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A Cross-country Analysis

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Abstract

Public spending on education has increased significantly in Latin America over the last decades. However, less is known whether increased spending has been translated into a more equitable distribution of resources within countries in the region. This study addresses this gap by measuring the inequality in per-pupil spending between regions with different levels of socioeconomic status (SES) within five Latin American countries: Brazil, Chile, Colombia, Ecuador, and Peru. Results show that Brazil, a federal country, has the widest socioeconomic funding gap due to large inequalities in local revenues between high and low SES regions. However, the country's funding gap has narrowed over time. School funding in Colombia has become more regressive over time, but its gap is half the size of the one in Brazil. The distribution of school funding in Peru has changed over time from being regressive—benefiting the richest regions—to being progressive—benefiting the poorest regions. Education spending in Chile and in Ecuador are, on the other hand, consistently progressive. However, while the progressiveness of funding in Ecuador is driven by transfers targeted at disadvantaged rural areas, the funding formulas in Chile addresses socioeconomic inequalities beyond the rural-urban gap.

Keywords: School finance policy, school funding gap, progressive spending, resource allocation.

JEL codes: I22, I28, I24.

Introduction

Since the Coleman Report (1966), there has been a long-standing debate about whether money matters in education. More recently, researchers have been able to exploit exogenous shocks in school funding to estimate the causal impact of additional resources on educational outcomes. These studies converge around the conclusion 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 (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 (Baker, 2014).

Over the last decades, public spending on education has increased significantly in Latin America and the Caribbean (LAC). In the region, government expenditure on education as a percentage of GDP increased from 3% in the 1990s to over 5% in 2017, converging to the OECD average. In current dollars, spending on primary and secondary schools surpasses US$2,000 per student, which, while still low compared to most OECD countries, in real terms represents roughly triple what was spent on each student in the 1990s. However, less is known about whether increased spending benefited equally students from diverse socioeconomic backgrounds within LAC countries.

During the same period, some reforms have been implemented to make the distribution of school funding more equitable in the region. For instance, in 2008, the Preferential Subsidy Law (*Ley SEP*) in Chile increased the voucher by 50% for students at the bottom 40% of the socioeconomic distribution and provided a differential subsidy for schools with greater concentrations of disadvantaged students. Another example is Fundeb (Fund for the Maintenance and Development of Basic Education and Teacher Appreciation) in Brazil. Implemented in 2009,

this policy aimed at reducing regional tax imbalances by redistributing local revenues within states based on student enrollment. Although there is evidence about the positive effects of these reforms, less is known about their role in reducing regional inequalities in a comparative perspective.

Using original school funding data from Brazil, Chile, Colombia, Ecuador, and Peru, we examine variation in public education spending within each country to see if there are funding disparities between regions with high and low soecionomic status. More specifically, this paper addresses three questions. First, is the distribution of school funds unequal according to the socioeconomic level of regions within these Latin American countries? Second, what are the time trends in school funding inequality? Third, how do the sources of funding and allocation rules of each country mitigate or aggravate these inequalities? To estimate the socioeconomic gap in school funding within these five countries, we employ regression models to estimate the relationship between regions' poverty rate and funding level, controlling for determinants of educational costs (Baker, Sciarra and Farrie, 2014).

We found that Brazil, a federal country, has the widest socioeconomic funding gap due to large inequalities in local revenues between high and low SES regions. However, the country's funding gap has narrowed over time. School funding in Colombia has become more regressive over time, but its gap is half the size of the one in Brazil. The distribution of school funding in Peru has changed over time from being regressive—benefiting the richest regions—to being progressive—benefiting the poorest regions. Education spending in Chile and in Ecuador are, on the other hand, progressive. However, while the progressiveness of funding in Ecuador is driven by transfers targeted at disadvantaged rural areas, the funding formulas in Chile addresses socioeconomic inequalities beyond the rural-urban gap.

The economic crisis in many countries in Latin America—which has worsened with the COVID-19 pandemic—is prompting governments to reconsider spending priorities and reduce education budgets. Based on existing research, it is known that the level of resources in disadvantaged regions and schools tend to be affected more severely 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 that can inform the design of more equitable school finance policies in the region.

Money matters for education equity

In earlier decades, most of the school finance literature was based on correlational studies of the association between school spending and student outcomes. In his influential synthesis of this literature, Hanushek (1986) concluded that "There appears to be no strong or systematic relationship between school expenditures and student performance" (p. 1162). This claim has echoed for many years and has been embraced by policymakers and lay audiences—most notably, Bill Gate's *Washington Post* op-ed, in which he suggested that money does not matter because student achievement in America has remained virtually flat although per-pupil spending has more than doubled.[1] However, both Hanushek's meta-analysis as well as Gate's long-term trend argument have serious methodological limitations and provide insufficient evidence on the *causal* link between school spending and student outcomes (Hedges et al., 1994; Baker, 2018).

Recently, an increasing body of literature that uses more credible research designs has shown 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

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

United States (U.S.), some of these recent studies exploit exogenous variation in spending resulted from court-ordered school finance reforms and consistently show that changes in per-pupil spending caused by the passage of these reforms had an impact on students' achievement and attainment outcomes. Card and Payne (2002) investigated equity-based school finance reforms in the 1970s and 1980s and found that equalization of spending levels across poorer and richer districts lead to a reduction in the SAT achievement gap between students from diverse socioeconomic backgrounds. Studies have shown that post-1990 school finance reforms also 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).

Few studies have also estimated the long-term effects of these court-ordered school finance reforms. For example, Jackson and colleagues (2015) examined changes in funding driven by school finance reforms of the 1970s and 1980s and found that an increase in per-pupil spending by 10% each year for all 12 public school years increased educational attainment of all children by 0.27 years, increased 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) found 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 to be explained by a reduction in the 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 impacts educational outcomes. They evaluated the causal effect of the Excellence in Cities (EiC) program, which provided extra resources to schools in disadvantaged areas in England with the objective of improving their educational standards. They show that 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, Machin and colleagues also found that additional resources were more beneficial in more disadvantaged contexts.

Vegas and Coffin (2015) explore the correlational relationship between expenditure and student outcomes from a cross-country perspective. They found that increased spending is correlated with higher test scores in 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 cutoff point of expenditure, the association between spending and outcomes becomes less apparent and non-significant.

In Latin America, evidence on the impact of spending on student outcomes is scarcer. Gordon and Vegas (2004) investigate the effects of the Fund for the Maintenance and Development of Primary Education and Teacher Appreciation (known as Fundef, which antecedes Fundeb—a policy aimed at reducing regional tax imbalances by redistributing local revenues within states in Brazil based on student enrollment) and show that increases in spending induced by Fundef raised middle school enrollment in poorer states. The effects are modest, however. In Chile, Murname and colleagues (2017) found that income-based gaps in student test scores declined by one-third in the five years after the passage of the Preferential School Subsidy Law (SEP), a policy that

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

increased the voucher in 50% for low-income students providing a differential subsidy for disadvantaged schools. In addition to the effect of increased resources, changes in school incentives might also have contributed to the narrowing of the gap. Specifically, evidence suggests that higher competition among schools in poorer neighborhoods has improved the academic achievement of disadvantaged students (Nielson, 2013).

Although recent research has found that the positive effects of increased spending are larger 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., vast 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). In the same fashion, our goal is to provide a cross-country comparison of the distribution in school funding within Latin American countries.

School funding systems in Latin America

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

Two important caveats should be noted. First, this study focuses on the socioeconomic distribution of public spending on education. It is possible, therefore, that public education

spending in a country is progressive and, yet, the overall distribution of per-pupil expenditure can be unequal if higher-income students are sorted into fee-paying private schools. 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 distributed between 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 unit of analysis are municipalities and states. Municipalities are mostly responsible for pre-primary, primary, and lower secondary education, whereas states are responsible for lower and upper secondary education. Municipalities and states 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 governments' tax revenues are redistributed based on student enrollment through the Fund for the Maintenance and Development of Basic Education and Teacher Appreciation (Fundeb).[3] Fundeb is a state-specific fund, which means that revenues are raised and

[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.

redistributed across local school systems within each state. Therefore, the Fundeb per-pupil revenue in a rich state like Sao Paulo is higher than the Fundeb per-pupil revenue in a poorer state like Alagoas (Cruz et al., 2019). In the Fundeb funding formula, students are weighted differently based on education levels (pre-primary, primary, secondary education) and school type (full- vs. part-time school, rural vs. urban school, special need 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* (complement).

States and municipalities also receive transfers from the federal government for discretionary initiatives—such as *Brazil Carinhoso* (Affectionate Brazil), which is a program that transfers resources to local governments for investments in early childhood education—as well as education programs—such as funds from the *Programa Nacional de Alimentação Escolar* (National School Meal Program-PNAE) and from the *Programa Nacional de Apoio ao Transporte do Escolar* (National Program to Support School Transportation-PNATE). Most of the federal transfers are funded by *Salário-Educação* (Education Salary), which corresponds to a 2.5 percent tax on the payroll of all formal employers in Brazil. Part of the resources from *Salário-Educação* (40%) goes to the federal government to finance the aforementioned programs and the other 60% are distributed to states and municipalies in proportion to their share of student enrollment.

Lastly, in 2013, Brazil's Cogress passed a bill that designates part of the royalties from newly discovered oil fields to education. Because most revenues of oil and natural gas production come from old concession contracts, the amount of revenues accrued through oil production going to education is still low (an estimate of 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 system of vouchers: 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 specific characteristics of each school and of the population it serves, such as education 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 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 joining SEP is voluntary, by 2015 virtually all public schools and 78% of the subsidized private institutions participated in the program to receive additional resources to educate more vulnerable students.[6]

In addition to the vouchers, the central government also transfers to municipalities and private subsided schools resources related to specific programs such as transfers to small rural schools and some teacher bonuses—however, most of the central government transfers are

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

[5] In order to qualify to receive the additional SEP funding, students need to 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.

[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.

included in the voucher system. Moreover, municipalities can raise revenues for public schools through their local taxes. Public and private subsidized schools can also charge an additional fee of up to $100 a month to families in the form of copayments[7]. This study will examine socioeconomic inequalities in three 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, the main revenue for pre-primary, primary and secondary public education is transferred from the central government to Certified Local Authorities, CLAs (*Entidades Territoriales Certificadas*), and is called the *Sistema General de Participaciones* (General System of Participation, SGP). SGP is composed of three different transfers: i) *Provision del Servicio* (Provision of Service), which covers mainly staff salaries (teachers, management, and support personnel); ii) *Calidad-Matricula* (Quality Enrollment), which are transfers 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 schools and school networks to invest in all spending categories, except personnel costs. The

[7] Traditionally, only subsidized private institutions charge fees since public institutions can only apply them in secondary education and with the 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 government direct transfers (or benefits) to families such as legally reduced fees for public transportation and scholarships for indigenous students between grades 1 to 12. We are also excluding some private contributions such as donations and family investments including tutoring and private transportation. Finally, we are also not considering public funding (or enrolllment) for preschool institutions managed by JUNJI or INTEGRA.

distribution of the SGP Education for 2016 was: 93% for the first component and 7% for the two other components of quality (Enrollment and free of charge) (Pineros, 2016).

The SGP formula accounts for some regions' characteristics, including proportion of rural schools and distribution of students in different education 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 more disadvantaged students. In our data, we cannot discriminate this progressive portion of SGP. However, it represents a small share of the overall SGP (about 6 percent) and it is conditional upon the CLAs' academic performance—that is, this component of SGP benefits higher performing low SES CLAs. Because of this restriction, this progressive transfer is only granted to 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 are only 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 use revenue from their own-resources that come from: i) direct taxes (ex. alcoholic beverages), ii) indirect taxes, and iii) non-tax revenue (contributions, fines, services revenue) that local authorities spend on education. Local authorities have autonomy to allocate these resources, but 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—or *fiscales*—(76% of enrollment), publicly funded private schools—or *fiscomisionales*—(6%), municipal schools (1%), and private schools (17%). We focus our analysis on the public schools, which are fully funded by transfers from the central government. In Ecuador, public 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 in charge of the operation of 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 the coordination of the school districts and for providing them with technical support. Our study focuses on inequalities in school funding between districts.

Peru

In Peru, schools can be classified into three categories according to their funding scheme: public schools, privately-run public schools, and private schools. Our analysis focuses on public schools, which correspond to 64 percent of the schools in Peru. Public education in this country is mainly funded by transfers from the central government to regional educational executing units (*Unidades Ejecutoras, UGELs*), which are responsible for managing schools and executing the education budget within their jurisdictions.

The main central government transfer to education comes taxes collected by the national government and converted into the public budget as *Recursos Ordinarios* (Ordinary Resources). In 2018, these resources represented 86% of the public spending on education. The second most important source of funding for education are *Recursos Determinados* (Determined Resources) 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) that 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 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, local revenues account for less than 0.1% of public spending on education and were not included in this study.

In 2013, the Peruvian government implemented a differential compensation scheme for 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 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 a description of the sources of funding—this information is relevant to answer our third research question, which explores how the 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 revenues that are transferred from the central and/or sub-national governments to local administrative units. General transfers do not have equalization or compensatory components that specifically target low SES regions and/or schools. Transfers are classified as progressive when they include equalization or compensatory components that aim to increase per-pupil spending of more disadvantaged regions and schools.

Method

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

Equation (1)

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

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 because we think that transforming the distribution of resources can mask important inequalities in school funding—for example, when few regions have much higher education spending. To answer the first and second questions, which examine the average and trends in socioeconomic funding gap, we use the regions' total per-pupil spending. To answer the 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 examine how the estimated per-pupil spending by socioeconomic levels changes after controlling for determinants of education costs. As described in more details 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)

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

The argument for controlling for these factors is to make a fairer comparison between regions with different costs and needs. However, a couple of caveats are warranted. First, for countries that have fewer number of regions (e.g. Ecuador), adding controls to the model that are highly correlated among 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 higher comparable wage index tend to have higher SES. Disantangling these two contructs (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. Our inequality index is then calculated by dividing the predicted per-pupil spending of quintile 5 by that of quintile 1, as shown in equation 3.

Equation (3)

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

We estimate a separate model for each country. For questions 1 and 3, we measure the average school funding gap pooling data from 2014-2016 because these are the years for which

data are available for most countries, as table 2 shows. In 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 of government revenues and spending on education by sources of funding. In table 2, we show the years available for analysis 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

Countries	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Brazil															
Chile															
Colombia															
Ecuador															
Peru															

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 schools, including school meals, textbooks, and school supplies for

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

students (see footnote 8 for more details). In Peru, spending from own resources represent 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 from the analysis 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*), in which municipalities and states report detailed information on their education budgets by sources of funding on a yearly basis. Longitudinal data of student enrollment comes from Brazil's Census of Basic Education.

In Chile, data on transfers from the central government come from official data reported by the Ministry of Educacion (*Subvenciones a establecimientos educacionales*). Data on municipalities' own resources come from the National System of Municipal Information (SINIM by its acronym in Spanish), which gathers information from the executed budget reported by each municipality. Data on school fees paid by families are reported by schools to the Ministry of education (*Reliquidación FICOM*). All private subsidized schools requiring fees from families are mandated by the government to report their total annual revenue from school fees. Student enrollment was retrieved 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 revenues (ii) intergovernmental transfers, and (iii) expenditure categories. This is the main tool that the Ministry uses to monitor CLAs 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 for its acronym in Spanish) used to report the executed budget by different government agencies. Specifically, we use data on expenditure at the pre-primary, primary, and secondary levels on school staff, educational resources, short-term and long-term investments, and infrastructure. Student enrollment data come 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). These data contain the executed budget on education by 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) teaching continuous support; c) teacher training; e) internet; f) basic services; 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 were collected by its national Census in 2010 and the poverty threshold is ¼ of the country'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, and also including estimation techniques for small areas (MDS, 2018). In Colombia, the

socioeconomic 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 of 2010-2014 are based on consumption rather than income. They were estimated following poverty rates defined by the Statistics Bureau of Ecuador, World Bank Group, and 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). When data are available for multiple years, we use the average of poverty rates so that every region is on the same SES quintile over time, to allow for a more comparable time series analysis in research question 2.

Factors that influence education costs

With respect to variables that influence education costs, a factor commonly discussed in the school finance literature is the scale of schools or districts. Studies have attempted to estimate optimal enrollment sizes of school districts 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). However, 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 and it is not possible 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 better described by a 'U' shaped function in which the operation costs are higher 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 controlling for student population size, we also control for the populational density of each region to account for transportation and other costs of providing education to children living in remote and sparser areas. Brazil's data on populational density come from its 2010 Census. In Chile, these data come from the Statistics Bureau (2015). In Colombia, they come from the 2005 Census. In Ecuador, we use the data from the Statistics Bureau (2015) and in Peru, from the National Bureau of Statistics (INEI 2015).

Geographic variations in prices of products and services also influence cost differentials in education, especially variation in teachers' wages, which can account for up to 80 percent of education expenditures in Latin America (Elacqua et al., 2018). One approach to control for variation in teacher wages across regions involves cost-of-living adjustments (Baker et al., 2008; Duncombe & Yinger, 2008). Data on cost-of-living at the regional level are, however, only available for Brazil. This measure was calculated using the 2010 Census data and is based on the average monthly rental costs of all Brazilian municipalities (Franco, 2018).

Another approach to account for variation in teacher salaries is to use the competitive wage index based on the average wage of workers in other industries with similar qualifications as teachers. We estimate a Competitive Wage Index (CWI) using data from the countries' national household survey. A detailed description of the methodology and data used to calculate the CWI is provided in the appendix. Below, we provide a summary of our data:

Table 3. Data sources and availability

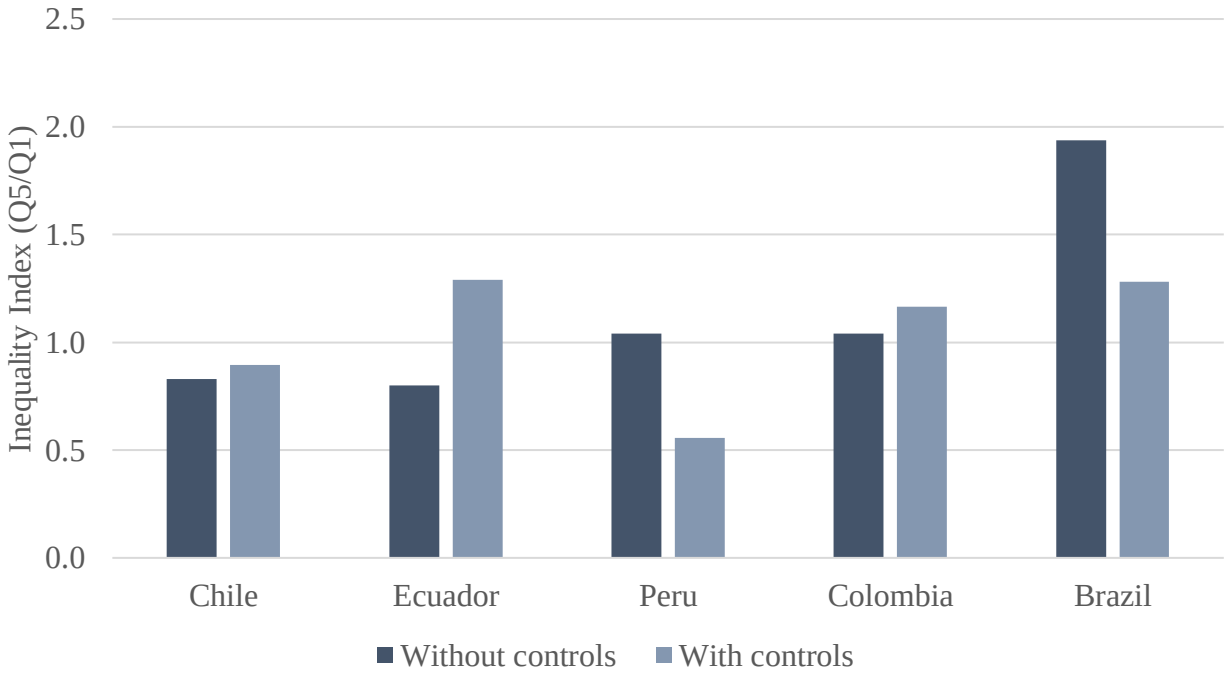
Countries	School Funding data		Student and school data	Poverty data	Populational density
	Source	Data excluded			
Brazil	Education Budget Information System (SIOPE)		Census of Basic Education	2010 Census	2010 Census
Chile	Ministry of Education (transfer from central government and school fees) and SINIM (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 StatisticsDANE	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

In this section, we show how public education spending is distributed across regions with different socioeconomic backgrounds in Brazil, Chile, Colombia, Ecuador, and Peru. Our first question explores whether the distribution of school funding within these countries is unequal. Tables 5 through 9 (in the appendix) show the results of equation 1 and 2 for all countries. Figure 1 summarizes the inequality indices before and after adding all controls to the model (that is, enrollment size, population density, and comparable wage index). Countries with an index greater than 1 (e.g., Brazil, Colombia and Peru) have an unequal distribution of school funding, in which

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

Figure 1. Inequality index before and after controlling for costs



The school funding inequality changes in different ways before and after controlling for cost differentials. For every country, there is a similar correlation between SES and factors that influence cost differentials in education: larger regions with higher population density and higher comparable wage index have lower poverty rates (and, therefore, 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 index have higher per-pupil spending. When we account for regions' characteristics, the socioeconomic funding gap in favor of rich regions decreases in both countries—in the case of Peru, the distribution becomes progressive. 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, on the other hand, is consistently progressive, before and after controlling for determinants of education costs. Unlike Ecuador, where progressive trasfers focus mostly on rural areas (which tend to be low SES), Chile's funding formulas account for rurality *and* have specific weights for student and school socioeconomic status. That explains why, after controlling for populational density (which correlates with whether regions are rural or not), school funding in Ecuador becomes regressive, while school funding in Chile is still progressive.

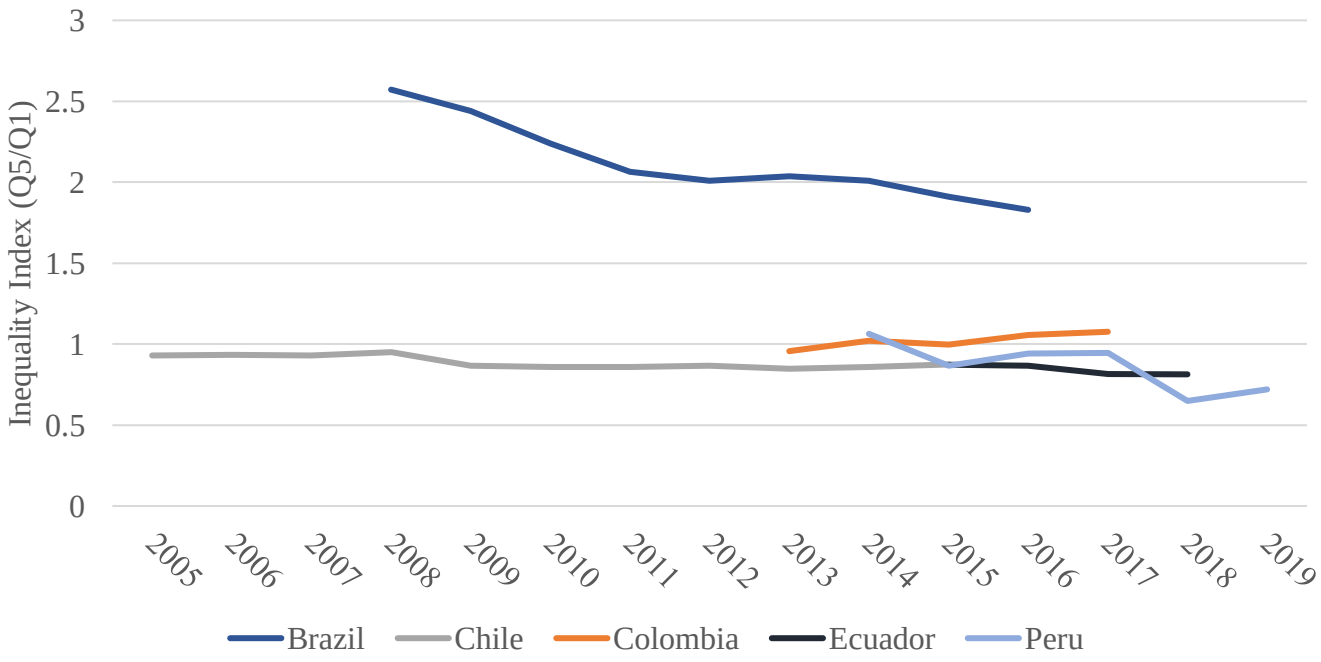
In all countries, except for Brazil, data are missing for some control variables. However, a comparison between models 1 and 2 in tables 6 through 9 shows that the inequality index is similar between the full sample and the sample without cases for which control variables are missing. Moreover, Brazil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

Next we show the results of questions 2 and 3 using a model without controls of cost differentials. As explained above, adding controls affects the precision of estimates in countries

with fewer regions. Moreover, because SES is highly correlated with our proxies of cost differentials, adding controls reduces the progressive spending that comes from transfers to low SES regions with 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 and shows the inequality index over time for each country without controlling for determinants of education costs. In the appendix, we show the trends in per-pupil spending separately for low- and high-SES regions to facilitate the interpretation of changes in school funding inequality over time.

Figure 2. Trends in school funding inequality



School funding inequality in Brazil decreases considerably over time. Figure 8, in the appendix, shows that both low and high SES regions in Brazil experience an increase in per-pupil spending between 2008 and 2012, probably due to the country's economic growth during this period. However, per-pupil spending increased more rapidly in low SES regions, narrowing the school funding gap.

In Chile, the inequality index remains fairly stable over time. The inequality index changes slightly after 2008 with the passage of *Ley SEP*, a policy that increased the voucher for poorer students and transfers for schools with large concentrations of disadvantaged students. Because *Ley SEP* are weighted transfers based on characteristics of schools (rather than regions), it probably played a more important role in reducing the socioeconomic funding inequality between schools of different socioeconomic levels *within* regions (municipalities). We do not see a big difference in the school funding gap after *Ley SEP* because our analysis focuses on the inequality between regions, rather inequality between schools. Moreover, it appears that a crowding out of funding occurred after the implementation of *SEP*, in which 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: while there has been a steady increase in per-pupil spending among high SES regions, the growth in per-pupil spending among low SES regions slowed down after 2015 (see figure 10 in the appendix). In Ecuador, the distribution of school funding has become slightly more progressive over time because per-pupil spending increased at a faster rate across low SES regions (see figure 11). Lastly, in Peru, the distribution of resources has become more progressive over time, in part because of the expansion of monetary incentives for teachers who work in disadvantaged and rural schools (Bertoni et al., 2019).

Lastly, we show how school funding is distributed across regions by sources of funding. Drawing on Baker and Corcoran's (2012) graphical representation of the school funding gap in the United States, we show the predicted per-pupil spending by sources of funding for each quintile

of SES in figures 3 through 7—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

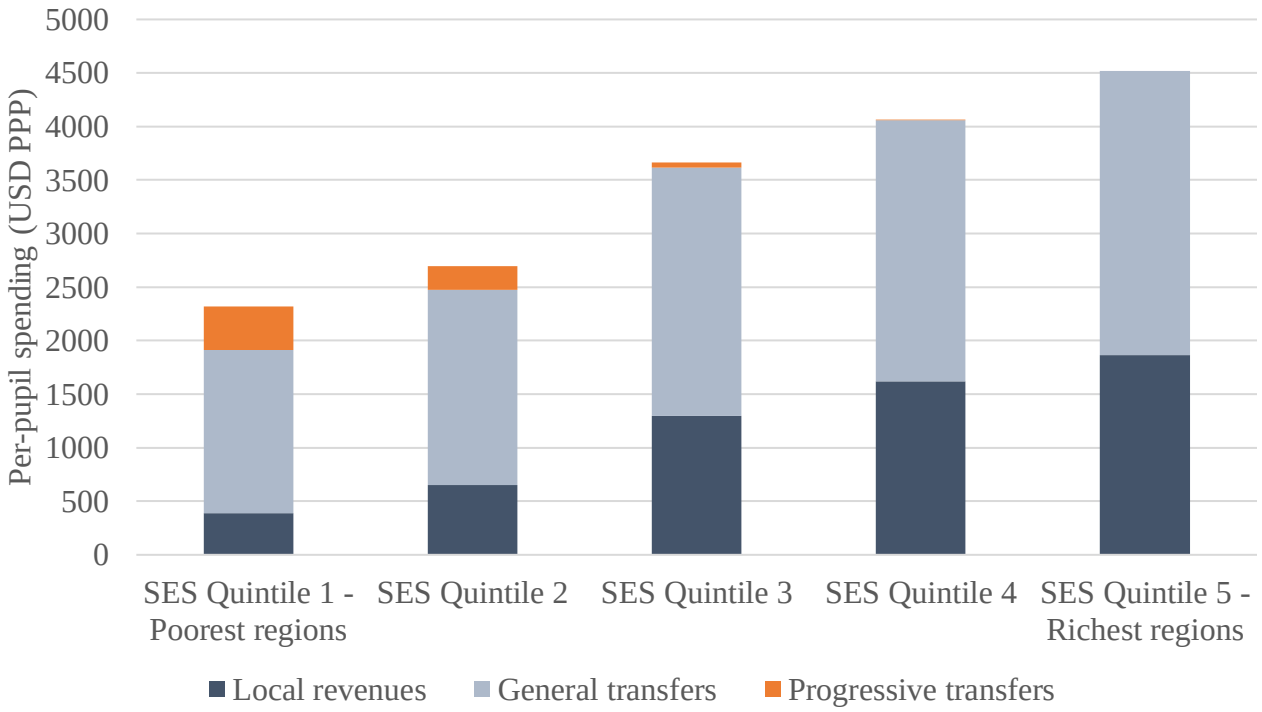


Figure 4. School funding inequality by source of revenue and SES – Chile

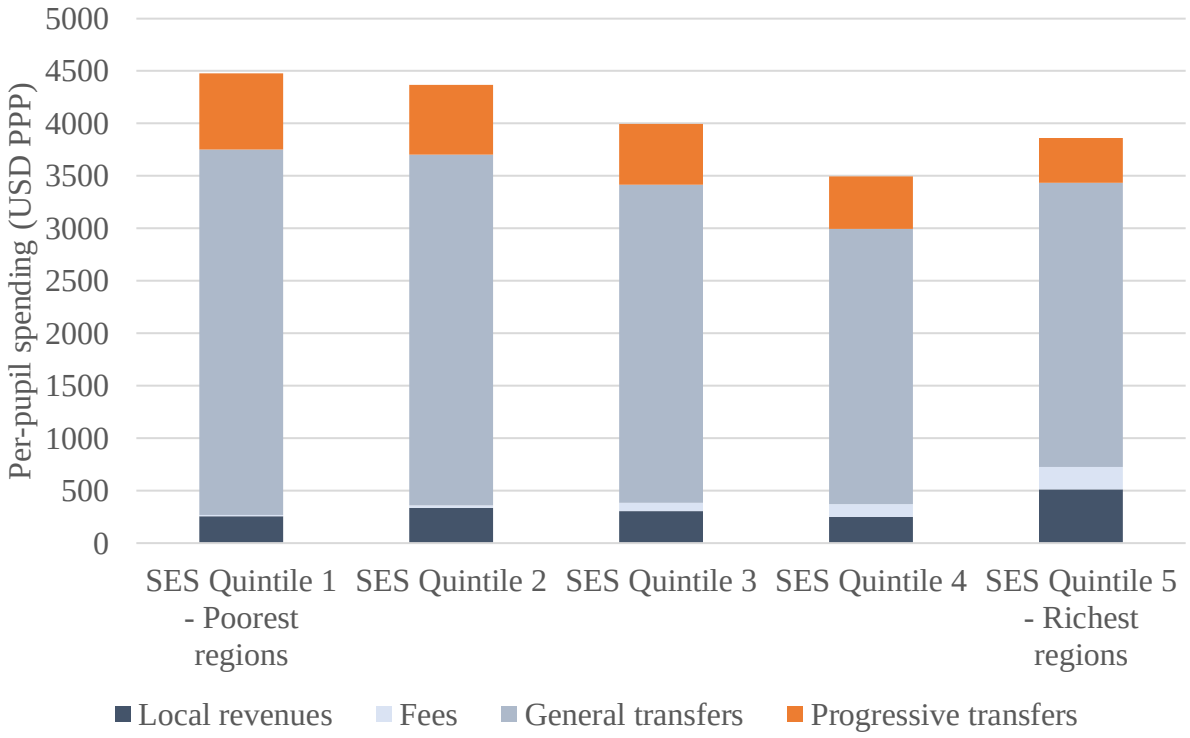


Figure 5. School funding inequality by source of revenue and SES – Colombia

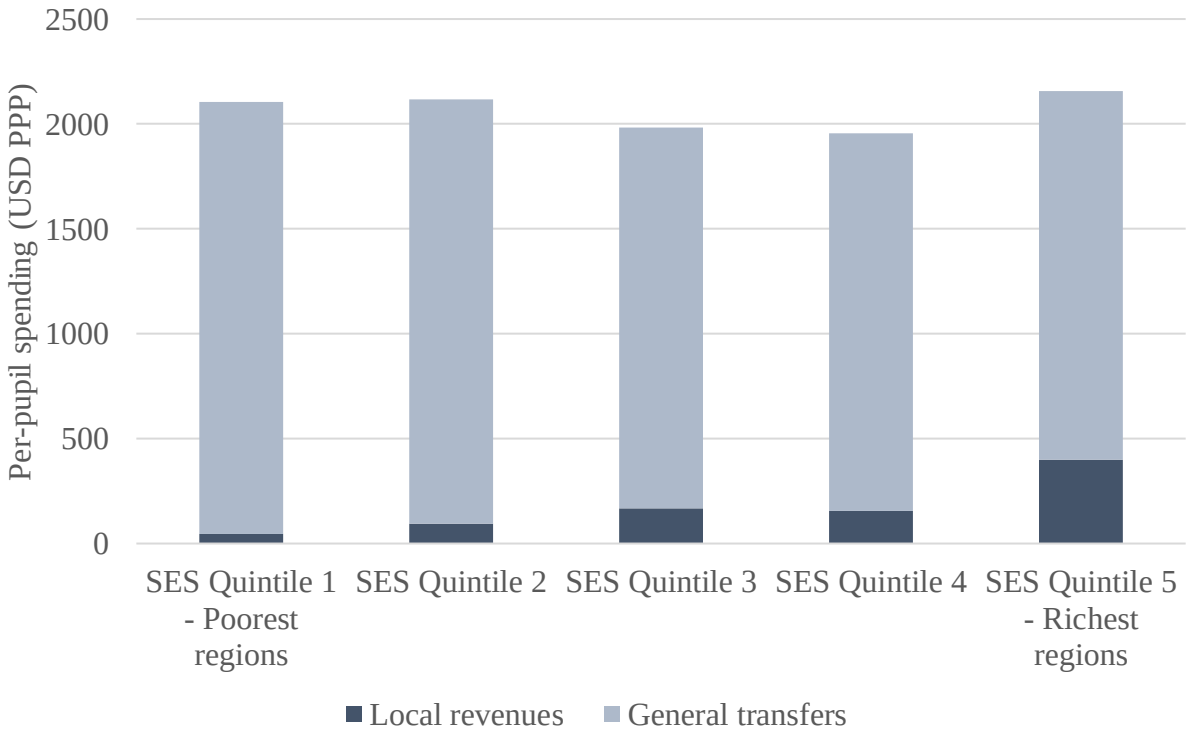


Figure 6. School funding inequality by source of revenue and SES – Ecuador

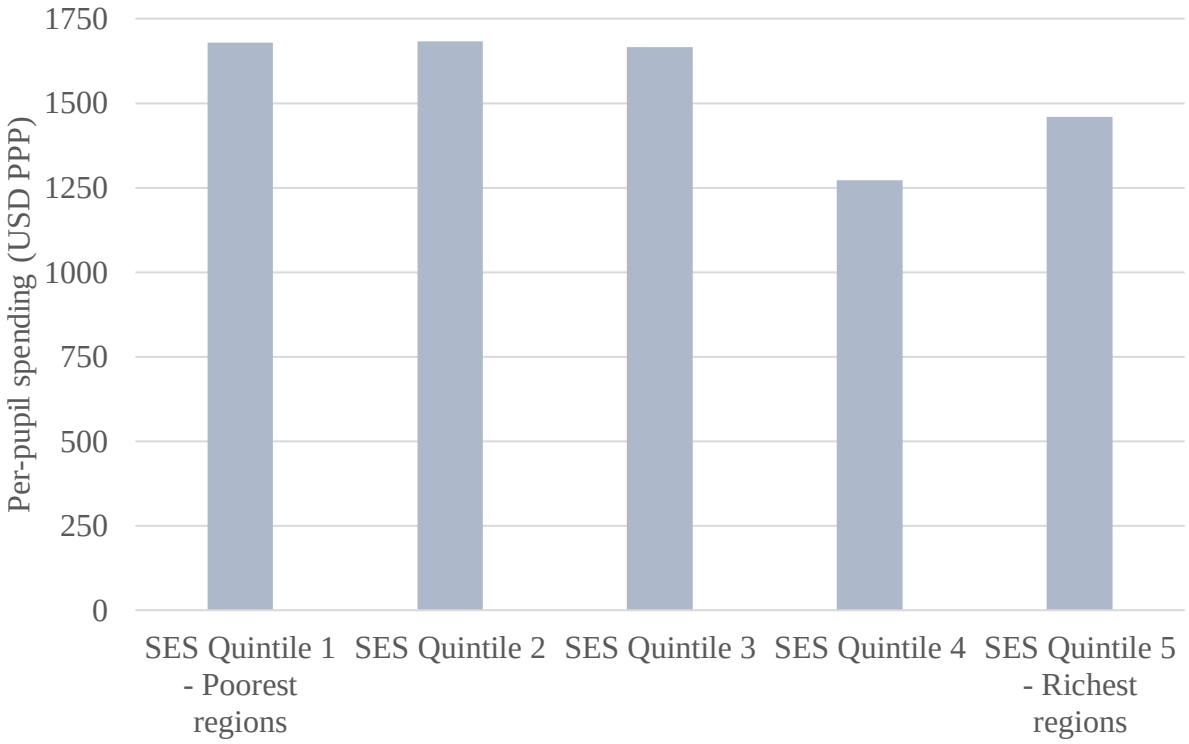
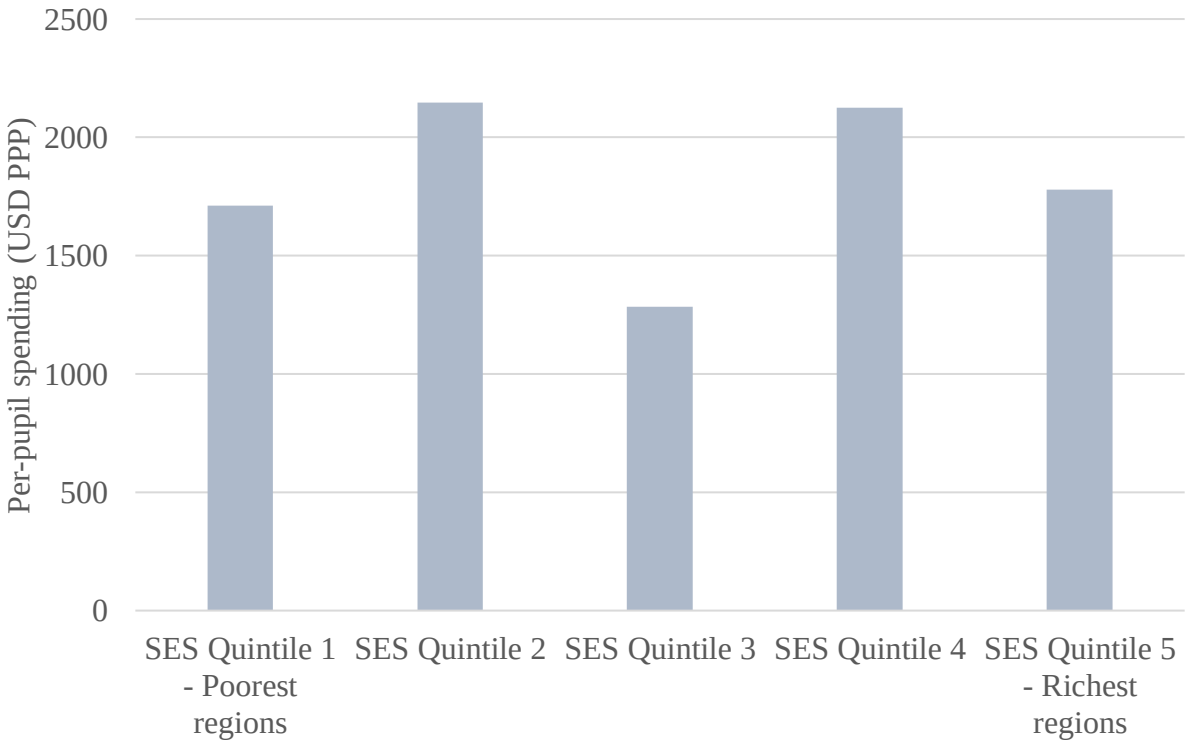


Figure 7. School funding inequality by source of revenue and SES – Peru



Not surpringly, education spending from local revenues are unequally distributed. Since the regions' ability to raise revenues is usually a function of the local wealth (e.g., level of economic development, property wealth, and income), poorer regions tend to accrue fewer education dollars per student than 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 regions' total revenue. For example, although the distribution of local revenues is much more unequal in Colombia than in Brazil (compare model 2 between tables 11 and 13 in the appendix), the regions' own resources in Brazil play a more important role in the overall socioeconomic funding gap 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. School fees, like the municipalities' own resources, are unequally distributed across regions with differing SES. However, school fees and local revenues represent a smaller proportion of the total spending on education in Chile and, 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 a higher weight to enrollments in certain education levels, including pre-primary and secondary school. Richer regions tend to receive more resources through these transfers because they can afford to expand early childhood education with their own resources and, in these regions, students are also 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 the previous years' transfers. The inequality in school funding in this country may result from the fact that richer regions have more political power to negotiate and bargain resources for public education. However, note that, as shown in figure 2, the distribution in school funding has become more progressive over the last couple of years.

Although central government transfers in Ecuador are also discricionary, they generally benefit regions at the bottom of the SES distribution—except that education spending in quintile 5 of SES is higher than in quintile 4. As explained above, the progressiveness of funding in Ecuador is driven by the fact that investments focused on disadvantaged rural regions.

In Colombia, general transfers from the central government to local authorities are generally progressive. This may reflect the fact that SGP, the country's main funding formula, transfers more resources to regions with a higher proportion of rural schools. Moreover, as explained above, SGP has a progressive component focused on low SES CLAs with high performance—which is not discriminated in our analysis due to data limitations. Although this is a small share of the overall SGP resources (6%), it may be contributing to a more equitable distribution of "general transfers." In Colombia, 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 aimed at compensating for regional differences in education spending. In this study, we highlight progressive school finance policies from Brazil and Chile. In Brazil, Fundeb's *Complementação* ("complement") can be classified as a progressive government transfer, since it is targeted at poorer states where the Fundeb per-pupil funding does not meet a minimum amount determined nationally. In Chile, transfers from *Ley SEP* are also progressive because they target

disadvantaged students and schools. Fundeb's complement is more equitably distributed between regions than *Ley SEP* (compare model 4 in table 10 and model 5 in table 11). This is not surprising because Fundeb's complement is specifically aimed at compensating for disparities in per-pupil spending *between* regions, while *Ley SEP* focuses on funding inequalities between schools. However, progressive transfers from *Ley SEP* represent a much higher proportion of the overall public education spending than expenditure from Fundeb's complement, which is not enough to significantly reduce the spending gaps across regions in Brazil.

Discussion

Latin America has experienced remarkable growth in public education spending over the last decades. However, less is known about whether increased spending has been translated into a more equitable distribution of resources within Latin American countries. Moreover, the economic crisis faced by many countries in the region—which has worsened with the advent of COVID-19—can affect more severely vulnerable regions and schools, increasing the inequality in school funding (Baker, 2014; Evans, Schwab, Wagner, 2014; Jackson, Wigger, Xiong, 2018). In this scenario, school finance strategies are key policy tools to improve equity in public education spending. Our findings can inform policymakers and contribute to the comparative literature on school funding by providing original evidence on the distribution of per-pupil spending in the region.

Using school funding data from Brazil, Chile, Colombia, Ecuador, and Peru, we examined patterns and trends of inequalities in public school spending between high and low socioeconomic regions. Following existing analysis of school funding fairness (Baker, Sciarra and Farrie, 2014), we measured the socioeconomic inequality in school funding and analyzed 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 some regions, the costs of services and products are higher than in others. However, we found 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 are aimed at reducing the rural-urban gaps in education. Ecuador's distribution of school funds, which is initially progressive, becomes regressive after controlling for populational density of its regions. In our study, we found that controlling for determinants of education costs can underestimate important patterns of progressiveness, specially in countries with a large rural and indigenous population, such as Ecuador.

We also found that Brazil has the widest socioeconomic funding gap among the countries we examined. This is not surprising given that Brazil is a large, diverse and highy unequal federal country, where education is largely funded by local governments. Considering that the regions' ability to raise revenues is a function of local wealth (e.g., level of economic development, property wealth, and income), poorer regions tend to spend fewer education dollars per student than richer regions (Hinchliffe, 1989; Baker & Corcoran, 2012). Our results show that, despite being highly progressive, funding from the Fundeb complement is not enough to eliminate the socioeconomic spending gap between regions, since it represents a very small proportion of the total expenditure in education. In that sense, Chile is more successful at narrowing the socioeconomic funding gap because the largest shares of education spending come from general and progressive transfers that favor the poorest regions.

Progressive school finance policies may improve the redistribution of school funding between regions, but they may not affect the funding inequality between schools if local

governments do not have incentives to invest more in disadvantaged schools. For example, Elacqua et al. (2019) explore data from the state of Pernambuco in Brazil and reveal that per-pupil spending in schools with high SES students is 1.5 times higher than per-pupil spending in low SES schools. The authors found that the between-school inequality in per-pupil spending results largely from full-time secondary schools with more skilled teachers and better equipment attracting more high SES students.[10] Similarly, Cascio et al. (2013) examined the effects of Title I—United States' largest federally funded educational program that awards funds to school districts based on child poverty counts—and found that additional spending induced by the program did not benefit the most disadvantaged students, as the federal government intended. 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 target the redistribution of resources *within* regions so money will matter for the most vulnerable students.

The scenario of economic crisis posed by the COVID-19 pandemic risks exacerbating existing inequalities in educational opportunities in Latin America, unless these countries implement progressive, properly designed, and effectively evaluated financing policies. As discussed above, such policies may include funding formulas that assign greater weights 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 students. Moreover, these policies should be transparent and institutionalized by law in order to ensure a sustainable progressive school funding system. Finally, it is important that progressive school funding policies create incentives for greater

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

financing efforts to be directed towards the most disadvantaged students in order to promote their learning, thus contributing to narrow existing learning gaps.

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Appendix

Comparable Wage Index (CWI) – methodology and data

To estimate the Comparable Wage Index (CWI), we estimate the average wage of noneducation workers that have similar education levels and professional skills 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' salary (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 surveys[11]. One caveat should be taken into account: our index is only available for the geographic areas for which the national surveys were designed to produce reliable estimates. Therefore, the school funding data and the CWI data are not necessarily at the same level, but the regions 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. The school funding data for Brazil, on the other hand, have states and municipalities. In our analysis, all Brazilian municipalities that are located within the same state receive the same index of Comparable Wage. 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 compares 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	Divisiones territoriales	287	335
Colombia	Departamentos[12]	25	94
Ecuador	Provincias[13]	18	140
Peru	Regions	25	175

To calculate the regions' CWI, we first use a model to estimate the salary of individual *i* in country *c* for noneducator workers who graduated or are attending college and who are employed in a full-time job:

$$\begin{aligned} \boldsymbol{Log\ W_{ic}} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1 work\_hours_{ic}} + \boldsymbol{\beta_2 gender_{ic}} + \boldsymbol{\beta_3 age_{ic}} + \boldsymbol{\beta_4 age_{ic}^2} \\ + \boldsymbol{\beta_5 education_{ic}} + \boldsymbol{\beta_6 indigenous_{ic}} + \sum_{1}^{J} \boldsymbol{\gamma_1 ocupation_{ic}} \\ + \sum_{1}^{R} \boldsymbol{\gamma_2 region_{ic}} + \boldsymbol{\gamma_3 urban_{ic}} + \boldsymbol{e_{ic}} \end{aligned}$$

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

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

[12] Information in GIHS Survey was unavailable to 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 GIHS is not disaggregated at this level.

[13] Information was unavailable to Galapagos, Morona Santiago, Napo, Orellana, Pastaza, Sucumbios, Zamora Chichipe).

$$CWI_{rc} = \widehat{\beta_0} + \widehat{\beta_1} * work_{hours_{rc}} + \widehat{\beta_2} gender_{rc} + \widehat{\beta_3} age_{rc} + \widehat{\beta_4} age_{rc}^2$$
$$+ \widehat{\beta_5} education_{rc} + \widehat{\beta_6} indigenous_{rc} + \sum_{1}^{J} \widehat{\gamma_1} ocupation_{rc}$$
$$+ \widehat{\gamma_2} region_{rc} + \widehat{\gamma_3} urban_i$$

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

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

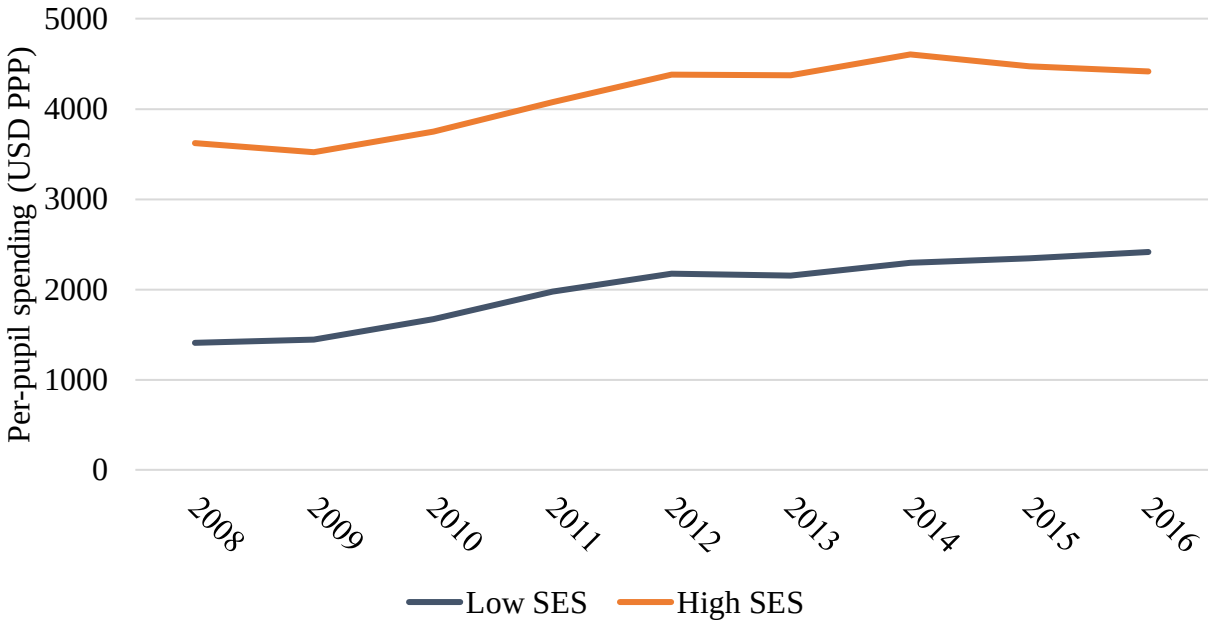


Figure 9. Trend in school funding between low and high SES regions – Chile

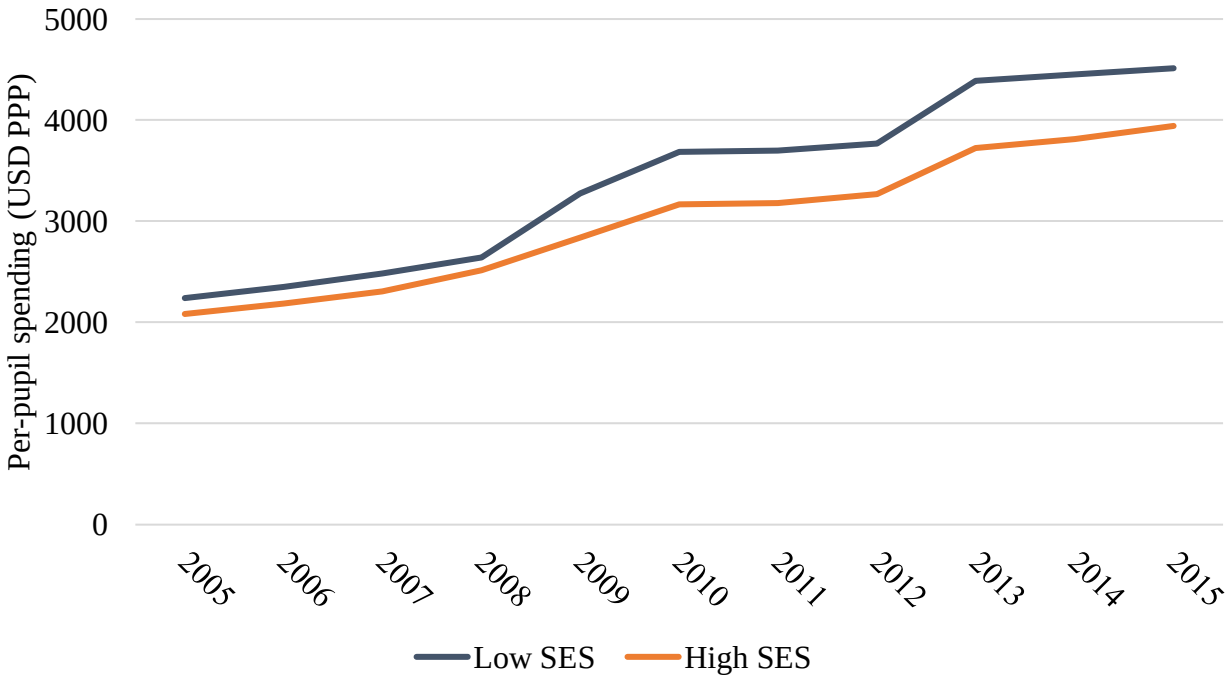


Figure 10. Trend in school funding between low and high SES regions – Colombia

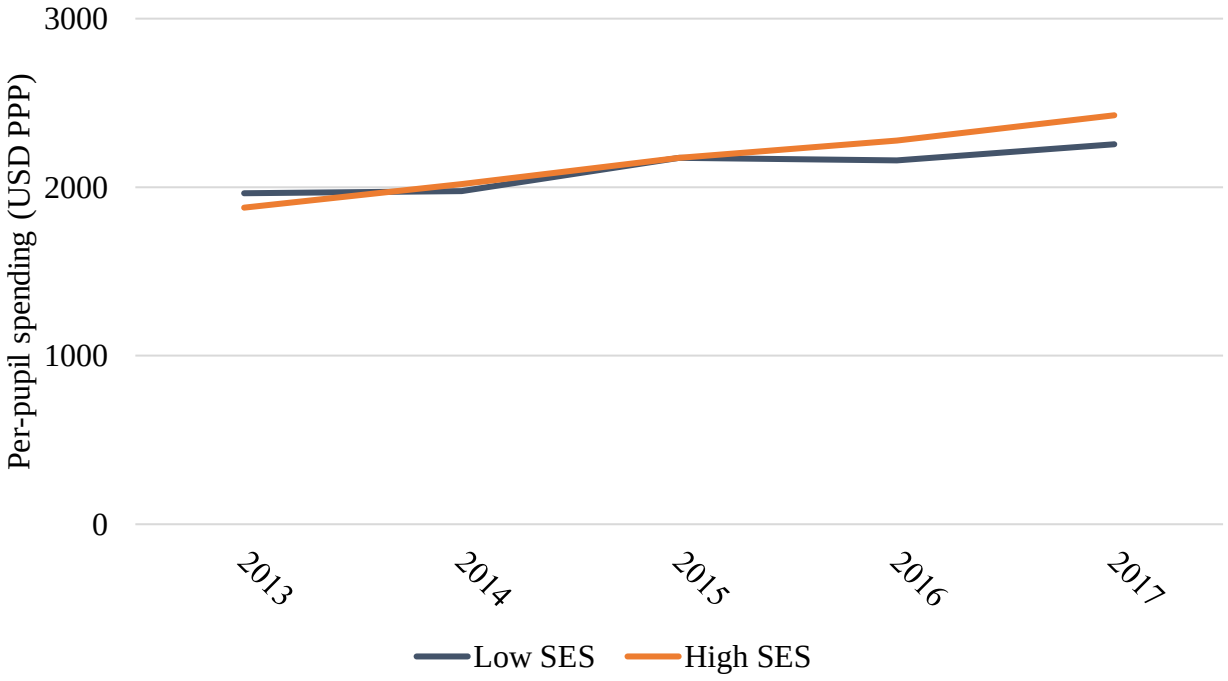


Figure 11. Trend in school funding between low and high SES regions – Ecuador

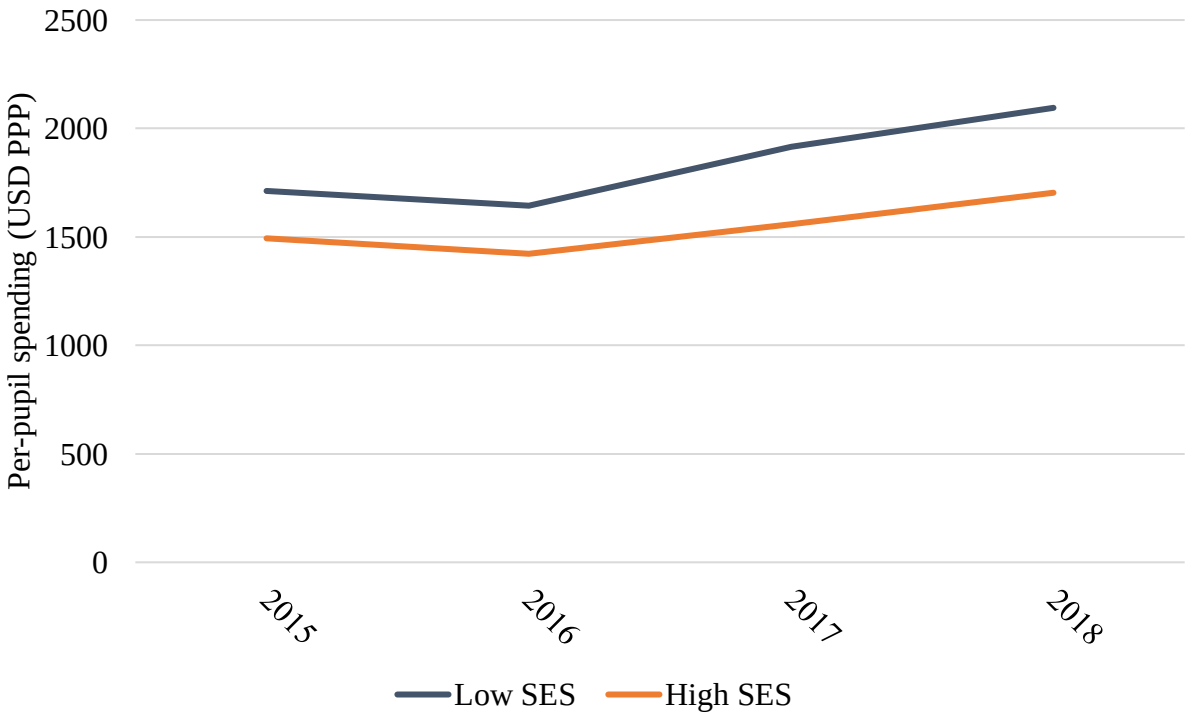
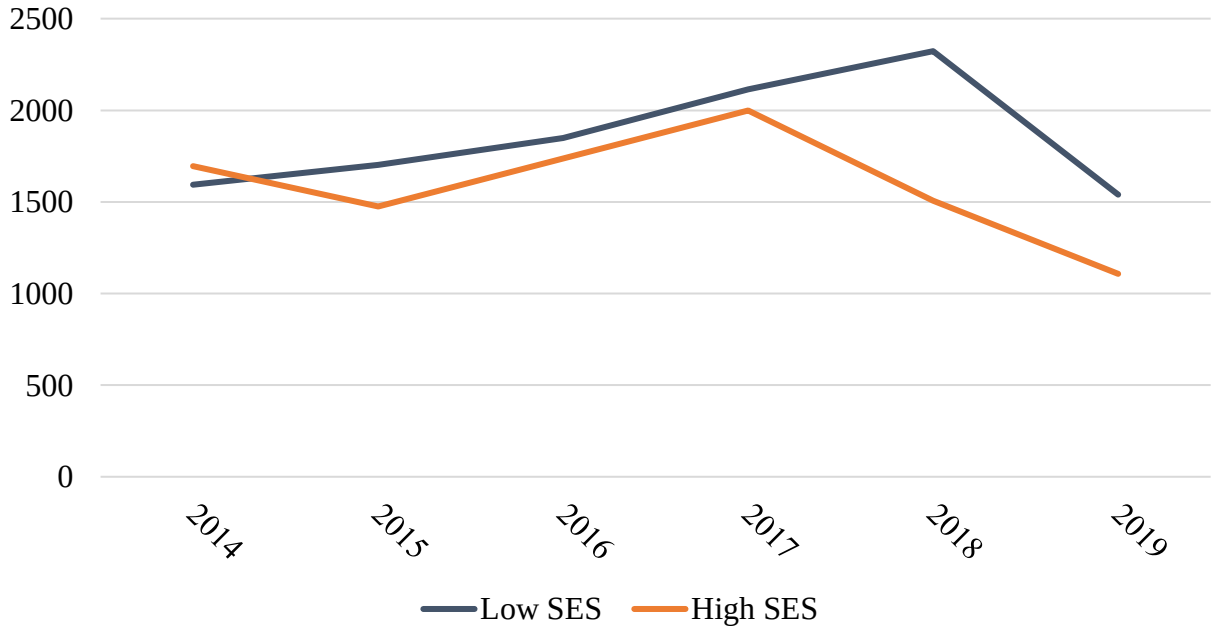


Figure 12. Trend in school funding between low and high SES regions – Peru



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

Table 11. School funding inequality by sources 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 sources 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 sources 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