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Is School Funding Unequal in Latin America? A Cross-country Analysis

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ABSTRACT

Public spending on education has increased significantly in Latin America over the last several decades. Yet, the question remains as to whether greater spending translates into a more equitable distribution of resources. We address this issue by measuring inequality in per-pupil spending between regions of varying socioeconomic status (SES) within five different countries: Brazil, Chile, Colombia, Ecuador, and Peru. The results show that while Brazil's funding gap has narrowed over time, this federal nation has the widest socioeconomic spending divide, due to large inequalities in local revenues between high and low SES regions. School funding in Colombia has become more regressive over time, though its gap is half the size of Brazil's. Meanwhile, the distribution of school funding in Peru has changed, shifting from regressive (benefiting the richest regions) to progressive (benefiting the poorest regions). Education spending in Chile and in Ecuador have instead been consistently progressive. However, while the progressiveness of funding in Ecuador is driven by transfers targeting disadvantaged rural areas, the funding formulas in Chile address socioeconomic inequalities beyond the rural-urban gap.

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Introduction

Since the Coleman Report (1966), there has been a long-running debate over whether money matters in education. To better understand this issue, recent studies have exploited exogenous shocks in school funding to estimate the causal impact of additional resources on educational outcomes. Their results converge around the conclusion that changes in per-pupil spending do, in fact, affect student outcomes both in the short and long terms, and that the positive effects of increased spending are larger for disadvantaged students (Card and Payne, 2002; Jackson et al., 2015; Lafortune et al., 2018; Candelaria and Shores, 2019). Yet, lower-income students are more likely to attend schools that are underfunded and under-resourced.

This question is particularly pertinent in Latin America and the Caribbean (LAC) region, where public spending on education has increased significantly over the last several decades. Indeed, government expenditure on education as a percentage of GDP rose from 3% in the 1990s to over 5% in 2017, converging to the OECD average. In current dollars, spending on primary and secondary schools now surpasses US$2,000 per student, which, while still low compared to most OECD countries, in real terms represents roughly triple that which was spent per student in the 1990s. Little is known, however, about the extent to which this greater spending has equally benefited students of diverse socioeconomic backgrounds within LAC countries.

During this same period, different reforms have aimed to make the distribution of school funding more equitable. For instance, in 2008, the Preferential Subsidy Law (SEP law) in Chile increased the voucher for students at the bottom 40% of the socioeconomic distribution by 50% and provided a differential subsidy for schools with greater concentrations of disadvantaged pupils. Meanwhile, Brazil implemented Fundeb (Fund for the Maintenance and Development of Basic Education and Teacher Appreciation) in 2009, a policy that seeks to reduce regional tax imbalances by redistributing local revenues within states based on student enrollment. While studies have shown the positive effects of these reforms, their role in reducing regional inequalities has been little explored, particularly from a broad comparative perspective.

Using original school funding data from Brazil, Chile, Colombia, Ecuador, and Peru, we examine variation in public education spending within each of these countries in an effort to discern whether there are funding disparities between regions of differing socioeconomic status.

In doing so, we address three specific questions. First, is the distribution of school funds within these different countries unequal according to their regions' socioeconomic levels? Second, what patterns emerge over time in terms of school funding inequality? Third, how do the sources of funding and the countries' allocation rules mitigate or aggravate these inequalities? To estimate the socioeconomic gap in school funding within each of these countries, we employ regression models that estimate the relationship between a region's poverty rate and funding level, controlling for different determinants of educational costs (Baker, Sciarra and Farrie, 2014).

We find that despite a narrowing of Brazil's funding gap over time, this federal country has the widest spending divide, due to large inequalities in local revenues between high and low SES regions. In Colombia, school funding has become more regressive, though its gap remains half the size of Brazil's. Meanwhile, the distribution of school funding in Peru has changed, shifting from regressive (benefiting the richest regions) to progressive (benefiting the poorest regions). Education spending in Chile and in Ecuador has remained consistently progressive. However, while the progressiveness of funding in Ecuador is driven by transfers targeting disadvantaged rural areas, the funding formulas in Chile address socioeconomic inequalities beyond the rural-urban gap.

Economic crises in many countries in Latin America—which have worsened with the COVID-19 pandemic—are prompting governments to reconsider spending priorities and reduce education budgets. This is particularly concerning given that resource levels in disadvantaged regions and schools tend to be more severely affected by economic recessions (Baker, 2014; Evans, Schwab, Wagner, 2014; Jackson, Wigger, Xiong, 2018). Our comparative analysis provides timely evidence about the socioeconomic funding gap in Latin America, which in turn can inform the design of more equitable school finance policies in this region.

Money matters for education equity

Early work on school finance largely consists of correlational studies on the association between school spending and student outcomes. In his influential synthesis of this literature, Hanushek (1986) concludes that "There appears to be no strong or systematic relationship between school expenditures and student performance" (p. 1162). This claim has held for many years and

has been embraced by policymakers and lay audiences alike. Perhaps most notably, Bill Gates argued in a *Washington Post* op-ed that money does not matter, given that student achievement in America has remained virtually flat despite the fact that per-pupil spending has more than doubled.[1] Yet, both Hanushek's meta-analysis and Gates's long-term trend argument are characterized by serious methodological limitations. Moreover, neither provide sufficient evidence on the *causal* link between school spending and student outcomes (Hedges et al., 1994).

Recently, a growing body of literature using more credible research designs shows that changes in per-pupil spending *do* affect student outcomes both in the short and long terms, and that the positive effects of increased spending are larger for disadvantaged students. In the United States, some of these studies exploit exogenous variation in spending resulting from court-ordered school finance reforms. They consistently show that shifts in per-pupil spending caused by the implementation of these reforms have had an impact on student achievement and attainment outcomes. Card and Payne (2002) investigate equity-based school finance reforms in the 1970s and 1980s and find that an equalization of spending levels across poorer and richer districts led to a reduction in the SAT achievement gap between students of diverse socioeconomic backgrounds. Other work similarly demonstrates that post-1990 school finance reforms increased the progressivity of school spending and improved students' test scores and high school graduation rates in low-income school districts (Lafortune et al., 2016; Candelaria and Shores, 2019).

A few studies have also assessed the long-term effects of these court-ordered school finance reforms. For example, Jackson et al. (2015) examine changes in funding driven by school finance reforms of the 1970s and 1980s and find that a rise in per-pupil spending of 10% each year for all 12 public school years increased the educational attainment of all children by 0.27 years, augmented wages by 7.25% percent, and led to a reduction in the annual incidence of adult poverty by nearly 4%. The effects were larger among low-income students: a 10 percent increase in spending led to 0.43 more completed years of education, 9.5 percent higher wages, and a 6.8 percentage-point reduction in the annual incidence of adult poverty. In another study of the long-run impacts of school finance reforms in the U.S., Biasi (2018) finds that a reduction in the school funding gap between high- and low-income districts increased intergenerational mobility for low-income students. The author suggests that this result is likely explained by a reduced

[1] Bill Gates, "How teacher development could revolutionize our schools," *Washington Post*, February 27, 2011.

socioeconomic gap in school inputs and intermediate educational outcomes (such as high school completion).

In the United Kingdom, Machin et al. (2007) found that additional school funding has an impact on educational outcomes. Specifically, they evaluate the causal effect of the Excellence in Cities (EiC) program, which provides extra resources to schools in disadvantaged areas in England with the objective of improving their educational standards. The EiC policy had a positive impact on student attainment in Mathematics (but not in English) and on school attendance. Similar to the U.S. findings, these authors also find that additional resources were more beneficial in disadvantaged contexts.

Vegas and Coffin (2015) explore the correlational relationship between expenditure and student outcomes from a cross-country perspective. They observe that increased funding is correlated with higher test scores on the PISA test[2] among low-spending systems up to a threshold of US$8,000 per student annually (in purchasing power parity). After this expenditure cutoff point, the association between the two becomes less apparent and non-significant.

Fewer studies have been conducted on this issue in Latin America. Gordon and Vegas (2004), for example, investigate the effects of the Fund for the Maintenance and Development of Primary Education and Teacher Appreciation (known as Fundef, and then later, Fundeb) in Brazil. This policy aimed to reduce regional tax imbalances by redistributing local revenues within states based on student enrollment. The authors show that increases in spending induced by Fundef raised middle school enrollment in poorer states. The effects are, however, modest. In Chile, Murname et al. (2017) find that income-based gaps in student test scores declined by one-third in the five years following the passage of the Preferential School Subsidy Law (SEP law). This policy increased the voucher for low-income students by 50%, thus providing a differential subsidy for disadvantaged schools. In addition to the effect of increased resources, changes in school incentives may also have contributed to the narrowing of the gap. Specifically, evidence suggests

[2] PISA or Programme for International Student Assessment is a worldwide study conducted by the Organisation for Economic Co-operation and Development in member and non-member states and aims to evaluate educational systems by measuring 15-year-old students' scholastic performance in mathematics, science, and reading. The PISA study is conducted every three years, with its first version implemented in 2000.

that higher competition among schools in poorer neighborhoods improves the academic achievement of disadvantaged students (Nielson, 2013).

Although recent research has found that the positive effects of increased spending are greater for disadvantaged students and that progressivity of school spending can effectively reduce achievement gaps, lower income schools and regions are generally underfunded and under-resourced. In the U.S., much research has been conducted to report and explain inequalities—or the lack thereof—in the distribution of per-pupil spending across low- and high-income school districts (Baker & Corcoran, 2012; Baker et al., 2014). Similarly, our goal is to provide a cross-country comparison of the distribution of school funding within Latin American countries.

School funding systems in Latin America

In Latin America, a significant portion of intra-government funding for education is transferred in a discretionary fashion (Bertoni et al., 2018). This is the case for two of the countries analyzed in this paper, Ecuador and Peru, where the revenues transferred from the central government to local authorities are determined by administrative discretion, depending on the amount of funding each school needs and/or based on historical expenditures. In Brazil, Chile, and Colombia, most government transfers to the regions are instead determined by funding formulas. Below, we provide a summary of the funding system in each of these five countries.

Before doing so, two important caveats should be noted. First, this study focuses on the socioeconomic distribution of public spending on education. It is possible, therefore, that in a given country the latter is progressive and yet, if higher-income students are sorted into fee-paying private schools, the overall distribution of per-pupil expenditure is unequal. Second, our paper focuses on government transfers to regions, not schools. Therefore, while school funding might be distributed under certain rules across regions within each country, the way resources are then distributed among the schools within these regions may vary. Regions are defined as the administrative entities responsible for executing the education funds at the sub-national or local level.

Brazil

In Brazil, public schools represent 83% of total enrollment in primary and secondary education. Our units of analysis are municipalities and states. Municipalities are mostly responsible for pre-primary, primary, and lower secondary education, whereas states manage lower and upper secondary education. Both are required by law to spend at least 25 percent of their tax revenues on education (known as "constitutional minimum" spending). However, part of the local government tax revenue is redistributed based on student enrollment through the Fund for the Maintenance and Development of Basic Education and Teacher Appreciation (Fundeb).[3] Fundeb is state-specific, meaning that revenues are raised and redistributed across local school systems within each state. The Fundeb per-pupil revenue in a rich state like Sao Paulo is consequently higher than the Fundeb per-pupil revenue in a poorer state like Alagoas (Cruz et al., 2019). Moreover, in the Fundeb funding formula, students are weighted differently based on education level (pre-primary, primary, secondary) and school type (full- vs. part-time, rural vs. urban, special needs education, vocational education, and adult education). If the Fundeb per-pupil revenue in a state does not meet a minimum amount determined nationally, the federal government transfers additional resources to the state's Fundeb fund—these additional resources are known as *Complementação* (Supplement).

States and municipalities also receive transfers from the federal government for discretionary initiatives. For example, *Brazil Carinhoso* (Affectionate Brazil) is a program that transfers resources to local governments for investments in early childhood education. Meanwhile, the *Programa Nacional de Alimentação Escolar* (National School Meal Program-PNAE) and the

[3] According to the constitutional minimum, at least 25% of the revenues of the following local taxes must be used to finance education: IPTU, Urban Real Estate Tax (Imposto Predial e Territorial Urbano); ISS, Municipal Service Tax (Imposto sobre Serviços); ITBI, Real Estate Transmission Tax (Imposto sobre Transmissão Intervivos); IRRF, Withholding Tax (Imposto de Renda Retido na Fonte); IOF, Financial Operations Tax (Imposto sobre Operações Financeiras); ITR, Rural Real Estate Tax (Imposto Territorial Rural); ITCMD, Tax On Inheritance and Gifts (Imposto sobre Transmissão Causa Mortis e Doação); ICMS, Tax on the Circulation of Goods and the Provision of Communication and Transportation Services (Imposto sobre Circulação de Mercadorias e Prestação de Serviços de Comunicação e de Transporte); IPVA, Vehicle Tax (Imposto sobre Propriedade de Veículos Automotores); FPE, State Revenue - Sharing Fund (Fundo de Participação dos Estados); FPM, Municipal Revenue - Sharing Fund (Fundo de Participação dos Municípios); IPI, Manufactured Goods Tax (Imposto sobre Produtos Industrializados); ITR, Rural Real Estate Tax (Imposto Terri torial Rural); Supplemental Law No. 87/1996, known as the Kandir Law. However, 20% of the ITCMD, ICMS, IPVA, FPE, FPM, IPI, ITR, and Kandir Law of a state and its municipalities are redistributed across the school systems within that state through the Fundeb reform—considering that 25% of these taxes must fund education, the remaining 5% stay with the local government and do not enter the Fundeb redistribution.

Programa Nacional de Apoio ao Transporte do Escolar (National Program to Support School Transportation-PNATE) provide more specific sorts of funds for schools. Most of these federal transfers are financed by the *Salário-Educação* (Education Salary), which corresponds to a 2.5 percent tax on the payroll of all formal employers in Brazil. Specifically, 40% of the *Salário-Educação* resources goes to the federal government to finance the aforementioned programs while the remaining 60% is distributed to states and municipalities in proportion to their share of student enrollment.

Lastly, in 2013, Brazil's Congress passed a bill that designates part of the royalties gained from newly discovered oil fields to education. Because most revenues from oil and natural gas production come from old concession contracts, the amount accrued that is then assigned to education remains low (an estimated 9 billion in 2020, which represents, on average, about 2 percent of the total expenditure in education).

Chile

Since 1980, Chile has financed two types of institutions with public funds through a voucher system: public schools, which are run by municipalities or by Local Educational Services (SLE), and private subsidized schools managed by private administrators that receive public subsidies. Public schools and private subsidized schools serve approximately 93% of k-12 students in Chile. The voucher system is based on a per capita funding formula at the school level that provides a universal subsidy to public and private subsidized schools based on their student enrollment and attendance. This formula takes into account the specific characteristics of each school and the population it serves, including institutional level, modality, geographic location, rurality, and special learning needs. The SEP law, which was enacted in 2008, introduced two progressive components to the per capita funding formula: the voucher was increased by approximately 50% for students at the bottom 40% of the socioeconomic distribution[4] [5] and schools with a larger concentration of students from disadvantaged backgrounds received an additional subsidy. While

[4] See Mizala & Torche, 2013 for more details.

[5] In order to qualify to receive the additional SEP funding, students must meet the following criteria: a) be enrolled in the *Chile Solidario* Social Protection System, the Ethical Family Income Program, or the Safety and Opportunity Subsystem; b) be within the most vulnerable one-third of the population, according to the Households Social Registry record; c) belong to Segment A of the National Health Fund (FONASA); d) be considered vulnerable by the Social Protection Ministry based on household income, education level of mother, father or guardian, and the community's poverty level.

joining SEP is voluntary, by 2015 virtually all public schools and 78% of the subsidized private institutions participated in the program, allowing them to receive additional resources for educating their more vulnerable populations.[6]

In addition to the vouchers, municipalities and private subsided schools may also receive transfers from the central government for specific programs (such as small rural schools) or for teacher bonuses. That said, most of the central government transfers are included in the voucher system. Municipalities can, in addition, raise revenues for public schools through their local taxes, and public and private subsidized schools can charge families an additional fee of up to $100 a month in the form of copayments.[7] We examine socioeconomic inequalities in all three of these sources of funding: (i) voucher and non-voucher transfers from the central government to municipalities and private subsidized schools, (ii) local resources reported by municipalities, and (iii) school fees.[8]

Colombia

In Colombia, under the *Sistema General de Participaciones* (General System of Participation, SGP), the main revenues for pre-primary, primary, and secondary public institutions are transferred from the central government to Certified Local Authorities, CLAs (*Entidades Territoriales Certificadas*). Specifically, the SGP consists of three different transfers: i) *Provision del Servicio* (Provision of Service), which mainly covers staff salaries (teachers, management, and support personnel); ii) *Calidad-Matricula* (Quality Enrollment), which goes to local governments (*municipios*) to cover different types of costs such as infrastructure, services, and teacher training; and iii) *Calidad-Gratuidad* (Quality-Free of Charge), which are resources delivered directly to

[6] For vulnerable students to receive SEP funds, they must attend a SEP school. See Elacqua et al. (2019) for a detailed description of the Chilean voucher formula.

[7] Traditionally, just subsidized private institutions charge fees since public institutions can only apply them at the secondary level and with prior consent of the parents. In mid-2015, legislation established that state funding would replace school fees. For 2016, the first year of implementation, copayments were frozen at the 2015 level and schools charging less than the annual increase in public spending per student were not allowed to continue charging fees. In 2015, there were 2,155 private subsidized schools that charged fees. Over the next three years, that number decreased to 1,410; 1,283; and 1,037, respectively.

[8] Due to data availability constraints, we excluded in kind transfers that schools receive directly from the central government such as books, school meals, and funding for new infrastructure. We also excluded direct government transfers (or benefits) to families such as legally reduced fees for public transportation and scholarships for indigenous students in grades 1 to 12. Excluded as well are some private contributions such as donations and family investments such tutoring and private transportation. Finally, we do not consider public funding (or enrollment) for preschool institutions managed by JUNJI or INTEGRA.

schools and school networks to invest in all spending categories, except personnel. The distribution of the SGP for 2016 was 93% for the first component and 7% for the two other quality components (Enrollment and Free of Charge) (Pineros, 2016).

The SGP formula takes into consideration some regional characteristics, including the proportion of rural schools and the distribution of students across different institutional levels and types (e.g., special needs students and adult education). The SGP Quality-Free of Charge has a progressive component that transfers more resources to CLAs the serve a greater number of disadvantaged students. While, in our data, we cannot discriminate this progressive portion of SGP, it represents but a small share of the overall SGP (about 6 percent) and is conditional upon the CLAs' academic performance. That is, this component of SGP benefits higher performing low-SES CLAs. This progressive transfer is thus granted to only a small number of regions.

The allocation rules for salary spending from CLAs to schools are defined by the Ministry of Education (MEN) using a formula that is based on the schools' staffing needs and the teacher salary scale. Staffing needs are determined by the central and local governments and teacher salaries are set based on a national pay scale. CLAs can add their own resources to hire support personnel, but teachers and administrative personnel can only be funded with SGP resources.

Other sources of funding include revenues from royalties *(regalías)* that come from the extraction of natural resources such as oil and gas. This budget is not earmarked for education, although its resources can be used to fund projects in the following areas: i) physical infrastructure to improve the quality of education, ii) school meals, iii) school transportation, and iv) projects related to information and communications technology (ICT) and connectivity. In our analysis, we also include other central revenues (*Otros recursos centrales*) from central government education programs, for example, the school meals program.

Finally, CLAs can spend revenue from their own resources on education, including from: i) direct taxes (e.g., alcoholic beverages), ii) indirect taxes, and iii) non-tax revenue (contributions, fines, services revenue). While local authorities have autonomy to allocate these resources, they cannot be used to fund staff salaries.

Ecuador

Schools in Ecuador can be divided into four categories according to their sources of funding: public schools (*fiscales*), which account for 76% of enrollment, publicly funded private schools (*fiscomisionales*), which make up 6% of enrollment, municipal schools (1%), and private schools (17%). We focus here on the public schools, which are fully funded by transfers from the central government. In Ecuador, these schools are financed through discretionary transfers, mainly based on historical criteria, from the central level to the district-level offices of the Ministry of Education. The districts are then in charge of operating the schools, including the managing and financing of school personnel and the provision of educational resources. Additionally, there is an intermediate level between the central government and the districts called "zones" that are responsible for coordinating the school districts and providing them with technical support. In our analysis, we look specifically at inequalities in school funding between districts.

Peru

In Peru, schools can be classified into three groups according to their funding scheme: public schools, privately-run public schools, and private schools. We focus on public schools, which make up 64% of the schools in the country. Public education is mainly funded by transfers from the central government to regional educational executing units (*Unidades Ejecutoras, UGELs*), responsible for managing schools and executing the education budget within their jurisdictions.

The main central government transfer to education comes from taxes collected by the national government and converted into the public budget as *Recursos Ordinarios* (Ordinary Resources). In 2018, these resources represented 86% of public spending on education. The second most important source consists of *Recursos Determinados* (Determined Resources) derived from natural resource revenues, which represented around 6% of total public spending on education. A similar amount of funding (4%) comes from the *Recursos Directamente Recaudados* (Directly Raised Resources), which each level of government obtains by charging fees for the services they provide. Finally, national debt is also issued to finance some public investment projects in education (3%). The resources from all of these different sources of funding are transferred from the central government to Executing Units in a discretionary manner, mainly based on historical budget criteria. Local governments can also raise some revenue for education; however, this accounts for less than 0.1% of public spending on education and is not included in this study.

In 2013, the Peruvian government implemented a differential compensation scheme, allowing teaching and non-teaching staff to increase their salaries up to 33 percent when they work in remote and vulnerable schools (see Bertoni et al., 2019 for more details about the policy). Although the overall distribution of funds across regions within Peru is not determined by formulas, the monetary incentives are an important mechanism for promoting a more progressive allocation of resources. This is especially so considering that non-teaching and teaching staff salaries account for about 80 percent of the country's education budget.

Table 1 summarizes the unit of analysis in each country as well as provides a description of the sources of funding. This information is particularly relevant to our third research question, which explores the extent to which the different allocation rules contribute to school funding inequalities.

Table 1. Regions and sources of funding

Countries	Regions		Sources of funding			
	Definition	# in 2015	Local revenues	School fees	General transfers	Progressive transfers
Brazil	Municipalities and States	5,487	Yes	No	- Fundeb - Federal government transfers - *Salário-Educação* - Royalties	- Fundeb Complement
Chile	Municipalities	335	Yes	Yes	- Non-targeted transfers from the central government (including general student voucher)	- Targeted transfers from the central government (mainly weighted voucher from Ley SEP)
Colombia	Territorial Entities	94	Yes	No	- SGP Provision of Service - SGP Quality Enrollment - SGP Quality-Free of Charge - Royalties - Other central resources	

Ecuador	Districts	140	No	No	- Discretionary central transfers
Peru	Executing units	175	No	No	- Ordinary Resources - Determined Resources - Directly Raised Resources - National Debt

General transfers include those revenues that are transferred from the central and/or sub-national governments to local administrative units. They do not have equalization or compensatory components that specifically target low SES regions and/or schools. We instead classify transfers as progressive when they do include components that aim to increase per-pupil spending in more disadvantaged regions and schools.

Method

Different approaches can be used to measure the level of school funding inequality between regions of varying socioeconomic status (Knight and Mendoza, 2019). In this study, we use a regression-based method to estimate the variation in per-pupil spending by the socioeconomic level of the regions in each country. This allows us to examine how school funding inequality differs when we control for factors that influence educational costs (Baker, Sciarra and Farrie, 2014). Our main model is described in Equation 1.

Equation (1)

$$PPP_{rt} = \beta_0 + \beta_1 SES_r + \beta_2 Year_t + e_{rt}$$

Where PPP_{rt} refers to per-pupil spending of region *r* in year *t*. SES_r represents quintiles of the regions' socioeconomic status, in which quintile 1 includes the lowest SES regions of the country and quintile 5 refers to the highest SES regions. We add year fixed effects ($Year_t$) to capture year-specific trends in school funding. Unlike Baker et al. (2014), we do not use the natural logarithm of region spending, as transforming the distribution of resources may mask important inequalities in school funding—for example, when a few regions have much higher education spending. To answer our first and second questions, which explore the average and trends in the socioeconomic funding gap, we use regions' total per-pupil spending. For our third question, which examines the funding gap by sources of funding, we estimate Equation 1 using as outcome

the regions' per-pupil spending from "local revenues," "general transfers," and "progressive transfers."

We also assess the extent to which the estimated per-pupil spending by socioeconomic levels changes after controlling for determinants of education costs. As described in greater detail below, our controls are a linear ($Total\_enrollment_{rt}$) and a quadratic ($Total\_enrollment_{rt}^2$) term of total enrollment, the log of population density ($lnDensity_r$), and the Comparable Wage Index of region *r* (CWI_r), as described in Equation 2:

Equation (2)

$$PPP_{rt} = \beta_0 + \beta_1 SES_r + \beta_2 Total\_enrollment_{rt} + \beta_3 Total\_enrollment_{rt}^2 + \beta_4 lnDensity_r + \beta_5 CWI_r + \beta_6 Year_t + e_{rt}$$

The argument for controlling for these factors is to make a fairer comparison between regions with different costs and needs. A couple of caveats should, however, be noted. First, for countries that have a fewer number of regions (e.g., Ecuador), adding controls to the model that are highly correlated amongst themselves leads to more imprecise estimates of the socioeconomic funding gap. Second, these controls are also correlated with the regions' socioeconomic level: larger regions with higher population density and a higher comparable wage index tend to have a higher SES. Disentangling these two constructs (costs and socioeconomic level) is difficult and, in some cases, conceptually incoherent if spending progressiveness originates from transfers that target low SES regions with lower costs (e.g., rural areas).

After estimating Equations 1 and 2, we predict the expected per-pupil spending for a region at the first and fifth quintiles of SES, holding constant the control variables and setting the year to 2015. We then calculate our inequality index by dividing the predicted per-pupil spending of quintile 5 by that of quintile 1, as shown in equation 3.

Equation (3)

$$Inequality\ Index_t = \frac{\widehat{PPP\_QSES5}}{\widehat{PPP\_QSES1}}$$

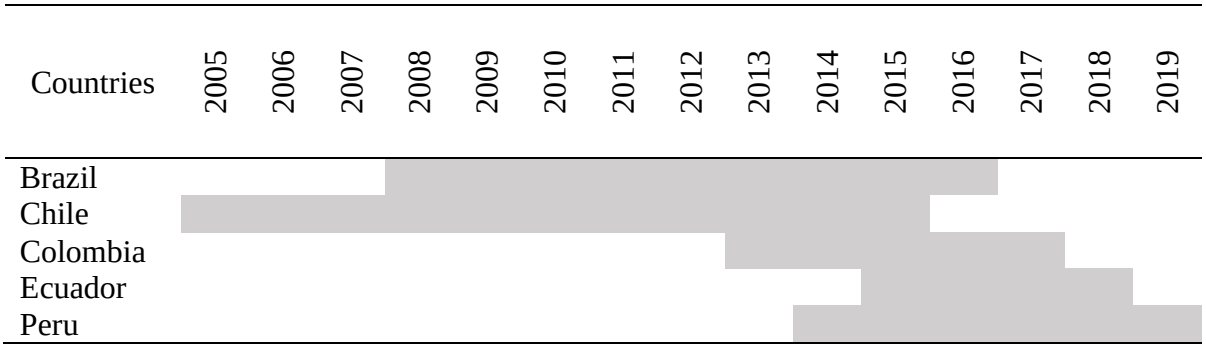
A separate model is estimated for each country. For questions 1 and 3, we measure the average school funding gap pooling data from 2014-2016, as these are the years for which data is

available for most countries (see Table 2). For question 2, which focuses on the trends in school funding inequality, we estimate one model for each year under study.

Data

To measure the school funding gap between regions, we use administrative data on government revenues and spending on education by sources of funding. Table 2 shows the years for which data is available in each of the five countries. These longitudinal data allow us to examine time trends in school funding inequality.

Table 2. Data availability by year and country



Per-pupil spending data

Our dependent variable, per-pupil spending, is calculated by dividing the regions' education spending by its total student enrollment. Our analysis uses expenditure per student corrected for inflation and converted into 2015 US dollars by purchasing power parity.[9] Data on school funding include all categories of k-12 education spending. There are some exceptions, however. Due to data constraints, the Chilean case does not include some resources transferred in-kind by the central government directly to institutions, including school meals, textbooks, and school supplies for students (see footnote 8 for more details). In Peru, spending from own resources represents a very small proportion of the overall public education spending (less than 0.1%). For this reason and given that data on expenditures from own resources are a less reliable source of information for Peru, our analysis excludes data on local revenues for this country. Additionally, we exclude

[9] To convert data into PPP per pupil spending, we use the Consumer price index and PPP conversion factor from the World Bank's International Comparison Program database.

resources that are directly transferred to schools, spending on education from executing units of the central headquarters of the Regional Governments (around 3% in 2018), and spending on the National Program on Infrastructure (PRONIED, around 4% in 2018).

Brazil's school funding data come from its Education Budget Information System (SIOPE-*Sistema de Informações sobre Orçamentos Públicos em Educação*), where municipalities and states annually report detailed information on their education budgets by sources of funding. Longitudinal data on student enrollment comes from Brazil's Census of Basic Education.

In Chile, data on transfers from the central government come from official information reported by the Ministry of Education (*Subvenciones a establecimientos educacionales*). Meanwhile, data on municipalities' own resources and reported executed budget is available from the National System of Municipal Information (SINIM). Data on school fees paid by families is reported directly by schools to the Ministry of education (*Reliquidación FICOM*). All private subsidized schools that require families to pay fees must report their total annual revenue from such fees to the government. Student enrollment numbers were gathered from official sources of the Ministry of Education (*Matrícula por Establecimiento*).

In Colombia, expenditure data at the CLA level come from information collected by the Ministry of Finance and Public Credit (*Formato Único Territorial or FUT*). In this database, all subnational governments (municipalities and departments) provide information regarding: (i) sources of revenue (ii) intergovernmental transfers, and (iii) expenditure categories. This is the main tool used by the Ministry to monitor CLA spending on education. Data on student enrollment comes from the government's statistics department—*Departamento Administrativo Nacional de Estadística* (DANE).

In Ecuador, school funding data were retrieved from the Integrated Financial Management System (eSIGEF), used by different government agencies to report their executed budget. Specifically, we use data at the pre-primary, primary, and secondary levels on expenditure for school staff, educational resources, short-term and long-term investments, and infrastructure. Student enrollment information comes from administrative records of the Ministry of Education (*Registros administrativos*).

In Peru, we use expenditure data provided by the Ministry of Economics and Finance through the Integrated Financial Administration System (SIAF), which contains the executed budgets on education of all the executing units of the country. These data include expenditures on a) teaching and administrative staff salaries; b) educational material and equipment; c) educational infrastructure maintenance; d) continuous teaching support; c) teacher training; e) internet; f) basic services; and g) security and cleaning services. Enrollment data come from the National Educational Census (*Censo Educativo*), collected by the Office of Statistics of the Ministry of Education.

Socioeconomic data

For our socioeconomic measure, we divide each country's regions in quintiles based on their poverty rates. Brazil's poverty data come from the country's 2010 national census, where the poverty threshold is ¼ of the nation's minimum wage (R$127.50 in 2010). In Chile, we use 2015 poverty rates in each municipality, computed from a nationally representative survey of family income, as well as employ estimation techniques for small areas (MDS, 2018). In Colombia, this measure is based on the Multidimensional Poverty Index (WPI), which combines information from five dimensions of well-being: 1) educational conditions of the household, 2) conditions of children and youth, 3) work, 4) health, and 5) public services and housing. WPI data come from Colombia's 2005 Census. In Ecuador, poverty rates for the period 2010-2014 are based on consumption rather than income and were estimated following poverty rates defined by the Statistics Bureau of Ecuador, the World Bank Group, and the United Nations (Molina et al., 2015). In Peru, regional poverty rates come from the National Household Survey (ENAHO) collected by the National Bureau of Statistics (INEI) in collaboration with the Presidency of the Council of Ministers (PCM) and the Technical Directorate of Demography and Social Indicators (DTDIS). Where data are available for multiple years, we use average poverty rates such that each region is on the same SES quintile over time, allowing for a more comparable time series analysis in response to our second research question.

Factors that influence education costs

With respect to variables that influence education costs, a factor commonly discussed in the school finance literature concerns the scale of schools or districts. Various studies have attempted to estimate the optimal enrollment size of a school district at which productivity is maximized and

costs decrease, finding cutoff levels that vary between 2,000 to 4,000 students (Duncombe & Yinger, 2007; Zimmer et al., 2009). Yet, most of these studies are based on the U.S. context and address scale at the district level. In our study, regions vary substantially in size across countries, making it difficult to determine an optimal enrollment size that applies to all countries in the same way. Moreover, research suggests that the relationship between cost and size is best described by a 'U' shaped function, where operation costs are highest among very small and very large systems (Fox, 1981; Duncombe et al., 1995; Reschovsky & Imazeki, 1997, 1999). Following these studies, we use the log of enrollment and its square to account for economies of scale. In addition to student population size, we also control for the populational density of each region in order to account for transportation and other costs of providing education to children living in remote and sparser areas. Brazil's data on population density comes from its 2010 Census, while for Chile, this information is available from the Statistics Bureau (2015), and for Colombia, the 2005 Census. For Ecuador we use data from the Statistics Bureau (2015) and for Peru, from the National Bureau of Statistics (INEI 2015).

Geographic variation in the prices of products and services also influence cost differentials in education, especially teachers' wages, which account for as much as 80 percent of education expenditures in some Latin American countries (Elacqua et al., 2018). One approach to control for variation in teacher wages across regions involves cost-of-living adjustments (Duncombe & Yinger, 2008). Data on cost-of-living at the regional level are, however, only available for Brazil. We accordingly calculate this measure using this country's 2010 Census data, based on the average monthly rental costs in all Brazilian municipalities (Franco, 2018).

Another way to control for variation in teacher salaries is to use a Competitive Wage Index (CWI), based on the average wage of workers in other industries with similar qualifications as teachers. To this end, we estimate a CWI using data from the countries' national household surveys. A detailed description of the methodology and data used is provided in the appendix.

Below, we provide an overall summary of our various data sources:

Table 3. Data sources and availability

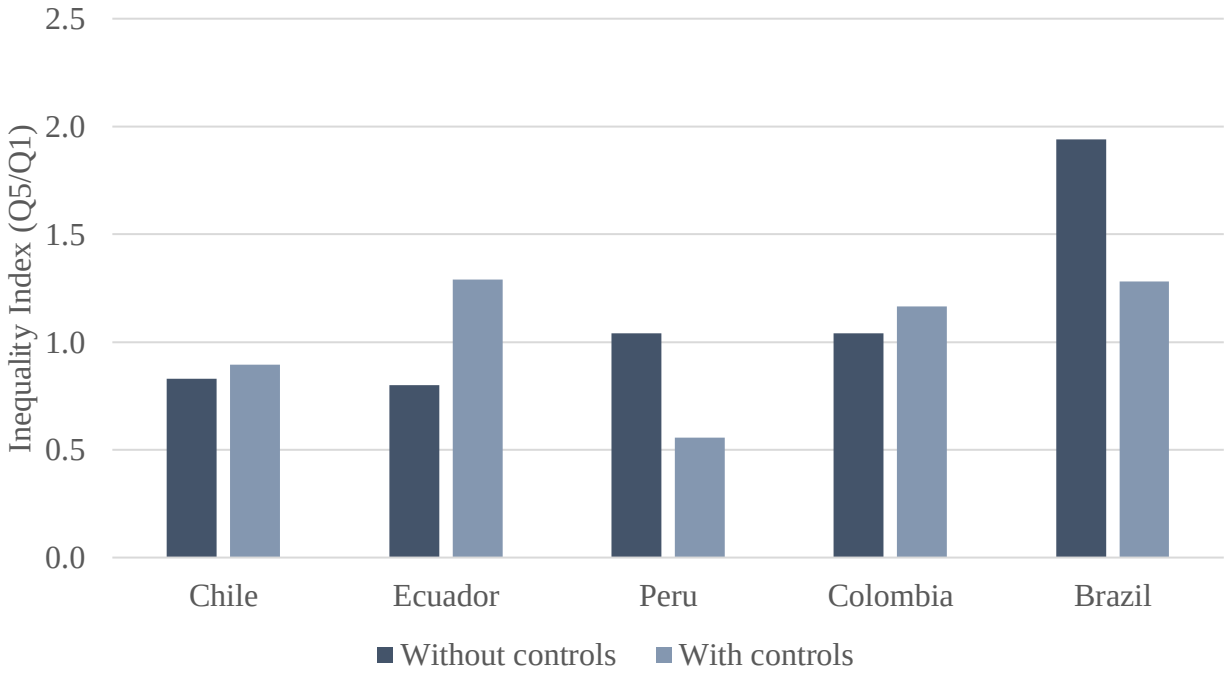
Countries	School Funding data		Student and school data	Poverty data	Populational density
	Source	Data excluded			
Brazil	Education Budget Information System (SIOPE)		Census of Basic Education	2010 Census	2010 Census
Chile	Ministry of Education (transfer from central government and school fees) and SINIM (Municipalities)	School meals, new infrastructure, scholarships for indigenous students, private donations to schools, kindergarten institutions managed by JUNJI or Integra	Ministry of Education	National Socioeconomic Survey (2015)	Statistics Bureau (2015)
Colombia	Ministry of Finance and Public Credit (Formato Unico Territorial or FUT)	Direct spending of the Ministry of Education (non-executed by CLAs)	National Administrative Department of Statistics DANE	DANE (2005 Census)	DANE (2005 Census)
Ecuador	Integrated Financial Management System (eSIGEF)	Programs executed directly by the central government	Ministry of Education	Census data (2010) and Life Conditions Survey (2014)	Statistics Bureau (2015)
Peru	Integrated Financial Administration System (SIAF)	Expenditure from donations and own resources, infrastructure investments, municipal spending	National Educational Census	National Household Survey (ENAHO)	Statistics Bureau (2015)

Findings

This section shows how public education spending is distributed across regions of differing socioeconomic status within Brazil, Chile, Colombia, Ecuador, and Peru. Recall that our first question asks whether the distribution of school funding within these countries is unequal. Tables 5 through 9 (in the appendix) show the results of Equations 1 and 2 for all countries. Figure 1 summarizes the inequality indices before and after adding all controls to the model (i.e., enrollment size, population density, and comparable wage index). Countries with an index greater than 1 (i.e.., Brazil, Colombia, and Peru) have an unequal distribution of school funding, where the richest

regions (5th percentile of SES) have higher per-pupil spending than the poorest regions (1st percentile of SES). Countries with an index lower than 1 (i.e., Chile and Ecuador) have a more equitable distribution of school funding, where the poorest regions have higher per-pupil spending than the richest regions.

Figure 1. Inequality index before and after controlling for costs



School funding inequality changes in different ways before and after controlling for cost differentials. For all of these countries, there is a similar correlation between SES and factors that influence cost differentials in education: larger regions with greater population density and a higher comparable wage index have lower poverty rates (and, therefore, a higher SES). However, the correlation between regional costs and public education spending varies across countries. In Brazil and Peru, richer urban cities with higher comparable wage indexes have higher per-pupil spending. When we account for regions' characteristics, the socioeconomic funding gap in favor of rich regions decreases in both of these countries and, in the case of Peru, the distribution becomes progressive. Meanwhile, in Chile, Colombia, and Ecuador, low-SES regions with lower population density receive more school funds from the central government. When we account for this regional disparity in per-pupil spending, the socioeconomic funding gap increases.

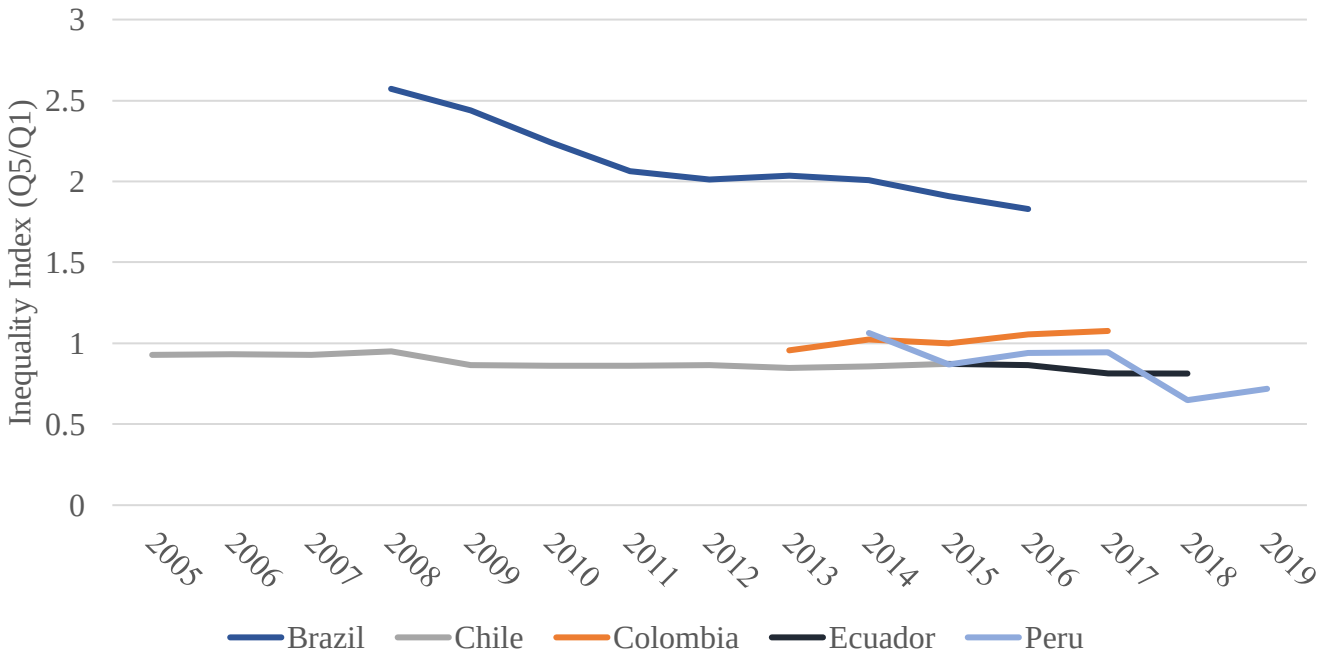
Brazil, a federal country, has the widest socio-economic funding gap, even after controlling for regional differences in education costs. In Colombia and Peru, higher SES regions also have higher per-pupil spending than lower SES regions. Without controlling for education costs, the distribution of school funding in Ecuador is more progressive. However, when we add controls to the model, the distribution of school funds becomes regressive. The distribution of funding in Chile is instead consistently progressive, before and after controlling for determinants of education costs. Unlike Ecuador, where progressive transfers focus mostly on rural areas (which tend to be of low SES), Chile's funding formulas account for rurality *and* have specific weights for student and school socioeconomic status. This explains why, after controlling for populational density (which correlates with whether or not regions are rural), school funding in Ecuador becomes regressive, while school funding in Chile remains progressive.

In all countries, with the exception of Brazil, data are missing for certain control variables. That said, a comparison between models 1 and 2 in Tables 6 through 9 shows that the inequality index is similar between the full sample and that without cases where control variables are missing. Brazil is also the only country that has data on two proxies of service prices, namely Comparable Wage Index (CWI) and cost-of-living. We find, however, that the socioeconomic gap does not change considerably between the model that controls for Comparable Wage Index (model 5) and that which controls for cost-of-living (model 6).

Next, we show results for our research questions 2 and 3, using a model without controls of cost differentials. As explained above, adding these controls affects the precision of the estimates in countries with fewer regions. Moreover, because SES is highly correlated with our proxies of cost differentials, the addition of such controls reduces the progressive spending that comes from transfers to low SES regions that have low costs (e.g., rural areas). In countries with large rural and indigenous populations, these types of transfers are crucial to promote school funding equity.

Figure 2 provides evidence related to our second research question, depicting the inequality index over time for each country without controlling for determinants of education costs. In an effort to further facilitate the interpretation of changes in school funding inequality, in the appendix we show the trends in per-pupil spending separately for low- and high-SES regions.

Figure 2. Trends in school funding inequality



We observe that school funding inequality in Brazil decreases considerably over the study period. Meanwhile, Figure 8 in the appendix shows that both low and high SES regions in this country experienced an increase in per-pupil spending between 2008 and 2012, likely due to the country's economic growth. Notably, such spending rose more rapidly in low SES regions, narrowing the school funding gap.

In Chile, the inequality index remains fairly stable over time, changing only slightly after 2008 with the passage of the SEP law, a policy that increased the voucher for poorer students and transfers for schools with large concentrations of disadvantaged pupils. Because the transfers are weighted based on school (rather than region) characteristics, the law has likely played a more important role in reducing socioeconomic funding inequality between schools of different socioeconomic levels *within* regions (municipalities). We do not, in fact, observe much difference in the school funding gap following the SEP law as our analysis focuses on the inequality between regions, rather than inequality between schools. Moreover, a crowding out of funding occurred after the implementation of SEP, where the poorest municipalities decreased their own financial contribution to schools more than the richest municipalities (a decrease of 23% vs. 11% of the local contribution per student between 2007 and 2008—not shown, but available upon request).

In Colombia, the socioeconomic gap in school funding slightly increases over time. Specifically, while there was a steady increase in per-pupil spending among high SES regions, the growth in per-pupil spending among low SES regions slowed after 2015 (see Figure 10 in the appendix). Meanwhile, the distribution of school funding in Ecuador becomes slightly more progressive because per-pupil spending increased at a faster rate across low SES regions (see Figure 11). Lastly, in Peru, the distribution of resources has turned more progressive, in part due to the expansion of monetary incentives offered to teachers who work in disadvantaged and rural schools (Bertoni et al., 2019).

Lastly, we show how school funding is distributed across regions by source of funding for each of the 5 countries under study. Drawing on Baker and Corcoran's (2012) graphical representation of the school funding gap in the United States, Figures 3 through 7 illustrate the predicted per-pupil spending by source of funding for each quintile of SES—the coefficients from the regression models are shown in the appendix. This model pools data from 2014 through 2016 and does not control for cost differentials.

Figure 3. School funding inequality by source of revenue and SES – Brazil

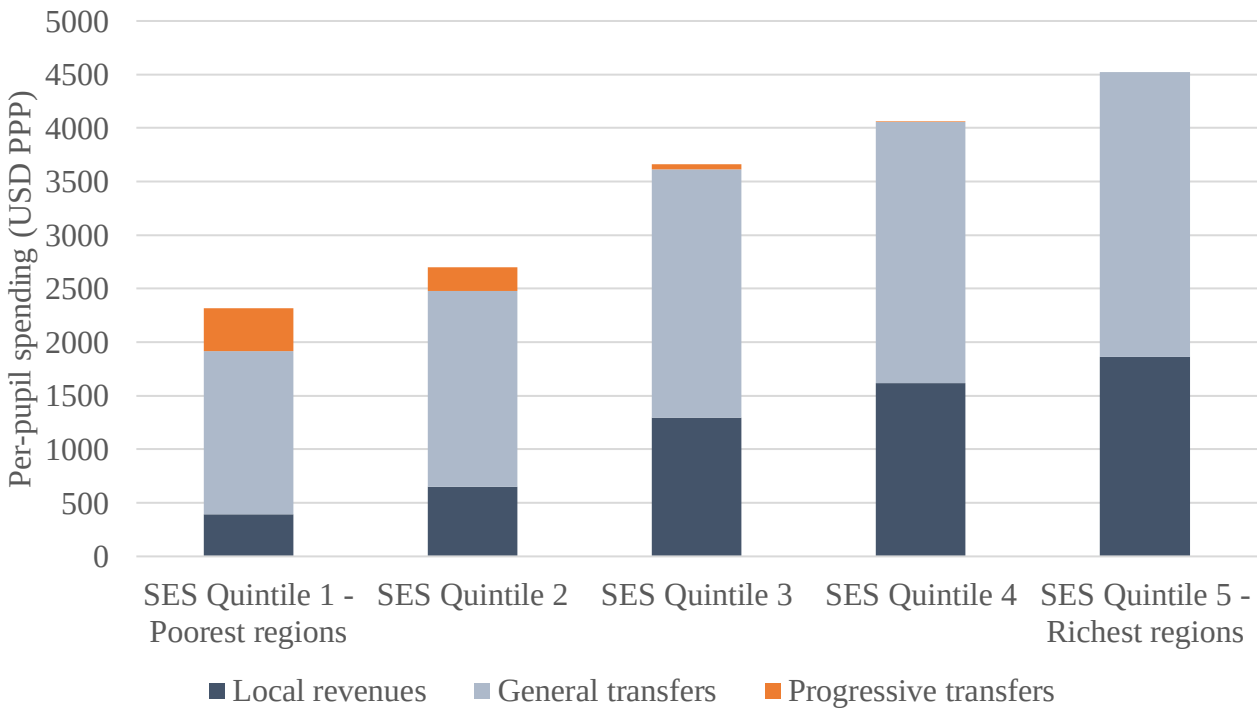


Figure 4. School funding inequality by source of revenue and SES – Chile

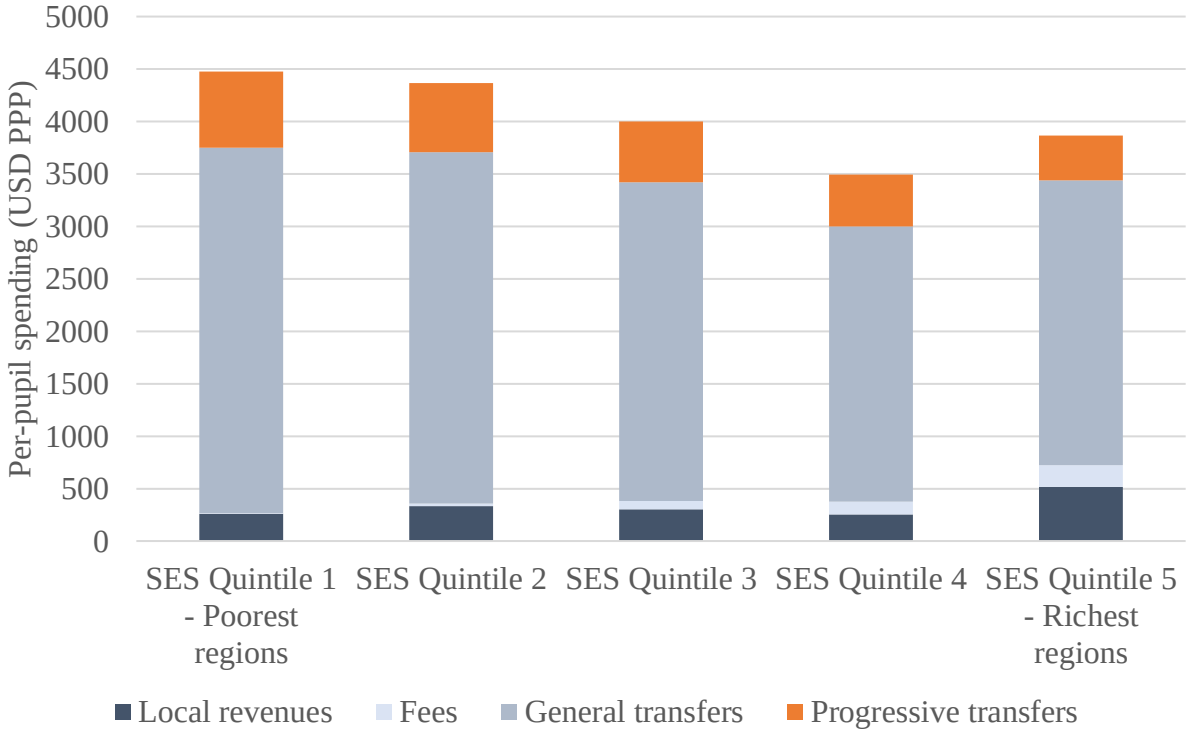


Figure 5. School funding inequality by source of revenue and SES – Colombia

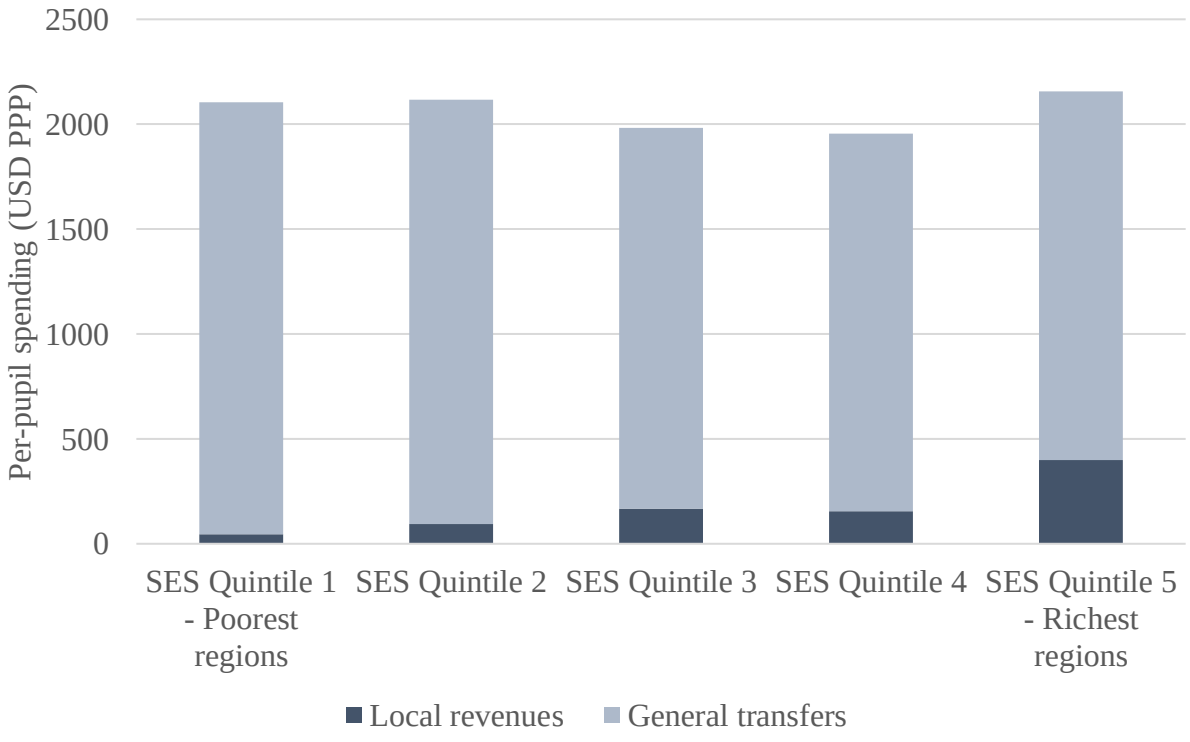


Figure 6. School funding inequality by source of revenue and SES – Ecuador

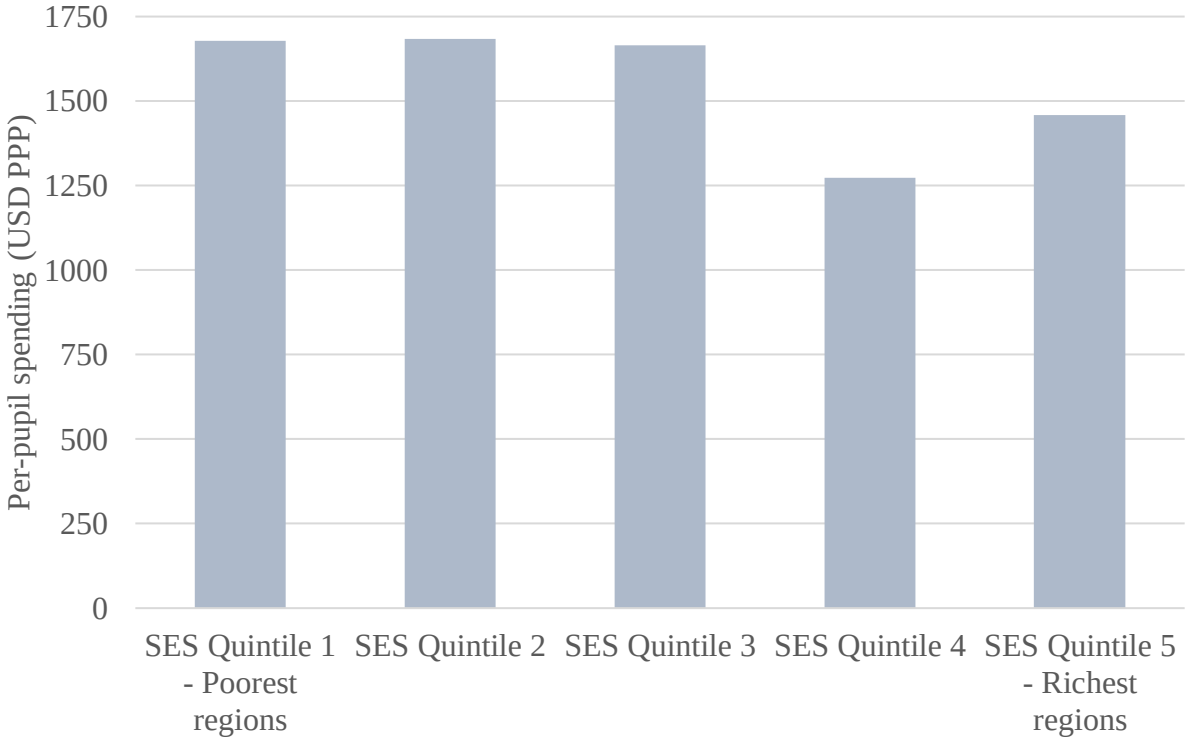
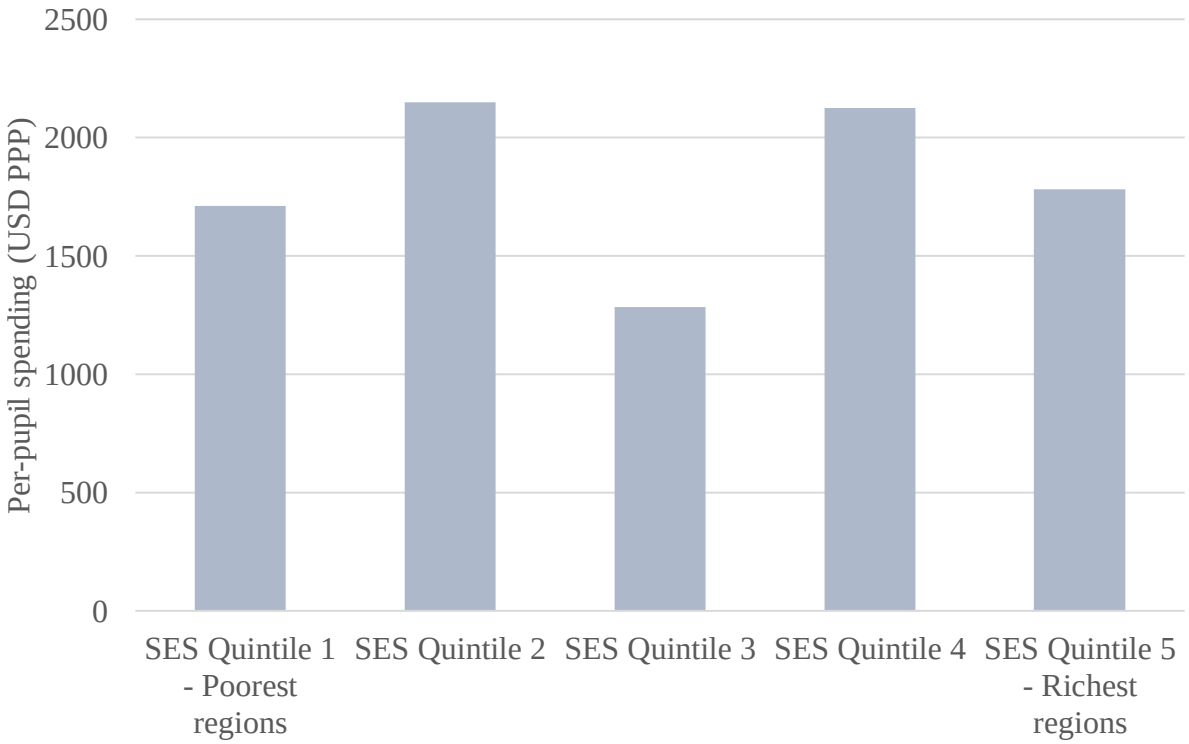


Figure 7. School funding inequality by source of revenue and SES – Peru



Not surprisingly, education spending from local revenues is unequally distributed. Since a region's ability to raise revenues is typically a function of local wealth (e.g., level of economic development, property wealth, and income), poorer regions tend to accrue fewer education dollars per student than do richer regions. The extent to which these local resources explain the overall socio-economic funding gap depends on how much these resources contribute to the region's total revenue. For example, although the distribution of local revenues is much more unequal in Colombia than it is in Brazil (compare model 2 between Tables 11 and 13 in the appendix), regions' own resources play a more important role in the overall socioeconomic funding gap in Brazil because they represent a larger share of this country's total spending on public education.

In Chile, in addition to raising revenues from local taxes, public and private subsidized schools can also charge small fees from families at the secondary level. These fees, like the municipalities' own resources, are unequally distributed across regions with differing SES. However, in Chile, school fees and local revenues represent a smaller proportion of the total spending on education. As a result, these resources do not affect the overall progressiveness of the public funding of schools.

In Brazil, general transfers also tend to be unequally distributed. Part of these government transfers is determined by Fundeb. Because Fundeb is a state-specific fund—that is, revenues are raised and redistributed within each state—it has limited capacity to reduce spending inequalities between regions. Moreover, the Fundeb formula as well as other intergovernmental transfers (e.g., federal education programs and *Salário-Educação*) give greater weight to enrollments at certain institutional levels, including pre-primary and secondary school. Richer regions tend to receive more resources through these transfers not only because they can afford to expand early childhood education with their own resources, but also because students in these wealthier regions are more likely to attend high school.

In Peru, transfers from the central government to regions are carried out in a discretionary way and often based on allocations of previous years. The inequality in school funding in this country may result from the fact that richer regions have more political power to negotiate and bargain for resources for public education. Note, however, that (as shown in Figure 2) the distribution of school funding has become more progressive over the last several of years.

While central government transfers in Ecuador are also discretionary, they generally benefit regions at the bottom of the SES distribution—though education spending in the fifth quintile of SES is higher than in the fourth. As explained above, the progressiveness of funding in Ecuador is driven by the fact that investments focus on disadvantaged rural regions.

In Colombia, general transfers from the central government to local authorities are generally progressive. This may reflect the fact that the SGP, the country's main funding formula, transfers more resources to those regions with a higher proportion of rural schools. Moreover, as explained above, the SGP has a progressive component focused on low SES, high-performing CLAs—not discriminated in our analysis due to data limitations. Although this component represents a small share of the overall SGP resources (6%), it may contribute to a more equitable distribution of "general transfers." In this country, the school funding gap favoring high SES regions is explained by the unequal distribution of local revenues.

Equalization of school funding can be achieved through more progressive funding formulas and grants that compensate for regional differences in education spending. Particularly notable here are the progressive school finance policies in Brazil and Chile. Specifically, Brazil's Fundeb *Complementação* (Supplement) can be classified as a progressive government transfer, since it targets poorer states where the Fundeb per-pupil funding does not meet the minimum amount determined nationally. In Chile, transfers under the SEP law are also progressive, as they are meant for disadvantaged students and schools; though the Fundeb Supplement is comparatively more equitably distributed between the country's regions (compare model 4 in Table 10 and model 5 in Table 11). This is not surprising, as the Fundeb Supplement specifically aims to compensate for disparities in per-pupil spending *between* regions, while the SEP law focuses on funding inequalities between schools. That said, the progressive transfers under the SEP law represent a much higher proportion of the overall public education spending in Chile than do those of the Fundeb Supplement, which are not enough to significantly reduce the spending gaps between regions in Brazil.

Discussion

There has been a remarkable rise in public education spending over the last several decades in Latin America. Yet, relatively little is known as to whether this increase in spending has translated into a more equitable distribution of resources within countries. Moreover, the economic crises faced by many nations in this area of the world—accentuated with the advent of COVID-19—may impact vulnerable regions and schools more severely, thus widening the gap in school funding inequality (Baker, 2014; Evans, Schwab, Wagner, 2014; Jackson, Wigger, Xiong, 2018). In this scenario, school finance strategies represent key policy tools for improving equity in public education spending. Our findings offer useful insights for policymakers as well as contribute to the comparative literature on school funding through original evidence on the distribution of per-pupil spending in Latin America.

Using school funding data from Brazil, Chile, Colombia, Ecuador, and Peru, we examine patterns and trends in public school spending inequalities between high and low socioeconomic regions within these different countries. Specifically, following existing analyses of school funding fairness (e.g., Baker, Sciarra and Farrie, 2014), we measure the socioeconomic inequality in school funding and assess whether the estimated gap changes after accounting for determinants of education costs. The underlying assumption is that an equitable distribution of school funds should take into account the fact that, in certain regions, the costs of services and products are higher than in others. We find, however, that spending progressiveness in some countries is driven by transfers to rural areas with lower costs and lower SES. Once we control for cost differentials, the progressiveness of school funding decreases. This is notably the case of Ecuador, where a portion of central government transfers aims to reduce rural-urban gaps in education. While the distribution of school funds in this country is initially progressive, it becomes regressive after controlling for the populational density of its regions. Generally, we observe that controlling for determinants of education costs can lead to underestimating important patterns of progressiveness, especially in countries with a large rural and indigenous population, such as Ecuador.

In addition, our results reveal that Brazil has the widest socioeconomic funding gap among the countries examined. This is not surprising given that Brazil is a large, diverse, and highly unequal federal country, where education is mostly funded by local governments. Given that a region's ability to raise revenues is a function of local wealth (e.g., level of economic development,

property wealth, income, etc.), poorer regions tend to spend fewer education dollars per student than richer regions (Hinchliffe, 1989; Baker & Corcoran, 2012). Despite being highly progressive, we observe that funding from Brazil's Fundeb Supplement is not enough to eliminate the socioeconomic spending gap between regions, as it represents a very small proportion of the total expenditure in education. In this sense, Chile is comparatively more successful at narrowing the socioeconomic funding gap since the largest shares of education spending consist of general and progressive transfers that favor the country's poorest regions.

While progressive school finance policies may improve the redistribution of school funding between regions, funding inequality between schools may ultimately not be affected if local governments do not invest more in disadvantaged institutions. For example, using data from the state of Pernambuco in Brazil, Elacqua et al. (2019) reveal that per-pupil spending in schools with high SES students is 1.5 times higher than per-pupil spending in low SES schools. They find that the between-school inequality in per-pupil spending largely results from full-time secondary schools with more skilled teachers and better equipment attracting greater numbers of high SES students.[10] Similarly, Cascio et al. (2013) examine the effects of Title I— the United States' largest federally funded educational program, which awards funds to school districts based on child poverty counts—and observe that additional spending induced by the program did not, in fact, benefit the most disadvantaged students, as intended by the federal government. These examples suggest that, in addition to equalization efforts such as progressive funding formulas and grants aimed at compensating for regional differences in school funding, policies should also encompass the redistribution of resources *within* regions, such that the money will truly matter for the most vulnerable students.

Economic crises exacerbated by the COVID-19 pandemic risk accentuating existing inequalities in educational opportunities in Latin America, unless these countries implement progressive, properly designed, and effectively evaluated financing policies. Such policies should consider funding formulas that assign greater weight to low-income students; monetary incentives to attract more qualified teachers to disadvantaged schools; and compensatory subsidies to help reduce fiscal inequalities among different local governments and increase spending on underprivileged pupils. Moreover, these policies should be transparent and institutionalized by law

[10] Most schools in Brazil operate on a part-time schedule and cost 35% less than full-time schools.

in order to ensure a sustainable, progressive school funding system. Finally, progressive school funding policies should create incentives for greater financing efforts to be directed towards the most disadvantaged students, in an effort promote their learning and a narrowing of existing learning gaps.

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Appendix

Comparable Wage Index (CWI) – methodology and data

To construct the Comparable Wage Index (CWI), we estimate the average wage of non-education workers that have similar professional skills and education levels as teachers (Taylor and Fowler 2006). The underlying assumption is that the school system should offer wages for teachers that are competitive enough to prevent them from leaving the profession to work in other industries. Although this is a strong assumption, since teachers do not typically move to other comparable professions (Podgursky et al., 2004), the CWI data can help account for important regional variations affecting teachers' salaries (e.g., cost of living and differential compensation to work in hard-to-staff areas).

To calculate the CWI, we use 2015 data from each country's national household survey.[11] Note that our index is only available for the geographic areas for which the national surveys were designed to produce reliable estimates. This means that the school funding data and the CWI data are not necessarily at the same level, though the regions do overlap. For example, in Brazil, the annual household survey (PNAD) and, as a result, the CWI data in this country are representative at the state level. Meanwhile the school funding data for Brazil covers both the state and municipality levels. In our analysis, we apply the same index of Comparable Wage to all Brazilian municipalities that are located within the same state. One implication of using more aggregated data to estimate the CWI is that we may not capture important labor market variation within regions. In Table 4, we describe the representativeness of the CWI and compare it with our school funding data.

[11] Colombia: Great Integrated Household Survey; Chile: National Socio-Economic Characterization Survey (CASEN); Brazil: Nacional Household Survey (PNAD); Peru: National Household Survey; Ecuador: Encuesta Nacional De Empleo, Desempleo Y Subempleo (ENEMDU).

Table 4 – Representativeness of CWI and SF data

	CWI data		School finance data
	Regions	# Regions	# Regions
Brazil	States and federal district	27	5,487
Chile	Territorial divisions	287	335
Colombia	Departments[12]	25	94
Ecuador	Provinces[13]	18	140
Peru	Regions	25	175

To calculate a region's CWI, we first use a model to estimate the salary of individual *i* in country *c* for a non-educator worker who graduated or is attending college and who is employed in a full-time job:

$$Log\ W_{ic} = \beta_0 + \beta_1 work\_hours_{ic} + \beta_2 gender_{ic} + \beta_3 age_{ic} + \beta_4 age_{ic}^2 + \beta_5 education_{ic} + \beta_6 indigenous_{ic} + \sum_1^J \gamma_1 ocupation_{ic} + \sum_1^R \gamma_2 region_{ic} + \gamma_3 urban_{ic} + e_{ic}$$

Where $Log\ W_{ic}$ represents the total earnings of individual *i*; $work\_hours_{ic}$ the weekly hours worked at the main job; $education_{ic}$ years of education; $indigenous_{ic}$ a dummy whether the individual is indigenous or not; $ocupation_{ic}$ represents the occupation of individual *i* in his main job. The occupations are classified into 9 categories (j) that range from agriculture to service. Finally, we control for whether the individual lives in urban or rural area ($urban_{ic}$) and region fixed effect, captured by a set of dummies for each region r.

Then, the predicted $\hat{\beta}$ are imputed to calculate the CWI of each region r in country c:

$$CWI_{rc} = \widehat{\beta_0} + \widehat{\beta_1} * work_{hours_{rc}} + \widehat{\beta_2} gender_{rc} + \widehat{\beta_3} age_{rc} + \widehat{\beta_4} age_{rc}^2 + \widehat{\beta_5} education_{rc} + \widehat{\beta_6} indigenous_{rc} + \sum_1^J \hat{\gamma_1} ocupation_{rc} + \hat{\gamma_2} region_{rc} + \hat{\gamma_3} urban_i$$

Our index is normally distributed and ranges from 0.8 to 1.2. The greater the index, the higher the relative wage of region r compared to the national average (which is normalized to 1).

[12] In the GIHS Survey, information was unavailable for Arauca, Amazonas, Casanare, Guaviere, Guanía, Putumayo, San Andrés, Vaupés, Vichada. Moreover, for Colombia, it is not possible to separate non-educators from educators since the job occupation variable available in the GIHS is not disaggregated at this level.

[13] Data were unavailable for Galapagos, Morona Santiago, Napo, Orellana, Pastaza, Sucumbios, Zamora, and Chichipe.

Question 1 – Socioeconomic inequality in school funding

Table 5. School funding inequality between regions – Brazil

	Model 1	Model 2	Model 3	Model 4	Model 5
SES Quintile 2	378.07***	115.74***	127.36***	50.06*	-41.65
	(29.87)	(22.90)	(23.09)	(22.73)	(22.95)
SES Quintile 3	1345.59***	644.34***	655.95***	269.13***	146.21***
	(29.76)	(23.58)	(23.75)	(27.06)	(27.80)
SES Quintile 4	1740.11***	1013.99***	1033.77***	515.17***	349.91***
	(29.78)	(23.66)	(24.19)	(30.11)	(31.41)
SES Quintile 5	2201.74***	1512.64***	1544.94***	877.04***	661.59***
	(29.61)	(23.47)	(24.88)	(34.19)	(36.21)
Constant	2339.68***	20246.64***	20312.62***	17879.28***	20554.60***
	(24.85)	(198.87)	(199.50)	(213.70)	(193.38)
Year FE	Yes	Yes	Yes	Yes	Yes
Economy of scale	No	Yes	Yes	Yes	Yes
Population density	No	No	Yes	Yes	Yes
CWI	No	No	No	Yes	No
Cost-of-living	No	No	No	No	Yes
$\widehat{Q1}$	2318.94	2800.89	2785.6	3121.14	3241.88
$\widehat{Q5}$	4520.68	4313.53	4330.54	3998.18	3903.47
Inequality Index $(\widehat{Q5}/\widehat{Q1})$	*1.949*	*1.540*	*1.555*	*1.281*	*1.204*
Observations	16216	16216	16216	16216	16216

Table 6. School funding inequality between regions – Chile

	Model 1	Model 2	Model 3	Model 4	Model 5
SES Quintile 2	-110.30	-184.65	-146.23	-141.15	-144.84
	(146.05)	(130.88)	(78.14)	(74.85)	(74.54)
SES Quintile 3	-480.29**	-654.00***	-380.17***	-338.84***	-334.27***
	(146.05)	(130.88)	(79.08)	(75.94)	(75.64)
SES Quintile 4	-985.14***	-1015.95***	-523.13***	-437.34***	-490.06***
	(146.32)	(130.63)	(82.49)	(79.81)	(82.07)
SES Quintile 5	-614.79***	-765.73***	-407.56***	-318.92***	-448.36***
	(145.51)	(131.93)	(84.65)	(81.91)	(95.90)
Constant	4451.87***	4449.32***	26323.36***	25391.27***	24150.46***
	(113.12)	(100.85)	(864.14)	(836.67)	(963.21)
Year FE	Yes	Yes	Yes	Yes	Yes
Economy of scale	No	No	Yes	Yes	Yes
Population density	No	No	No	Yes	Yes
CWI	No	No	No	No	Yes
$\widehat{Q1}$	4478.56	4478.56	4247.71	4204.02	4239.51
$\widehat{Q5}$	3863.77	3712.83	3840.15	3885.1	3791.15
Inequality Index ($\widehat{Q5}/\widehat{Q1}$)	*0.863*	*0.829*	*0.904*	*0.924*	*0.894*
Observations	671	651	651	651	651

Table 7. School funding inequality between regions – Colombia

	Model 1	Model 2	Model 3	Model 4	Model 5
SES Quintile 2	12.65	92.36	113.87	139.61*	166.02*
	(79.36)	(68.98)	(67.17)	(67.28)	(66.76)
SES Quintile 3	-119.76	40.27	54.12	136.86	175.10*
	(79.36)	(68.98)	(67.64)	(75.05)	(74.93)
SES Quintile 4	-148.24	-124.71	-99.31	65.79	117.18
	(79.36)	(68.98)	(68.74)	(96.05)	(96.06)
SES Quintile 5	53.10	78.61	70.16	257.29*	303.69**
	(79.36)	(68.98)	(75.14)	(106.95)	(106.34)
Constant	1993.06***	1881.88***	9035.97**	9672.67***	11963.21***
	(66.87)	(59.26)	(2822.44)	(2803.90)	(2865.43)
Year FE	Yes	Yes	Yes	Yes	Yes
Economy of scale	No	No	Yes	Yes	Yes
Population density	No	No	No	Yes	Yes
CWI	No	No	No	No	Yes
$\widehat{Q1}$	2103.42	1982.48	1971.61	1875.88	1842.12
$\widehat{Q5}$	2156.52	2061.09	2041.77	2133.17	2145.82
Inequality Index $(\widehat{Q5}/\widehat{Q1})$	*1.025*	*1.040*	*1.036*	*1.137*	*1.165*
Observations	282	231	231	231	231

Table 8. School funding inequality between regions – Ecuador

	Model 1	Model 2	Model 3	Model 4	Model 5
SES Quintile 2	5.34	83.20	70.53	187.09	153.63
	(155.03)	(140.12)	(121.06)	(119.01)	(121.58)
SES Quintile 3	-13.29	14.54	235.51*	354.99**	314.54**
	(147.58)	(130.04)	(115.09)	(113.58)	(117.60)
SES Quintile 4	-405.53**	-325.78*	-20.41	218.60	200.16
	(152.23)	(138.32)	(128.76)	(134.44)	(134.98)
SES Quintile 5	-219.80	-403.26**	-42.93	413.10*	374.06*
	(152.23)	(131.19)	(138.19)	(166.72)	(169.15)
Constant	1716.11***	1677.37***	29134.07***	27101.74***	26941.26***
	(119.37)	(104.53)	(4815.55)	(4643.39)	(4637.92)
Year FE	Yes	Yes	Yes	Yes	Yes
Economy of scale	No	No	Yes	Yes	Yes
Population density	No	No	No	Yes	Yes
CWI	No	No	No	No	Yes
$\widehat{Q1}$	1678.37	1640.41	1456.70	1264.96	1292.00
$\widehat{Q5}$	1458.57	1237.15	1413.76	1678.06	1666.06
Inequality Index $(\widehat{Q5}/\widehat{Q1})$	*0.869*	*0.754*	*0.971*	*1.327*	*1.290*
Observations	280	234	234	234	234

Table 9. School funding inequality between regions – Peru

	Model 1	Model 2	Model 3	Model 4	Model 5
SES Quintile 2	437.14	435.65	403.99	257.60	134.89
	(366.12)	(375.01)	(344.43)	(339.12)	(334.13)
SES Quintile 3	-425.70	-411.44	42.06	389.91	499.68
	(387.63)	(399.83)	(368.81)	(369.11)	(363.29)
SES Quintile 4	415.16	413.44	83.74	365.22	757.02*
	(362.49)	(371.58)	(342.21)	(340.83)	(345.86)
SES Quintile 5	69.41	67.92	-82.78	282.59	-756.27
	(378.57)	(387.37)	(368.73)	(369.81)	(430.47)
Constant	1716.88***	1715.44***	48790.22***	55414.88***	42239.91***
	(316.33)	(323.59)	(7910.68)	(7883.29)	(8277.75)
Year FE	Yes	Yes	Yes	Yes	Yes
Economy of scale	No	No	Yes	Yes	Yes
Population density	No	No	No	Yes	Yes
CWI	No	No	No	No	Yes
$\widehat{Q1}$	1710.9	1710.8	1745.74	1583.58	1701.99
$\widehat{Q5}$	1780.31	1778.73	1662.97	1866.17	945.72
Inequality Index ($\widehat{Q5}/\widehat{Q1}$)	*1.041*	*1.040*	*0.953*	*1.178*	*0.556*
Observations	538	529	529	529	529

Question 2 – Trends in socioeconomic inequality in school funding

Table 10. School funding inequality full vs restricted sample

	Brazil		Chile		Peru	
	All regions	Only regions with all years	All regions	Only regions with all years	All regions	Only regions with all years
SES Quintile 2	385.70***	388.48***	-83.83	-108.90*	25.85	83.73
	(17.34)	(18.72)	(52.43)	(51.53)	(186.30)	(201.79)
SES Quintile 3	1324.98***	1306.83***	-404.10***	-473.36***	-525.33**	-475.80*
	(17.29)	(18.41)	(52.41)	(51.13)	(194.54)	(215.00)
SES Quintile 4	1716.65***	1676.91***	-780.44***	-797.10***	-22.96	79.89
	(17.32)	(18.34)	(52.48)	(51.95)	(182.14)	(202.99)
SES Quintile 5	2192.07***	2148.31***	-415.68***	-406.73***	-260.59	-265.79
	(17.22)	(18.26)	(52.20)	(50.94)	(189.06)	(209.90)
Constant	1398.85***	1426.78***	2399.93***	2405.68***	1987.37***	1894.22***
	(19.67)	(20.99)	(64.19)	(62.95)	(193.56)	(207.78)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Economy of scale	No	No	No	No	No	No
Population density	No	No	No	No	No	No
CWI	No	No	No	No	No	No
$\widehat{Q1}$	1956.66	1985.64	3407.88	3409.02	1899.06	1852.73
$\widehat{Q5}$	4148.73	4133.95	2992.20	3002.29	1638.47	1586.94
Inequality Index $(\widehat{Q5}/\widehat{Q1})$	*2.120*	*2.081*	*0.878*	*0.881*	*0.863*	*0.857*
Observations	49399	45027	3683	3575	1149	1032

Figure 8. Trend in school funding between low and high SES regions – Brazil

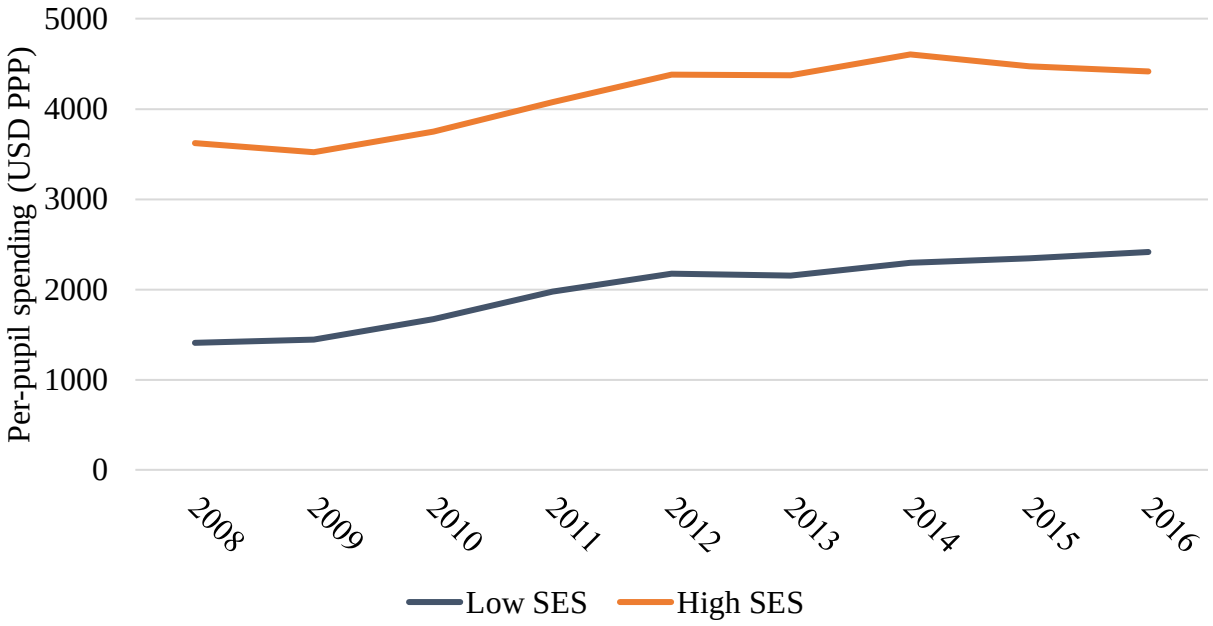


Figure 9. Trend in school funding between low and high SES regions – Chile

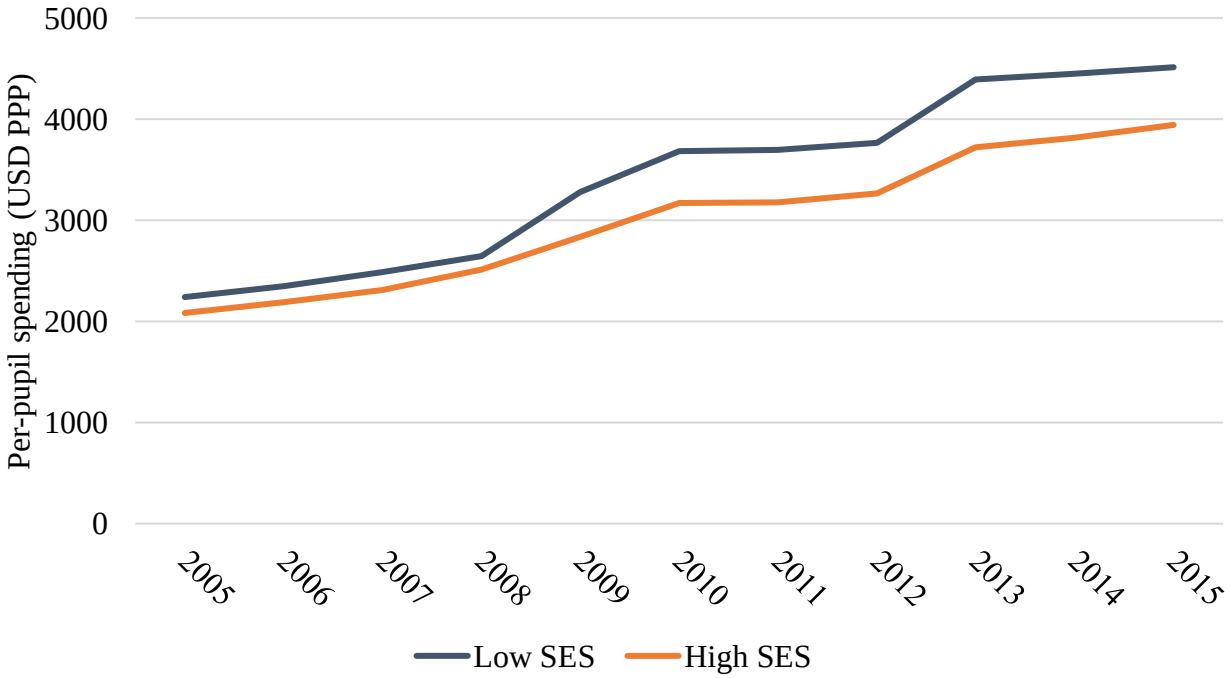


Figure 10. Trend in school funding between low and high SES regions – Colombia

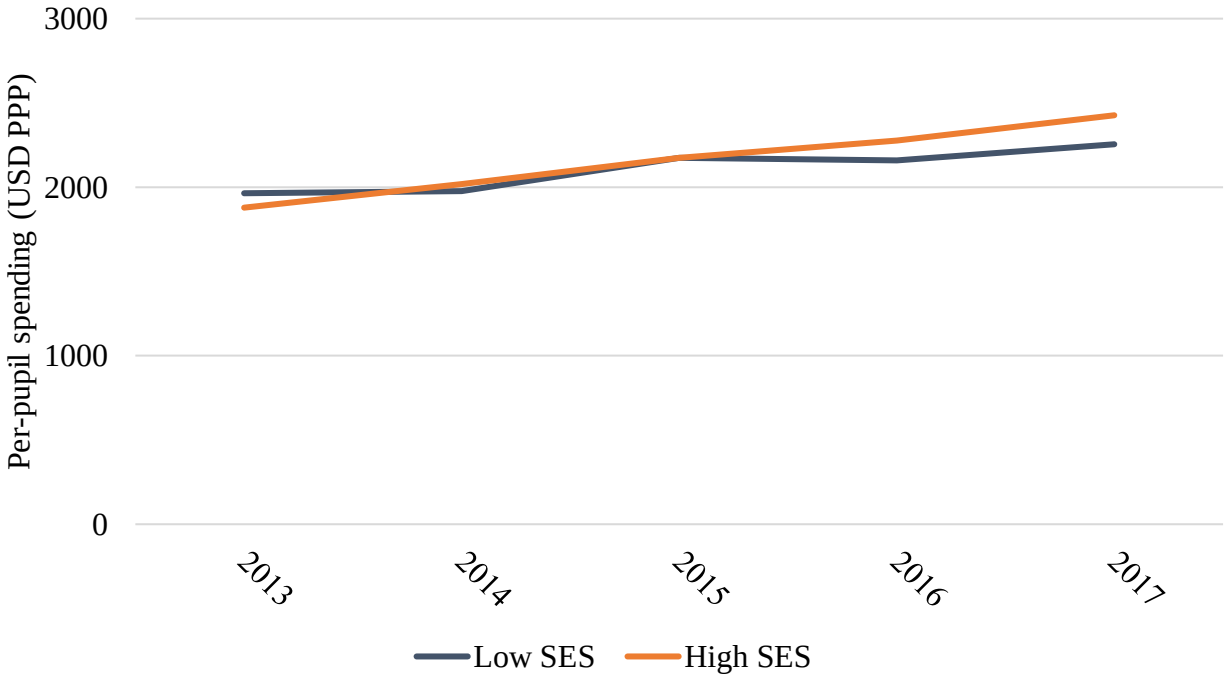


Figure 11. Trend in school funding between low and high SES regions – Ecuador

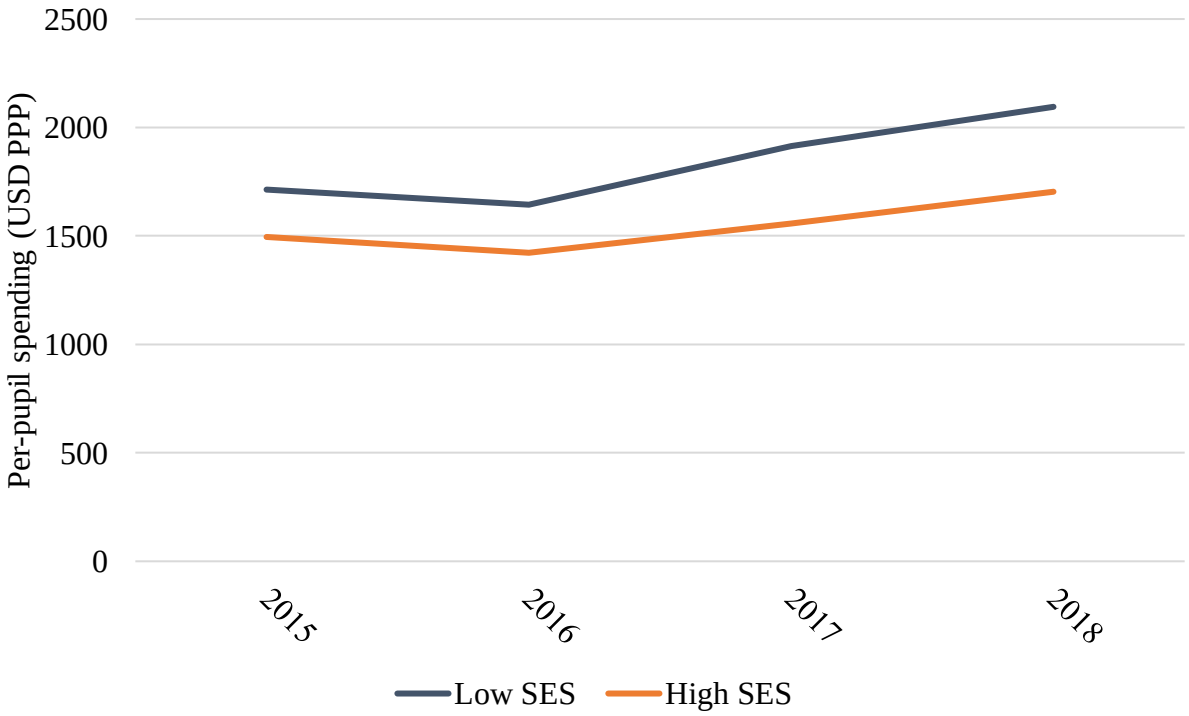
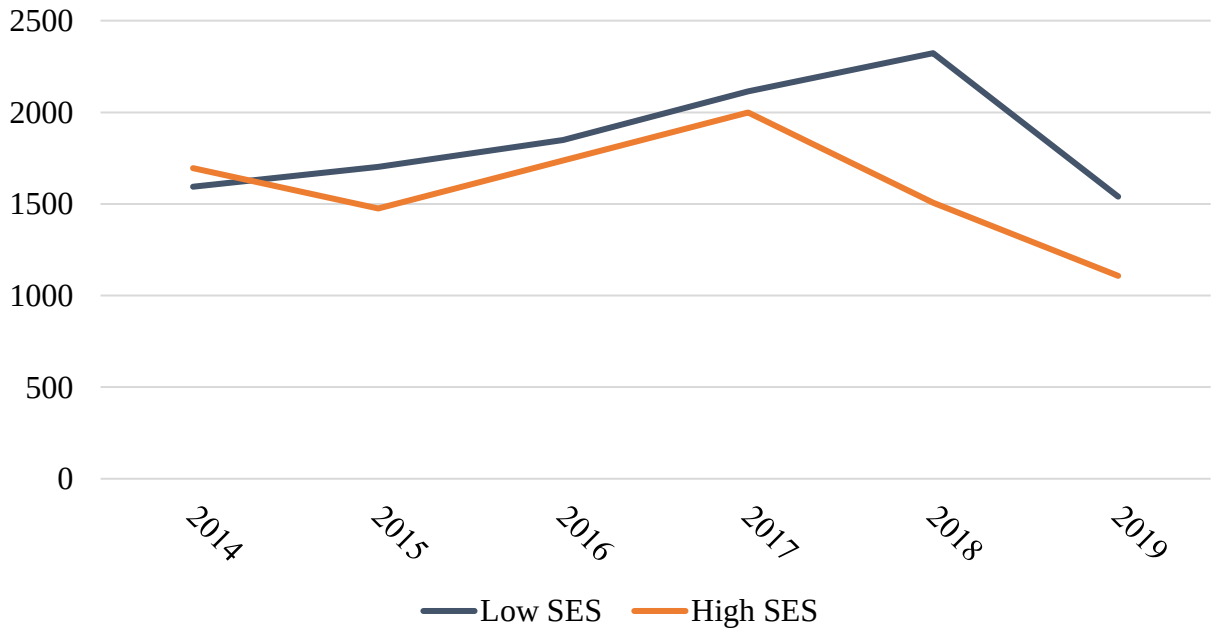


Figure 12. Trend in school funding between low and high SES regions – Peru



Question 3 – Socioeconomic gap in school funding by source of funding

Table 11. School funding inequality by source of funding – Brazil

	Model 1	Model 2	Model 3	Model 4
	Total	Local revenues	General transfers	Progressive transfers
SES Quintile 2	378.07***	259.95***	300.29***	-182.17***
	(29.87)	(22.44)	(14.46)	(4.06)
SES Quintile 3	1345.59***	903.00***	795.23***	-352.64***
	(29.76)	(22.36)	(14.41)	(4.05)
SES Quintile 4	1740.11***	1227.93***	914.88***	-402.71***
	(29.78)	(22.38)	(14.42)	(4.05)
SES Quintile 5	2201.74***	1470.82***	1134.35***	-403.43***
	(29.61)	(22.25)	(14.34)	(4.03)
Constant				
	2339.68***	394.62***	1553.93***	391.13***
	(24.85)	(18.67)	(12.03)	(3.38)
Year FE	Yes	Yes	Yes	Yes
Scale	No	No	No	No
Population density	No	No	No	No
CWI	No	No	No	No
$\widehat{Q1}$	2318.94	391.68	1523.93	403.33
$\widehat{Q5}$	4520.68	1862.5	2658.28	-0.1
Inequality Index ($\widehat{Q5}/\widehat{Q1}$)	*1.949*	*4.755*	*1.744*	*0.000*
Observations	16216	16216	16216	16216

Table 12. School funding inequality by source of funding – Chile

	Model 1	Model 2	Model 3	Model 4	Model 5
	Total	Local revenues	School fees	General transfers	Progressive transfers
SES Quintile 2	-110.30	75.27	14.02	-135.53	-64.06***
	(146.05)	(73.86)	(15.04)	(93.74)	(16.45)
SES Quintile 3	-480.29**	45.56	70.32***	-450.38***	-145.79***
	(146.05)	(73.86)	(15.04)	(93.74)	(16.45)
SES Quintile 4	-985.14***	-6.78	112.03***	-859.58***	-230.81***
	(146.32)	(74.00)	(15.07)	(93.92)	(16.48)
SES Quintile 5	-614.79***	255.93***	200.17***	-772.22***	-298.67***
	(145.51)	(73.58)	(14.98)	(93.40)	(16.39)
Constant					
	4451.87***	259.28***	9.97	3453.46***	729.15***
	(113.12)	(57.20)	(11.65)	(72.61)	(12.74)
Year FE	Yes	Yes	Yes	Yes	Yes
Scale	No	No	No	No	No
Population density	No	No	No	No	No
CWI	No	No	No	No	No
$\widehat{Q1}$	4478.56	259.08	9.82	3483.33	726.33
$\widehat{Q5}$	3863.77	515.01	209.99	2711.11	427.66
Inequality Index ($\widehat{Q5}/\widehat{Q1}$)	*0.863*	*1.988*	*21.384*	*0.778*	*0.589*
Observations	671	671	671	671	671

Table 13. School funding inequality by source of funding – Colombia

	Model 1	Model 2	Model 3
	Total	Local revenues	General transfers
SES Quintile 2	12.65	50.34	-37.69
	(79.36)	(38.72)	(67.15)
SES Quintile 3	-119.76	121.80**	-241.56***
	(79.36)	(38.72)	(67.15)
SES Quintile 4	-148.24	111.04**	-259.28***
	(79.36)	(38.72)	(67.15)
SES Quintile 5	53.10	356.05***	-302.95***
	(79.36)	(38.72)	(67.15)
Constant			
	1993.06***	24.96	1968.10***
	(66.87)	(32.63)	(56.59)
Year FE	Yes	Yes	Yes
Scale	No	No	No
Population density	No	No	No
CWI	No	No	No
$\widehat{Q1}$	2103.42	44.4	2059.03
$\widehat{Q5}$	2156.52	400.45	1756.08
Inequality Index ($\widehat{Q5}/\widehat{Q1}$)	*1.025*	*9.019*	*0.853*
Observations	282	282	282