

Bertoni, Eleonora; Elacqua, Gregory; Jaimovich, Analía; Rodriguez, Julio; Santos, Humberto

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Teacher policies, incentives, and labor markets in Chile, Colombia, and Perú: Implications for equality

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Bertoni, Eleonora
Elacqua, Gregory
Jaimovich, Analía
Rodriguez, Julio
Santos, Humberto

Inter-American Development Bank
Education Division

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1300 New York Ave NW. Washington DC, 20577 United States

Teacher policies, incentives, and labor markets in Chile, Colombia, and Peru: Implications for equity

Eleonora Bertoni, Gregory Elacqua, Analía Jaimovich, Julio Rodríguez & Humberto Santos

August 24, 2018

Abstract

This paper contributes to the teacher sorting literature by analyzing equity in the distribution of teachers in three educational systems in Latin America, with different equalization policies, teacher assignment rules, and incentives to work in disadvantaged schools: Chile, Colombia, and Peru. We use unique micro-data at the teacher and school level to describe the distribution of teachers across the three systems. Two main conclusions emerge from our results. First, we find that differences in the sources of funding and teacher salaries legislation can affect the equity in teacher allocation between administrative units. Second, we find substantial teacher sorting across schools (vertical inequities) in the three systems. Overall, the comparison of the three countries confirms that, after controlling for confounding variables, disadvantaged students, particularly those in rural areas, are more likely to attend schools with teachers who are less qualified (temporary and inexperienced) and paid less. One of the most consistent findings in this analysis are the vertical inequities across the three measures in Colombia. In contrast, in Chile, the three measures have an inconsistent and weak relationship with mother's level of schooling and a moderate relationship with the geographic location of the school (rural). While our analyses are descriptive and do not attempt to identify the underlying causes of these patterns, we suggest that these differences are related to the salary structure and hiring policies in the three countries. We discuss some policy alternatives to increase equity, including the introduction of monetary and non-monetary incentives to attract teachers to hard-to-staff schools, improving the working conditions and modifications in the teacher hiring and assignment process.

Keywords: Teacher sorting, Latin America, School finance

JEL Classification: I220, I240, J450.

1. Introduction

Having a high-quality teacher can dramatically improve student's academic (Araujo et al., 2016) and economic outcomes (Chetty et al., 2014). At the same time, evidence shows that rural, isolated, and low-performing urban schools that serve disadvantaged students have difficulties to attract and retain high-quality teachers (Lankford, Loeb and Wyckoff, 2002; Hanushek, Kain and Rivkin, 2004; Feng, Figlio and Saas, 2010; Clotfelter, Ladd and Vigdor, 2006). A growing literature in Latin America shows that teachers sort unequally across schools, with novice and uncertified temporary teachers often found in rural schools and in low-performing urban schools with high concentrations of low-income students (for Brasil: Rosa, 2017; for Chile: Meckes and Bacospé, 2010; Ortuzar et al, 2009; Ruffinelli and Guerrero 2009; for Colombia: Fundación Compartir, 2014; for Peru: Jaramillo, 2013). There is also evidence that teacher sorting is associated with wider learning gaps (Jackson, 2009). Given that in most systems salaries are determined by observable teacher characteristics (e.g. experience and educational level) and, in some cases, by the results on teacher evaluations, sorting inequity also has an impact on the distribution of resources, especially since teacher salaries represent a high share of the total spending in education in most countries.¹

The determinants of teacher sorting are related to both supply and demand factors. On the supply side, teachers choose the region or municipality and the school to apply to, based on monetary and non-monetary working conditions (e.g. salary and benefits, location, characteristics of the contract, school climate, socioeconomic and racial composition, etc.). On the demand side (i.e. the school or the administrative level at which teachers are hired), there are four policies that can affect the allocation of teachers: i) Policies that define teacher salary composition (e.g. autonomy of local levels of government and schools to raise resources to be spent on salaries and incentives to work in hard-to- staff schools); ii) Hiring mechanisms (e.g. the rules defining teacher assignment to schools and the use of uncertified or temporary teachers); iii) Rules that regulate the mobility of teachers across schools; and iv) Regulations on personnel needs by school (e.g. minimum/maximum number of students per teacher).

Based on these factors, policymakers and researchers have introduced measures to mitigate the sorting of teachers across local governments and schools. For instance, several systems have modified the school funding formulas to offset spending differences across municipalities due to differences in local wealth. However, governments have adopted different measures to pursue this objective. Some school systems (e.g. some states in the United States such as New Jersey and the federal government of Brazil) changed the parameters in their funding formulas to include equalization plans (i.e. special funds focused on low-income regions). Other school systems have created incentives for low-income districts to raise local spending, by increasing transfers to disadvantaged districts with higher local tax rates (e.g. the state of Georgia in the United States). Other systems impose limits on the amount a local government can spend on education².

¹ On average, around 62% of current expenditure in education is used for the compensation of teachers for both primary and secondary education in OECD countries (OECD, 2017). For some countries in LAC these percentages are even higher. For example, in Mexico, Argentina and Colombia those figures amount to 85%, 72%, and 78% in primary, and 65%, 68%, and 85% in secondary, respectively.

² For example, Colombia and Peru centralized the teacher salary scale and local governments are not permitted to increase salary spending with resources raised at the local level. The objective of these measures is to limit the sorting of the most talented teachers to the highest spending local governments.

Recent evidence in the United States finds that school finance equalization reforms caused increases in spending, teacher salaries and achievement in low-income and low-wealth districts (Lafortune et al., 2016; Jackson et al., 2016). Elacqua et al. (2017) find that equalization plans in Brazil increased resources for low-income municipalities but were not enough to eliminate spending disparities with more advantaged municipalities. However, there is evidence that increasing taxes through reward programs and spending limits can generate the unintended consequence of reducing overall spending (Jackson et al., 2016).

While there is a growing literature on the effects of policies on per-pupil spending and teacher salaries across local levels of government, less attention has been paid to the policies that influence teacher sorting across schools. One approach is through the hiring and school matching processes – to assign teachers to schools based on needs rather than teacher preferences³. Elacqua et al. (2018) find that in Latin America, while most countries give teachers the ability to choose where to work, systems have adopted different assignment rules. In some countries (e.g. Argentina and Chile), local governments and schools have discretion over the hiring and matching processes and teachers can apply to multiple local districts. Other systems have adopted centralized hiring processes where candidates are ranked based on their performance on the screening assessments and interviews (e.g. Colombia, Mexico, Peru, most municipalities and states in Brazil)⁴. In many systems, more experienced teachers with higher teaching credentials (e.g. graduate degrees) are also given priority to transfer schools (e.g. Buenos Aires, Ecuador, Rio de Janeiro) over other teachers.⁵ While these policies may be effective to attract higher quality candidates into the profession (teachers have more freedom to choose), they may also generate systematic sorting since observably better teachers will be more likely to apply or transfer to the most desirable schools.

Luschei, Chudgar & Rew (2013) analyzed the distribution of effective teachers in Mexico and South Korea and found that qualified teachers were more likely to work in disadvantaged schools in South Korea and more advantaged schools in Mexico. Specifically, in South Korea students living in rural areas and those in schools with lower average parental education have greater access to better educated and more experienced teachers. In contrast, in Mexico, novice and uncertified teachers are more likely to work in rural and low-income urban schools. The authors maintain that the policy of mandatory teacher rotation every five years in South Korea works as an equalizer since every teacher ends up working in schools with different backgrounds.

An alternative approach for promoting an equitable distribution of teachers is to pursue compensation strategies through salary adjustments⁶, incentives, or rapid advancement in a teacher's career path, to

³ For example, South Korea has a system of mandatory rotations every five years, which requires teachers to work in schools based on student needs as defined by national policymakers. Singapore also centrally assigns teachers to schools based on school needs. China also recently centralized deployment decisions from the township to the county government and introduced mandatory rotation of teachers within each region. These systems prevent the concentration of effective teachers in more advantaged schools and give more flexibility to authorities when allocating teachers. However, centralized policies that limit teacher choices and mobility based on preferences may backfire in systems that struggle to attract high quality professionals into teaching.

⁴ The highest ranked candidates have priority to choose among the available vacancies. Low ranking candidates are often forced to choose among the least desirable vacancies that higher ranked candidates did not select. The schools that are unable to fill their vacancies with certified teachers, are often forced to hire uncertified or temporary teachers who did not pass certification examination.

⁵ Some systems require teachers to stay at the contract school for a minimum number of years. For example, teachers in Rio de Janeiro, are required to stay at their first school (*escola de origem*) for 5 years before formally requesting a transfer.

⁶ There is a growing literature in the United States on the effects of differential pay in hard-to-staff schools. Most evidence finds that monetary incentives are effective to attract qualified applicants to work in disadvantaged schools (e.g. Ladd et al.). However, the size of the salary increases influences teacher decisions to work and remain in these schools (Glazerman et al., 2013).

make up for differences in the level of challenge teachers face associated with teaching large proportions of disadvantaged students or working in schools located in isolated areas or high crime urban neighborhoods. For example, targeted teacher incentives have been used in many urban school systems to mitigate the problem of disadvantaged and minority students being taught by uncertified teachers with little experience or training (e.g. Steele et al., 2010). In addition, in many developing countries teacher incentives are used to attract more talented teachers to rural and isolated areas (e.g. Elacqua et al., 2018 for Latin America). Recent reforms in Mexico and Peru have introduced measures for teachers that choose to work in more disadvantaged schools to advance more rapidly in the career path. Peru also allows a proportion of student college loans to be forgiven for rural school teachers.⁷

This paper contributes to the teacher sorting literature by analyzing equity in the distribution of teachers in three educational systems in Latin America, with different equalization policies, teacher assignment rules, and incentives to work in disadvantaged schools: Chile, Colombia, and Peru. The contribution of this paper is twofold. First, to the best of our knowledge, this is the first analysis of equity in teacher distribution at the school level in Latin America. Second, it is the first comparative study of the policies that influence teacher distribution in the region.

The paper is organized as follows. In the first section, we describe the equalization policies, adopted in the three countries to address regional disparities in educational spending, that may influence teacher sorting. We then review the sources of funding of teacher salaries, the teacher assignment and transfer policies and the monetary and nonmonetary incentives to work in disadvantaged schools in each system. Next, we present new empirical analyses examining teacher sorting across local governments and schools in Chile, Colombia, and Peru. We conclude with a discussion of policy implications.

2. Policies influencing the distribution of teachers in Chile, Colombia and Peru

This section summarizes the design of the policies that influence the equity in the distribution of teachers in Chile, Colombia and Peru.

Sources of funding for teacher salaries and equalization policies

Chile⁸

There are two types of schools that receive public funds in Chile: i) public schools, which are administered by local government institutions (municipalities) and which enroll approximately one-third of students,

⁷ Recent legislation in Ecuador requires all teachers to work at least one year in a rural school. However, this measure is currently not enforced.

⁸ Important educational reforms have been implemented since 2016 in the country. See, for example, Jaimovich et al. (2018). We are going to describe the system as it was before the application of those policies, because for this study we are using data from 2015.

and ii) subsidized privately managed schools, which represent a little under two-thirds of total enrollment.⁹ Both school types receive the same per-pupil voucher¹⁰ from the Ministry of Education (MINEDUC), determined by a formula that uses a base subsidy (*Subvención de Escolaridad*) which depends on the school curriculum (e.g. extended day) and the grade of the student. There are additional subsidies that consider some characteristics of the school (e.g. rural, isolated) and student socioeconomic background (e.g. *Subvención Preferencial*) or educational needs. There are over 20 different subsidies. Approximately 75% of the total voucher amount can be used to pay or complement classroom teacher salaries.¹¹

These transfers are delivered by MINEDUC to the managers (*sostenedores*) of the educational institutions (municipalities for public schools and school owner for private voucher schools). Municipalities can raise additional local funding (*Aporte Municipal*) which, in 2015, represented about 8% of total spending in the public sector. On the other hand, subsidized privately managed schools can charge add-on fees to parents, and the total amount of these payments accounted for approximately 16% of their total spending in 2015. These two funding sources can be used to pay for classroom teacher salaries. All teachers (regardless of whether they work in municipal or private voucher schools) are entitled to a minimum salary (*Remuneración Básica Mínima Nacional*, RBMN)¹². There are no caps on salaries, and managers can pay more than the established *minimum hour value*. Municipal administrators can also establish local merit pay programs and other incentives.

Colombia

In Colombia teacher salaries are entirely funded by the central government, via the General Participation System (SGP). The SGP is a set of transfers from the Ministry of Education (MEN) to Certified Local Authorities¹³ (ETCs). The main transfer is called the Provision of Service and Complement, which covers staff salaries (teachers, principals, and support personnel). The formula to allocate these resources is based on a per-student allocation which is estimated for every territorial entity, using spending information¹⁴. For those ETCs with a deficit, a special item was created (*Complemento*). Unlike the transfer based on a per-student formula, the complement is more discretionary because it implies negotiations between the ETCs and the central government.

The allocation rules for salary spending from ETCs to schools are also defined by MEN, because the formula is based on the staff needs at the school level and a national teacher salaries scale. Staff needs are decided between central and local levels (ETCs estimate staff needs by school, based on technical

⁹ Approximately 7 percent of students attend privately financed and privately managed schools that mainly serve advantaged families and do not receive public funding.

¹⁰ The voucher is based on the average attendance of the student, instead of the enrollment.

¹¹ Source: MINEDUC data.

¹² Teacher salaries are regulated by the *Estatuto Docente*¹². This law, that regulates the labor relationship between teachers and municipalities, as well as some aspects for private voucher school teachers.

¹³ In Colombia, the education is managed by Certified Territorial Entities (Entidades Territoriales Certificadas) that can be Departments (Sub-national level) or Municipalities (local level) (Law 715 of 2001). The education in municipalities that are not certified is run by the Departments they belong to. In the first stage after the reform that introduced the ETCs, certification was assigned to those municipalities exceeding 100 thousand inhabitants (Brutti, 2014). Currently, municipalities with less than 100 thousand inhabitants can apply to be certified after an evaluation of their technical, administrative and financial capacity to manage the education service.

¹⁴ The resources of this transfer also can be used to hire a private organization to provide the education service when there are not enough vacancies in public schools. But it is restricted to non-profit institutions and they cannot charge beneficiary students (contratación del servicio). For 2016, this modality corresponded to 9.4% of the official enrollment in the transition levels to secondary (Ministerio de Educación Nacional, 2016).

studies and national standards, approved by MEN)¹⁵. Teacher salaries are set based on a national pay scale. ETCs can only pay teachers included on the approved staff list. ETCs can add locally-raised resources to hire support personnel, but teacher and administrative personnel is funded exclusively with SGP resources.

Peru

In Peru, budgetary resources for teacher salaries are assigned and transferred entirely by the Ministry of Finance (MEF) to the regional authorities. Regional authorities cannot add additional resources to increase teacher salaries, a rule intended to mitigate teacher quality disparities across regions.

Like Colombia, the teacher pay scale is set at the central level. In the case of permanent teachers (*Docentes Nombrados*), the amounts and technical criteria of the four components of the monthly income (hourly basic wage, temporary assignments, incentives, and benefits) are determined and regulated by the central government¹⁶. The hourly basic wage (*Remuneración Integral Mensual RIM*) is established for permanent and temporary teachers according to their salary scale and working hours.

To determine the annual budget for the payment of teachers, information systems generated from the contributions of both the MINEDU and the decentralized instances of educational management¹⁷ are used. The budget considers the total number of teacher positions (*plazas docentes*), and their position in the salary scale.

Hiring process

Chile

Teacher assignment is decentralized to the local management authority (municipal or private) for publicly funded schools in Chile. Private voucher schools are required to abide by the same Labor Code (*Código del Trabajo*) as private firms in the country, and they can hire and dismiss teachers based on local needs. Each school manager can decide on the characteristics of the hiring process to be followed to choose teachers. On the other hand, the teacher hiring mechanism for municipal schools is less flexible and governed by the National Teacher Labor Code (*Estatuto Docente*) and the Teacher Career Path (*Carrera Docente*). However, the specific rules that govern hiring processes are determined at the municipal level, making the process less centralized than Colombia and Peru (see below).

Each municipality defines the number of teaching positions based on the number of students at each school, by grade and courses offered, and according to the type of education and the curricular modality (e.g. extended school day). Education staff are incorporated into municipalities as permanent (*titulares*) or temporary (*a contrata*) teachers. The salaries do not vary between these two types of contracts, but

¹⁵ The Territorial Entity must generate a proposal of required personnel based on a technical study detailing the number of teachers, teaching and administrative directors necessary for the provision of the educational service. The MEN should conduct an analysis and assess the technical and financial feasibility of the proposed plan.

¹⁶ Determined by Supreme Decree by the Executive Power, based on a proposal from the Ministry of Education (MINEDU), in coordination with the Ministry of Finance.

¹⁷ These decentralized administrative entities are the “Regional Educational Direction” (Dirección Regional de Educación – DRE) at the regional level, and the “Local Educational Management Units” (Unidad de Gestión Educativa Local – UGEL) at the provincial level.

there are significant differences in terms of job stability¹⁸. Moreover, their contract must be renewed annually, and they cannot fulfill management functions. Additionally, the *Estatuto Docente* establishes that, of the total number of teacher hours in each municipality, there must be a maximum of 20% temporary teacher hours. A 1999 law¹⁹, modified in 2014²⁰, recognizes teachers as permanent staff if they have been working for three consecutive, or four non-consecutive, years in the same municipality. This changes the proportion of permanent staff teachers from approximately 50% to 85%, under the new rules, in the municipal system.

Each municipality establishes the rules for a public contest for permanent teachers at least once a year, but a contest may be called whenever a crucial vacancy must be filled. The applicants compete for a specific position (hours) in a determined school, which in practice means that the teacher chooses the municipality and the school she wishes to work in. The *Qualification Commission* classifies the qualifications of the applicants. The Commission defines the criteria against which the applicants will be judged, in terms of their professional resumé and their performance in the interview. The MINEDUC, through the Center for Pedagogical Training, Experimentation and Research (*CPEIP*), oversees the technical coordination for the application of the evaluation processes.

Colombia

Since 2002 teachers in the public sector are hired through a centralized public contest procedure (*Concurso*)²¹. The applicants must choose which education authority they wish to apply to in that year (contests are called separately for each ETC). Each ETC determines the number of vacancies, by position, grade, cycle and areas of knowledge. The contest has four stages (Brutti and Sanchez, 2016). First, the applicants must participate in a country-wide standardized exam, which is administered and evaluated centrally by governmental agencies²². It is structured into three modules: i) testing teaching aptitude, ii) subject knowledge and iii) psychometric values. Candidates who do not score a minimum of 60/100 points on each of the three modules are disqualified. The exam represents 65% of the candidate's global score (55% for school directors). Second, points are assigned for academic degrees, additional training courses, academic publications, experience, past teaching evaluations and career awards. This component constitutes 20% of the total score. Third, a local committee conducts an interview. The committee interviews each candidate in person and the evaluation accounts for the remaining 15% of the global contest score.

After the selection process, the CNSC establishes a list of eligible candidates, in strict order of merit, for each ETC, according to the position, level and area of knowledge. Following the ranking, eligible candidates choose one of the available vacancies. This selection is implemented through a process of public hearings (*Audiencias*). These hearings may be face-to-face or virtual. When there is a vacancy in a teaching position, the ETC must make it available to the highest ranked applicant first. If the highest

¹⁸ Permanent staff are hired through a public contest and for a specific number of hours (if these hours are modified, the teacher must be compensated by the municipality), and they are hired for an indefinite period. In contrast, the hours of temporary teachers can be modified without compensation by the municipality.

¹⁹ Law 19.648.

²⁰ Law 20.804.

²¹ Before 2002, the teacher law also ordered that the linking of teachers be carried out through a merit contest, but there was no clarity and structure in the contest (Ome, 2013).

²² ICFES (Instituto Colombiano para la Evaluación de la Educación) and CNSC (Comisión Nacional del Servicio Civil). The exam questions are elaborated by the National University, the largest public university in Colombia.

ranked applicant declines the offer, the position can be offered to the next applicant in order of merit. The list of eligible candidates is valid for 2 years.

To fill teacher vacancies involving temporary separation or teachers under probation, the ETC must select the highest ranked candidate from the list of temporary teachers. One of the main weaknesses in the system has been the situation of some ETCs where there are not enough eligible candidates. In those cases, provisional appointments or uncertified teachers fill the positions. To improve the assignment process of provisional vacancies, in 2016, the Ministry of Education created the Bank of Excellence, which is an online register of applicants for teaching and support positions. With the background information of the applicants, the system can ensure that they meet the minimum requirements and that the best candidates fill the vacancies.

Once the vacancy is filled, the candidate starts a probation period that lasts to the end of the current academic year (minimum four months). After this stage, the school principal evaluates the applicant's performance, and conditional on a positive evaluation, the new teacher is registered on the pay scale (*nombrado en propiedad*). This evaluation is designed by MEN and implemented by the principal or vice-principal. The evaluation has the following components: i) specific competencies, ii) educational achievements and non-cognitive skills and iii) performance evaluation. Recent evidence suggests that virtually all teachers pass the probation period and are then appointed to a permanent position (Brutti and Sanchez, 2016).

Peru

Since November 2012, the "Law of Magisterial Reform" (*Ley de Reforma Magisterial – LRM*) establishes a unique labor regime for all teachers in the public sector²³. The public contest to enter the teaching career in Peru runs every 2 years²⁴. To be eligible to apply for a teacher position, candidates must hold a bachelor's degree (or a professional title) in education (Art.18 LRM)²⁵.

The hiring process consists of both centralized and decentralized stages.²⁶ The centralized stage is carried out by the Ministry of Education through a national, standardized test (*Prueba Única Nacional - PUN*). In this stage, the applicants select the "registration group" (*grupo de inscripción*) for which they wish to be evaluated.²⁷ The PUN is divided into three sub-tests: (1) Logical reasoning (25%); (2) Reading comprehension (25%); and (3) Pedagogical knowledge of the specialization (50%). Only those applicants who achieve the minimum scores required in each of the three sub-tests can move on to the decentralized stage.

The decentralized stage is carried out by each school, and by the UGEL in the case of single-teacher institutions. In this stage, through the Ministry of Education online portal, applicants can select up to 5 vacancies in order of preference, in each geographical region. The Ministry of Education assigns up to 3 vacancies to each candidate considering his/her preferences and his/her final score in the PUN. At the school level, candidates are evaluated by an evaluation committee composed of the school principal, the assistant principal or academic coordinator of the grade level, and a parent representative, and a member

²³ The teacher hiring process defined by the LRM applies to permanent and temporary teachers in public and in publicly financed and privately managed schools.

²⁴ The first "appointment contest" (*Concurso de Nombramiento*) was in 2015 and the second in 2017.

²⁵ Granted by an institution of accredited teacher training in the country or abroad. In the latter case, the title must be validated in Peru. Both titles correspond to an undergraduate level.

²⁶ Each contest is independent, and its results are cancelable.

²⁷ Where the "registration group" is a combination of school modality, level, and area of specialization.

of the Institutional Educational Council (*Consejo Educativo Institucional - CONEI*)²⁸. The evaluation consists of a classroom observation (50%); an interview (25%); and an evaluation of the teacher's curriculum vitae (25%).²⁹

The Ministry of Education uses the sum of the scores obtained in both stages to assign the vacancies in order based on merit. Teachers without previous experience or with less than two years of experience in the public sector are provided with a training program (*Programa de Inducción*) through a mentor-professor of a higher salary scale for up to six months³⁰.

The DRE or UGEL will publish the positions that remain vacant after the appointment resolutions (because no candidates selected the vacancy, or in the case that the selected candidate resigns or withdraws)³¹, to make them available to temporary teachers. Candidates will only be evaluated according to their final score in the PUN, without the requirement of a minimum passing score. Temporary teachers enter a "list of merit" (*cuadro de méritos*) for each UGEL according to the score in the centralized stage and are hired through a public award (*acto público de adjudicación*) where candidates with the highest score will be the first to choose among the available vacancies. Candidates that are not awarded a vacancy will be kept in the list of merit until the following national contest and will participate in subsequent public contests for vacancies that opens throughout the school year³².

Teacher transfers between schools

Chile

Educational professionals may be transferred to other schools within the same Municipality, at their request or because of local staff adjustment needs. If, after the transfer, the teacher believes that they were unjustly treated, they can appeal through the process established in the Labor Code, to the General Comptroller Office of the Republic, or the Labor Directorate. The municipalities may establish agreements that allow education professionals to be assigned to other municipalities. Teachers must agree to the transfer, and they may last one to two years. The new temporary assignment outside of the municipality does not entail the loss of staff category at the municipality of origin. Education professionals will have the right to change their positions if they work in jobs of the same nature and with the authorization of the respective employers. The swap can take place between any municipality in the country.

²⁸ In the case of single-teacher institutions, the evaluation committee is composed of a specialist from the local educational management units or of the DRE, the director of the Educational Network (*Red Educativa*), and a representative of the parents. The representative of the parents must be elected by a majority vote in a general assembly and have teacher training, or higher education, preferably.

²⁹ The evaluated components of the curriculum are: (1) educational and professional trainings (40%); merits (20%); and professional experience (40%).

³⁰ Temporary teachers hired through the *Concurso de contratación* can access this training program only if they are occupying the vacancy for the first time (Supreme Decree N.004-2013-ED).

³¹ In the specific case of single-teacher institutions, the vacancies identified by the DRE or UGEL will be offered in a public award act administered by the corresponding evaluation committee, and assigned in order of merit according to the candidate's final score. Candidates allowed to apply for these vacancies are those who were left without a vacancy despite passing the decentralized stage. They can select a vacancy in a single-teacher institution within the DRE or UGEL in which they have been evaluated in the decentralized stage. Positions that result vacant after this "exceptional stage" will be offered to temporary teachers.

³² If the list of candidates in a UGEL is empty but there still are available vacancies, candidates from different UGEL within the same region can apply for those positions. Finally, if even after this second round there are vacancies left, the hiring committee will evaluate candidates according to an evaluation of educational and professional records.

Colombia

Teachers must fill out a transfer form to apply for vacancies published by the Territorial Entity (ordinary process). The criteria according to which transfers are approved includes: i) recognition, prizes or incentives for pedagogical management; ii) years of teaching in the current school; and iii) teacher or family health reasons. When two or more teachers or principals have an equal basis upon which to be transferred to the same school, the Territorial Entity will make the decision based on the opinion of the receiving school. However, the Territorial Entity may transfer teachers or principals through an administrative act, at any time of the academic year, without being subject to the ordinary process of transfers for the following reasons: i) academic or administrative service needs, which must be resolved on a discretionary basis to guarantee the continuity of the provision of the educational service, giving priority to the applications that have been applied to the last ordinary process; ii) health reasons of the teacher or director, and iii) need to resolve a conflict that seriously affects coexistence within a school.

Peru

Permanent teachers can be reallocated for (1) personal interest and family reasons; (2) health issues; (3) emergency situations; (4) exchange; and (5) “rationalization process”. The reallocation process for personal interest and family issues is carried out by a “reassignment committee”³³ that evaluates the teachers’ work performance; salary scale; time spent in rural or border areas; and length of service in the career. To be eligible for this type of reallocation, teachers are required to have worked for at least 3 years as a permanent teacher and at least 2 years in the position they wish to transfer from. In the case of health and emergency situations, the head of personnel of the DRE/UGEL at the institution they wish to transfer to evaluates the teachers based upon requirements such as: having worked at least 1 year in the position they wish to move from, and present detailed medical certification or proofs of threat at the school. Two teachers of the same salary scale and who hold the same position in the same modality, form, level, cycle, and educational specialization, can exchange positions by agreement. Teachers who wish to change position will be evaluated by the personnel team of the DRE/UGEL and are required to have approved their last performance evaluation and to have worked for at least 5 years as a permanent teacher and remain at least 3 years in the position they wish to transfer from.

In addition, every year between the months of March and June, the schools (or DRE/UGEL as appropriate), identify surplus and deficits of teaching staff, hierarchical and directive positions, seeking to balance the educational supply and demand. The director of the UGEL, through its “Commission of Rationalization” (*Comisión de Racionalización – CORA-UGEL*), has the responsibility to identify the personnel’s surplus³⁴. Personnel identified as a surplus can select the vacancy to which they wish to be reassigned within the same UGEL or DRE. If they fail to do so they will be automatically assigned to a vacancy by the Commission of Rationalization.

Salary structure and incentives to work in hard-to-staff schools

³³ The *Comité de reasignaciones* are composed by the director of institutional management; the personnel’s Chief; an education specialist of the highest salary scale in the DRE/UGEL; and a representative of the teachers’ trade union.

³⁴ According to the following criteria: (1) professor with pedagogical title that does not belong to the level, modality, cycle or educational form; (2) professor with pedagogical degree that does not have the specialization for the position; (3) teachers with a lower salary scale; and (4) teachers with lower results on the teacher performance evaluation.

Chile

Wages in Chile consist of the National Minimum Basic Salary (*Remuneración Básica Mínima Nacional*, RBMN) for each level, which is calculated by multiplying the established *minimum hour wage* for each teacher by the number of hours. The amount (close to US\$20 per hour in 2015 dollars) is the same in any publicly funded school and increases annually with the readjustment of public-sector workers.

The second component, BRP, consists of a monthly lump sum of approximately US\$1 per hour (for a maximum of 30 hours) for having an education degree, and about another US\$3 per hour (for a maximum of 30 hours) for having a specialized education degree. For teachers working in the municipal sector, the RBMN increases by 6.76% over the first two years of teaching and by 6.66% with each additional two years of teaching experience (up to 15 biennials).

Additionally, there is a set of monetary incentives. For example, teachers that work in municipal schools can earn up to 40% more than RBMN by participating in certified training programs. Moreover, there is a zone assignment that increases teacher's salaries working in rural schools by 15% to 210% of the RBMN. The eligible teachers are those working in: (i) subsidized schools located more than 5 kilometers from the nearest urban boundary, or (ii) subsidized schools located in municipalities with less than 5,000 inhabitants and a population density of less than 2 inhabitants per square kilometer. This zone assignment is complemented with a bonus for teachers in charge of rural schools, since many rural schools do not have principals, and the amount of this bonus is approximately 20% of the RBMN.

Another incentive is the *assignment for performance in difficult conditions*, which benefits teachers who work in schools that are considered to have difficult learning conditions due to geographical location (e.g. lack of transportation), violence, extreme poverty or other analogous characteristics. This salary increase may reach up to 30% of the RBMN. The criteria to determine if a school has difficult learning conditions is: a) Adverse climate, distance from urban centers, difficult to access public transportation; b) Requires teachers to reside in a rural environment, and c) Students and communities in situations of extreme poverty or insecurity in the urban environment, and students from bilingual or bicultural communities. Each municipality provides a list of schools and their background, and MINEDUC's Regional Office determines every two years the schools with the status of difficult conditions and its degree. For the subsidized private schools, the mechanism is similar, but each school must apply individually.

Colombia

In Colombia, there are two different pay scales for teachers in the public sector. Teachers that began a teaching career before 2002 are governed by the 1979's Decree 2277, and those hired after that year by the Decree 1278 of 2002. Both pay scales are defined by the central government and apply to all Territorial Entities. The 2002 pay scale is divided into three different grades, defined by the level of education of teachers³⁵. In each grade there are four levels (A, B, C and D) through which teachers progress as they gain experience and complete a Competency Assessment (*Evaluación de Competencias* or EC). The evaluation is voluntary and can be presented by teachers and directors aspiring to be promoted or relocated in the scale.

The old pay scale consists of 14 levels. The education level of the teacher determines at what level she enters the salary scale. For example, a teacher with an Associate (*Normalista*) technical degree enters at Level 4, while a teacher with a bachelor's degree enters Level 7. Ascension through the scales happens

³⁵ i) Normal-school teacher or Education technician, ii) University graduate in education or non-graduate professional, and iii) University graduate in education or non-graduate professional with master or doctoral degree.

automatically with tenure; every three years, teachers ascend to the next level of the scale, which entails a salary increase of approximately 12% (Ome, 2013). If a teacher acquires additional education, (which does not necessarily lead to a formal education qualification), he can substitute this additional education for experience, implying that he will ascend faster.

The only explicit criteria regarding school needs is a wage supplement for teachers and principals in difficult to access areas (15% of basic monthly salary), but each ETC is responsible for defining which areas are difficult to access. There is a central level guide indicating that a difficult to access area must meet at least one of the following criteria: (i) usual use of two or more means of transportation is necessary to get to the school; (ii) no roads allow access by motorized traffic for most of the school year; and (iii) public transport service by land, river or sea, has a single round trip available daily.

Peru

Since the adoption of the LRM in 2013, regardless of the teacher's type of contract, monthly salaries are composed of: hourly basic wage (*Remuneración Integral Mensual – RIM*), benefits, and incentives. The RIM is determined according to the teacher salary scale and working day. The salary scale is composed of 8 levels, where the 8th is the highest and corresponds to 210% of the lowest salary level³⁶. All new teachers, regardless of the level of higher education, enter in the first salary scale. Permanent teachers may ascend the salary scale through public contests after having spent the mandatory time of service in each previous scale, while temporary teachers only receive the salary amount corresponding to the lowest scale, regardless of the level of experience or education. Benefits are in place for time of service³⁷ and death of the teacher or of a teacher's family member³⁸. Finally, permanent teachers are provided with two types of performance incentives: (1) *Bono de Atracción*; and (2) *Bono Escuela*. The former, is a monetary incentive of 18,000 PEN for teachers that classify within the upper third of the appointment contest (*Concurso de Nombramiento*). The latter is a monetary incentive between 1,000 and 3,000 PEN released according to student's performance in the census evaluation (*Evaluación Censal de Estudiantes – ECE*) of the previous year³⁹.

Permanent and temporary teachers receive the same monetary incentives to work in hard-to-staff schools. Incentives are in place for schools' location and characteristics. Incentives for schools' characteristics include: (1) single-teacher institutions, corresponding to 7-10% of the basic salary⁴⁰; (2) bilingual school, corresponding to 2.5% of the basic salary; (3) teacher bilingual certification, corresponding to 5% of the basic salary. Incentives for schools' location include: (1) rural areas, corresponding to 3.5%, 5% and 25% of the basic salary according to the "gradient of rurality", defined at the central level based on population size and accessibility to the nearest provincial capital; (2) border areas, corresponding to 5% of the basic salary; (3) difficult areas (*Valle de los Ríos Apurímac, Ene y Mantaro*

³⁶ As of November 2017, the first salary level for a working day of 30 hours/week has been set at 2,000.10 PEN (1,080 constant 2011 USD PPP). The second to the highest level are determined according to the following increasing percentages of the first salary level: 110%; 120%; 130%; 150%; 175%; 190%; and 210% (Art.57 LRM, modified by the Law N.30541; Supreme Decree N.305-2017-EF).

³⁷ Permanent and assistant teachers receive the equivalent of two hourly basic wage upon reaching 25 or 30 years of service (*Asignación por tiempo de servicios – ATS*), and the equivalent of 14% of the RIM for each year of service when he/she retires (*Compensación por tiempo de servicios – CTS*). Temporary teachers do not receive the ATS.

³⁸ Corresponding to a fix amount of 3,000 PEN, regardless of the teacher's type of contract.

³⁹ Temporary teachers do not receive the *Bono de Atracción*, receive the *Bono Escuela* for a maximum of 1,000 PEN, and receive a fifth of their monthly income at the end of their contract (*Vacaciones truncas*).

⁴⁰ These percentages relate to the basic salary of the lowest salary scale for a 30 hours/week working day of 2000.10 PEN, which is the highest salary scale option for temporary teachers.

- *VRAEM* region) defined by levels of poverty and violence, corresponding to 15% of the basic salary. Teachers can receive up to 5 incentives if they are not mutually exclusive. Non-monetary incentives are in place for permanent teachers only. For example, working in rural or border areas will increase permanent teachers' reallocation opportunities and will shorten the time of service required to apply for a higher salary scale.

Comparative salary structure

Figure 1 shows the relative weight of monetary incentives to work in hard-to-staff schools across the systems of reference. For the sake of comparison, we are considering secondary teachers in the lowest salary bracket in each system. Teachers in the lowest salary scale in Peru are provided with the highest number of incentives to work in hard-to-staff schools, which make up for almost 35% of their monthly salary. Moreover, 46% of teachers in Peru receive at least one of these incentives. On the other hand, in Colombia the incentive to work in rural areas only represents 12% of the monthly salary, and in Chile it sums up to around 30%.

Figure 1 here

3. Definitions and data

Definitions

In this paper, we will analyze the distribution of: i) teacher salaries; ii) the type of teachers' contracts; and iii) teachers' years of experience. Although the main reason for choosing these characteristics is the availability of comparable data in the three systems, we have to acknowledge that the lack of data (e.g. consecutive assessments) needed to estimate teacher value-added measures in the three systems makes it hard to identify the most effective teachers⁴¹. However, there is empirical evidence that supports the relevance of these characteristics in the debate of school finance and teacher policies.

First, we will examine the differences in teacher salaries across schools in each system. While most evidence suggests that salaries are not a good predictor of student performance (e.g. Hanushek & Rivkin 2007), we use teacher pay as a measure of school spending.

Second, we will analyze the distribution of different teachers' contracts. In the literature, there is an ongoing debate on the impact of different contract types on educational outcomes. For example, in several school systems, fixed-term and temporary contracts have been increasingly used as a mechanism to increase flexibility to respond to teacher needs and to reduce costs, but the impact of this trend on educational results is unclear. The available evidence suggests that temporary teachers apply higher levels of effort and can have a positive impact on student achievement when faced with performance incentives for contract renewal (Duflo et. al., 2009; Muralidharan and Sundararaman, 2013). At the same time, when temporary contracts are not subject to accountability pressures, temporary teachers are found to have a negative influence on test scores (Ayala, 2017), particularly for low income students (Marotta, 2017). Moreover, temporary teachers are less involved in school activities and provide students with less support and feedback than teachers on permanent contracts (Ayala, 2017)⁴².

⁴¹ One exception in the LAC region is the teacher value added measure generated for Ecuador in Araujo et al., 2016.

⁴² The author also presents suggestive evidence that the allocation of temporary contracts in Colombia can be partly determined by political criteria. The introduction of the new teacher career in 2002, reduced the political influence in the allocation of permanent contracts, but may have increased the political use of temporary contracts.

Lastly, we will analyze the distribution of teachers' years of experience. There is consistent evidence that the first years of a teacher's career is an important predictor of his/her future performance. For example, recent studies support the idea that teacher experience has a positive effect on student test scores (Clotfelter, Ladd, & Vigdor, 2006; Goldhaber & Anthony, 2007; Rivkin et al., 2005; Rockoff, 2004). At the same time, there is evidence that this effect is non-linear. For example, teachers with less than 1 year of experience and, to a lesser extent, teachers with less than 3 years of experience, are found to perform significantly worse than more experienced teachers (Rivkin et al., 2005).

Data

We constructed the following four school-level variables to measure teacher attributes in Chile, Colombia, and Peru: (i) school-averaged gross hourly wage in 2011 constant USD PPP; (ii) the percentage of teachers with temporary contracts; (iii) the percentage of teachers with less than one year and less than three years of experience. We measured the socioeconomic status of schools by the percentage of students whose mother completed secondary education and above. This threshold was defined according to the distribution of the student-level maternal education variable in the three countries (See table 1). Parental education has been widely used in other research to construct indicators of student SES.⁴³

Chile

The sources of information are different databases from the Ministry of Education (MINEDUC), the Education Superintendence (*Superintendencia de Educación*), and the independent public agency that evaluates the quality of education (*Agencia de Calidad de la Educación*).

First, from the school directory of MINEDUC, we selected the subsample of the subsidized schools that offered secondary education for children and youth in 2015. We also gathered information on some of the school characteristics, such as rural/urban, type of school (public or private), and level of schooling.

We used their average results on a battery of standardized tests (*SIMCE*⁴⁴) conducted every year to establish a proxy for school performance, for different levels and subjects, in all schools across the country. Specifically, we used the average results of 10th graders (15-16) on Spanish and Math assessments in 2015. The *SIMCE* test also includes a background questionnaire. We included the highest level of education attained by the mothers of 10th graders in 2015, which allowed us to create the proportion of mothers in each school who completed secondary education and have a minimum of incomplete higher education.

Next, from the teachers' census database of 2015, where the observation units are every teacher-school relation of that year (i.e. if a teacher worked in three different schools in 2015, there are three observations for that teacher), we selected the teachers that worked in the schools of our subsample, whose first or second function⁴⁵ is to be a classroom teacher, and at least one of the two levels taught⁴⁶ corresponds to secondary education (15 to 18 years old). From the same source of information, we obtained the teacher's years of experience.

⁴³ According to Sirin (2005), parental education is considered one of the most stable aspects of socioeconomic status because it is determined at an early age and tends to remain constant over time, unlike income which is subject to temporary shocks.

⁴⁴ Sistema de Medición de la Calidad de la Educación.

⁴⁵ In this data base only the two principal functions are available for each teacher-school observation.

⁴⁶ In this data base only two educational levels where the teacher teaches are available for each teacher-school observation.

Finally, we merged the individual teacher salary data and temporary or permanent contract data from the accountability (*Rendición de Cuentas*) 2015 data base for each school. The information comes in a teacher-school-month contract format and we collected the total annual payments made to teachers and the total hours of contract corresponding to those payments. We consider only the gross total salary of the teachers and the contributions made by the public or private school manager (i.e. pension contributions, unemployment insurance, etc.). Additionally, we exclude payments financed by two specific subsidies: the preferential school grant (*Subvención Escolar Preferencial*, SEP) and the school inclusion program grant (*Programa de Inclusión Escolar*, PIE). We excluded these payments to compare the three systems, because those two subsidies, by law, are not allowed to be used to pay wages of classroom teachers who teach the regular curriculum. With these, we created the average hourly⁴⁷ payment to secondary classroom teachers made by each school in our subsample.

Colombia

The main source of information is a teacher census database for the public sector (Annex 3A) for the year 2013⁴⁸, which includes, for each teacher, the position in the national salary scale and other characteristics like educational level, experience and type of contract. Based on the laws regulating the teacher salaries in the public sector, we estimated the annual total salary, which include the basic allocation, additional payments (e.g. food, transport, aid mobilization, services, holidays, social security, unemployment insurance) and bonuses to which she is entitled (additional responsibilities, difficult to access zones, etc.). To estimate a per-hour cost by teacher, we divide the annual cost by the number of weeks in the school year, multiplied by the number of hours per week in the teacher contract (40)⁴⁹.

Regarding contract type, in Colombia the temporary contracts include two categories. First, provisional contracts in permanent vacancies, are used when it is not possible to fill the vacancies with other teachers with permanent contracts (*encargos*) or when there is no available eligible candidate (those that meet the requirements to be appointed to a permanent position). Second, temporary contracts in temporary vacancies, are filled by uncertified teachers (that did not pass the *concurso* certification examination), who fill vacancies for permanent teachers on leave for different administrative reasons (e.g. illness, disability, maternity leave and suspensions for criminal or disciplinary measures). Newly appointed permanent teachers, that have not passed the probationary period are also included in this category.⁵⁰ Teacher experience is estimated using the date on when the teacher entered the public education sector for the first time.

The socioeconomic information comes from the background questionnaire of the standardized test SABER 11, which is applied to 11th grade students (final year of secondary education). Currently, the exam consists of five tests: Mathematics, Critical Reading, Social and Citizenship skills, Natural Sciences and English. Results of two subtests are also reported: Citizen competences and Quantitative Reasoning. Given

⁴⁷ We weighted the hours of contract with the proportion of the corresponding remuneration that was not paid with SEP and PIE.

⁴⁸ Each Entidad Territorial must report their teacher and administrative personnel of the public schools and they need to give this information to the Ministry of Education.

⁴⁹ MEN (2002) Jornada escolar y jornada laboral. [Decreto No. 1850] DO: Diario Oficial No. 44.901. The law states that students must study for 40 weeks annually. On the other hand, the Decreto 1850 de 2002 states that public teachers must spend at least six (6) hours per day to complete their academic assignment and the execution of complementary curricular activities and the remaining time (two hours), to carry out, outside or within the school, complementary curricular activities, such as academic work, evaluation, qualification, planning, meetings with parents, student guidance service, cultural and sports activities, etc.

⁵⁰ According to teacher law (Decree 1278 of 2002), the teachers with temporary contracts or in the probation period, will receive the basic monthly base salary corresponding to the first salary level of the grade in which they would be enrolled in the case that they approve the probation period evaluation.

the restriction in the socioeconomic information (available for 11th grade students) we only use the data of teachers working in basic secondary and secondary education⁵¹. In the teacher database if a teacher works at more than one educational level (e.g. primary and secondary), she must register in the one to which she devotes most of her hours.

Peru

Salary data are made available by the MINEDU through the consolidation of the information on teacher positions per school, included in the Vacancy Management and Control System (*Sistema de Administración y Control de Plaza NEXUS*), and that of teacher monthly salary contained in the “Single Payroll System” (*Sistema Único de Planilla - SUP*). Together with monthly salary data, the dataset contains vacancy-level information on contracts’ hours and teachers’ date of entry in the public sector (from which we recovered teachers’ years of experience).

The dataset includes two types of teacher contracts: permanent (*Docentes Nombrados*) and temporary (*Docentes Contratados*). Permanent teachers are those teachers that qualified for a vacancy after the decentralized stage of the national hiring contest, as well as those coming from the previous teaching career⁵². Permanent teachers will maintain their position only if they succeed in the teachers’ performance evaluation. Temporary teachers can be hired on a full-time or part-time basis. Temporary contracts cannot be shorter than 30 days and a vacancy cannot be covered with more than one temporary contract. Temporary teachers can have more than one contract if compatible but can only be paid at the lowest salary scale and they can have their contract renewed, for the same vacancy, for the subsequent school year following an evaluation.

The socioeconomic variable used in this analysis is the percentage of students per school whose mothers have completed secondary studies and above. The variable is available for second year secondary students, which participated in the 2015 students’ census evaluation. Students directly report mother’s education.

Table 1 provides descriptive data on the socioeconomic variable in the three countries. The distribution of public school parent education levels is similar in the three countries. Chile has a higher percentage of high school graduates. Colombia has a higher share of high school and primary drop outs than Chile and Peru. Chile and Peru have similar shares of parents with some higher education. However, when you include private voucher schools in our sample in Chile, the proportion of parents that complete high school and college increases.

Table A1 shows the descriptive statistics of the regressors used in the regression analysis.

Table 1 Here

4. Methodology

The school finance literature has identified five main criteria for examining equity in resource allocation: (i) neutrality: minimizing the link between school community’s wealth and schools’ funding; (ii) horizontal equity: students who are alike should be treated the same; (iii) vertical equity: some groups of students

⁵¹ In Colombia primary education consists of nine years (Grades 1 to 9, for children from 6 to 14 years old), divided in two stages: básica primaria (5 years) and básica secundaria (4 years). The secondary education (educación media) lasts two years (Grades 10 and 11, generally for 15 and 16-year-old students).

⁵² Ley de Profesorado and Carrera Pública Magisterial (CPM).

need more resources than others; iv) need-based: achievement of fairness is made through differential per-student compensation for initial deficits; and v) equality of educational opportunity: provide a fair starting point, especially for students from disadvantaged and/or minority groups (Baker & Green, 2014; Ben David-Hadar, 2016).

The two most studied dimensions of equity are horizontal and vertical equity (Bandaranayake, 2013; Levačić, 2008; Toutkoushian & Michael, 2007). Horizontal equity is based on the principle of “equal treatment of equals” which means that funds should be allocated equally among schools that share certain characteristics. Vertical equity follows the philosophy of “unequal treatment of unequals” which implies that if students have different educational needs, an equitable funding system should provide different levels of resources to meet those needs. Typically, the educational needs are defined in terms of educational inputs needed to achieve a defined level of performance (Rubenstein, 2000; Berne & Stiefel, 1999).

Various indicators have been proposed in the literature to measure horizontal and vertical equity (Nina et al., 2006; Verstegen, 2015; Kelly, 2014). In this paper we use two measures of statistical dispersion (range and coefficient of variation) and two inequality indices: the Gini Index, widely used in the literature, and the General Entropy Index ($GE(\alpha)$). To decompose the variance of teacher attributes between and within local governments, we estimate a multilevel model (linear mixed-effects models). More precisely, we use a two-level model in Colombia (school and ETC levels) and a three-level model in Peru (school, UGEL, and region levels) and Chile (school, municipality, and region levels).

Vertical equity is a more complex concept to operationalize since educational needs vary by students and identifying those needing greater compensation is subject to a vigorous debate (Vesely & Crampton, 2004). Different studies have attempted to identify the factors that put children at risk of academic failure to justify a greater allocation of resources to these students. These factors vary by educational systems and might be different for the LAC countries when compared to countries in other regions. For example, while in LAC countries the indigenous population might be at a disadvantage, in the United States and the European Union, black and immigrant children may be the most disadvantaged (McEwan & Trowbridge, 2007; Condron et al., 2013; Schnell & Azzolini, 2015). Among the most cited risk factors of students' academic failure are poverty, race, ethnicity, disability, poorly educated parents, and remoteness of school location. According to some studies, poverty is the most consistent predictor of academic failure (Bandaranayake, 2013; Land & Legters, 2002). Given the above, we focus our measure of vertical equity by assuming that poorer students should have more educational resources than wealthier ones.

To estimate the vertical equity of the teacher distribution we first constructed Concentration Curves. A concentration curve represents the cumulative distribution of a variable, in this case some measure of teacher characteristic at the school level, once they have been ordered according to another variable, in this case the socioeconomic level of the students⁵³ (Jann, 2016). Depending on the definition of the teacher characteristic and the socioeconomic level, the curve will be above or below a 45-degree line (line of equality), which represents the case where all the schools have the same value in the teacher attribute. For example, if the percentage of teachers with temporary contracts takes higher (lower) values among poorer schools, the concentration curve will lie above (below) the line of equality. The farther the curve is above the line of equality, the more concentrated the variable is among the poor schools. We use the curves to compare the distribution of different teacher attributes in the three systems. If the

⁵³ The Concentration Curves are a general case of the Lorenz Curves, widely used in the literature on income distribution. Specifically, the Lorenz Curves show the cumulative distribution of a variable (e.g. per capita income of households) once the units have been ordered according to this same variable.

concentration curve for one system lies everywhere above that of the other, the first curve is said to dominate the second, and the ranking by degree of inequality would be unambiguous. Alternatively, curves may cross, in which case neither distribution dominates the other. In that case it is necessary to calculate an inequality index, which inevitably involves the imposition of value judgments concerning the relative weight given to inequality arising at different points in the distribution (O'Donnell et al, 2008).

For simplicity and comparability reasons, we use the Concentration index. The concentration index is defined as twice the area between the concentration curve and the line of equality (the 45-degree line) (O'Donnell et al, 2008). Its range is between -1 and 1, with negative values indicating that educational resources are higher for poorer schools and positive values indicate the opposite⁵⁴. In terms of the magnitude, the index doesn't have an intuitive interpretation, but Koolman and van Doorslaer (2004) have shown that multiplying the value of the concentration index by 75 gives the percentage of the outcome variable that would need to be (linearly) redistributed from the richer to the poorer half of the population (in the case that inequality favors the rich) to get to a distribution with an index value of zero⁵⁵.

Finally, following other papers measuring equity in education spending (e.g. Rubenstein et. al., 2007; Iatarola and Steifel; 2003), we estimate a set of regressions, where the dependent variables are different teacher characteristics at the school level and the independent variables are proxies of the level of disadvantage of the school. We use the following specification:

$$Y_i = \beta_0 + \beta_1 Size_i + \beta_2 SES_i + \beta_3 Zone_i + \beta_4 Perf_i + \gamma + e_i$$

where i indexes schools, Y is a school level teacher characteristic; $Size$ is the school enrollment; SES is a variable capturing the socioeconomic characteristics of students in school i ; $Zone$ is the location of the school (urban or rural); $Perf$ is a vector of variables measuring the performance of the school on standardized tests; and e is an error term with the usual properties. Finally, to control for non-observable characteristics at the local authority level we include a fixed effect γ ⁵⁶.

It is important to emphasize that the objective of this estimation is to empirically evaluate the equity in the allocation of teachers, but not necessarily to estimate a causal relation between teacher and school characteristics. For that objective we would need more advanced econometric techniques to solve endogeneity problems and omitted variable bias (Costrell, Hanushek and Loeb, 2008). Also, with this model we are not trying to disentangle the preferences of teachers and employers. The observed teacher sorting is a combination of supply and demand factors⁵⁷.

5. Results

Horizontal equity

⁵⁴ It is important to note that the concentration index depends only on the relationship between the outcome variable and the rank of the socioeconomic variable and not on the variation in the socioeconomic variable itself. For example, a change in the degree of income inequality need not affect the concentration index measure (O'Donnell et al, 2008).

⁵⁵ For example, if the outcome variable is the average teacher salary by school, the CI multiplied by 75 represents the percentage of reduction in the average salary of the schools in the richer half to have an index 0.

⁵⁶ Fixed effect: in Colombia at the ETC level, in Chile at the municipality level and in Peru at the UGEL level.

⁵⁷ A recent paper for the US context estimates a model that identifies the key factors explaining the allocation of teachers from the supply and demand side (Boyd et. al., 2013).

Table 2 presents the horizontal equity indicators for teacher salaries and other measures of teacher characteristics in Chile, Colombia, and Peru. In the case of Chile, we calculate the indicators for the subgroup of public schools and for all the schools receiving public funds (public and subsidized private).

Colombia has the highest overall average gross hourly wage, followed closely by Chile. Peruvian public-school teachers earn, on average, 44% less than Chilean and Colombian teachers. Relatively to the distribution of salaries, as shown in Figure 2 and in the measures of dispersion in Table 2 (CV, Gini and GE2), while there is considerable variation in teacher salaries across schools in Colombia and Chile, the same measure has lower dispersion in Peru and is concentrated in the lowest salary scales.

Table 2 shows substantial variation in other teacher measures across schools. For example, the share of teachers with less than one year of experience ranges from a low average of 5.8% in Colombia to 6.5% in Chile to reach almost 28% in Peru. On average, in Peru 33% of teachers have less than three years of experience. This likely explains the narrow distribution of salaries illustrated in Figure 1. The share of teachers with less than 3 years of experience in Chile and Colombia is 21% and 18% respectively. The proportion of novice teachers increases in Chile when private voucher schools are included in the analysis, indicating a younger teaching force in the private voucher sector. Further, Table 2 highlights a wide dispersion in the percentage of novice teachers in Colombia. For example, for the percentage of teachers with less than three years of experience the Gini Index is 0.58, compared with 0.48 in Peru and 0.33 in the public schools in Chile. Results are similar for other measures of horizontal equity.

As shown in Table 2, there are substantial differences in the proportion of temporary teachers across countries. In public schools in Chile, almost 60% of teachers are temporary, while the share of temporary teachers in Peru and Colombia is 40% and 30% respectively. As described above, temporary teachers in Colombia and Peru are generally those who have not passed the certification exam (*concurso*)⁵⁸. Like the distribution of teachers according to experience, Colombia shows the highest dispersion in the percentage of temporary teachers. In this case, the Gini Index is 0.54, compared to 0.40 in Peru, and to 0.20 in the public schools in Chile. Results are similar for other measures of horizontal equity.

Table 2 Here

Figure 2 Here

Table 3 presents the variance decomposition of the three teacher measures in Chile, Colombia, and Peru. When higher variation is found between schools within a local government, teacher sorting reflects higher differences among teacher preferences and school characteristics. In contrast, if most of the variation is found between decentralized levels of government, systematic sorting of teachers may reflect elements that vary substantially across regions, such as the quality of undergraduate institutions, the availability of alternative occupations, or differences in available local resources (Rivero, 2013).

The results indicate that in Colombia and Peru, most of the variation in teacher attributes is explained by differences between schools within local school administrative units (*entidades certificadas* in Colombia, and UGELs in Peru). In the Chilean public sector, most of the variance in teacher salaries is explained by inter-municipalities differences. This is most likely because municipalities can use local revenues to

⁵⁸ In the case of Chile, differences between permanent and temporary contracts do not originate from a certification exam. In addition, between the two types of contracts there are no stark differences in terms of the type of institution in which they studied and the years of duration of their training.

complement teacher salaries and hire additional teachers, while in Colombia and Peru, there is a national salary scale and local government entities are not permitted to use local resources to increase teacher salaries. Including the private voucher sector in Chile increases the variance of salaries within municipalities, because of the higher autonomy of private schools in hiring teachers and raising resources to increase teachers' salaries. The substantial sorting of the three teacher measures at the school level suggests that school level characteristics may be influencing teachers' decisions of where to work.

Table 3 also shows that there is less variation across regional and local governments in the distribution of novice teachers in Chile and Colombia than in Peru. In Peru, over 40% of the variation in the distribution of novice teachers is between UGELs within regions. The sorting of novice teachers across UGEL suggests that wealthier (or larger) UGEL may have a greater capacity to attract and retain more experienced teachers than disadvantaged ones. This suggests that policymakers should focus on strategies to improve the design of the teacher allocation policies that foster inequities in the distribution of novice teachers across UGEL.

As shown in Table 3, in Colombia a higher share of the variance in the percentage of temporary teachers is explained at the local government entities. These patterns could reflect teacher shortage in local entities located in rural areas or post conflict zones where permanent teachers are less likely to apply (Fundación Compartir, 2014). High levels of variance in the distribution of temporary teachers are also found across regions and UGELs in Peru. More isolated regions and UGELs are likely to have higher proportions of understaffed schools. Attracting certified teachers to more isolated local governments would likely require greater investments in teacher salaries than in other local entities. However, differentiating salaries at the local level would violate the national single salary compensation scheme in Colombia and Peru.

Table 3 Here

Vertical equity

Table 4 displays the concentration index (CI) for the three teacher measures in Chile, Colombia, and Peru. Figure 3 and 4 show the concentration curves for the same measures. The results explore to what extent the characteristics of teachers are sorted with respect to socioeconomic characteristics (percentage of students whose mother completed secondary education) of schools. As explained in Section 4, a negative (positive) value of the concentration index indicates a higher concentration of the teacher attribute in lower (higher) SES schools. As shown in Table 4, a negative CI for Peru suggests that salaries are higher for schools with lower SES, most likely due to the different incentives provided to work in hard-to-staff schools. In Chile, salaries CI are close to 0 suggesting a weak correlation with SES. On the other hand, the positive value in Colombia indicates that teachers with higher salaries are concentrated in more advantaged schools.

As shown in columns 2 and 3 of Table 4, although novice and temporary teachers are generally inequitably distributed, patterns vary across the three countries. Indeed, disadvantaged students are more likely to be enrolled in schools with novice and temporary teachers in Colombia and Peru, while the relationship is close to zero in Chile. This finding is likely related to the preferential subsidy (Ley SEP) described above that provides additional resources to schools that serve disadvantaged students in Chile. Schools in low-income communities likely use these additional resources to improve working conditions to attract and hire more experienced and permanent teachers. It is worth noting that, the CI in Chile becomes negative when private voucher schools are included. This pattern is likely due to more flexible hiring processes in the private sector.

Table 4 Here

Figure 3 Here

Figure 4 Here

Tables 5 to 7 present the school-level results of the regression analyses examining the relationship between teacher characteristics and observable public schools' and students' characteristics. Table 8 presents the same set of results for Chilean public and private voucher schools. The results for the distribution of teacher salaries in the three countries are reported in Table 5. The table shows that in Chile and Colombia, higher teacher salaries are associated with a higher percentage of advantaged students (whose mother completed high school). However, in Chile, the differences are no longer significant when municipal fixed effects are included, which is consistent with the horizontal equity findings reported in the previous section. In Peru, schools' socioeconomic status does not appear to be driving the distribution of teacher salaries. Interestingly, the relationship is negative and significant in Chile when private voucher schools are included (Table 8). Chilean teachers working in schools with a higher proportion of disadvantaged children are paid more on average in private voucher schools. As emphasized earlier, this is likely the result of the differential subsidy program (Ley SEP) that provides schools with additional resources to compensate for the higher costs of educating low-income students. While these subsidies cannot be used to pay base teacher salaries, they can be allocated to create better working conditions to attract more experienced teachers.

Table 5 also shows how salaries differ for teachers of students in urban and rural schools. In Chile and Colombia, rural teachers receive significantly lower salaries than their urban counterparts. The results in Table 8 also indicate that, after adding the private voucher schools to the model for Chile, hourly wages in urban areas are on average higher than rural wages. In general, it appears that wage differentials for rural teachers do not compensate for the potential non-monetary effects of working in isolated areas in Chile and Colombia. In Colombia, this is likely related to the non-pecuniary effects of working in a difficult to access or post-conflict area. In contrast, in Peru, salaries paid to rural teachers exceed those paid to urban teachers. As seen in Figure 1, teachers with the same level of experience earn on average 16% more if they work in rural compared to urban areas. In the next section, we will explore whether this is enough to attract experienced and credentialed teachers to work in rural schools.

Table 5 Here

Table 6 presents the results of the sorting of temporary teachers. Schools with a higher proportion of disadvantaged students in Colombia and Peru have higher percentages of temporary (uncertified) teachers. The results are also negative and significant in Chile only when private voucher schools are included. However, the differences are smaller than in Colombia and Peru. These findings suggest that more qualified teachers are not responding to incentives to work in disadvantaged schools in the three systems.

In the three countries, rural schools are more likely to have teachers with temporary contracts. The differences are the most pronounced in Peru, followed by Colombia⁵⁹. These results suggest that monetary incentives to work in rural schools are not enough to attract and retain more qualified teachers. It appears that certified teachers may seek more than wage differentials to work in isolated areas.

⁵⁹ In the case of Peru, this is also related to the salary structure that pays temporary teachers the same incentive to work in rural and isolated areas.

Moreover, the combined findings from Tables 5 and 6 show that Peru is currently paying higher salaries to temporary teachers to work in rural schools.

Table 6 Here

Turning to the exposure of novice teachers, the results in Table 7 indicate that poor students tend to be particularly disadvantaged in their exposure to novice teachers in Colombia and in Peru. Differences are the starkest in Peru. In Chile, the results are not significant, except for the full model that includes private voucher schools. As emphasized earlier, these patterns could reflect the preferential subsidy (Ley SEP) introduced in Chile, which provides more resources for schools that serve disadvantaged students.

Rural schools in the three countries, on average, have a higher percentage of inexperienced teachers than urban schools. To the extent that rural school teachers receive significantly higher salaries in the three countries, we would predict that the monetary incentives would reduce the gap in exposure rates to novice teachers between rural and urban schools. However, it appears that the salary increase is not enough to attract more experienced teachers to schools in rural and more isolated areas. The wage differentials for rural schools seem to be benefiting inexperienced and uncertified teachers. Once again Peruvian rural schools exhibit even larger differences than Colombian and Chilean schools.

Tables 5 to 8 indicate that teachers that work in lower performing schools (first quintile of math results in standardized test scores) are more likely to earn less in Colombia, and more in Peru. The differences are not significant in Chile when we do not include private voucher schools. The results also show that, apart from Chile, low performing schools have consistently less qualified (temporary) and more inexperienced teachers than higher performing schools. The differences are most striking in Peru, more than twice as high as in Colombia. These results corroborate previous evidence that the incentives to work in hard-to-staff schools (urban and low SES) are not sufficient, possibly due to the lack of other non-pecuniary incentives, to attract qualified and experienced teachers. These teacher sorting patterns likely explain some of the persistent achievement gaps in the three countries.

Table 7 Here

Table 8 Here

Conclusion

This article explores teacher sorting in Chile, Colombia, and Peru. As both the literature review and the review of the policies that aim to impact teacher decisions make clear, teacher sorting is a major policy concern in the region. There are two main conclusions that emerge from this analysis. First, the findings regarding horizontal equity are mixed. For instance, in Chile, a greater part of the variance in the average salary per school is explained by differences between municipalities and between regions. With respect to the experience and the type of contract, the results show that most of the variance is explained by differences within the local levels. The only exception is Peru, where half of the variance in the percentage of teachers with less than three years of experience is explained by differences between local governments and between regions. While our analyses are descriptive and do not attempt to identify the underlying causes of these patterns, the horizontal equity trends likely reflect differences in national teacher allocation rules in the three countries. For example, while municipal governments can complement teacher salaries with local revenues in Chile, the national teacher salary scales in Colombia and Peru do not allow local governments to top up teacher salaries. The salary differentials across

municipalities likely generates inequities in Chile. However, the uniform salary scales in Colombia and Peru, may hinder some local governments, with more difficult working conditions, from attracting more experienced and certified teachers.

Second, there is substantial teacher sorting across schools (vertical inequities) in the three systems. Overall, the comparison of the three countries confirms that, after controlling for confounding variables, disadvantaged students, particularly those in rural areas, are more likely to attend schools with teachers who are less qualified (temporary and inexperienced) and paid less. One of the most consistent findings in this analysis is the vertical inequities across the three measures in Colombia. In contrast, in Chile, the three measures have an inconsistent and weak relationship with mother's level of schooling and a moderate relationship with the geographic location of the school (rural). The results also indicate that there appears to be an inefficient allocation of teachers in Peru. The Peruvian government pays higher salaries to inexperienced and uncertified rural school teachers. While we do not attempt to disentangle the causal determinants that explain these findings, the patterns are likely due, at least in part, to some of the teacher allocation policies described above. For instance, Chile and Peru provide monetary incentives to work in rural schools and schools that serve a high proportion of disadvantaged students. Chile's preferential subsidy program also provides additional resources for low-income schools that can be used to improve working conditions and attract more qualified teachers. While Colombia provides rural teachers with a 15% compensation bonus, the salary schedule provides little incentive for teachers to teach in urban disadvantaged schools. Moreover, as described above, the centralized teacher assignment systems in Colombia and Peru, that give first preferences to higher ranked teachers may exacerbate inequities in teacher sorting. The stronger the preferences of teachers to work in more advantaged schools, the more likely it is that disadvantaged students will end up with inexperienced and temporary teachers.

There is a raging debate on the most effective policies to address teacher sorting. Some school systems have adopted monetary incentives to attract teachers to hard-to-staff schools. The literature finds that, for this policy to be effective, the incentives needs to be significant. For example, evidence in the United States finds that a salary increase of 15-18% improved attraction and retention of teachers in hard-to-staff and low-performing urban schools.⁶⁰ Similar size incentives to motivate teachers to hard-to-staff schools were also introduced in Chile, Colombia, and Peru. While there is limited empirical evidence on how these programs impact teacher decisions, the descriptive evidence presented in this paper suggest that they may not have alleviated the teacher sorting problem. In the case of Peru, the targeted incentives are more likely to go to inexperienced and uncertified teachers. Rural students in Chile and Colombia are also more exposed to novice and temporary teachers than their urban counterparts. Recent evidence in Chile also shows that the incentives to work in schools with a high proportion of low-income students mainly go to inexperienced teachers (Hinze-Pifer & Mendez, 2016)

An alternative strategy to attract teachers to disadvantaged schools is to improve working conditions. Simon and Johnson (2016) find that high teacher turnover is not only a result of student race and poverty but also school organizational dysfunction such as lack of administrative support. Forms of motivating teachers in hard-to-staff schools attempt to address these concerns by offering professional development opportunities or trying to improve the work environment at school. For example, the preferential subsidy program in Chile provides funds to disadvantaged schools to be spent on technical pedagogical and

⁶⁰ For example, the Governor's Teaching Fellowship program in California offered a \$20,000 bonus and a 15 percent annual premium to attract talented novice teachers to disadvantaged schools. The Talent Transfer Initiative offered highly effective teachers an increase of 18% of their annual salary for two years if they taught in low-performing schools (Glazerman et al., 2015)

administrative assistance and other activities that may improve working conditions for teachers. Recent evidence in Chile shows that achievement gaps declined by one-third since the passage of the SEP law (Murnane et al., 2017). The authors argue that the increased support of schools and accountability was the mechanism through which the preferential subsidy improved test scores in disadvantaged schools. Our findings also suggest that this policy may have also played a role in reducing disparities in teacher sorting across schools, which also may impact the income-based test score gap. However, recent evidence also finds that increased accountability may have had an adverse effect on teacher turnover in disadvantaged schools as higher skilled teachers move to vacancies in higher performing schools (Elacqua et al., 2015).⁶¹

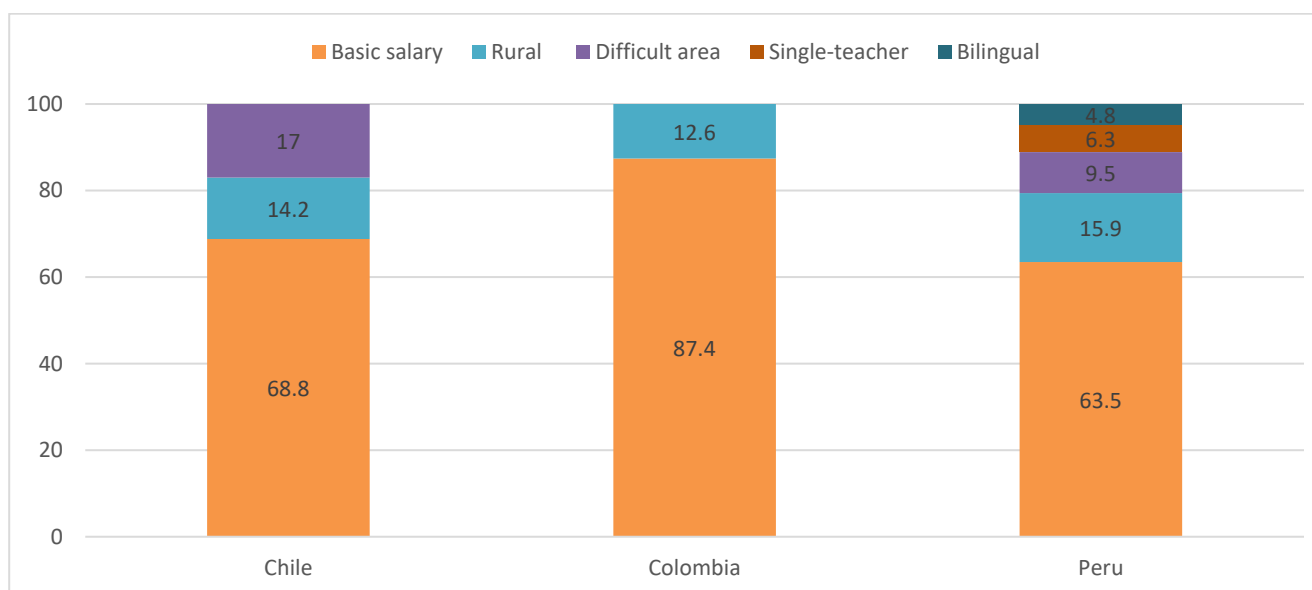
Policies that aim to improve the teacher assignment process can also impact the sorting of teachers. For example, South Korea and Singapore instituted a policy of mandatory rotation every five years (Luschei et al., 2013). The government centrally matches teachers with schools based on needs. Most teachers, over their careers, end up working in a diverse set of schools with students from different social backgrounds. As emphasized above, the design of teacher assignment policies in Chile, Colombia, and Peru is in sharp contrast with the rules in South Korea and Singapore. In Colombia and Peru, high ranking candidates have priority to select among the available vacancies. While the process is more decentralized in Chile, teachers can choose the municipalities or private voucher schools that they will apply to. These teacher assignment policies may foster inequities in teacher sorting if more effective teachers are more likely to choose openings in high-performing and more advantaged schools.

Strategies that focus on improving the achievement of disadvantaged students but do not consider teacher labor markets are unlikely to affect the substantial sorting of qualified teachers in disadvantaged rural and urban schools, which could potentially increase the socioeconomic achievement gap in Latin America (Araujo et al., 2016). This analysis lays the groundwork for future research by examining the extent of teacher sorting in three countries and describing the policies to address imbalances. For example, there is scant evidence on how teachers make employment decisions. What monetary and non-pecuniary factors are the most important when they choose to become a teacher and decide where to teach? Should monetary incentives be tied to performance to avoid the inefficiencies in teacher allocation identified in Peru? For example, recent research shows that paying high performing teachers an additional bonus to work in hard-to-staff schools in Washington DC reduced inequities in teacher sorting (Dee & Wyckoff 2015). Should school systems emphasize organizational culture or the working environment to alter teacher sorting? Could behavioral insights be employed to attract and retain effective teachers in disadvantaged schools? The work presented in this paper underscores the importance of developing research to disentangle the underlying causes of teacher sorting and identify the most effective policies and interventions that impact the distribution of qualified teachers among local governments and schools.

⁶¹ The universal class size reduction program introduced in California in the 1990s had similar adverse effects on the distribution of effective teachers. After the program was introduced, higher skilled teachers moved from disadvantaged and low-performing schools to vacancies in wealthier communities (Jepson & Rivkin, 2002).

Tables and figures

Figure 1. Incentives to work in hard-to-staff schools for secondary teachers



Note: In Chile, we consider a high school teacher with a 44 hour a week contract (the maximum allowed by law), with two years of experience, working in an educational establishment with full school day, located in a rural area classified with difficult conditions. The basic salary consists of the RBMN, the experience component, and the BRP (for degree and specialization). In Colombia, we are considering a teacher in the first grade of high school of the lowest salary scale hired under the Decree 1278 of 2002. The only explicit criteria regarding the school needs is a wage supplement for teachers and principals in difficult to access areas (15% of basic monthly salary). In Perú, we consider a full-time teacher in the lowest salary scale with a contract of 30 pedagogical hours per week. We are not including assignments for higher-level positions (such as school principal, vice-principal, director of UGEL, among others). At the same time, benefits and performance incentives were not included since these are mainly one-time payments which represent a very small share of the referenced teacher's monthly salary.

Table 1. Distribution of socioeconomic variable

Highest educational level of student's mother	Chile		Colombia	Peru
	Public	Public+Private	Public	Public
No education	0.55	0.38	2.4	3.67
Incomplete primary	17.94	11.69	20.8	17.6
Complete primary	15.94	11.7	17.8	15.98
Incomplete secondary	15.63	13.12	19.2	17.79
Complete secondary	35.47	38.65	26.6	26.07
Incomplete technical	2.45	3.45	1.7	3.35
Complete technical	7.12	11.84	5.2	2.78
Incomplete professional	1.39	2.23	1.1	2.9
Complete professional	3.18	6.25	4.4	6.21
Postgraduate	0.32	0.69	0.9	3.67
Total	100	100	100	100

Table 2. Descriptive statistics

	Chile (public)				Colombia				Peru			
	Gross hourly wage	<1 year exp	< 3 years exp	% temporary teachers	Gross hourly wage	<1 year exp	< 3 years exp	% temporary teachers	Gross hourly wage	<1 year exp	< 3 years exp	% temporary teachers
Mean	15.95	6.52	20.89	57.93	16.20	5.76	17.63	30.44	9.01	27.82	33.02	40.90
Median	15.60	5.45	19.23	56.52	16.19	0.00	11.76	20.00	8.67	20.00	25.93	33.33
Min	7.98	0.00	0.00	0.00	6.59	0.00	0.00	0.00	7.25	0.00	0.00	0.00
Max	21.31	50.00	100.00	100.00	23.02	100.00	100.00	100.00	16.64	100.00	100.00	100.00
Range	13.32	50.00	100.00	100.00	16.43	100.00	100.00	100.00	9.39	100.00	100.00	100.00
CV	0.18	1.00	0.61	0.35	0.18	2.00	1.18	1.01	0.13	1.04	0.87	0.71
Gini	0.10	0.53	0.33	0.20	0.10	0.76	0.58	0.54	0.07	0.56	0.48	0.40
GE2	0.02	0.50	0.19	0.06	0.02	2.01	0.69	0.51	0.01	0.54	0.37	0.25
N	743	743	743	743	7,268	7,268	7,268	7,268	8,014	8,033	8,033	8,033

Chile (public+private)				
	Gross hourly wage	<1 year exp	< 3 years exp	% temporary teachers
mean	14.88	7.63	24.13	50.26
p50	14.49	6.25	22.22	48.44
min	7.98	0.00	0.00	0.00
max	21.31	100.00	100.00	100.00
range	13.32	100.00	100.00	100.00
cv	0.20	1.07	0.64	0.47
Gini	0.11	0.55	0.35	0.27
GE2	0.02	0.57	0.20	0.11
N	2,338	2,338	2,338	2,338

Figure.2 Gross hourly wage secondary teachers

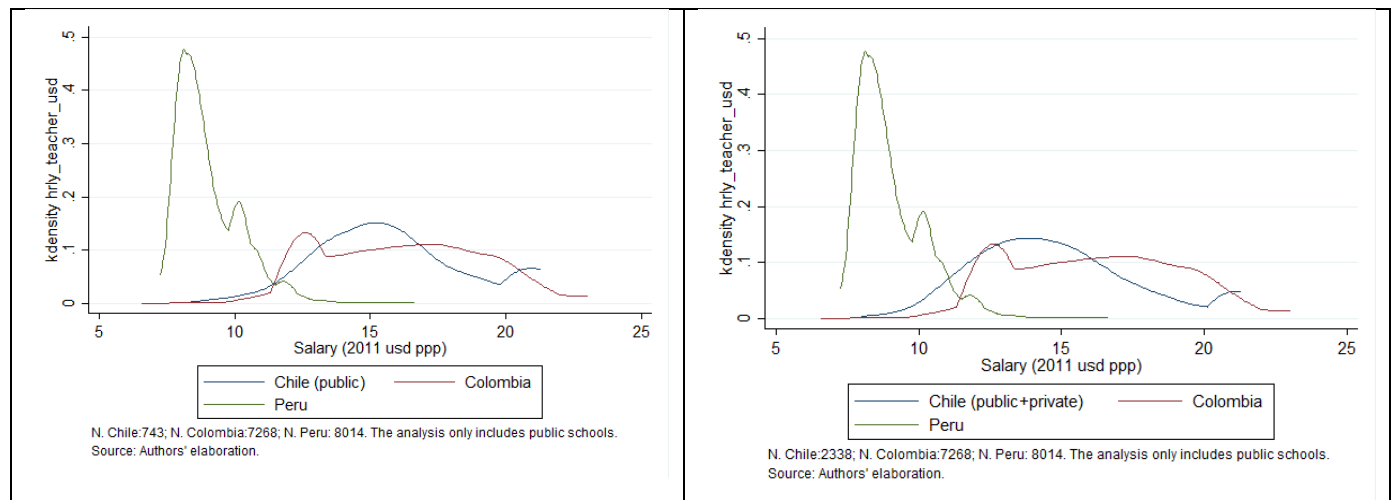


Table 3. Variance decomposition

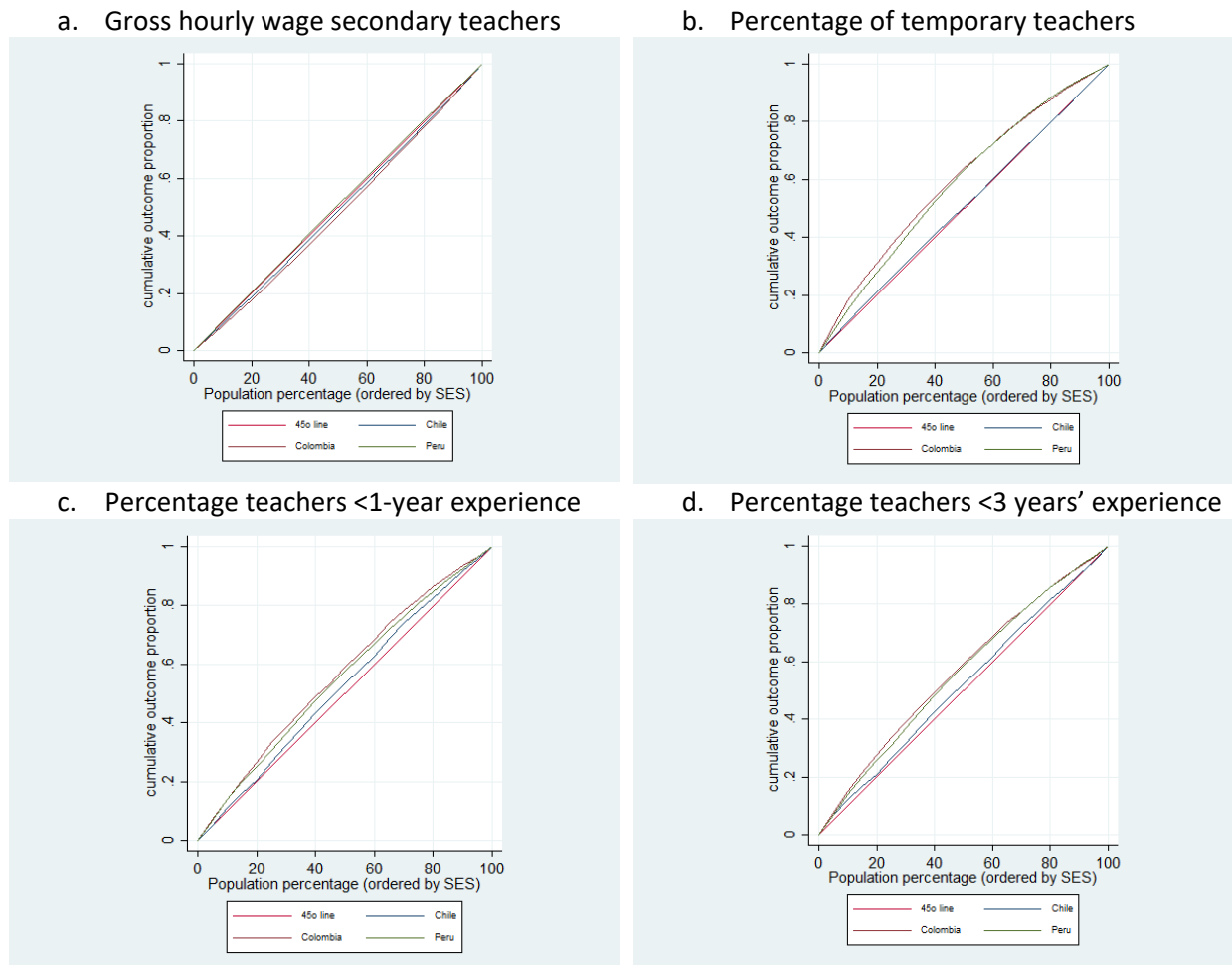
	Chile (public)			Colombia			Peru		
	Gross hourly wage	< 3 years exp	% temporary teachers	Gross hourly wage	< 3 years exp	% temporary teachers	Gross hourly wage	< 3 years exp	% temporary teachers
var(Regional)	26.77	0.73	5.10	-	-	-	3.99	7.33	12.36
var(Local)	37.05	1.66	9.85	18.92	9.87	21.29	22.46	41.01	16.76
var(School)	36.19	97.62	85.05	81.08	90.13	78.71	73.55	51.67	70.88
Tot.	100	100	100	100	100	100	100	100	100
N	743	743	743	7,268	7,268	7,268	8,014	8,033	8,033

	Chile (public+private)		
	Gross hourly wage	< 3 years exp	% temporary teachers
var(Regional)	34.12	0.82	0.00
var(Local)	3.94	2.00	3.96
var(School)	61.94	97.18	96.04
Tot.	100	100	100
N	2,338	2,338	2,338

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Table 4. Concentration Index

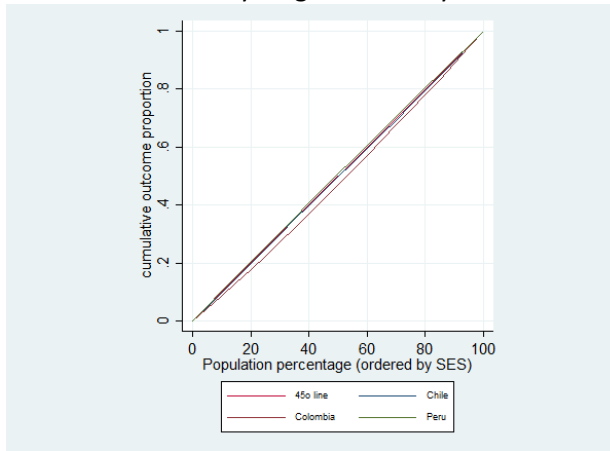
	Gross hourly wage	< 3 years exp	% temporary teachers
Chile (public)	0.021***	-0.032**	-0.001
Chile(public+private)	0.005**	-0.025***	-0.063***
Colombia	0.041***	-0.131***	-0.193***
Peru	-0.011***	-0.116***	-0.172***

Figure 3. Concentration curves teachers' attributes (Chile – public only)

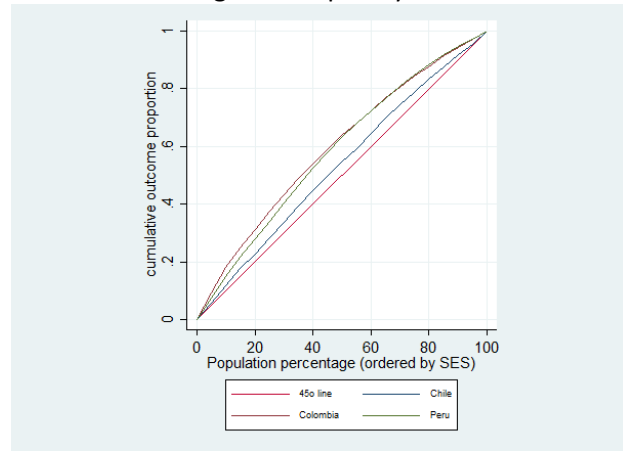
Note: Concentration index - Its range is between -1 and 1, with negative values indicating that educational resources are higher for poorer schools and positive values indicate the opposite.

Figure 4. Concentration curves teachers' attributes (Chile – public and private)

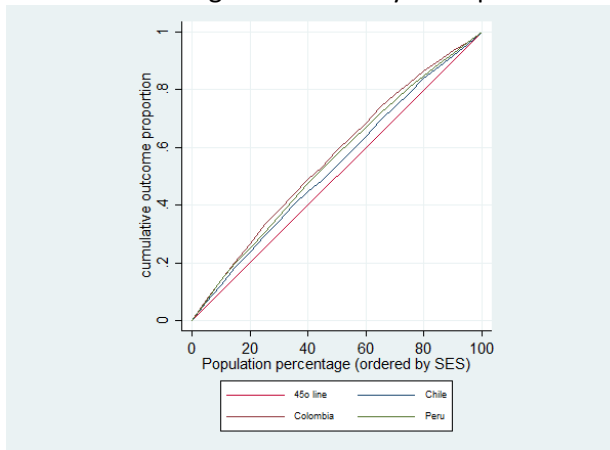
a. Gross hourly wage secondary teachers



b. Percentage of temporary teachers



c. Percentage teachers <1-year experience



d. Percentage teachers <3 years' experience

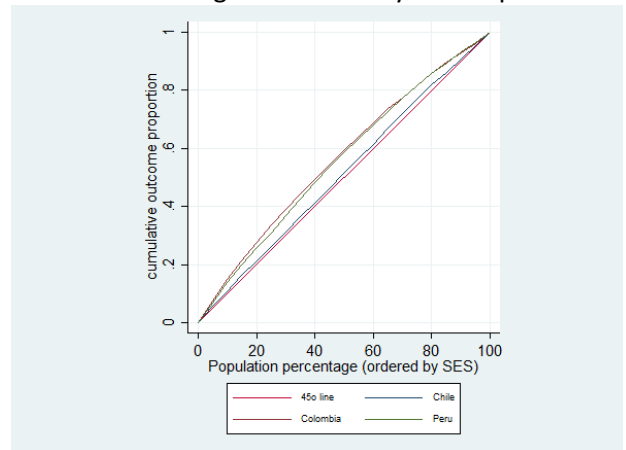


Table 5. Regressions of teacher salary

Var. Dep.: Gross hourly wage secondary teachers												
	(1) Chile	(2) Chile	(3) Chile	(4) Chile	(5) Colombia	(6) Colombia	(7) Colombia	(8) Colombia	(9) Peru	(10) Peru	(11) Peru	(12) Peru
students	0.000908*** (0.000261)	0.000806*** (0.000275)	0.000821*** (0.000263)	0.000741** (0.000289)	0.000843*** (6.77e-05)	0.000782*** (6.72e-05)	0.00108*** (6.53e-05)	0.00102*** (6.49e-05)	-0.000142*** (3.30e-05)	-0.000116*** (3.33e-05)	2.40e-05 (3.21e-05)	4.20e-05 (3.29e-05)
ise	0.0211*** (0.00579)	0.0163** (0.00658)	0.00356 (0.00639)	-0.00421 (0.00828)	0.0303*** (0.00179)	0.0233*** (0.00191)	0.0334*** (0.00172)	0.0261*** (0.00190)	0.00103 (0.000641)	0.00131* (0.000681)	-0.000933 (0.000800)	-0.000818 (0.000822)
Urban	0.695** (0.330)	0.769** (0.331)	0.912** (0.355)	0.948** (0.367)	1.221*** (0.0763)	1.194*** (0.0756)	1.350*** (0.0798)	1.325*** (0.0791)	-0.750*** (0.0319)	-0.704*** (0.0330)	-0.645*** (0.0296)	-0.621*** (0.0304)
2.stc_math		0.0215 (0.243)		0.0146 (0.273)		0.481*** (0.0957)		0.493*** (0.0913)		-0.246*** (0.0512)		-0.204*** (0.0488)
3.stc_math		0.333 (0.372)		0.130 (0.347)		0.592*** (0.0983)		0.669*** (0.0966)		-0.273*** (0.0519)		-0.188*** (0.0529)
4.stc_math		0.223 (0.466)		0.584 (0.526)		0.690*** (0.101)		0.794*** (0.104)		-0.265*** (0.0559)		-0.215*** (0.0583)
5.stc_math		0.964* (0.543)		0.908 (0.567)		1.184*** (0.108)		1.175*** (0.117)		-0.137 (0.103)		-0.200** (0.0979)
Constant	13.80*** (0.345)	13.91*** (0.368)	15.20*** (0.810)	15.65*** (0.848)	14.61*** (0.0579)	14.28*** (0.0738)	13.24*** (0.100)	12.86*** (0.111)	9.435*** (0.0282)	9.615*** (0.0471)	9.208*** (0.0860)	9.366*** (0.0960)
Observations	742	742	742	742	5,828	5,828	5,828	5,828	7,608	7,608	7,608	7,608
R-squared	0.066	0.070	0.774	0.777	0.258	0.275	0.401	0.414	0.102	0.107	0.325	0.327
Municipality FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 6. Regressions for temporary teachers

	Var. Dep.: Percentage of temporary teachers											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Chile	Chile	Chile	Chile	Colombia	Colombia	Colombia	Colombia	Peru	Peru	Peru	Peru
students	-0.0102*** (0.00186)	-0.0116*** (0.00181)	-0.0111*** (0.00258)	-0.0127*** (0.00256)	-0.00864*** (0.000577)	-0.00823*** (0.000580)	-0.00756*** (0.000561)	-0.00694*** (0.000556)	-0.0113*** (0.000815)	-0.00947*** (0.000768)	-0.0108*** (0.000911)	-0.00929*** (0.000887)
ise	0.0688 (0.0420)	-0.00252 (0.0461)	0.130** (0.0646)	0.00460 (0.0775)	-0.207*** (0.0176)	-0.162*** (0.0191)	-0.236*** (0.0167)	-0.166*** (0.0189)	-0.301*** (0.0153)	-0.274*** (0.0158)	-0.146*** (0.0189)	-0.139*** (0.0190)
Urban	-8.894*** (2.524)	-8.191*** (2.496)	-9.378** (3.802)	-8.729** (3.747)	-8.494*** (0.694)	-8.300*** (0.690)	-10.43*** (0.744)	-10.11*** (0.734)	-15.86*** (0.730)	-12.96*** (0.735)	-14.86*** (0.693)	-13.00*** (0.701)
2.stc_math		-1.059 (1.698)		0.911 (2.746)		-3.789*** (1.108)		-5.150*** (1.014)		-13.31*** (1.067)		-10.87*** (1.025)
3.stc_math		0.647 (2.487)		5.019 (3.275)		-4.049*** (1.108)		-7.882*** (1.066)		-17.05*** (1.089)		-14.55*** (1.136)
4.stc_math		3.122 (3.150)		5.651 (4.372)		-4.668*** (1.100)		-9.274*** (1.133)		-15.90*** (1.213)		-12.93*** (1.290)
5.stc_math		16.16*** (4.298)		16.59*** (5.211)		-7.958*** (1.111)		-11.57*** (1.243)		-10.76*** (2.238)		-8.641*** (2.144)
Constant	68.99*** (2.662)	71.77*** (2.807)	65.21*** (8.157)	72.09*** (8.686)	41.84*** (0.680)	44.28*** (0.924)	56.74*** (1.387)	61.18*** (1.484)	60.66*** (0.596)	70.80*** (0.943)	43.47*** (1.999)	53.95*** (2.135)
Observations	742	742	742	742	5,828	5,828	5,828	5,828	7,623	7,623	7,623	7,623
R-squared	0.059	0.083	0.514	0.528	0.165	0.172	0.342	0.356	0.245	0.276	0.403	0.420
Municipality FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 7. Regressions of teacher experience

Var. Dep.: % of teachers with less than 3 years experience												
	(1) Chile	(2) Chile	(3) Chile	(4) Chile	(5) Colombia	(6) Colombia	(7) Colombia	(8) Colombia	(9) Peru	(10) Peru	(11) Peru	(12) Peru
students	-0.00357*** (0.00111)	-0.00382*** (0.00112)	-0.00358** (0.00163)	-0.00353** (0.00166)	-0.00283*** (0.000376)	-0.00282*** (0.000378)	-0.00415*** (0.000399)	-0.00396*** (0.000401)	-0.00780*** (0.000804)	-0.00700*** (0.000795)	-0.00900*** (0.000767)	-0.00802*** (0.000764)
ise	-0.00785 (0.0259)	-0.0198 (0.0321)	0.0249 (0.0444)	0.0287 (0.0607)	-0.101*** (0.0127)	-0.0944*** (0.0138)	-0.113*** (0.0127)	-0.0791*** (0.0143)	-0.129*** (0.0157)	-0.119*** (0.0167)	-0.114*** (0.0157)	-0.109*** (0.0160)
Urban	-4.999*** (1.863)	-4.799** (1.886)	-6.153** (3.095)	-6.022* (3.120)	-3.170*** (0.456)	-3.231*** (0.456)	-3.613*** (0.517)	-3.571*** (0.515)	-11.03*** (0.776)	-9.657*** (0.796)	-8.964*** (0.584)	-7.758*** (0.590)
2.stc_math		0.168 (1.135)		1.113 (1.793)		-0.285 (0.753)		-0.979 (0.736)		-7.379*** (1.212)		-6.817*** (0.891)
3.stc_math		0.858 (1.550)		-0.689 (2.454)		0.824 (0.765)		-1.705** (0.786)		-8.223*** (1.234)		-9.550*** (0.991)
4.stc_math		0.361 (1.919)		-0.744 (3.298)		0.454 (0.752)		-2.629*** (0.826)		-8.062*** (1.365)		-8.317*** (1.114)
5.stc_math		2.544 (2.665)		0.604 (3.972)		-0.822 (0.773)		-4.741*** (0.925)		-6.563*** (2.242)		-6.246*** (1.820)
Constant	27.92*** (2.003)	28.15*** (2.118)	27.90*** (5.864)	27.23*** (6.286)	22.59*** (0.480)	22.40*** (0.644)	21.81*** (0.780)	22.73*** (0.903)	44.41*** (0.654)	49.83*** (1.089)	41.96*** (1.598)	48.66*** (1.760)
Observations	742	742	742	742	5,828	5,828	5,828	5,828	7,623	7,623	7,623	7,623
R-squared	0.035	0.036	0.439	0.440	0.060	0.061	0.166	0.172	0.090	0.098	0.538	0.545
Municipality FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 8. Regressions for Chile (Public+Private)

Var. Dep:	Gross hourly wage secondary teachers				Percentage of temporary teachers				% of teachers with less than 3 years of experience			
	Chile											
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
students	0.00153*** (0.000135)	0.00130*** (0.000133)	0.00174*** (0.000142)	0.00152*** (0.000140)	-0.0102*** (0.000959)	-0.00849*** (0.000970)	-0.0125*** (0.00109)	-0.0109*** (0.00112)	-0.00293*** (0.000594)	-0.00277*** (0.000624)	-0.00405*** (0.000691)	-0.00369*** (0.000730)
ise	-0.00329 (0.00257)	-0.0182*** (0.00330)	-0.00337 (0.00285)	-0.0189*** (0.00384)	-0.163*** (0.0207)	-0.0527* (0.0282)	-0.180*** (0.0248)	-0.0689* (0.0360)	-0.0167 (0.0142)	-0.00438 (0.0192)	0.0163 (0.0169)	0.0459* (0.0250)
1.area	0.154 (0.239)	0.318 (0.240)	0.483** (0.229)	0.639*** (0.233)	-3.390* (2.020)	-4.463** (2.017)	-3.485 (2.352)	-4.294* (2.380)	-3.779** (1.471)	-3.892*** (1.479)	-3.753** (1.753)	-4.090** (1.760)
2.stc_math		-0.222 (0.186)		-0.216 (0.183)		-1.540 (1.374)		-1.185 (1.593)		0.978 (0.976)		0.743 (1.102)
3.stc_math		-0.275 (0.208)		-0.285 (0.204)		-2.572 (1.611)		-1.672 (1.807)		2.943*** (1.100)		2.261* (1.233)
4.stc_math		0.679*** (0.226)		0.499** (0.228)		-9.516*** (1.794)		-8.331*** (2.077)		-0.628 (1.211)		-1.824 (1.424)
5.stc_math		2.057*** (0.264)		1.949*** (0.279)		-11.60*** (2.188)		-9.911*** (2.522)		-1.781 (1.407)		-3.004* (1.695)
Constant	13.84*** (0.239)	14.50*** (0.258)	14.78*** (0.461)	15.75*** (0.448)	71.19*** (2.003)	68.37*** (2.129)	84.38*** (4.457)	79.01*** (4.595)	30.86*** (1.507)	29.58*** (1.618)	28.03*** (3.012)	25.96*** (3.151)
Observations	2,337	2,337	2,337	2,337	2,337	2,337	2,337	2,337	2,337	2,337	2,337	2,337
R-squared	0.062	0.112	0.380	0.421	0.098	0.117	0.256	0.269	0.017	0.027	0.175	0.184
Municipality FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

References

- Araujo, M. C., Carneiro, P., Cruz-Aguayo, Y., & Schady, N. (2016). Teacher quality and learning outcomes in kindergarten. *The Quarterly Journal of Economics*, 131(3), 1415-1453.
- Ayala, M.C. (2017). Efecto de los docentes provisionales sobre desempeño académico: Evidencia para la educación secundaria oficial en Colombia. Universidad de los Andes.
- Bandaranayake, B. (2013). Formula-Based Public-School Funding System in Victoria: An Empirical Analysis of Equity. *International Journal of Educational Leadership Preparation*, 8(2), 191-207.
- BenDavid-Hadar, I. (2016). School finance policy and social justice. *International Journal of Educational Development*, 46, 166-174.
- Baker, B., Green, P.C., Richards, C. Financing Education Systems. Pearson/Merrill Prentice Hall.
- Berne, R. and L. Stiefel. (1999). *Concepts of school finance: 1970 to the present*. In H.F. Lad., R. Chalk, and J.S. Hansen (Eds.) *Equity and adequacy in education finance: Issues and perspectives*, eds., (pp. 7-33). Washington, DC: National Academy Press
- Boyd, D., Lankford, H., Loeb, S., & Wyckoff, J. (2013). Analyzing the Determinants of the Matching of Public School Teachers to Jobs: Disentangling the Preferences of Teachers and Employers. *Journal of Labor Economics*, 31(1), 83-117. doi:10.1086/666725
- Brutti, Z. (2014). Decentralizing Public Education: Does Everyone Benefit? Evidence from Colombia. SITE Conference 2014.
- Brutti, Z., & Sanchez, F. (2016). New Teachers for Colombia: Is Quality Control Working? *Working paper* Universidad de los Andes. http://www.ieb.ub.edu/files/PapersWSEE2016/WSEE2016_Brutti.pdf
- Chetty, R., Friedman, J., & Rockoff, J. (2014). Measuring the Impacts of Teachers II: Teacher Value-Added and Student Outcomes in Adulthood. *American Economic Association*, 104(9), 2633-2679.
- Clotfelter, C., Ladd, H., and Vigdor, J. (2006). Teacher-Student Matching and the Assessment of Student Effectiveness. *Journal of Human Resources* 41 (4), pp. 778-820. <https://www.jstor.org/stable/40057291>
- Condron, D. J., Tope, D., Steidl, C. R., & Freeman, K. J. (2013). Racial segregation and the black/white achievement gap, 1992 to 2009. *The Sociological Quarterly*, 54(1), 130-157.
- Costrell, R., Hanushek, E., and Loeb, S. (2008). What Do Cost Functions Tell Us About the Cost of an Adequate Education? *Peabody Journal of Education* Volume 83 (2), pp. 198-223.
- Cowell, F.A. and Jenkins, S.P. 1995. How much inequality can we explain? A methodology and an application to the USA. *Economic Journal* 105: 421-430.
- Dee, T. S. and Wyckoff, J. (2015), Incentives, Selection, and Teacher Performance: Evidence from IMPACT. *J. Pol. Anal. Manage.*, 34: 267–297. doi:10.1002/pam.21818

Duflo, E., Dupas, P., and Kremer, M. (2009). Additional resources versus organizational changes in education: Experimental evidence from Kenya. *Unpublished manuscript. Abdul Latif Jameel Poverty Action Lab (JPAL), Cambridge, Mass.: Massachusetts Institute of Technology, 9(789231), 002205.*

Elacqua, G. Hincapie, D. Vegas, E. and Alonso, M. () Profesión: Profesor en América Latina ¿Por qué se perdió el prestigio docente en América Latina y cómo recuperarlo? Manuscript Title. Manuscript submitted for publication.

Elacqua, G., Marotta, L., Powidayko, N. (2017). *Políticas de Financiamento para Equidade*. Presented at the Public Hearing Discussão da PEC nº 15 de 2015: análise do texto e sugestões para o seu aprimoramento, Brasília, Brazil.

Elacqua, G., Figueroa, C., Martínez, M., Santos, H. (2015). Los efectos de las presiones de accountability en la movilidad de los docentes en escuelas de bajo desempeño. Concurso FONIDE: Evidencias para políticas públicas en educación, Ministerio de Educación.

Feng, L., Figlio, D.N., and Sass, T. (2010). School accountability and teacher mobility. *NBER Working Paper* No. 16070. <http://www.nber.org/papers/w16070.pdf>

Fundación Compartir (2014). Tras la excelencia docente: Cómo mejorar la calidad de la educación para todos los colombianos. <http://www.fundacioncompartir.org/pdf/Traslaexcelenciadocente18.02.2014.pdf>

Glazerman, S., Protik, A., Teh, B. R., Bruch, J., & Max, J. (2013). *Transfer Incentives for High-Performing Teachers: Final Results from a Multisite Randomized Experiment*. Washington DC: National Center for Education Evaluation and Regional Assistance.

Goldhaber, D. D., & Anthony, E. A. (2007). Can teacher quality be effectively assessed? *The Review of Economics and Statistics*, 89(1), 134–150.

Hanushek, H., Kain, J.F., and Steven G. (2004). Rivkin Why Public Schools Lose Teachers. *Journal of Human Resources*, XXXIX, pp. 326-354. doi: 10.3368/jhr.XXXIX.2.326

Hanushek, E and Rivkin, S. (2007). Pay, working conditions and teacher quality. *The Future of Children*. Spring 2007.

Hinze-Pifer, R. and Mendez, C. (2016). Can Pay Draw Teachers to Hard-to-Staff Schools? Evidence from Chile. *AEFP 41st Annual Conference*

Iatarola, P., & Stiefel, L. (2003). Intradistrict equity of public education resources and performance. *Economics of Education Review*, 22(1), 69–78.

Jepson, C. & S. Rivkin (2002) Class size reduction, teacher quality, and academic achievement in California public elementary schools. Public Policy Institute of California.
http://www.ppic.org/content/pubs/report/R_602CJR.pdf

- Kelly, A. (2014). Measuring equity in educational effectiveness research: the properties and possibilities of quantitative indicators. *International Journal of Research and Method in Education*, 38(2), 115-136.
- Jackson, C. (2009). Student Demographics, Teacher Sorting, and Teacher Quality: Evidence from the End of School Desegregation. *Journal of Labor Economics*, 27(2), 213-256.
- Jackson, C.K., Johnson, R., and Persico, C. (2016). The Effects of School Spending on Educational and Economic Outcomes: Evidence from School Finance Reforms. *The Quarterly Journal of Economics* 131 (1): pp. 157-218. doi:10.1093/qje/qjv036
- Jann, B. (2016). Estimating Lorenz and concentration curves. *The Stata Journal* 16 (4), pp. 837-866.
- Koolman, X., and E. van Doorslaer (2004). On the Interpretation of a Concentration Index of Inequality. *Health Economics* 13: 649–56.
- Lafortune, J., Rothstein, J., and Whitmore Schazenbach, D. (2016). School finance reform and the distribution of student achievement. *NBER Working Paper Series*, No. 22011 www.nber.org/papers/w22011.pdf.
- Land, D., & Legters, N. (2002). The extent and consequences of risk in US education. *Yearbook of the National Society for the Study of Education*, 101(2), 1-28.
- Lankford, H., Loeb, S. and Wyckoff, J. (2002). Teacher Sorting and the Plight of Urban Schools: A Descriptive Analysis, *Educational Evaluation and Policy Analysis*, 24 (1), pp. 38-62. <http://epa.sagepub.com/content/24/1/37>
- Levacic, R. (2008). Funding Schools by Formula, in Nils C. Soguel and Pierre Jaccard (eds.) *Governance and Performance of Education Systems*, Springer, Netherlands, pp. 205-235. https://rd.springer.com/chapter/10.1007/978-1-4020-6446-3_10
- Luschei, T. F., Chudgar, A., & Rew, J. W. (2013). Exploring differences in the distribution of teacher qualifications across Mexico and South Korea: Evidence from the Teaching and Learning International Survey. *Teachers College Record*, 115(5).
- Marotta, L. (2017). Teachers' Contractual Ties and Student Achievement: The Effect of Temporary and Multiple-School Teachers in Brazil. Draft.
- McEwan, P. J., & Trowbridge, M. (2007). The achievement of indigenous students in Guatemalan primary schools. *International Journal of Educational Development*, 27(1), 61-76.
- Meckes, L. and Bacospé, M. (2010). Distribución inequitativa de los nuevos profesores mejor preparados: Características de origen y destino laboral de los egresados de Pedagogía Básica 2010). http://achie.cl/ciie2010/docs/doc/sesiones/249_LMeckes_Distribucion_profesores.pdf
- Muralidharan, K., and Sundararaman, V. (2013). Contract teachers: Experimental evidence from India. *NBER Working Paper* No. w19440. National Bureau of Economic Research.

Murnane, R. Waldman, R., Willett, J.B., Bos, M.S., Vegas, E. (2017). The Consequences of Educational Voucher Reform in Chile. *NBER Working Paper* No. 23550

Nina, O., Molina, O., Barrientos, P. y Aguilar, P. (2006). ¿Es equitativa en Bolivia la asignación del gasto público en educación? *Revista Latinoamericana de Desarrollo Económico*, 7, 57-96.

O'Donnell, O., van Doorslaer, E., Wagstaff, A., and Lindelow, M. (2008). *Analyzing Health Equity Using Household Survey Data a Guide to Techniques and Their Implementation*. WBI Learning Resources Series.

Ome, A. (2013). El estatuto de profesionalización docente: una primera evaluación. <http://www.repositorio.fedesarrollo.org.co/handle/11445/156>

Ortuzar, S., Flores, C., Milesi, C. and Cox, C. (2009). Aspectos de la formación inicial docente y su influencia en el rendimiento académico de los alumnos. In *Camino al Bicentenario Propuestas para Chile*. <http://cedle.cl/publicaciones/aspectos-de-la-formacion-inicial-docente-y-su-influencia-en-el-rendimiento-academico-de-los-alumnos/>

Piñeros, L.J. (2016). El Sistema General de Participaciones como mecanismo de financiación de la educación básica en Colombia: Balance y perspectivas. Inter-American Development Bank.

Rivkin, S. G., Hanushek, E. A., & Kain, J. F. (2005). Teachers, schools and academic achievement. *Econometrica*, 73(2), 417–458.

Rockoff, J. E. (2004). The impact of individual teachers on student achievement: Evidence from panel data. *American Economic Review*, 94(2), 247–252.

Rosa, L. (2017). Teacher Preferences in Developing Countries Evidences from the City of Sao Paulo, Brazil. Stanford University. Draft

Rubenstein, R. Schwartz, A.E., Stiefel, L. and Bel Hadj Amor, H. (2007). From districts to schools: The distribution of resources across schools in big city school districts. *Economics of Education Review*, Volume 26, Issue 5, 2007, Pages 532-545, <https://doi.org/10.1016/j.econedurev.2006.08.002>.

Ruffinelli, A. and Guerrero, A. (2009). Círculo de segmentación del sistema educativo chileno: destino laboral de egresados de Pedagogía en Educación Básica. *Revista Calidad en La Educación* N° 31. Consejo Nacional de Educación.

Schnell, P., & Azzolini, D. (2015). The academic achievements of immigrant youths in new destination countries: Evidence from southern Europe. *Migration Studies*, 3(2), 217-240.

Sirin, S. (2005). Socioeconomic status and academic achievement: A meta-analytic review of research. *Review of Educational Research*, 75, 417-453. doi: 10.3102/00346543075003417

Steele, J. L., Hamilton, L. S., & Stecher, B. M. (2010). Incorporating student performance measures into teacher evaluation systems. Santa Monica, C. A.: The RAND Corporation

Toutkoushian, R. K., & Michael, R. S. (2007). An alternative approach to measuring horizontal and vertical equity in school funding. *Journal of Education Finance*, 395-421.

Verstegen, D. (2015). On doing an analysis of equity and closing the opportunity gap. *Education Policy Analysis Archives*, 23(41).

Vesely, R. S., & Crampton, F. E. (2004). An assessment of vertical equity in four states: Addressing risk factors in education funding formulas. *Journal of Education Finance*, 30(2), 111-122.

Annex 1. Regressors

		Chile (public)					Chile (public+private)					Colombia					Peru				
		mean	p50	min	max	N	mean	p50	min	max	N	mean	p50	min	max	N	mean	p50	min	max	N
Students	Number of secondary students	607.36	527	41	4,039	743	722	607	40	4,039	2,338	543	382	4	4,484	6,974	215	106	3	2,909	8,008
ISE	% of students whose mother completed secondary education	45.98	43.40	0	100	742	64.01	66.67	0	100	2,337	28.99	26.45	0.00	100.00	5,838	27.57	23.08	0.00	100.00	7,624
Urban	Schools in urban areas	0.90	1.00	0.00	1	743	0.94	1.00	0	1	2,338	0.39	0.00	0.00	1.00	7,268	0.59	1.00	0.00	1.00	8,033
STC_math 1	Standardized test score quintile 1	0.46	0.00	0.00	1	743	0.22	0.00	0	1	2,338	0.20	0.00	0.00	1.00	5,838	0.14	0.00	0.00	1.00	7,624
STC_math 2	Standardized test score quintile 2	0.31	0.00	0.00	1	743	0.22	0.00	0	1	2,338	0.20	0.00	0.00	1.00	5,838	0.35	0.00	0.00	1.00	7,624
STC_math 3	Standardized test score quintile 3	0.12	0.00	0.00	1	743	0.22	0.00	0	1	2,338	0.20	0.00	0.00	1.00	5,838	0.33	0.00	0.00	1.00	7,624
STC_math 4	Standardized test score quintile 4	0.06	0.00	0.00	1	743	0.21	0.00	0	1	2,338	0.20	0.00	0.00	1.00	5,838	0.15	0.00	0.00	1.00	7,624
STC_math 5	Standardized test score quintile 5	0.05	0.00	0.00	1	743	0.14	0.00	0	1	2,338	0.20	0.00	0.00	1.00	5,838	0.02	0.00	0.00	1.00	7,624

