetically a rather complex system (see discussion in Box 2). Still, its simple logic can be well understood by stakeholders and hence, could be seen as meeting the goals of allocating funds in a transparent and predictable way (Shewbridge et al, 2016, p. 103).

As for equity in allocating resources, which was one of the major objectives of the reform, the student basket formula contains elements to promote horizontal equity of funding across schools (i.e. similar schools receive similar funding). In itself the redistribution of a small share of the school funding at the municipal level may result in some deviations from equal per student allocation across similar schools, but it may not endangers horizontal equity in a substantial way (Shewbridge et al, 2016,p.105). Moreover, the non-fungibility of the student basket funding forteaching quality from municipal funding of school maintenance -- and also municipalities being also not allowed to increase expenditures on teaching--further support horizontal equity (Shewbridge et al, 2016).

Still, some disparities in funding could be expected to emerge with regard to school maintenance allocated by local governments. However, local governments revenues relying mostly on intergovernmental grants (i.e. the share of local tax and non-tax revenues being below 20% (2012)), this suggests that wealth inequalities between municipalities are not likely to create substantial differences in school maintenance expenditures (Shewbridge et al 2016).

As for vertical equity, the student basket formula recognizes additional funding for some schools and student needs to enhance equity in access and quality of education. However, equitable funding of small rural schools is especially difficult to ensure with the tradeoff between equity and efficiency. The formula leaves open imbalances between funding and costs with overall level of funding per class lower in smaller schools facing diseconomies of scale. Also, with rural schools attended by students with a lower socio-economic status on average, the achievement gaps between poor and rich are reinforced by a lower level of student basket funding in small schools (with teaching costs divided by a smaller number of students per classes).

Moreover, the Student Basket being calculated using average teacher wages, differences in education quality and inequalities of opportunity in education are also affected, rural schools are constrained in attracting teachers of the highest quality (Shewbridge et al 2016). Furthermore, the formula does not currently condition funding on socio-economic characteristics of students, leaving aside achievement gaps with respect to children's socio-economic background.

Examining the results of the education system, the Lithuanian system appears comparatively less efficient than other OECD countries with lower secondary level students showing below average performance in PISA 2018 (e.g. reading 476 vs 489), but in a context where education spending per student as a proportion of per capita GDP is quite below OECD average (2.4% vs 3.5% in 2016).

Examining equity in outcomes, Lithuania education system presents various indications of inequality of opportunities. Almost a quarter of student are not reaching minimum level of achievement in reading in PISA 2018, socio-economic parity index in terms of minimal level of achievement is below OECD average (e.g. reading: 0.68 vs 0.72), and a relatively high between school variance (31.6%) above OECD average is observed (See table 3). Also, while differences related to family background can be regarded to be at medium level, for instance with the variance in students' reading scores in PISA 2018 explained by social, educational and cultural index at 13.2%, somewhat below the average of OECD countries, it is significantly higher than in the Nordic countries or Estonia.

This suggests and as emphasized by Herczynski (2011, p.113-114) that though it is not an outstanding social problem at the moment in Lithuania, considerable inequalities between students from relatively less and more advantaged socio-economic backgrounds do exist and would benefit at being directly accounted for in the education policies and school funding schemes.

Box 2: Illustration of the activity-led funding method: The basic student basket formula in Lithuania

Costing of the various components within the per-student school formula in Lithuania is done using the activity-led method which consists at identifying the resources required to deliver a given educational program then determining the cost of these activities and finally aggregating these costs. This illustration is for the "basic student basket" which comprises teaching staff costs as well as other overall teaching costs (other staff, supplies, etc.).

The basic idea behind the "student basket formula" is to calculate the number of necessary teachers as a function of student enrolment (N). The key elements of this calculation are the number of students' teaching hours (h) set by the national curriculum, teachers' teaching hours (p) according to teacher employment and salary regulation, and a presumed class size (n) which can be interpreted either as the average size of actual classes or a target that the central government expects schools to achieve. Dividing students' hours by the number of teaching hours of full-time teachers provides the number of required teachers for an average class. Multiplying this with the inverse of the class size results in the number of required teachers (T) per student enrolled:

$$\frac{T}{N} = \frac{h}{p} \times \frac{1}{n}$$

Multiplying the number of required teachers per student by the average teacher salary results in the per student amount needed to cover teacher salaries (TS). The average teacher salary, the second term of the equation, enters into the formula as the product of the average teacher salary coefficient (R) and the fixed basic salary (B) in the public sector for 12 months, since the regulation of teacher salaries is built on this approach (see the subsection on teacher salaries below). This amount forms the core of the student basket:

$$\frac{TS}{N} = \left(\frac{h}{p} \times \frac{1}{n}\right) \times (R \times B \times 12)$$

Moreover the formula also incorporates further components, as the student basket is intended to fund other teaching costs in addition to the teacher salaries. Some of them are included as coefficients augmenting the per student grant in a multiplicative manner. Social insurance contributions (Ksocins) and administration and library costs (Kadmlib) are entered proportional to the required teacher salaries. At the same time the component for funding textbooks, teaching materials and municipal pedagogical and psychological services (Kmatmun) is added independently of the number of required teachers, expressed as a percentage of the fixed basic salary. Finally, the student basket (SB) includes supplementary elements (Z), e.g. the student basket funding for non-formal education in schools:1

$$SB = \left(\frac{h}{p} \times \frac{1}{n}\right) \times (R \times B \times 12) \times (K_{socins} + K_{admlib}) + (B \times 12) \times K_{matmun} + Z$$

Note that the calculation of the number of required teachers and the sum of their estimated salaries are derived directly from parameters of educational regulation, measured average teacher salaries and an expected class size. In contrast, the additional coefficients – with the exception of social insurance contributions – are set in a more ad hoc way. This might be one reason for policy debates often focusing on these elements.
Source: Shewbridge et al 2016 p.97

UNITED STATES (Maine, Massachusetts, Vermont)

The United States has a population of 332.6 million and GDP per capita of 65,118 US$ (2019). It has a federal form of government with the 50 States having each constitutional responsibility for education. Historically, primary and secondary education management and financing was devolved to local districts, which were given the authority to tax local property to raise funds for their school systems. Education costs being supported primarily by local property taxes lead to important inequities in school financing. In many states, the wealthiest district spent two to three times what the poorest district spent per pupil, leading to major differences in teacher salaries as well as learning conditions for students. Over the past three decades, states have substantially reformed their funding systems, equalizing local revenues in many states and achieving higher level of adequacy and equity. However, the US education system is still going through desegregation and school finance reforms in many states and, in the current context of worsening economic disparities, there are profound remaining inequalities in the school system (DarlingHammond, 2019).

Funding formulae

In the 1990s, several states started to implement decentralized school management approaches giving more freedom for school authorities to spend allocated budgets. Such decentralized models of authority responsibility and accountability generated a strong demand for formula funding. Furthermore, with the courts emphasizing constitutional requirement of adequacy of education, per student formulae were developed at the district and state level in most states in the late 1990s (Odden and Picus, 2019, p. 198).

Currently in all states, school funds are distributed at least in part via statewide per pupil formula funding, with substantial variations in equity components and results from state to state. Most states implement K12 education funding policies that take into account differences in the cost of educating students across districts and schools and provide additional resources to school districts to offset these higher costs, particularly those located in communities that are less able to raise the revenues needed to pay for the cost of education (Baker, 2018). Each state's funding policies operate differently. However, most recognize a core set of cost factors that contribute to differences in educational costs across districts, and then use one or more common mechanisms to distribute additional aid to offset these additional costs. We focus here on the case of 3 northern states, Maine, Massachusetts and Vermont which present relatively developed emphasis on equity considerations within their per student funding formulae.

Maine

Maine is a small state with population of 1.3 million which operates a hybrid funding formula using input based and weighted student formula (WSF). According to the formula, the cost of education in a school district is first determined using the value of a stipulated package of resources (e.g., teachers, administrative personnel, classroom materials) using an activity-led costing approach. A district-specific per student adjusted base cost amount is then obtained by dividing the total district cost adjusted for regional differences in resource prices, by district's enrollment.[85]

Pupil weights are applied to districts' adjusted base funding amounts to account for differences in student needs. With regard special education, multiple weights are used to adjust for differences in the share of students with disabilities (SWD) in a school district. A single weight (1.15) is used to factor in the base funding amount for each eligible student categorized as economically disadvantaged or at risks in terms of achievement.

Maine's formula includes multiple weights to adjust for the cost of educating non-native English learners. The weight depends on the number of students in a district that are limited-English proficient, ranging from 1.7 for school districts with fewer than 15 of such students, to 1.525 above 250. With regard to remote and small schools, the formula uses multiple weights to adjust for differences in educational costs.[86] Furthermore, a separate categorical funding program outside of the formula is available for gifted and talented students allocating additional funding to schools[87].

[85] For FY 2018, the base foundation funding per student amount from $5,134 to $7,353, depending on the district (Kolbe et al, 2019).
[86] A school is eligible for additional funding when it meets specific size and distance criteria – e.g., PK-8 schools with less than 15 students per grade and more than 8 miles from the nearest other PK-8 school; secondary schools with less than 29 students per grade, fewer than 200 students, and more than 10 miles from the nearest high school. P18
[87] The amount is based on prior year spending for an approved program or an approved budget amount (whichever is less) (Kolbe et al 2019, P18)

Massachusetts

With population of 6.7 million, Massachusetts operates a hybrid funding system that incorporates both resource and student-based elements to determine a foundation budget for each school district.[88]Special education and low-income students receive additional weight above the basic foundation level. With regard to special education, the formula assumes an average share of special student enrolment (3.75%), and provides additional support for each additional 1% of district enrollment for special education and related services appropriate to a student's needs (Kolbe et al, 2019).

As for economically-disadvantaged students, each district is assigned to a decile according to the share of students participating in one or more state-administered social programs and additional allocation depends on the decile to which a district is assigned.[89] Massachusetts does not provide additional funding for small districts or schools nor for gifted and talented students.

Vermont

In Vermont, which has a population of 630,000, local education spending is funded through a statewide Education Fund, which among other sources, includes pooled revenues from local property taxes and which seek to ensuring all students achieve common educational standards (Kolbe et al 2019). Vermont WSF school funding formula accounts for differences in educational costs across school districts by recognizing three cost factors – student poverty, limited English proficiency, and secondary-level education – and assigning weights to these factors it its equalized pupil calculations. In addition, the State operates categorical funding programs for special education, small schools, and transportation.

A distinct component of Vermont formula is that the base level grant per student is determined by school boards and approved by district voters. The formula accounts for two student-needs, as well as two grade levels differentials: 1) Economically-disadvantaged students within a district are considered to represent an additional cost (weight) of 1.25;[90] 2) Students with limited-English proficiency are provided a factor of 1.20, 3) Secondary students receive a weight of 1.13, assuming to cost 13% more to educate than elementary students, 4) Pre-kindergarten students are deflated by applying a weight of 0.46 when calculating a district's student funding (Baker 2018).

Also, Vermont adjusts for differences in costs using three categorical grants outside of the main formula that provide supplemental funding for specific programs or services, i) Special education costs within a district is reimbursed at 60%. Note that starting in FY 2021, a census-based funding model will be used to allocate state-aid to school districts on a per capita basis. This change is intended to break the link between student identification, service delivery, and state aid (Baker 2018). ii) Vermont also provides supplemental funding to "small" schools and districts through a categorical grant outside of the main formula.[91] iii) Districts are also eligible to have up to 50% of their allowable transportation expenditures reimbursed by the state (Baker 2018).Table 9 presents the cost adjustment categories as well as the weights and specific categorical programs outside of the main formula when applicable, for the three states.

[88] The "foundation budget" is calculated by multiplying the number of pupils enrolled in various categories by a set resource-based cost rate in 10 categories from pre-school to K12 (Kolbe et al 2019, p. 18)

[89] For FY2018, school districts with the smallest share of economically-disadvantaged students received $3,817 per student, while those with the largest shares received $4,181 (Kolbe et al 2019).

90 The district's weighted long-term population is further multiplied by the district's poverty ratio and account also for economically-deprived persons. The latter is defined as a person who resides with a family unit receiving nutrition benefits, and any other persons who do not reside with a family unit receiving nutrition benefits for whom English is not the primary language (Kolbe 2019, p. 28)

91 School districts operating schools with (a two-year average) enrollment of fewer than 100 students, or in instances where the average grade size is 20 or fewer students, are eligible for an annual per capita grant from the state (Kolbe et al, 2019).

Table 9: Education Funding Policies in 3 US states

	Maine	Massachusetts	Vermont
Funding Model	Hybrid System	Input-Based	Local Control
Cost Adjustment			
Student With Disabilities	Multiple student weights	Census-based allocation	Cost reimbursement
Economic Disadvantage/ At-Risk Students	Single weight (1.15)	Dollar amount that varies by economic disadvantage decile	Single weight (1.25)
English Language Learners	Multiple student weights (Weight depends on ELL density)	Multiple student weights (Weight depends on ELL grade level)	Single weight (1.20)
Giften and Talented	Categorical grant	None	None
Grade Level	Single weight (Students in Grades K–2, 1.1)	Different base funding amounts for students in: K, elementary, junior middle grades, and high school	Multiple weights (1.13; Students in Grades 7–12; 0.46 PK students)
Size and Geography	Multiple weights	None	Small schools categorical grant program
Resource Prices	Regional labor market adjustment	Wage adjustment factor	None

Categorical grants Formula funding

Sources: Adapted from Tolbe et al 2019 and 2020. The summary of state policies is based on information reported by: (1) EdBuild's FundEd: State policy analysis (retrieved from http://funded.edbuild.org/state); and (2) A quick glance at school finance: A 50 state survey of school finance policies (retrieved from https://schoolfinancesdav.wordpress.com). In addition, individual states' staute and other documents were reviewed when further information or clarification was neededd.
Souce: Addapted from Kolbe et al (2019)

Analysis

We could assess the relative level of equity of inputs of the three state systems using various indexes of education spending at the district level. Table 10 presents four summary statistics of equity financing (see Section 3 for a discussion of these indicators), as well as an overall equity score for the three states and the overall value for the US, estimated by Education Week's Quality Counts assessment (2017). Note that overall percentage scores are measured using equity scores and spending (not shown).

Table 10: School finance equity using selected equity financing indicators

State	Wealth-Neutrality score	McLoone Index	Coefficient of variation	Restricted range	SUM (%)
Maine	0.143	89.8	0.18	6,455	83.5
Massachusetts	0.143	91	0.179	7,173	83.2
Vermont	0.109	81.3	0.226	11,595	85.9
United States	0.132	91	0.159	4,592	73.9

Source: Brimley et al (2020) p. 71-72 from Editorial project in Education (2017)

Overall, the equity scores for the three states are above the US average, with Vermont scoring slightly higher among the three states, with a score of 85%. Examining more specifically each of the equity indexes, we observe that according to the wealth neutrality score (a score increase correspond to decrease equity), which measures the extent to which education funding at the district level is related to local ability to pay for education (using property wealth), Vermont education spending is less dependent on local wealth, while the other 2 states are above the US average.

However, according to the McLoone index which measures equity in the lower half of the revenue distribution (and for which an increase in the index correspond to increase equity), Vermont scores below the other states and US average. As for the coefficient of variation (CV) which measures variability in revenue distribution around the mean (as it decreases equity increases), as well as for the restricted range which is the difference between the revenue per pupil at the 95th and 5th percentile of income (as the range decreases equity increases), Vermont scores below the other states. Overall, the higher score of Vermont appears to be linked to a lower better wealth neutrality score associated with a state level education fund pooling education resources and neutralizing local wealth inequalities.

In terms of outcomes of the state systems, we could examine the overall US performance in PISA standardized assessment. The US education system appears comparatively less efficient showing just average performance in reading in PISA 2018 compared to other OECD countries, and below average performance in mathematics (478 vs 494 respectively) in a context where education spending per student as a proportion of per capita GDP is above OECD average (3.8% vs 3.5%, see Table 3).

A distincIn terms of equity in outcomes, the US education system presents various indications of inequality of opportunities. Overall,a fifth of students in PISA 2018 are not reaching minimum level of achievement in reading and more than a fourth in mathematics (27.1%), socio-economic parity index in terms of minimal level of achievement, especially in mathematics is below OECD average (0.62 vs 0.68, see Table 3). Still, the variation of educational outcomes in reading explained by the socio-economic status (ESCS) of students is below OECD countries average (12% vs 18% respectively), despite being much less equitable than Estonia and Canada for instance.

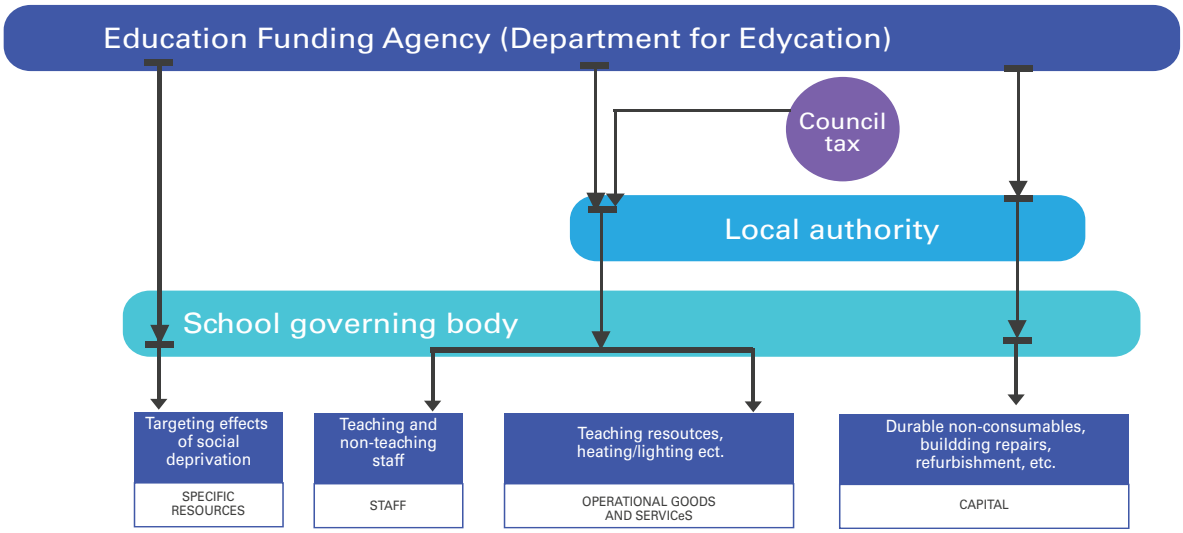
ENGLAND

England, the largest country part of the United Kingdom, has a population of 56 million and GDP per capita of 42,980 US$ (2019). It has a unitary form of government with 125 elected local government authorities (Las) responsible for education under the overall responsibility of the national Department for Education (DfE). Most state-funded schools are administered by LA's education departments. About 90% of funding of state schools is provided via the Las and the rest directly from the DfE in the form of specific earmarked grants (UK, 2020). Las finance about three quarters of their education expenditures for pupils in state-funded mainstream schools and academies from DfE's Dedicated School Grants (DSG) and the rest mostly from a tax on residential property (Levacic 2008, p. 216; UK 2018, p. 5).[92]

The flows of funding through from the DfE to maintained primary and secondary public schools through LAs is illustrated in Figure 4.

Figure 4: England. Flow of funding from the Department for Education to primary and secondary schools through Local authorities (LAs)

Maintained school[1] (primary and genral secondary education)



Source: European Commission/EACEA/Eurydice (2016) p. 86

Formula funding for state schools' expenditures was introduced in England part of the 1988 Education Reform Act. The main objectives of the reform were to promote a more market-driven education system by giving parents greater choice of schools and creating incentives for competition among schools through financial incentive to recruit students, to ultimately improve efficiency and education quality. It was accompanied by an increase in local responsibility through the introduction of "Local management of schools (LMS)" which saw the delegation of schools management and budgeting responsibility to schools' governing bodies (school councils). The aim was to enhance the quality of education by enabling more informed and effective use of resources. LAs were required to distribute the delegated budgets of their schools by means of a formula driven by student numbers and characteristics, within guidelines set by the DfE.

However, there were important variations in the local level allocation formulae and funding levels across schools. This prompt the introduction a further school funding reform in 2016-17 and introduction of a national per student formula.

[1]Maintained school are those that are funded via the local authority and include different legel categories, such as coumunity school. foundation school, trust school, voluntary controiledd and voluntary school. The flow in this figure represent the mechanisms for funding pre-16 education (the DDedicated School Grant , Pupill Premium, Devolved Capital Funding and ddepending on the category of school. either Local Authority Capital Maintenance or Local Authority Coordinatedd Voluntary alded Programme) and post-16 edducation (the 16-19 funding formula Devolved Capital Funding and depending on the category of school either Local Authority Capital Maintenance or Local Authority Coordinated Voluntary Alddedd Programme).
Maintained schools are responsible for managing their own recurrent funds (individual school budget share of the Dedicatedd Schools Grant). There are no set amounts which have to be spent on the base categories. The subcategories indicated the kinds of goods and services schools may choose to spend this funding on but are not exhaustive. Pupill Premium fundds (which should be uesd to target the effects of social deprivation) are shown as directly transferred by the Education Funding Agency to schools. However, they are in fact distributed to schools via the local authority who must pass it on in its entirety.
Regarding capital expenddiure, the diagram focuses on on-going funding allocation (ddevoled capital funding and maintenaance fundding). In addition, the Education Funding Agency (EFA) may transfer a Basic Need Aliocation to LAs to support the capital requirement for providing new pipill places in new or expandded maintained schools.
[92] A particularity of the English education model is the presence of publicly-funded private schools, called academies. These privately run schools are outside the control of local authorities and receive funding directly from the central authorities. The academy school model was initiated in the early 2000s to address concerns about the quality of education in some local authorities, usually serving urban inner-city disadvantaged neighborhoods. Like public schools run by local authorities, academies must follow legislation and guidance on admissions, exclusions and special educational needs and disabilities, but they can charge fees and benefit from greater autonomy (e.g. for setting pay and conditions for their staff or for changing the length of school terms). (OCDE funding of school education… p111112).

National Funding Formula (NFF)

In 2016-2017, major changes to the formula funding system were put forward with the introduction of the National Funding Formula (NFF). The new approach of school funding was perceived as necessary because the previous system was seen as 'unfair, untransparent and out of date.' It aimed to remove discrepancies in funding that had arisen from allocation to local authorities were based on a historic assessment that had not kept pace with demographic change and from school budgets being allocated by LAs, rather than central Government, and ensure that all school budgets are set using the same criteria.

The aim is "to ensure that the funding system is fair and transparent for every school in the country with similar schools supporting children with similar characteristics receiving similar funding no matter where they are located". (DfE, 2019, p. 3 The National Funding Formula). The objective was to: "move to a funding system where allocations are calculated consistently, based on factors that evidence show can create barriers to children attainment and outcomes. By property matching the allocation of funding to need, we will be placing the education system as a whole in the best position to ensure that all children and young people, regardless of their location, prior attainment or background can achieve, to the best of their ability, and thus to provide educational excellence everywhere". (DfE, 2016, p. 4, National funding formula equality analysis).

During the current transition towards the NFF, LAs still retain flexibility over how they distribute locally the NFF funding. The NFF was supposed to become compulsory at the local level in 2021. However, in the context of the pandemic, the move to a country wide formula has been postponed (DfE, 2020, p. 4).

Characteristics of the formula

The NFF allocates funding for 5 to 16-year-old pupils (grade 1 to 11) in mainstream, state-funded schools.[93] The NFF is relatively comprehensive as it covers a large proportion of the expenditure on resources used by the regular state schools that are allocated by the formula. It covers in particular most current wage and non-wage costs. , except for special education student and pupil premium. Additional funding also comes from the Pupil Premium[94] grant and other programs (e.g. Sport Premium) distributed separately from the formula to the schools.

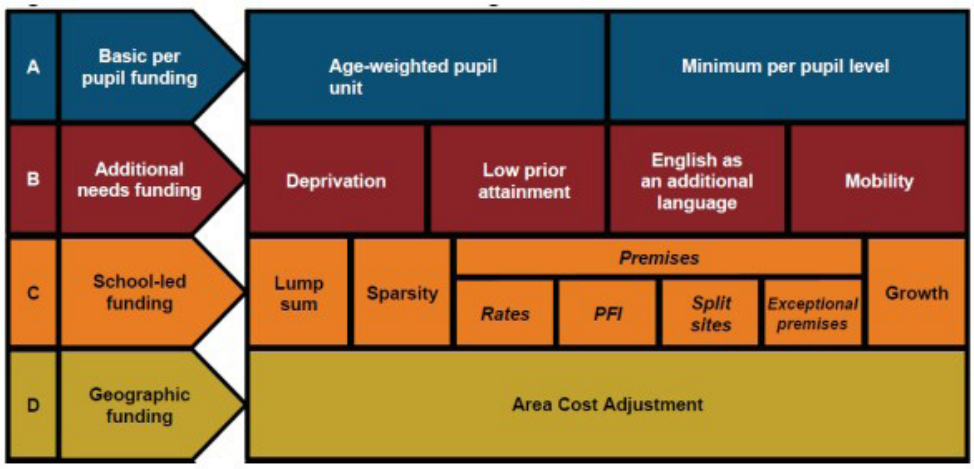
Moreover, a separate High Needs NFF is used to calculate the funding local authorities receive for children with SpecialEducational Needs and Disabilities (SEND) (DfE 2020 : Guide to national funding). Also, capital expenditures are covered by a different block grants.

The NFF per pupil grant is made of 4 main "building blocks" composed of both pupil-led elements (based on characteristics of students), and school-led funding elements (based on the characteristics of the school itself).[95] The majority of funding in the NFF is 'pupil-led'. Ultimately, total levels of funding per pupil are calculated using aggregate pupil-led and school-led funding (the total funding for both pupils and the school). These school-level allocations are then added up to create a total allocation for each LA.

[93] There are separate national funding formulae for nursery classes and post-16 pupils. Also, special schools, alternative provision, the City of London and Isles of Scilly as well as the 2 city technology colleges are excluded and receive a separate education grant, (DfE 2018, p.5).
[94] The Pupil Premium (PP) program awards an amount to schools for each child who qualifies for free school meals on the basis of their family income. It seeks to improve prospects for these pupils, for example by funding one-to-one or small-group support, extracurricular activities, school trips, etc. PP may eventually be merged into the NFF. Source:

Figure 5 presents the various components of the formula with the main factors part of those blocks.

Figure 5: Factors in the schools national funding formula



Note: This illustrates the factors taken into account when calculating schools block DSG funding allocations through the national funding formula. Source: DfE (2020) p.5 The components of each of these blocks are as follows:

Block A: Basic per pupil funding. The minimum level of funding for a school is calculated based on the number of pupils in the school and their characteristics. All schools get a basic amount for each pupil weighted by age and grade levels. The basic per pupil funding was £3750 for each primary school and £5000 for secondary school pupil in 2020-21 (DfE, 2020).

Block B: Additional need funding. As for block A, this component is pupil -led and provides extra funding for pupils with additional needs, with the view of supporting schools in deprived areas or that have a large number of pupils from a disadvantaged background, to help raise the attainment of children who perform less well than their peers. The allocation is provided for schools on the basis of the number of pupils who have particular characteristics. For each factor schools receive a unit of funding per eligible pupil. Four needs are considered: deprivation; low prior attainment with additional funding based on the number of children who are assessed as not achieving a good level of development in the Early Years Foundation Stage Profile; English as an additional language; mobility, for schools that have high numbers of pupils leaving and joining throughout the year.

Bloc C: School block funding. This funding is allocated to schools independently of factors relating to pupils. It includes a lump sum for every school, and extra funding for schools with certain characteristics, such as a school that operates across more than one site, or a school that is small and remote.[96]

Block D: Geographic funding. This component is 'weighting' based on the school's location and recognizes factors such as the difference in teachers' salaries depending on region or other recognized costs differentials. Table 11 presents factor values and proportion of each of the main components within the NFF in 2021-2022.

[95] A fifth component (E) , "protection funding", was added in 2020-21 to ensures that no school sees a fall in its NFF allocation as a result of the introduction of a new mobility factor in the formula.
[96] More precisely, lump sum is a fixed and equal amount given to every school in the area by their local authority. Sparsity is extra money for small or isolated schools that can't save money by sharing services or facilities with other schools. Premises: money allocated on the basis of rates and other factors like split sites. Growth is extra funding for schools that are expecting significant increases in pupil numbers. Falling rolls is allocated to schools that have observed a reduction in attendance.

Costs

Estimation of costs for the different components part of the NFF are derived using actual school level financial and student data. In 2020-21, for instance, the pupil basic allocations and unit of funding estimates were based on school and pupil characteristics and financial data from the 2019-20 Authority proforma tool (APT) data developed by the DfE. Also, various specific indexes are used to construct specific components within the formula based on census-based data. For instance, the need-base deprivation factor within the second component is constructed using the Income Deprivation Affecting Children Index (IDACI), which measures the likelihood that a child is in a household experiencing socio-economic deprivation.97 The cost components are revised annually and made public by the DfE. Some funding factors are allocated based historic spending by local authorities (DfE, 2020).

Table 11: Factor values and proportion of the total NFF in 2021-22

Factors	Unit Values	Proportion of core total
Basic per pupil Funding		**76.5%**
AWPU	£3,123	**75.3%**
Primary AWPU	£4,404	38.3%
KS3 AWPU	£4,963	21.8%
KS4 AWPU		15.2%
Minimum per pupil		**1.2%**
Primary Minimum Per Pupil funding	£4,180	0.8%
Secondary Minimum Per Pupil funding	£5,41	0.4%
Additional Needs Funding		**17.0%**
Deprivation		**8.8%**
Primary FSM	£460	1.0%
Secondary FSM	£460	0.6%
Secondary FSM6	£840	1.9%
Low Prior Attainment		**6.9%**
Primary LPA	£1,095	4.1%
Secondary LPA	£1,660	2.8%
English as an Additional Language		**1.1%**
Primary EAL	£550	0.8%
Secondary EAL	£1,485	0.3%
Mobility		**0.1%**
School Led Funding		**6.5%**
Lump Sum		**6.4%**
Primary lump sum	£117,800	5.4%
Secondary lump sum	£117,800	1.1%
Sparsity		**0.1%**
Premises		**1.4%**
Total	**£38,916m**	

Note: This shows the unit values and proportion of funding for each factor in the formula. Total funding is rounded to the nearest £1m. Proportion of core total is rounded to the nearest 0.1%.

Source: DfE (2020), p12

Analysis

As discussed, the relative importance of the various components in a funding formula reflects the emphasis in the social policy context given to the equity objective relative to other goals in particular efficiency (Ross and Levacic, 1999).

In the NFF 2021-22 spending previsions, the basic per pupil allocation of component A is by far the major element of the formula, representing 76% of the NFF funding for recurrent expenditures within the school budget (see Table 2).[98] This overwhelming importance of this first component gives to the formula a strong market function, providing incentives for efficiency through economies of scale and basic horizontal equity of funding at the student level.[99]

Component B of pupils' specific needs and component C and D of school structural factors, which importance would correspond to support for the specific needs of individuals and communities, due to factors that are deemed to be outside of their control, represent respectively 17% and 6.5% of total school funding.

These relatively small shares indicate relatively weak commitment toward vertical equity withing the formula. However, to properly assess the school funding system support of equity objectives, one would need to account for other specific grants outside of the main formula for which we do not have information, in particular the PP and the special need SEND students which are supported with the High Need NNF grants.

One has to notice however that the NFF does not cover the full array of funding targeted toward special student needs, and in particular two targeted programs provide specific support for Premium pupils (PP) and student with disabilities (SEND). With regard to assessing the equity effects of the English school funding formula, we observe that England perform relatively well with regard to performance in reading in international assessments as well as with regard to the various equity indicators (see Table 3). In particular, the variation of educational outcomes in reading explained by the socio-economic status (ESCS) of students is relatively low at 9.3%, about half the OECD average.

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CANADA (Ontario)

Canada is an OECD country with population of 37.6 million and GDP per capita of 46,200 US$ (2019). According to the Canadian Constitution, education is a provincial jurisdiction. Each of the ten provinces and three territories have their own education systems. Despite the provincial jurisdiction over education, various federal institutions and policies have affected schooling across Canada, in particular the Charter of Rights and Freedoms, child-care policies, language rights, immigration, and Indigenous people policies (Campbell 2020). All school-age children who are resident in Canada have access to free, publicly funded pre-primary, primary and secondary school education in either English and/or French language.

[98] Note that the second component part of the standard formula presented by Ross and Levacic (1999), curriculum enhancement, is not present in the NFF formula.

[99] Interestingly, despite the stated objective of greater equity of the national formula, the NFF presents very little variation with the previous LA specific formulae in place in England in 2006 for which Levacic (2008: 216) also identified a share of 75% for the basic component overall. This could be interpreted as an emphasis on only horizontal equity, through the eventual universal nature of formula among LAs, without changes with regard to vertical equity.

We focus on the case of Ontario, the most populous Canadian province accounting for 38.6% of the population of Canada, including a foreign-born population of 29% and 3% indigenous population. There are over 2 million students enrolled in Ontario's K-12 publicly funded education system.

The public education system in Ontario is under the overall responsibility of the provincial Ministry of Education (MoE) and administered by 72 school districts (school boards) which have responsibility of schools on their territory.[100] There is a total of almost 5,000 schools in four education systems (English public, English Catholic, French Catholic, French public).[101] Private schools are regulated by the MoE but not publicly funded.

The education system is funded through provincial taxation that is then distributed to school boards using funding formulae. The provincial Ministry of Education provides the majority of operating funding for primary and secondary education through a funding formula system known as the "Grants for Student Needs" (GSN).

The GSN is provided to Ontario's 72 district school boards which make decisions about individual school budgets.[102] With the recognition that conditions vary across the province and that the funding formula cannot take every situation into account, local school boards have flexibility in how they use funding, within an overall accountability framework. Given their key role in providing services at the local level, a school boards have a responsibility to ensure the effective use of resources and are accountable to the ministry, students, parents, and others with a stake in public education[103] (OMOE 2020).

In addition to GSN funding, school boards also receive funding from the ministry for special, often time-limited programs, and from other ministries for specific purposes related to their mandate.School boards may also raise funds on their own. Examples include renting out excess school space or charging fees for enhanced programming (Ontario Ministry of Education 2019: 2).

Learning Opportunities Grant: This grant provides funding to help students who are at greater risk of lower academic achievement. It comprises 6 allocations to support program to improve student achievement, including literacy and math outside of the school day (remedial courses or classes for students who are at risk of not meeting the requirements).

It includes a demographic allocation is based on social and economic indicators that signal a higher risk of academic difficulty for students. Boards can use this funding for initiatives such as breakfast programs, homework clubs, reading recovery and independent supports. It also includes a local priorities fund to address a range of local priorities and needs. This may include more special education staffing to support children in need, "at-risk" students and adult education.

This allocation also includes a student achievement envelope comprising six discrete allocations. These allocations directly support programs to improve student achievement. There is flexibility in how boards may use the individual allocations, as long as the total funding is spent on the programs within the envelope. There is also an allocations are for literacy and math outside the school day, which funds remedial courses or classes for students who are at risk of not meeting the curriculum standards for literacy or math and/or the requirements of the Grade 10 literacy test.

[100] There are also 10 school authorities which are very small school boards usually located in remote areas and for which funding allocations is authorized under different regulations (Ontario Ministry of Education 2020)

[101] Among the 72 public school boards in Ontario, 38 are public secular boards (31 English boards and 4 French boards, 38 are public separate boards (29 English Catholic boards, 8 French Catholic boards), and 10 public school authorities that operate in children's treatment centers (Ontario Ministry of Education, 2020)

[102] School principals receive their school budget from the school board and make various budgetary and management decisions, including about the distribution of teachers and class size within MoE criteria, how to allocate educational assistants, and other staff, etc. make decisions about school maintenance and repairs.

[103] There is for instance a provision that school board balance their budgets. There are also various requirements around budgeting and financial reporting, as well as grant-specific reporting requirements, monitoring, audit, review and, in some cases, supervisory activities by the province.

Safe and Accepting Schools Supplement: This grant is targeted to support secondary schools in priority urban neighborhoods. In includes two components: (i) non-teaching staff, such as social workers, child and youth workers, psychologists, and attendance counsellors who work to prevent and mitigate risks to the school environment and (ii) long-term suspended and expelled students, and prevention and intervention resources.

Continuing Education and Other Programs: This grant supports a range of programs aimed at adult learners and day school students, including secondary students who have completed more than 34 credits and wish to continue their studies.

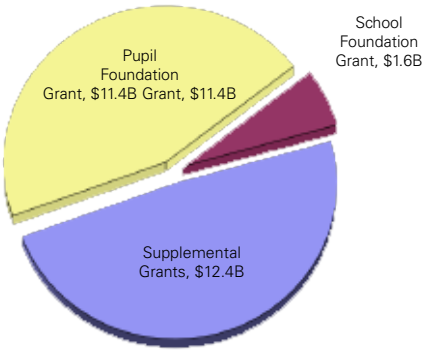
Cost Adjustment and Teacher Qualifications and Experience Grant: This grant provides additional support for classroom staff that have qualifications and experience above those provided for through the Pupil Foundation Grant.

Student Transportation Grant: This grant provides school boards with funding to transport students to and from school.

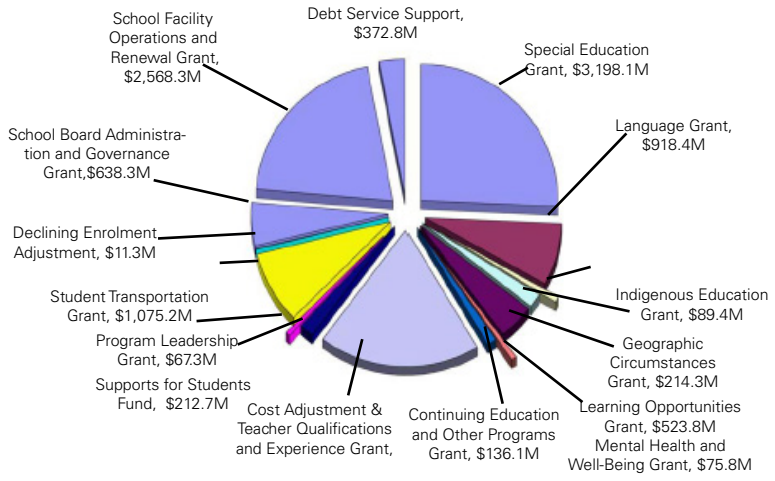
Declining Enrolment Adjustment: This grant recognizes the need for extra time for a board to adjust to declining enrolment, given that approximately two-thirds of a school board's revenue is determined by enrolment.

Figure 6 illustrates the different components and shares of the total GSN funding for 2020-21.

Figure 6: 2020–21 Grant Allocations (Projections) Total: $25.52B1 2F ,



Supplemental Grants



Source: Ontario Ministry of Education (2020)

School Board Administration and Governance Grant: This grant provides funding for board administration and governance costs, including those related to board-based staff and board offices and facilities.

School Facility Operations and Renewal Grant: This grant supports the costs of operating, maintaining and repairing school facilities. Under the formula, funding is adjusted for boards that have older schools with unique design features such as wide hallways, large shop spaces, and auditorium spaces.

Costs

Costing within the GSN is done using the activity-led method.[104] For each grade level, the perpupil foundation amount reflects teacher benchmark salaries and benefits, class size requirements based on Average daily enrolment (ADE) pupils (for instance 25.6 in kindergarten) and the need for preparation time. A separate allocation recognizes teachers' relative qualifications and experience. For other staff, such as educators and librarians, the per-pupil amount is based on salaries and benefits and staffing levels. The basic amount also includes benchmark costs of textbook and learning material, classroom supplies, computer and software, etc.

Adjustments are made annually to the GSN funding based on ministry's discussions and working groups that make technical recommendations on how to improve the GSN including from school board representatives, school principals, teachers' unions, parent and student groups (OMOE 2020, p. 3).

Table 4 provides an illustration for a kindergarten pupil of the detailed cost calculation for the basic foundation amount per pupil, including class size requirements and benchmarks which corresponds to 6,403 CAN $ in 2020-21.

Analysis

The Ontario education funding model is one of decentralized education management structure, based on district level school boards which possess roles in resource allocation and governance plans, and school governance.School boards have a key role in providing services at the local level, and have the responsibility to ensure the effective use of resources and the pursuit of effective and equitable education system and are accountable to the ministry, students, parents and other stakeholders.

The decentralized service provision model is based on a centralized provincial level funding system, with detailed grant systems encompassing a very comprehensive set of recurrent and capital expenditures of schools and school boards.

[104] Detailed information on the methodology used to determine the unit cost considered in the various grants is presented in Ontario MoE (2020) Education Funding, Technical Paper 2020-21.

Table 12: Example of detailed costing assumptions for the basic pupil foundation allocation: Kindergarten pupil, school year 2020-21

KINDERGARTEN (JK/SK) Pupil Foundation Pupil Foundation	**# staff per 1,000 Average Daily Enrolment (ADE)**		**benchmark salary + benefits (% of salary)**	**$ allocation per ADE**
Classroom Staffing	Classroom Teacher [1]	39.11	$78,519 + 10.10%	$3,381.04
Funded Average Class Size 25.57:2	Specialist Teacher and Preparation Time[3]	7.66		$662.20
	Early Childhood Educator (ECE)[2]	39.11	$32,327 + 25.69%	$1,589.02
Library Services	Teacher Librarian[3]	1.31	$78,519 + 10.10%	$113.08
Classroom Consultant		0.41	$108,087 + 9.86%	$48.69
Supply Teacher				$165.54
Supply ECE				$88.96
Educational Assistant		0.20	$45,845 + 25.69%	$11.52
Professional/Para-Professional Support		1.73	$62,164 + 20.68%	$129.78
Elementary Supervision				$26.88
Textbooks and Learning Materials				$69.00
Additional Educational Software Licensing				$0.49
Classroom Supplies				$82.82
Classroom Computers				$34.52
TOTAL Kindergarten (JK/SK) Per Pupil Amount				**$6,403.54**

Note: Pension plan contributions for teachers and other eligible members of the Ontario Teacher' Pension Plan (OTPP) are matched by the government and are not included in the benefits benchmarks.

Kindergarten Pupil Foundation Allocation = Kindergarten ADE × $6,403.54

souce: Ontario Ministry of Education (2020) Technical paper 2020-21, Spring 2020, p. 19

The fact that the education systems are funded through provincial taxation which is redistributed using a consistent set of funding formulae means that there are no large disparities in funding across schools in the province. Although some local schools may benefit more, for example, from parent and community fundraising activities (Campbell 2020). While the GSN is constituted of a series of grants with distinct formulae, its inclusive nature at the school board level is consistent with predictability and transparency of school funding.

Analyzing the relative importance of the various components in the GSN funding formulae, we can observe that the basic foundation allocations represent about half of the total grant allocation (see Figures). Supplemental grants represent about the other half of the GSN, which for a majority represent support for the specific needs of individual pupils and communities. This large share devoted to specific needs and structural factors outside of the control of individuals and communities, tend to indicate a strong commitment toward vertical equity withing the formula funding system in Ontario.

The Canadian education system appears comparatively efficient with lower secondary-level students showing high performance in PISA in a context where education spending per student as a proportion of GDP per capita is about OECD average (3.6% vs 3.5 % respectively in 2016).

To assess the equity effects of the Ontario school funding formula, we could examine the country's relative situation at the international level in terms of education outcomes. By international comparisons, the province of Ontario and Canada have excellent and equitable educational outcomes, where gender, socio-economic and immigrant status do not have the same level of negative consequences for reduced educational achievement or inequitable outcomes as is typical across OECD countries (Campbell 2020).

Canada is among the few countries having been identified as excellent and equitable in terms of educational outcomes with above average performance and lower than average impact of socioeconomic status (SECS) and immigrant status in PISA 2018 and previous assessment. Indeed, Canada has consistently achieved above performance results in PISA in various subjects and show less impact of socio-economic status (SECS) on educational outcomes, and present as well high achieving results for immigrant students (OECD 2019b). The variation of educational outcomes in reading explained by the socio-economic status (ESCS) of students is 6.7%, much below the OECD average of 18% (See Table 3). The percentage of between school variance in science performance in PISA 2015 explained by students' and schools' SECS was 7.3% in Canada compared with an OECD average of 62.9% (OECD 2015a, p. 202). In the same assessments, there was no difference in performance between non-immigrant, 2nd generation and 1st generation immigrant students; whereas across the OECD countries, immigrant students generally achieve lower performance results. However, there are concerns that First Nations students overall achieve below the Canadian average in national and international assessments (Campbell 2020).

[7]

CONCLUSION

Equity in school finance refers to equal opportunities for all of educational resources and quality school environment to achieve adequate levels of academic performance. For such purpose, the design of a school funding formula has to account not only for the horizontal component of equity -- to treat similar students and schools similarly-- but also for vertical equity, that is to account for differences of needs that are beyond students and schools' control and support them distinctively.

Indeed, closing school access and achievement gaps between children of different background and personal circumstances requires fair and progressive distribution of resources targeted to children with greater educational needs (Baker, 2018). "Unequal education opportunities are certain to result when funding does not consider such common variable as socio-economic background, physical and mental disabilities, language deficiencies and many other diverse characteristics of students" (Brimley et al 2020, p. 115). This requires determining exactly how unequal those students are with unequal needs or abilities, and how they should be treated over time.

In addition to these differing student characteristics, the cost of an educational program is also related with variables such as the size of the school, sparsity and other geographical or demographic characteristics, which require additional resources and services needed to provide all students regardless of their personal or other disabilities with reasonably equal educational programs.

The use of need-based funding formula, in particular weighted student formulae, have been seen as presenting various advantages compared to other mechanisms to allocate funding recognizing different needs across students and schools. Indeed, given that cost of education varies with these various student needs and school structural cost differences, the use of weighting adjustment factors adds some measures of fairness and potentially also transparency to finance formulas.

While there is no single best practice with regard to the design of school funding formula and more generally for the pursuit of equity in education resource allocation (OECD 2017), among the key principles generally emphasized include that a funding formula needs to adequately reflect the differences in student costs of providing quality education (Ross and Levacic, 1999; Levacic 2008, OECD 2017a).

However, identifying these various cost categories and cost differentials present major empirical difficulties that arise from the difficulty of comparing students, programs and schools. The framework needs to be based on empirically set targets of the cost and needs of providing equal educational opportunity.

One consistent finding across countries is the importance of early childhood education on a child development and on inequality, especially for disadvantaged children who benefit most from preschool education programs. Incentives and mechanisms to reduce access gaps to quality preschool education for children with greater learning needs, in order to equalize learning opportunities during early childhood, is a fundamental step for greater improvements in educational equity over the child education years.

The process of identifying school access and outcome gaps and setting targets begins with high quality data and estimation of education costs. In this view, evolving toward a more equitable funding system and sufficient level of financing, requires informed conceptual frameworks, guided by robust empirical analysis and evidence, based on detailed student and school levels data (Baker, 2018, p.110).

In this process of adequately reflecting the varied student costs and legitimate differences in unit costs which are beyond the control of schools of providing education, there is another principle of balancing simplicity and accuracy. Indeed, there is a trade-off between a simple formula which might fail to capture some of the needs with adequacy, and a sophisticated formula which might be difficult to implement and understand (OECD, 2017a, p.142).

Another key principle to consider in the pursuit of equity in education resource allocation is to align formulas with school system priorities, identify adequate evaluation criteria and collecting adequate set of data and indicators. This include ensuring that education financing should be defined with clear objectives and targets.

However, a frequent constraint with regard aligning formulas with school system priorities is the presence of multiple authorities and ministries within education systems. Often, programs and budgets which target demand and supply sides of the education system are managed by different line ministries which complexifies coordination and assessment of equity results. Particularly, funding targeted toward disadvantaged groups in education is often administered by different line ministries and recorded in more than one budget by functions, which affects adequate transparency, accountability, and evaluation.[105]

There are also advantages of wide coverage funding formulae to favor transparency and predictability. Targeted educational programs outside of the main formula may be used to allocate funding to priority areas or two address new priorities or promote innovations within the school system. However, targeted funding also increases transaction costs, including potentially greater reporting and administrative burden for schools. Therefore, there are arguments to reduce transaction costs by including adjustment for vertical equity within the major part of the funding allocation via formula, which can simplify the funding system overall (OECD, 2017a, p. 144). Furthermore, there is an argument for including personnel resource allocation within the main school funding formula. Given the importance of personnel resources in the school budget, its inclusion would provide greater accountability at the school level.

Ultimately the pursuit of vertical equity involves a value judgment of determining the level of program support and funding for what categories of students or schools (Baker, 2018). However, there is no consensus on the specific threshold in achievement gaps that should trigger a specific intervention or optimal levels at which these funding support should be. Indeed, no one has determined exactly "how unequally" those students with "unequal needs" should be treated, and how progressive the formula should be.

Various considerations are at play in the determination by policy-makers of the magnitude of these adjustments -- the level of assistance provided to help disadvantaged students fill the gap in access and outcomes and the determination of which inequities are prioritized in terms of intervention, as well as other structural factors such as school size and remoteness -- that will be factored-in the formula.

Given resource constraints, there are tradeoffs between funding toward general education programs versus special-needs programs -- basic per student and per school allocations versus specific student and school allocations. These allocation choices could potentially have an impact on overall academic achievement levels and on the distribution (equity) of these results among students (achievement gaps). However, high performing and equitable education systems in countries such as Canada, Estonia, Finland show that both equity and efficiency are achievable simultaneously and could even be self-reinforcing.

The design of an equitable educational system also requires identifying evaluation criteria and devising a rigorous evaluation system. This requires identifying and collecting indicators to benchmark the education system and track the patterns of resources generated by the formula and overall, as well as progress at the program, student and school level over time.

[105] Makarova (2016) gives the example of the data on demand-oriented programs targeting households with disadvantage students being generally recorded in social protection budgets, while scholarship and grants tend to be part of the education budget.

As an initial step, we provide in the Appendix a draft equity checklist of support currently provided in the education system and progress toward the pursuit of educational inclusion and fairness. The draft equity checklist could help benchmarking where schools and districts currently stand with regard to equity goals to help inform stakeholders needs for additional interventions and priorities.

Ultimately, detailed longitudinal data collection at the student, school and district levels and proper choice of indicators for funding allocation are pre-conditions for the design and maintenance of effective allocation mechanisms (OCDE 2017a, p. 135). Rigorously evaluating the school funding system involves detailed longitudinal data and rigorous studies testing the relationships between school finance interventions, educational quality and student outcomes. This process builds on the collection of a series of indicators for comparing school funding levels.

Comparisons of resources are contingent on differences in concentration of children with from low income backgrounds and other student special needs and in structural costs, such as economies of scale and population density. All else equal, an equitable funding formula should yield progressive distribution of recurrent spending per pupil, accounting for local revenues.

On important consideration when comparing resources is that all school revenue sources should be accounted for. Indeed, one key issue to be considered to assess equity in financing is that school funding may not be fully equitable across schools and students given the possibility that local government and school authorities could influence spending per student. Often the positive relationship between local governments revenues per capita (fiscal capacity) and expenditures for students is observed (especially if the per student funding formula itself does not include the weights (or insufficient weights) for low income per capita or indicators of social disadvantage (Makarova, 2018, OECD, 2017a).

Empirically evaluating the school funding system also involves testing the link between the occurrence of a school funding and changes in student outcomes from before to after reforms within the system. It is empirically difficult and requires a rigorous longitudinal study testing the relationships between school finance reforms and student outcomes.

Finally, the pursuit of educational equity also requires ensuring the periodical review of the formula and other educational programs to assess the need for adjustments, and collect and balance the views of the various stakeholders.

RECOMMENDATIONS

- Funding formulas should allocate school resources adjusted / weighted for specific student needs, such as special education status, poverty, language proficiency, etc., and further adjusted for school structural characteristics, such as size and various geographic cost differentials, so that high quality education is available for all to achieve adequate academic performance.

- Funding allocations should be made progressive so that high-needs and high poverty areas receive a greater share than low poverty areas, to address the opportunity and achievement gaps of low-income and high-needs children and families.

- Provide high-quality preschool for children with greater learning needs, such as from low-income families, children with disabilities and immigrants, to help close the gap at entry to kindergarten and into early education years.

- The inclusion of personnel within the school funding formulae is fundamental for an equitable and efficient funding policy given its overwhelming share in school resources.

- Develop policies and incentives to balance the availability and qualifications of teachers across schools in rural and urban areas and serving less-advantaged students.

- Ensure monitoring and evaluation of resources and learning progress, and contribution of programs and funding toward quality of learning and reduced disparities in access and results.

- Ensure that districts and schools report on the availability of resources and progress in achievement gap reduction across student categories and out-of-school children. Resources indicators include well-qualified teachers; books, materials, and equipment (such as science labs and computers); and adequate facilities. And progress toward the improvement in the quality of learning of the different student needs mix and different student categories, as well as out-of-school children.

- Ensure the periodical review of the formula and other educational funding programs to assess the need for adjustments and collect and balance the views of the various stakeholders.

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APPENDIX

Equity diagnostic checklist (draft)

This equity diagnostic checklist seeks to verify where schools and districts currently stand with regard to equity goals. It aims to benchmark the support currently provided in the system and measure progress in the pursuit of educational inclusion and fairness to inform stakeholders on needs for additional interventions and priorities. The following checklist is addressed to schools. [A similar checklist could be directly adapted to collect district-level information.]

Remind that equitable education goal requires equal access to quality education for all and equal opportunity in the education process to achieve relatively similar academic performance across categories of students.

A. Reducing access gaps: Progress in reducing out-of-school children and youth

Preschool and kindergarten

-Does the school provide preschool and/or kindergarten? [Yes, No] _____

-How many children age 3-5 have been attending preschool and/or kindergarten at this school in 2020? [Number] _____

-How many children age 3-5 in the area served by the school are currently not enrolled / out-ofschool? [Number] _____

Primary and secondary

-How many children age 6-17 in the area served by the school are currently out-of-school? [Number] _____ - (and Percentage of out-of-school children 6-17 years old in the area) [%] _____

(Potential details to add: Of which, Primary, Lower secondary, Secondary).

A. Reducing access gaps: Progress in reducing out-of-school children and youth

School population with special needs

- Number (and %) of poor students among the total school population.[106]
  [Number] _____ [%] _____
- Number of non-native language students in the school population (not speaking the main language of instruction at home) [Number] _____ Of which number of foreign students [Number] _____
- Number of special needs (i.e. disabilities, etc.) students among the total school population [Number] _____

Support received and provided

% of poor students within school receiving poor-student subsidy (i.e. coverage of the subsidy support) [%] ☐

-Is the school using the poor student subsidy (1) For all students or (2) Using specifically to allocated poor students? [1, 2] ☐

-Is the school providing supplementary academic assistance based on the following student needs:

- Poor students [Yes, No] ☐
- Describe the type of supplementary assistance provided _____
- Non-native language learner and foreign students [Yes, No] ☐
- Describe the type of supplementary assistance provided _____
- Student with lower test scores or at risk of dropping out of school [Yes, No] ☐
- Describe the type of supplementary assistance provided _____

C. School resources and characteristics

Incomplete grades and multi-grade teaching

- Are there multilevel (multi-grade, common) classes in your school? [Yes, No] ☐
- If yes, what are the grades grouped together? (ex. 1, 2; 1,2,3)

☐ ☐ ☐

Teaching resources

Kindergarten

- What is the number of educators employed in this school at the kindergarten level in 2020? [Number] ☐

Primary and secondary

- What is the total number of primary and secondary students enrolled in this school in 2020? [Number] ☐
- What is the number of primary and secondary teachers employed in this school (including the principal if he also teaches) in 2020? [Number] ☐

[106] Using the current poor family definition used by Ministry of Interior.

Box 3: Illustration: The use of the Cost Function (CF) approach to evaluate cost factors and weights in Vermont's School Funding Formula

We illustrate here the application of the CF approach for the case of the weighted-student school formula of the state of Vermont in the United States developed by Kolbe et al. (2019. We summarize here the steps involved in their analysis and main findings.

Kolbe et al. (2019) used a cost function approach part of their review of the Vermont education system. They use the approach to identify the main cost factors and the magnitude of the adjustment for each cost factor to address differences in educational costs in order to ensure equal opportunity across Vermont schools in the school funding formula.

Kolbe et al (2019)'s cost function approach included two sets of statistical analyses: (1) a risk analysis to inform decisions about which indicators of student needs and measures of economic disadvantages influencing equal opportunity achievement should be in the cost function modeling exercise , and (2) a cost function analysis to allow identifying two components, (2a) the cost factors for each of these main student and school needs, and (2b) the weights reflecting the magnitude of these costs adjustments to be included the per-student school formula.

1) Risk analysis: As a first step to formally integrate equity and adequacy into the funding formula, a statistical risk analysis was conducted to identify factors (e.g., poverty levels, non-native language, etc.) that pose a "risk" to students achieving reasonably common outcome standard. The rationale being that risk factors adversely affecting student outcomes should be addressed through additional resources allocated through the formula to mitigate negative effects in order to equalize educational costs and opportunities to learn for students.

This first step seeks at identifying the strongest student and school predictors of the student outcomes across schools and where additional resources might be required to ensure that all students attain an adequate level of common outcomes in an equity perspective.

The empirical estimation of the relationships between multiple measures of student needs/risk factors and student outcomes based on standardized results of student academic achievement is as follows: Outcomes = f (Risk factors),

where outcome is a measure of aggregated student outcomes at the school of district level (in district, d, (or school, s) in year, j); risk factors include measures of student needs and school contexts. Multiple indicators of student needs were used, including the percentages of (i) students who are economically disadvantaged, (ii) non-native langua6ge speakers, and (iii)

students with mild and severe disabilities (see table 4.2 in the appendix).[107] With regard to school context, they incorporated measures of grade range, school size (enrollment categories: <100, 101-250, >250) and population density in the district. Kolbe et al (2019) found that relevant measures of student needs that should be incorporated in the cost function modeling exercise included: the percentage of students who are economically disadvantaged, students with disabilities (mild and severe), and non-native language speakers, each showing a strong negative relationships with average levels of student achievement in a school.[108]

[107] Alternative measures for the share of students who are economically disadvantaged were used including share of students eligible for school nutrition programs.

[108] More precisely, the negative relationship between the share of students who are economically disadvantaged in a school and average levels of student achievement was found to be more pronounced at the middle and secondary levels than at the elementary level. Also, the negative relationship between the share of students who are economically disadvantaged in a school and average levels of student achievement is weaker in smaller schools than it is in larger schools (Kolbe et al 2019: 30). Furthermore, using models with interactions between student need variables and school context, they also found, that school size and grade range were significant in explaining academic outcomes.

2a) Cost function estimation

The statistical estimation seeks at evaluating the relationship between aggregate spending and outcomes given the student population and school setting characteristics. The rationale is to estimate the additional level of expenditures needed to ensure that at-risk students and schools with higher operating costs have sufficient resources for students to meet common academic standards of equity criteria.In other words, it seeks to measure how much more it costs to achieve a given outcome target in a school with, for instance, higher versus lower concentrations of student characteristics (poverty levels, disabilities); in smaller versus larger schools; and those in more and less populated areas.

The cost function model of Kolbe et al. (2019) estimates per pupil school-level spending as a function of student outcomes, cost factors, and controls for efficiency in producing outcomes, as follows:

$$\text{Spending}_{dsj} = f(\text{Outcomes}_{dsj}, \text{Students}_{dsj}, \text{Input Prices}_{dsj}, \text{Structure}_{dsj}, \text{Scale}_{dsj}, \text{Inefficiency}_{dsj})$$

where : spending is a measure of current per pupil operating expenses in school, s (or district, d) in year, j;

outcomes are the outcome measure(s) of interest, for instance standardized test results;
students is a matrix of student needs and demographic characteristics for school, s, (or district) in year j;

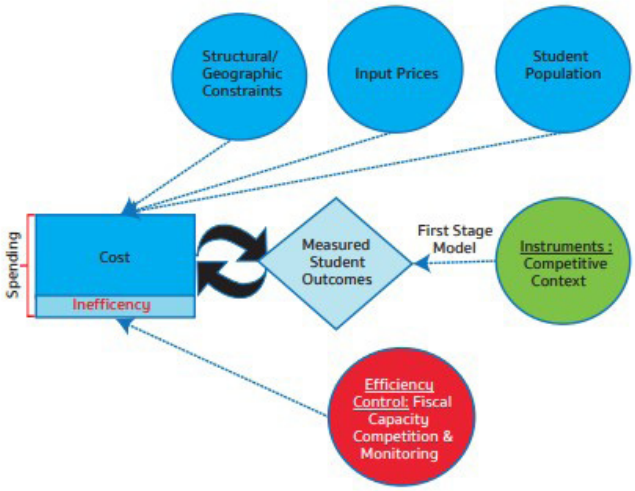
input prices is a measure of geographic variation in the prices of key inputs to schooling, such as teacher wages. All the variables in the models are standardized.

Kolbe et al (2019) use a two-step estimation approach to control for endogeneity issue arising from the circular relationship between spending and outcomes.[109] Furthermore, they attempt to control for inefficiencies in the spending. They do so by including measures that the research literature

identifies as predictors of differences in district spending not directly associated with outcomes (i.e.,inefficiencies)

[109] Student outcome measures is hence treated as "endogenous" and instrumented in a first stage equation using measures of the competitive context within which local public-school districts operate. Endogeneity issue arise with regard to student outcome measures given that the estimation seeks to assess cost for a certain level of student outcome. One needs to correct for the fact that spending is influenced by outcome levels, while, simultaneously, for inefficiencies in the spending, They do so by including measures that the research literature identifies as predictors of differences in district spending not directly associated with outcomes (i.e., inefficiencies),

Figure 7: Estimation of a Cost Function Model



Source: Kolbe et al. (2019)

Table 13 presents the estimated coefficients of the cost function model at the school-level. Kolbe et al (2019: 93) found that,for the case of Vermont, a $1,958 increase in per pupil spending is associated with one standard deviation higher student assessment scores (in math and reading). Also, achievingthe same outcome levels in a school where 100% of the children are categorized as poor is expected to cost $3,948 per pupil more than achieving the same outcome in a school with 0% children from. poor families. Furthermore, achieving the same outcome levels in a school with 100% of the childrenhaving learning disabilities, behavioral disorders, or other health impairments is expected to cost an. additional $12,128 per pupil.

outcomes also are affected by levels of spending (the circular/feedback loop relationship) (See Figure A.1). Given that there is no clear causal direction, with the two factors affecting each other simultaneously, the use of a two-stage model seeks to isolate the causal effect of outcomes on spending (i.e. distinct from the effect of spending on outcomes).Exogenous instruments (outside the loop) measures used are each district's competitive context.

[110] These include measures of local district competition density and measures of fiscal capacity and influencing local public monitoring of public expenditures (share of aid coming from nonlocal sources and the proportion of the local population that is school aged).

[110] Ultimately, the objective of the cost function is to identify the levels of spending associated with achieving specific outcome levels across varied student populations and circumstances, holding factors associated with inefficiency constant." Figure 7 illustrates the main cost function model, linking spending (costs and inefficiency) and outcomes and main cost categories.

Table 13. School-Level Cost-Function Model

	Total Spending	
	Total Spending	Standard Error
Average z-Score: All Grades & Subjects	1,958.663***	539.905
Labor Market: Northeastern VT	1,276.488***	477.596
Labor Market: Southeastern VT	1,500.557***	504.588
Labor Market: Southwestern VT	1,647.238***	567.835
FRPL Percentage (CCD PSU)	3,947.743***	1,507.794
% ELL	16,651.186***	3,680.005
% Disability School (Learning Disabled, Behavioral Disorders & Other Health Impairments)	12,127.550***	3,444.542
% Other SWD School	13,835.026***	4,613.161
MS Grade Enrollment % (AOE)	1,865.577***	439.117
HS Grade Enrollment % (AOE)	2,543.938***	502.622
<100 Students	1,059.000**	413.708
101 to 250 Students	323.048	294.888
Rural Local Codes	1,157.085**	556.860
Town Local Codes	1,402.154**	562.140
Log of Population per Square Mille	847.073**	364.277
Herfindahl Index: Enrollment	607.673	882.655
County Median Household Income	3,123.478**	1,476.646
Constant	24,555.283	15,513.832
Number of Observations	2,940	
First-Stage Partial F	15.61	
Hansen J (p-value)	0.0227	

Note. Year dummies included. Instruments used in first-stage equation: median household income of neighboring districts, median housing unit value of neighboring districts, and average test scores of neighboring districts. ***p < 0.01, **p < 0.05, *p < 0.1 Source: Kolbe et al. (2019) p. 96

2b) Weight Estimation Models

The second sub-step of the cost estimation analysis consists at estimating the magnitude of the cost adjustments to be used in the formula funding, that is the set of weight adjustments.

The weights are derived from the coefficient from a linear relationship between predicted per pupil cost for a school derived from the cost function model results and selected cost factors that most readily account for differences in student achievement across schools consistent with those included in the formula.

The estimation model between predicted per pupil costs and cost factors is as follows:
Predicted Cost Per Pupil = f (Poverty, language, disabilities, grade range, enrollment shares, enrollment size, population density)

Predicted Cost Per Pupil = f (Poverty, language, disabilities, grade range, enrollment shares, enrollment size, population density)

Where per-pupil cost predictions are from the Cost Function Model Estimation,
In the case of Vermont, cost factors incorporated in the weight estimation models included in particular:
Percentage of students who are economically disadvantaged
Percentage of students who are ELL

Percentage of students who are enrolled in the middle- and secondary-grades

- Indicators for geographically-necessary small schools
- Population density of the community in which a district is located

This estimation calculation produces a "weight" for each cost factor included in the estimation model. Weights are defined as the coefficients of the linear cost factors divided by the base cost, as follows: Weight = Cost Factor/Base Cost

Table 14. Vermont' School Model Weights

Table 14 presents the final weight estimated for the WSF in Vermont. The base cost or minimum per student allocation was 5,144$. For instance, a poverty coefficient of 2.97 means that students in poverty cost 297% more than students not in poverty.

	Weights Derived from Model with Disability
Poverty (centered on 0)	2.97
Middle School Students (centered on 1)	1.23
High School Students (centered on 1)	1.20
Additive Weights (All centered on 0)	
English Learners	1.58
% Disability (Learning Disabled, Behavioral Disorders & Other Health Impairments)% Disability (Learning Disabled, Behavioral Disorders & Other Health Impairments)	3.15
% Other SWD District	2.15
School Enrollment <100	0.26
School Enrollment 100 to <250	0.12
Sparsity Category 1 (<36 per square mile)	0.23
Sparsity Category 2 (36 to 54.9 per square mile)	0.17
Sparsity Category 3 (55 to 99.9 per square mile)	0.11

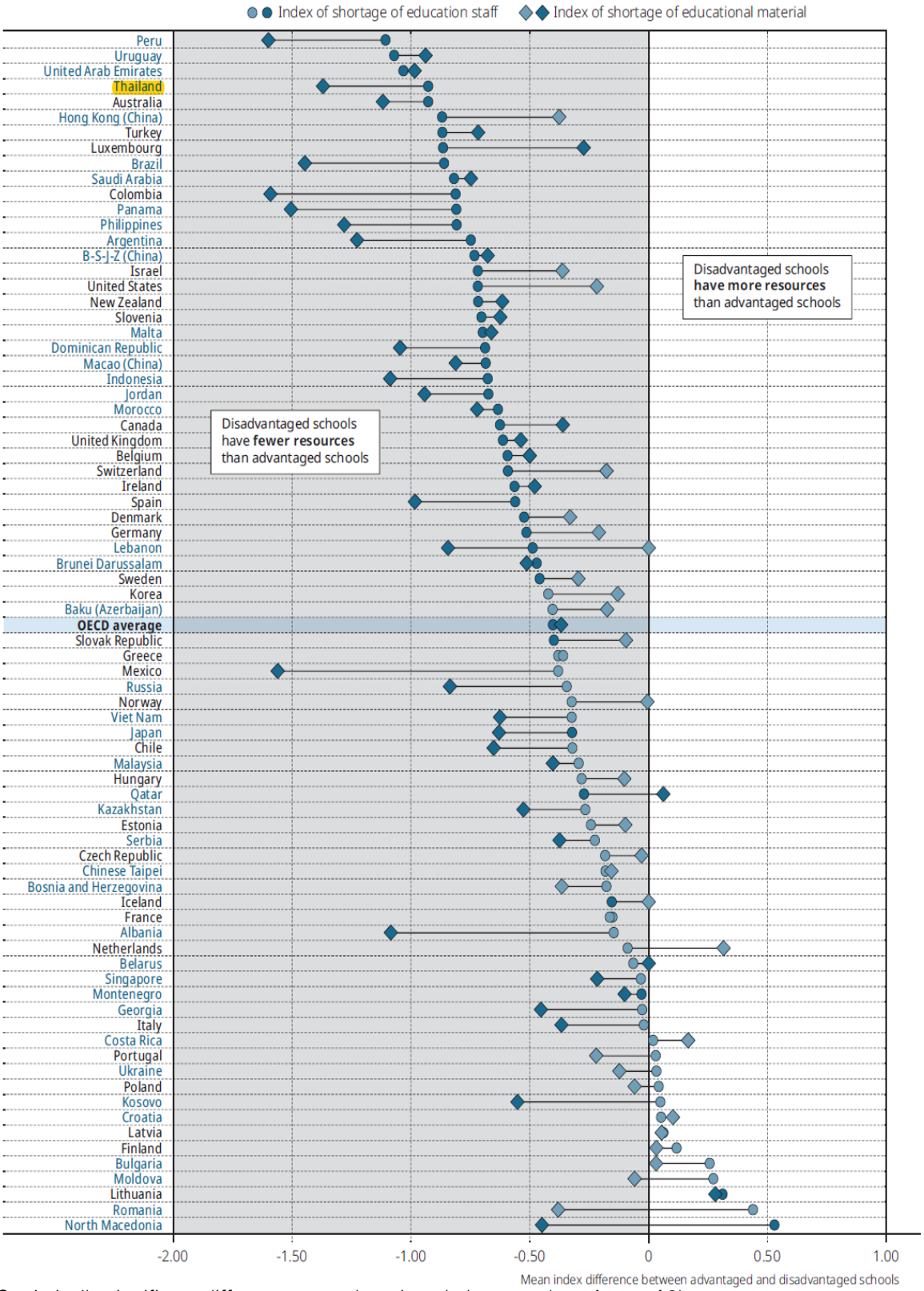
Source: Kolbe et al 2019 P. 103

To evaluate the consistency of their findings, Kolbe et al (2019) generated weights using various models based on different units of analysis (districts and schools) and data sources. They also realized a set of simulations to illustrate how the recommended weights might be incorporated in the education funding formula in Vermont.

Source: Kolbe et al (2019)

[110] Ultimately, the objective of the cost function is to identify the levels of spending associated with achieving specific outcome levels across varied student populations and circumstances, holding factors associated with inefficiency constant." Figure 7 illustrates the main cost function model, linking spending (costs and inefficiency) and outcomes and main cost categories.

Figure II 1.5.5 Difference in education and Saff, by schools' Socio-economic profile



Notes: Statistically significant differences are show in a darker tone (see Annex A3).
The socio-economic profile is measured by the schools average PISA index of economic, social and cultural status (ESCS).For this analysis, the sample is restricted to schools with the modal ISCED level for 15-year-old students (see Annex A3).Countries and economies are ranked in ascending order of the difference in the mean index of shortage of education staff.
Source : OECD, PISA 2018 Database, Tables II.B1.5.13 and II.B1.5.14.
StatLink https://doi.org//10.1787/888934037678
Source OECD 2019, vol II, p. 116

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