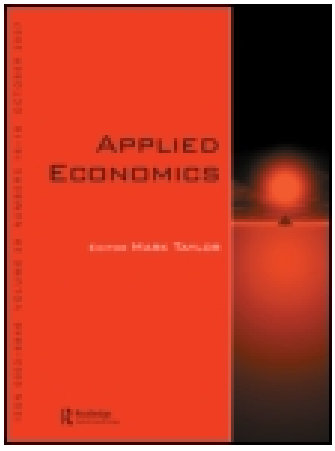

Applied Economics
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/raec20

Self-selection in the market of teachers

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Published online: 02 Jan 2015.

To cite this article: Juan A. Correa, Francisco Parro & Loreto Reyes (2015) Self-selection in the market of teachers, Applied Economics, 47:13, 1331-1349, DOI: 10.1080/00036846.2014.995365

To link to this article: http://dx.doi.org/10.1080/00036846.2014.995365

Applied Economics, 2015
Vol. 47, No. 13, 1331–1349, http://dx.doi.org/10.1080/00036846.2014.995365

Routledge
Taylor & Francis Group

Self-selection in the market of teachers

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Public school teachers are usually paid according to centralized earning schedules, in which their income depends mainly on experience. By contrast, in private schools, there is high wage dispersion, and salaries correspond mainly to teachers' performance. That dichotomous labour regulation encourages teachers with better unobservable skills to self-select into private schools because the likelihood of earning higher wages is higher than in public schools. The other side of the coin is the self-selection of 'bad' teachers into public schools. Using a representative sample of Chilean teachers, we estimate a two-sector Roy model to test self-selection. We find evidence of negative self-selection of teachers into public schools.

Keywords: education; human capital; self-selection

JEL Classification: I21; I28; J24

I. Introduction

In public schools, teachers are commonly paid according to centralized earnings schedules with high seniority returns, and there are strong limitations on firing poor-quality teachers. By contrast, the setting of wages in private schools is decentralized, and earnings are more directly related to the performance of teachers in the classroom. This dichotomous labour regulation is linked with the influence of teachers' unions over the earnings schedule in the public sector.[1] Those distinct regulatory schemes for public and private schools produce different wage structures in the private and public education sectors. Private

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[1] Ballou and Podgursky (2002) find that returns to seniority are relatively higher for public school teachers in the United States. They posit that this phenomenon cannot be explained by teachers' human capital or the imperfect monitoring of their performance. They find that unions seek to reward senior teachers with 'backloaded increases in pay' and junior teachers with fewer steps in their salary schedules, allowing them 'to reach high levels of pay more quickly'. Heutel (2009) shows that higher teacher salaries in unionized districts in the United States can be explained by a tournament model. He states that high administrator-to-teacher salary ratios lure teachers to compete to be promoted as administrators. Like Ballou and Podgursky (2002), Heutel (2009) also rejects the imperfect monitoring hypothesis as a cause of high seniority returns. He argues that 'teachers are among the most difficult of all employees to fire'. The findings of Ballou and Podgursky (2002) and Heutel (2009) present different explanations consistent with the idea that tenure protections challenge public schools to use alternative models to fire shirking teachers, rather than traditional models of imperfect monitoring.

schools exhibit high wage dispersion, whereas public schools have a very rigid wage structure with low variance of wages.

If highly qualified teachers perform well in both markets, a traditional two-sector Roy model would predict that teachers with higher unobserved abilities should be concentrated in the market with higher wage dispersion (i.e. private schools) and that negative selection should be observed in the sector with highly compressed wages (i.e. public schools). Therefore, overregulation or bad regulations governing the teaching career in public schools could result in important differences in the quality of teachers between public and private schools.

Chile presents a case where two different regulations for public and private schools coexist. On the one hand, public schools have been regulated since 1991 by the Teaching Statute, which limits the grounds for dismissal and produces a very rigid wage structure that is heavily based on teachers' years of experience. On the other hand, private schools are regulated by the Labour Code, with very general and flexible rules for setting salaries, in the same way that the Code regulates interactions between employers and employees in other private markets of the economy.

We take advantage of this dichotomous labour regulation in Chile to test the existence of self-selection of teachers into public schools. Our empirical strategy considers a two-sector Roy model with no cost to teachers from moving between public and private schools. After controlling for teachers', schools', and students' observable characteristics, we find evidence consistent with the existence of negative self-selection (based on unobservable characteristics) of teachers into public schools.

Our results are important for two reasons. First, empirical evidence supports the idea that unobservable characteristics (e.g. persistence, reliability and self-discipline) are as important as, or even more important than, observable characteristics (e.g. education, training courses) for the effectiveness of teachers in the classroom. Therefore, the rigid wage structure for teachers in public schools, which promotes negative self-selection, may partially explain poor academic results of students attending these schools. Second, our results suggest that an improved regulation that increases the variance of wages in public schools might be an effective way of attracting teachers with better unobservable skills to the public sector.

Empirical evidence supports the key role of teachers in the cognitive and noncognitive development of students. Aaronson *et al.* (2007) find that replacing a teacher with another one who is rated two SD superior in quality can add 0.35 to 0.45 grade equivalents, or 30% to 40% of an average school year, to a student's math performance. Kane *et al.* (2008) use 6 years of data on student test performance to evaluate the effectiveness of teachers in New York City public schools. They find that, among those with the same certification status, there are large and persistent differences in teacher effectiveness. They show that raising the effectiveness of novice teachers in New York by one SD would improve student achievement similar to the expected improvement of teachers who spend 8 years teaching in the district. Rivkin *et al.* (2005) show that teacher quality has powerful effects on reading and mathematics achievement. Their results suggest that the effects of a costly 10-student reduction in class size are smaller than the benefit of moving one SD up the teacher quality distribution, highlighting the importance of teacher effectiveness in the determination of school quality. Rockoff (2004) finds that a one SD increase in teacher quality raises test scores by approximately 0.1 SD in reading and math on nationally standardized distributions of achievement.

Additionally, it has been found that effectiveness, or teacher quality, depends not only on observable characteristics (education, family background, etc.) but also on unobservable ones. Aaronson *et al.* (2007) show that the vast majority of the teacher effects that they measured are unexplained by the standard observable characteristics of teachers, including those that are typically used for compensation purposes. Lazear (2003) suggests that 'there is no strong evidence that observable characteristics of the teacher are good predictors of the ability to affect student performance'.

Those pieces of evidence suggest that the existence of negative self-selection of teachers into public schools may partially explain why several studies using Chilean student-level data find that, even after properly controlling for students' socioeconomic backgrounds, students attending voucher

private schools have higher educational outcomes than those from public schools.[2]

A related literature studies the forces behind teacher sorting and the link with student performance. However, none of those previous works offer an optimal setting to study the effects of a dichotomous labour regulation for public and private schools on teacher sorting. This article exploits the existence of this institutional setting in the education market in Chile to study how different wage structures in the public and private education sectors encourage teachers with different unobservable skills to self-select into different types of schools.

Bacolod (2007) explores the impact of the expansion in professional opportunities for American women on teacher supply and teacher quality. She presents evidence of a marked decline in the quality of young women going into teaching and, in contrast, a rise in the quality of young women becoming professionals. She finds that higher relative salaries increase the probability that women in the top quintile of the IQ distribution enter the teaching profession. Therefore, the focus of Bacolod (2007) is on understanding the selection of women into the teaching profession. In a related paper, Ballou and Podgursky (1997) analyse whether an increase in salaries for teachers leads to a more qualified teaching workforce. The authors find little evidence to support the link between increased salaries and teacher quality. Unlike Bacolod (2007) and Ballou and Podgursky (1997), we analyse how agents that are already teachers self-select into public and private schools. Therefore, we try to understand not why agents decide to become teachers but why teachers with certain unobservable characteristics decide to work in public or private schools and what effect a dichotomous labour regulation in the market of teachers has on the type of sorting observed in the data.

Hensvik (2012) examines the impact of local private school competition in Sweden, introduced by a voucher reform, on teacher flows and wages in a decentralized wage setting where local administrators have substantial room to adjust wages at the individual level. She focuses her analysis on the observable characteristics of teachers. Additionally, Bonesrønning *et al.* (2005) study a specific aspect of teacher sorting across schools. The authors undertake an empirical analysis of the relationship between teacher sorting and student body composition, separating the effects of student body composition on teacher supply and teacher demand. Unlike in Hensvik (2012), in our article, the existence of a dichotomous labour regulation for public and private schools is what drives teacher sorting, not competition. Moreover, in our empirical model, we show that, even controlling for student composition, a dichotomous labour regulation triggers self-selection of teachers in the Chilean education market. In this sense, we offer a different explanation than those exposed in Hensvik (2012) and Bonesrønning *et al.* (2005).

Lankford *et al.* (2002) use data on New York State teachers to describe the sorting of teachers across schools, but they do not test hypotheses for why this sorting occurs. They show that the transfer and quit behaviour of teachers is consistent with the hypothesis that more qualified teachers seize opportunities to leave difficult working conditions and move to more appealing environments. Teachers are more likely to leave poor, urban schools, and those who leave are likely to have greater skills than those who stay. The analysis presented by the authors provides a foundation for further work by documenting the extent and nature of teacher sorting. However, the authors conclude that there is much to learn about the behaviour of individuals interested in teaching

[2] McEwan (2001) finds that there is no consistent difference between student achievement in public and nonreligious private voucher schools, although fee-paying private schools and Catholic private voucher schools have higher achievement levels than public schools. Mizala and Romaguera (2001) and Sapelli and Vial (2002, 2005) find that students who attended private voucher schools have higher educational outcomes than those from public schools. More recently, Anand *et al.* (2009) find that students in fee-charging private voucher schools score higher than students in public schools. However, they find no difference in the academic achievement of students in fee-charging private voucher schools relative to their counterparts in free private voucher schools. Their results suggest that low-income students who typically attend public schools can benefit from attending private voucher schools. Bravo *et al.* (2010) use the 2002 and 2004 Social Protection Surveys (Encuesta de Protección Social) to estimate a dynamic model of schooling and working decisions. They conclude that the school voucher program induced individuals affected by the program to attend private voucher schools at a higher rate, to achieve higher educational attainment, to participate more in the labour force and to earn higher wages. Finally, Lara *et al.* (2011) use a number of propensity-score-based econometric techniques and changes-in-changes estimation methods and find that private voucher education leads to small differences in academic performance.

and the schools that employ them. Among the questions that they raise for future research is how changes in the structure of salaries alter the current sorting of teachers. Our article offers an answer to that question; the dichotomous labour market in Chile provides an optimal setting to study the effect of different wage schemes on self-selection into private and public schools.

The existence of negative self-selection in the public sector based on unobserved abilities and the importance of these abilities for the effectiveness of teachers in the classroom also have direct policy implications. An efficient way of attracting teachers with better unobservable skills to public schools is by increasing the flexibility of the legal framework regulating teachers' salaries in public schools to produce higher wage dispersion, similar to that in the private sector. This policy may encourage teachers with higher unobserved abilities to migrate from private to public schools and, in the end, improve the academic results of children attending those schools.

The rest of the article is organized as follows. Section II analyses the Chilean education system, focusing on the regulation that governs the wage structure in public and private schools. Section III develops the theoretical model. Section IV describes the data set used. Section V discusses the empirical strategy for identifying the model. Section VI presents the empirical results. Section VII concludes.

II. The Structure of Teachers' Salaries in Chile

The Chilean primary and secondary education system is composed of three types of schools: (i) public schools financed by government subsidies based on students' attendance and by additional funds from local governments (municipalities); (ii) private schools that are also financed by the government and, since 1992, in some cases by co-payments made by parents (semiprivate schools[3]); and (iii) private schools financed exclusively by parents (private schools).[4] The current labour legislation governing public schools differs from that for private and semiprivate schools. Since 1991, the hiring, firing and salaries of teachers working in public schools have been regulated by the Teaching Statute. The statute set up a basic remuneration system called the Basic National Minimum Salary (BNMS), which is supplemented by several bonuses, many of them indexed to the BNMS.

Table 1 summarizes the main bonuses that a typical public school teacher earns during her working life. As this table shows, the wage structure in public schools is very rigid and heavily based on experience and training courses taken by teachers, with almost no compensation linked to teachers' performance in the classroom. For instance, in addition to their BNMS, teachers receive a bonus based on their teaching experience, which is equivalent to 6.76% of the BNMS for the first two years in the labour market and 6.66% of the BNMS for every two additional years.[5] Additionally, depending on their participation in training courses, teachers can receive additional compensation equivalent to 40% of their BNMS (as maximum). The wage structure in the public sector also establishes special bonuses related to the type of degree obtained by teachers (professional degrees and majors), their celebration of national holidays and the number of their children between 4 and 24 years old attending school.

On the other hand, semiprivate and private schools are regulated by the Labour Code, with very general and flexible rules for hiring, firing and setting salaries, in the same way that the Code regulates interactions between employers and employees in other private markets of the economy. The flexible regulation of this sector produces a higher wage dispersion than that found in the public sector.

Table 2 presents summary statistics of teachers' earnings by school type. On average, semiprivate and private school teachers receive a higher monthly wage than public school teachers. In relation to wage dispersion by school type, Table 2 shows that, on average, wages in semiprivate and private schools have a higher dispersion than those in public schools.

[3] Among those schools, there exist free semiprivate schools that do not charge co-payments to parents as well as fee-charging semiprivate schools.
[4] Public, semiprivate and private schools represented 40.71%, 50.73% and 8.56%, respectively, of the total enrollment in primary and secondary education in 2010.
[5] The maximum is set at 100% of the BNMS for a teacher with more than 30 years of experience.

Table 1. Public sector wage structure (2009)

Basic national minimum salary (BNMS)	Value per hour of contract[a](US$)
Preschool, primary and special education	4.2
Secondary education	4.5
Bonus based on teacher's work experience	
First 2 years	6.76% of BNMS
For every two additional years[b]	6.66% of BNMS
Bonus based on participation in training courses	40% of BNMS (Max.)
Bonus based on teacher's managerial responsibility	
Public headmasters	25% of BNMS
Other administrative personnel	20% of BNMS
Other teaching personnel	15% of BNMS
Bonus based on professional improvement unit[c]	
From January to November 2009	11.74 (per month)
December 2009	12.27 (per month)
Other bonuses	
Bonus based on teacher's professional degree	
Degree	68.18 (per month)
Major	22.72 (per month)
National holiday bonus	
Net salaries ≤ 953 (US$/month)	93.60 (per year)
Net salaries > 953 (US$/month)	65.20 (per year)
Schooling bonus[d]	
Net salaries ≤ 953 (US$/month)	92.23 (per year)
Net salaries > 953 (US$/month)	38.58 (per year)

Notes: [a]Typical job contracts consider the workweek to be between 30 and 44 h. [b]This bonus establishes a maximum of 100% of the BNMS for teachers with more than 30 years of experience. [c]In January 2010, the bonus based on the Professional Improvement Unit ceased to be paid. [d]For teachers with children between 4 and 24 years old attending preprimary, primary, secondary and postsecondary school.

Table 2. Wage structure by funding type (2009)

	Hourly wages (US$)						
School Funding type	Mean	SD	P5	P25	P50	P75	P95
Public	7.2	5.2	4.2	5.5	6.7	8.2	10.6
Semiprivate and private	8.3	13.3	4.8	6.0	7.1	8.7	12.3

Source: Teaching longitudinal survey (2009).

III. The Model

The basic model for our analysis is the Roy model of self-selection for workers with heterogeneous skills, in the spirit of Heckman and Sedlacek (1985). We assume that there are two market sectors in which income-maximizing teachers can work. The first market is composed of public schools and the second of private and semiprivate schools. Teachers can choose the sector in which they work. However, they can work in only one type of school. We assume that there are no costs of moving among schools, that public and private schools have identical characteristics and that all schools enrol the same type of students. Therefore, the only difference between private and public schools is their wage structure.

In our model, the production of primary and secondary education is carried out by performing a sector-specific task t_i. Each teacher is endowed with a vector of skills s that enables her to perform the sector-specific task. Therefore, different teachers endowed with different skills will tend to specialize in different sectors. Denote by $t_i(s)$ the sector-i-specific task that a

teacher with skills s can perform. We assume that the human capital that the average student receives in sector i depends on the specific task t_i performed by the average teacher working in that sector.

We denote by p_i the exogenously determined fixed price of the task produced in sector i. Then, the wage that a teacher with a level of skills s obtains in sector i is the amount of the sector-i-specific task that the teacher produces multiplied by the market price of that task. Therefore, the log wages in sector i for a teacher with s skills are given by the following expression:

$$\ln w_i = \ln p_i + \ln t_i(s) \quad \forall i \in \{1,2\} \tag{1}$$

A teacher endowed with s skills will choose sector i if the following condition is satisfied:

$$\ln w_i \geq \ln w_j \tag{2}$$

where Equation 2 is the selection equation of the model.

We assume a simple functional form relating tasks to skills:

$$\ln t_i = b_i s \tag{3}$$

Additionally, following the results of Aaronson *et al.* (2007) and Lazear (2003), we assume that the vector of skills has measured and unmeasured components, s_{m} and s_{u}, with coefficients $b_{i\mathrm{m}}$ and $b_{i\mathrm{u}}$. That is,

$$b_i s = b_{i\mathrm{m}} s_{\mathrm{m}} + b_{i\mathrm{u}} s_{\mathrm{u}} \tag{4}$$

Equation 4 highlights the fact that not only are the observed characteristics of teachers important in the production function of education, but so are the unobserved ones. Assume that s_{m} is distributed independent of s_{u} and $E(b_{i\mathrm{u}} s_{\mathrm{u}}) = 0$. Then, the log wages in sector i can be written as

$$\ln w_i = \beta_i X + U_i \tag{5}$$

where $\beta_i = [1 b_{i\mathrm{m}}], X = [\ln p_i s_{\mathrm{m}}]'$ and $U_i = b_{i\mathrm{u}} s_{\mathrm{u}}$. We assume that (U_1, U_2) is a mean zero normal vector with covariance matrix Σ. We define σ_{ij} as the component located in row i and column j of matrix Σ.

We define sector 1 as the market that includes public schools managed by local government. Therefore, sector 2 includes semiprivate and completely private schools. The mean of log wages observed in the markets of public and private schools, respectively, is given by

$$E(\ln w_1 | \ln w_1 > \ln w_2, X) = \beta_1 X + \left(\frac{\sigma_{11} - \sigma_{12}}{\tilde{\sigma}}\right)\lambda(c) \tag{6}$$

$$E(\ln w_2 | \ln w_2 > \ln w_1, X) = \beta_2 X + \left(\frac{\sigma_{22} - \sigma_{12}}{\tilde{\sigma}}\right)\lambda(-c) \tag{7}$$

where $\tilde{\sigma}^2 = \mathrm{Var}(U_1 - U_2)$, $c = \frac{-(\beta_1 - \beta_2)X}{\tilde{\sigma}}$, $\lambda(c) = \frac{\phi(c)}{\Phi(-c)}$ and $\lambda(c) \geq 0$.

λ is the so-called inverse Mills ratio, which depends negatively on the propensity score, that is, the teachers probability of choosing the public sector. The goal of this article is to present evidence of self-selection based on teachers' unobserved skills in the market of Chilean schools. This article aims at empirically identifying the coefficient that accompanies the inverse Mills ratio in Equation 6. Unlike other studies in the literature that use this type of methodology, this article considers the inverse Mills ratio itself as the variable of interest. To gain further insight, let us analyse Equations 6 and 7.

Teachers' abilities should ensure equal performance in both markets. That is, an agent with high unobserved abilities to teach in the private sector should also be an agent with high unobserved abilities to teach in the public sector. Therefore, we expect a high value of σ_{12}. Second, as discussed in Section II, different labour regulations in the private and public sectors generate two different markets. Sector 1 (the market of public schools) should be characterized by highly compressed wages, whereas sector 2 should have a higher wage dispersion. That means that σ_{11} should be small and σ_{22} large. Therefore, according to Equations 6 and 7, we expect negative selection in sector 1 but positive selection in sector 2. That is, the average teacher working in sector 1 earns a lower wage than the wage that the average teacher in the population would earn in that

sector, conditional on their observable characteristics. As suggested by the model developed in this section, this result reflects the fact that teachers with lower unobservable skills self-select into the public sector because of the distinct wage structures existing in sectors 1 and 2.

The previous result is very intuitive. If σ_{12} is high, then a teacher with high unobserved abilities in sector 2 will also be a teacher with high unobserved abilities in sector 1. Additionally, teachers with unobserved skills have a higher probability of earning a high wage in the sector where the wage variance is higher. Therefore, teachers with higher unobserved abilities will choose to work in the private sector, and teachers with lower unobserved abilities will choose the public sector. This phenomenon is what we call 'negative self-selection', which is the natural consequence of the dichotomous labour regulation. In addition, as the propensity score tends to one, λ tends to zero, and thus the wage of the average teacher working in the public sector is not so different from the wage that the average teacher in the population would earn in that sector. That is because a propensity score close to one means that almost all teachers choose to work in the public sector. The opposite interpretation applies when the propensity score is close to zero.

Our main goal is to provide formal empirical evidence on the previous intuition. Section IV describes the data used in our estimations, Section V discusses the empirical strategy to identify the key parameters of our model, and Section VI presents empirical results.

IV. Data

We use data from the 2009 Chilean Teaching Longitudinal Survey. This database contains information on a representative sample of teachers working in public and private schools (including both semiprivate and private establishments) in Chile. The survey contains nine modules that include information about teachers' socioeconomic backgrounds, academic careers and earnings, as well as the schools where they worked, the training programs in which they participated and whether they received bonuses from the Ministry of Education associated with their participation in programs designed to evaluate their performance.

The first module collects all the background information on the initial training of the teachers interviewed: basic education, secondary education and higher education for all fields studied. The second module contains specific questions about the training completed by teachers in teaching or complementary areas. Specifically, it asks about training courses taken in education, internships abroad, national internships and postgraduate degrees, including masters and doctorates. The third module includes the self-reported health status of teachers and their recent history of medical leaves. The fourth module captures the labour history of teachers. The fifth module explores characteristics of the educational establishment where the teachers were working in 2009. The sixth module provides information on their reasons for choosing the teaching profession, their reasons for staying in the profession and their development opportunities, and the reasons for which teachers would leave the teaching profession. The seventh module records information about the participation of teachers in the main programs carried out by the Ministry of Education. The eighth module collects information on the family history of teachers. Finally, the ninth module allows us to characterize the demographic, educational and socioeconomic level of teachers' family. Specifically, it seeks to know the number of persons in the household and basic demographic data regarding sex, age and marital status, among others.

We use the information contained in those modules to collect information on teachers' observable characteristics, postsecondary studies, participation in training programs, both pecuniary and nonpecuniary benefits provided by schools, characteristics of the student body and characteristics of the places where schools are located. Table 3 presents summary statistics of the covariates included in our empirical estimates. As controls on the observable characteristics of teachers, we include gender, parents education, teachers years of experience in the education sector and the square of experience. Additionally, we include a vector of variables that characterizes teachers' postsecondary studies: the score that a teacher obtained on a standardized admissions test to enter postsecondary education (the PSU[6]), and three dummy variables that take the value one if a teacher completed a tertiary degree in a field related to education, if a teacher completed a tertiary degree in other subjects or if a teacher earned a master's degree (and zero otherwise).

[6] PSU stands for *Prueba de Selección Universitaria.*

Table 3. Summary statistics

	Public schools					Semiprivate and private schools				
Variable	Obs.	Mean	SD	Min.	Max	Obs.	Mean	SD	Min.	Max
Male	347	0.187	0.391	0	1	694	0.195	0.396	0	1
Mother with more than 12 years of schooling	347	0.138	0.346	0	1	694	0.140	0.347	0	1
Father with more than 12 years of schooling	347	0.150	0.357	0	1	694	0.223	0.417	0	1
Experience	347	17.620	9.132	1	35	694	15.941	8.016	1	35
PSU score	347	576.006	64.208	350	790	694	599.499	65.782	300	770
Tertiary education	347	0.963	0.190	0	1	694	0.971	0.167	0	1
Tertiary education in other subjects	347	0.040	0.197	0	1	694	0.033	0.179	0	1
Master's degree	347	0.023	0.150	0	1	694	0.023	0.150	0	1
Training (thousand of hours)	347	1.075	1.606	0	9.806	694	0.464	1.007	0	11.423
Courses in methodology	347	1.118	1.295	0	5	694	0.788	1.053	0	5
Courses in curriculum	347	0.548	0.915	0	5	694	0.405	0.736	0	5
Courses in educational management	347	0.144	0.412	0	3	694	0.120	0.363	0	3
Courses in disciplinary knowledge	347	0.279	0.756	0	5	694	0.293	0.700	0	5
Courses in teaching evaluation methods	347	0.184	0.522	0	5	694	0.181	0.445	0	3
Courses in personal development	347	0.144	0.433	0	3	694	0.180	0.502	0	4
Vouchers for lunch or snack	347	0.046	0.210	0	1	694	0.284	0.451	0	1
Resources for education of children	347	0.003	0.054	0	1	694	0.160	0.367	0	1
Access to training courses	347	0.150	0.357	0	1	694	0.222	0.416	0	1
Health insurance	347	0.0115	0.107	0	1	694	0.085	0.279	0	1
Work environment 1[a]	347	0.303	0.460	0	1	694	0.339	0.474	0	1
Work environment 2	347	0.260	0.439	0	1	694	0.340	0.474	0	1
Work environment 3	347	0.320	0.467	0	1	694	0.249	0.433	0	1
Work environment 4	347	0.205	0.404	0	1	694	0.284	0.451	0	1
Work environment 5	347	0.179	0.384	0	1	694	0.239	0.427	0	1
Work environment 6	347	0.378	0.485	0	1	694	0.438	0.496	0	1
Work environment 7	347	0.245	0.431	0	1	694	0.241	0.428	0	1
Work environment 8	347	0.049	0.216	0	1	694	0.036	0.186	0	1
Socioeconomic group of student body[b]	347	0.164	0.371	0	1	694	0.020	0.141	0	1
Rurality of student body	347	0.141	0.349	0	1	694	0.042	0.200	0	1
Fraction of students with 450 or more on the PSU	347	0.585	0.138	0.179	0.935	694	0.645	0.139	0	0.935
Poverty rate	347	0.128	0.060	0.023	0.379	694	0.122	0.056	0.023	0.379
New buildings and infrastructure	347	0.001	0.003	0	0.034	694	0.001	0.004	0	0.034
Extreme poverty rate	347	0.674	0.054	0.525	0.838	694	0.669	0.056	0.558	0.857
Unemployment rate	347	0.102	0.031	0.019	0.191	694	0.103	0.031	0.019	0.191
Fraction of mothers in poverty	347	0.797	0.082	0.416	0.956	694	0.771	0.113	0.416	0.947
Fraction of mothers in extreme poverty	347	0.600	0.092	0.252	0.804	694	0.576	0.116	0.252	0.827
Female population rate	347	0.506	0.016	0.446	0.568	694	0.513	0.018	0.446	0.568
Senior population rate	347	0.723	0.032	0.632	0.824	694	0.729	0.038	0.604	0.824

(*continued*)

Table 3. Continued

	Public schools					Semiprivate and private schools				
Variable	Obs.	Mean	SD	Min.	Max	Obs.	Mean	SD	Min.	Max
Fraction of public schools located in rural areas	347	0.206	0.274	0	1	694	0.165	0.247	0	1
Fraction of the population living in rural areas	347	0.098	0.154	0	0.928	694	0.076	0.133	0	0.756

Source: Teaching Longitudinal Survey (2009).
Notes: [a]Work environment number are dummy variables that take the value one if the teacher agrees with the following statements: The work environment is very professional (Work environment 1); There is a good professional relationship among colleagues in the school (Work environment 2); The school promotes training activities (Work environment 3); The infrastructure of the school is comfortable (Work environment 4); There are adequate resources in the school to support high-quality teaching performance (Work environment 5); Teachers have enough autonomy to develop their teaching career (Work environment 6); Teachers are allowed to participate in pedagogical decisions (Work environment 7); and Teachers are allowed to participate in administrative decisions (Work environment 8). [b]Dummy variable that takes the value one if the school is classified in the lowest socioeconomic group by the Ministry of Education.

We also include a vector of variables that describe the training courses taken by a teacher as well the area of training. Specifically, we include the number of hours that a teacher spent in training courses and the number of training courses that a teacher has taken in the areas of teaching methodology, curriculum development, educational management, disciplinary knowledge, teaching evaluation methods, and personal and professional development.

Additionally, we include several covariates to control for pecuniary and nonpecuniary benefits provided by schools, the characteristics of the student body of schools, and characteristics of the places where schools are located. First, we include a vector of variables that characterize some pecuniary benefits that a teacher may receive. Specifically, we include four dummy variables that take the value one if a teacher receives vouchers for lunch or snack, gets extra resources to pay tuition for her children, has access to training courses, or has access to a health insurance paid for by the school (and zero otherwise). Second, we include a set of variables that characterize some nonpecuniary aspects of schools. These are dummy variables that take the value one if a teacher agrees with the following statements: the work environment is very professional (Work environment 1); there is a good professional relationship among colleagues in the school (Work environment 2); the school promotes training activities (Work environment 3); the infrastructure of the school is comfortable (Work environment 4); there are adequate resources in the school to support high-quality teaching performance (Work environment 5); teachers have enough autonomy to develop their teaching career (Work environment 6); teachers are allowed to participate in pedagogical decisions (Work environment 7) and teachers are allowed to participate in administrative decisions (Work environment 8). Third, we include a vector of variables to control for the characteristics of the student body of schools. Specifically, we include a variable that describes the socioeconomic level of the students attending the school, according to an official classification released by the Ministry of Education, and a variable that describes the level of rurality in which the students live. Finally, we include a set of variables to characterize the places where schools are located (at the county level): the fraction of students with a score of 450 or more on the standardized admissions test to enter postsecondary education, the fraction of the population living in a condition of poverty, the fraction of the land with new buildings and infrastructure, the fraction of poor households living in a condition of extreme poverty, the unemployment rate, the fraction of mothers (who are heads of household) that live in poverty, the fraction of mothers (who are heads of household) that live in extreme poverty, the fraction of the population that is female, the fraction of the population that is senior, the fraction of public schools located in rural areas and the fraction of the population living in rural areas.

We observe in Table 3 that teachers working in private schools have more educated parents, a higher PSU score and a higher probability of holding a tertiary degree in education. However, teachers in public schools have more training hours and training courses in areas such as teaching methodology,

curriculum development and teaching evaluation methods. Additionally, the probability of receiving some pecuniary benefits is higher in private schools (for instance, vouchers for lunch or snack, extra resources to pay tuition for their children, access to training courses and access to health insurance). The nonpecuniary benefits characterized by the work environment variables are, in general, also better in private schools. Regarding the characteristics of the student body, students in public schools are more likely to belong to the lowest socioeconomic group and live in a rural area. Finally, the last set of variables in Table 3 shows that public schools are located in poorer and more rural places than private schools.

V. Parameter Identification

In this section, we discuss the empirical strategy for identifying the key parameters of our model. Before doing so, we describe the econometric specifications for the outcome equations. Our baseline specification uses the natural logarithm of the hourly wage earned by a teacher in sector i in 2009 as the outcome variable. As we previously explained, sector i takes the value of one for public schools and two for private schools (including semiprivate and private schools). As covariates, we include a rich set of controls on the observable characteristics of teachers and schools (see Section IV for a detailed description of the covariates). Denoting by X the vector of covariates, we first run a probit regression to compute the probability that a teacher chooses the public school sector, controlling for observable characteristics of teachers and schools:

$$\text{Prob}(\ln w_1 > \ln w_2 \mid X) = \Phi\left(\frac{(\beta_1 - \beta_2)'X}{\tilde{\sigma}}\right) \tag{8}$$

Notice that with the previous probit, we can identify $\hat{c}$ and build the inverse Mills ratio $\lambda(\hat{c})$. After doing that, we use the estimated inverse Mills ratio as regressor in the following regression:

$$\ln w_1 = \beta_1' X + \left(\frac{\sigma_{11} - \sigma_{12}}{\tilde{\sigma}}\right)\lambda(\hat{c}) + \varepsilon_1 \tag{9}$$

The coefficient of $\lambda(c)$ will tell us whether positive, negative or no selection exists in the public school sector. Notice that even though positive selection could potentially be observed in both sectors, negative selection can exist only in one market. We know that $0 \leq \text{correlation}^2(\ln w_1, \ln w_2) = \sigma_{12}^2/\sigma_{11}\sigma_{22} \leq 1$, and thus $0 \leq (\sigma_{12}/\sigma_{11})(\sigma_{12}/\sigma_{22}) \leq 1$. Negative self-selection in sector 1 implies that $\sigma_{12} > \sigma_{11}$, and thus $\sigma_{12}/\sigma_{11} > 1$, which in turn implies that $\sigma_{12}/\sigma_{22} < 1$. Therefore, if $\sigma_{11} - \sigma_{12} \leq 0$, then $\sigma_{22} - \sigma_{12} > 0$. That is, negative self-selection in sector 1 automatically implies positive self-selection in sector 2.

Additionally, because the inverse Mills ratio is a nonlinear function of the variables included in the first-stage probit model, then the second-stage equation is identified even with no exclusion restriction. The nonlinearity of the inverse Mills ratio arises from the assumption of normality in the probit model. It is beyond the scope of this article to test or justify the use of the normality assumption. Therefore, to make the source of identification clear, we also estimate our baseline empirical model, including an exclusion restriction, that is, a vector of variables Z included in the selection regression but excluded from the wage equation. We discuss the exclusion restriction in detail in Section VI.

VI. Results

In this section, we analyse the results of the empirical implementation of our model. Before presenting the results from the two-step estimation procedure, we report OLS estimates as a benchmark. This initial approach will allow us to have an idea about the difference in wages between teachers in private and public schools before addressing the endogeneity problem. We run the following OLS regression:

$$\ln w = \alpha D + \gamma' X + \varepsilon \tag{10}$$

The dependent variable is the log of the hourly wages earned by teachers. D is a dummy variable that takes the value one if a teacher is working in a public school and zero otherwise. X denotes the covariates that include controls for the observable characteristics of teachers, schools and students as discussed in Section IV. ε represents an idiosyncratic error term. Table 4 reports the results. We observe that, controlling for observable characteristics of teachers and schools, teachers working in public schools earn wages that are

Table 4. OLS regression

Dependent variable: log of hourly wage	
Dummy public schools	–0.056** (0.027)
Observable characteristics of teachers	
Male	0.071*** (0.022)
Mother with more than 12 years of schooling	0.081*** (0.026)
Father with more than 12 years of schooling	–0.014 (0.025)
Experience	0.017*** (0.005)
Experience^2	–0.000 (0.000)
PSU score	0.000 (0.000)
Tertiary education	–0.027 (0.063)
Tertiary education in other subjects	–0.013 (0.043)
Master's degree	0.041 (0.053)
Training (thousands of hours)	–0.009 (0.008)
Courses in methodology	0.002 (0.013)
Courses in curriculum	0.009 (0.013)
Courses in educational management	0.036* (0.020)
Courses in disciplinary knowledge	0.009 (0.013)
Courses in teaching evaluation methods	–0.034 (0.023)
Courses in personal development	0.003 (0.019)
Observable characteristics of schools	
Vouchers for lunch or snack	0.043 (0.027)
Resources for education of children	–0.025 (0.034)
Access to training courses	0.047 (0.033)
Health insurance	0.048 (0.046)
Work environment 1	0.000 (0.022)
Work environment 2	–0.011 (0.023)
Work environment 3	0.002 (0.024)
Work environment 4	0.032 (0.024)
Work environment 5	0.056** (0.026)
Work environment 6	–0.036 (0.026)
Work environment 7	–0.011 (0.027)
Work environment 8	–0.010 (0.045)
Characteristics of the student body	
Socioeconomic group of student body	–0.022 (0.064)
Rurality of student body	–0.006 (0.041)
Characteristics of school location	
Fraction of students with 450 or more on the PSU	0.035 (0.115)
Poverty rate	0.291 (0.336)
Extreme poverty rate	–0.816 (0.884)
New buildings and infrastructure	2.975 (3.191)
Unemployment rate	–0.881* (0.519)
Fraction of mothers in poverty	–1.172 (0.932)
Fraction of mothers in extreme poverty	0.871 (1.217)
Female population rate	0.760 (1.472)
Senior population rate	–0.646 (0.674)
Fraction of public schools located in rural areas	0.042 (0.103)
Fraction of the population living in rural areas	–0.001 (0.190)
Province fixed effect	Yes
Constant	8.835*** (0.976)
N	1.041
R^2	0.28

Notes: *, **, *** indicate significance at the 10%, 5% and 1% level, respectively. Huber–White SE are in parentheses. Sample weights were used.

5.6% lower than those earned by teachers in private schools.

The sector where teachers work is a choice variable that could possibly be correlated with unobservables relegated to the error term of Equation 10. In that case, the negative sign of the coefficient α is not the causal effect of school sector on wages but could reflect the fact that less capable teachers are more likely to work in public schools and, therefore, receive lower wages, ceteris paribus. To test the existence of this type of negative self-selection of teachers into public schools, we follow a two-step estimation procedure where the main variable of interest will be the inverse Mills ratio.

As we previously explained, we first estimate the probability that a teacher, conditional on her observed characteristics and the observed characteristics of the school, chooses to work in a public school. After estimating the probability of working in public schools, we estimate the effect of self-selection on wages using the approach of two-step estimation developed by Heckman (1979). The third column of Table 5 presents the results of Equation 9 for the sample of teachers who work in public schools in 2009 (sector 1). The main coefficient of interest, the inverse Mills ratio coefficient, is negative and statistically significant at conventional levels of significance. Therefore, our empirical results suggest the existence of negative self-selection of teachers into public schools. In the fourth column of Table 5, we also present the OLS regression for teachers who worked in semiprivate and private schools in 2009 (sector 2). In this case, the inverse Mills ratio is built as $\lambda(-\hat{c})$, as explained in Section III. Consistent with the discussion in Section V, we find evidence of positive self-selection of teachers into sector 2. Because good teachers perform well in both sectors, the fact that bad teachers are self-selecting into public schools automatically implies that the good ones are choosing to develop their teaching career in private schools, as observed in the results exhibited in Table 5.

Next, we perform a robustness analysis for our main empirical result. As we explained in Section II, we consider three types of schools, classified by their funding sources: public schools, semiprivate schools and private schools. These differences also determine the legal framework that regulates schools. Specifically, even though semiprivate schools are regulated by the Labour Code, they share with public schools some minor elements of their wage structure,[7] although the main elements that rigidify the wage structure in public schools are basically absent in semiprivate schools. In this context, we redefine sector 2 to consider only semiprivate schools. We seek to analyse whether the results of Table 5 are driven only by the sample of private schools. Table 6 presents the results of this analysis. We observe that the results remain consistent with our initial estimations. The estimated coefficient of the parameter that identifies the type of selection is negative and statistically significant at conventional levels in sector 1, whereas it is positive and statistically significant in sector 2. Therefore, negative self-selection of teachers is observed in sector 1 and positive self-selection in sector 2.

Additionally, as discussed in Section V, the identification of the two-step models relies upon the nonlinearity of $\lambda(\hat{c})$; hence, two-step models with no exclusion restrictions may have problems of collinearity. Therefore, we present additional results using as an exclusion restriction a variable that characterizes the reasons why a teacher chose a career related to education. Specifically, we use as an exclusion restriction a dummy variable that takes the value one if a teacher declares that the main reason she pursued a teaching career is because she likes to teach. This variable is not related to the stock of human capital of teachers and, thus, should not have an independent effect on wages. As a simple way to empirically evaluate the exogeneity of this variable in the wage equation, we run Equation 9 including as an additional regression the exclusion variable. The coefficient of this variable in the OLS regression is −0.005 and the t-statistic is −0.11, meaning that the partial correlation between this variable and wages is not statistically significant at conventional levels of significance.

Tables 7 and 8 present the estimates of the empirical model with the exclusion restriction, using the same definitions of sector 2 as those exhibited in Tables 5 and 6, respectively. We again observe evidence of negative self-selection of teachers into public schools, as the inverse Mills ratio coefficient is negative and statistically significant at conventional levels.

[7] For instance, teachers who work in public and semiprivate schools can receive special monetary benefits according to their performance in government programs designed to measure teachers' achievement (such as *Asignación por Excelencia Docente* and *Asignación por Excelencia Pedagógica).*

Table 5. Two-step estimates: public, semiprivate and private schools

	Probit (public schools)	OLS (Sector 1)	OLS (Sector 2)
Dependent variable	Working at public school	Log of hourly wage	Log of hourly wage
Inverse Mills ratio		−0.213* (0.119)	0.286** (0.115)
Observable characteristics of teachers			
Male	0.035 (0.145)	0.065 (0.042)	0.043* (0.024)
Mother with more than 12 years of schooling	0.397** (0.181)	0.050 (0.065)	0.034 (0.036)
Father with more than 12 years of schooling	–0.326* (0.167)	–0.002 (0.051)	0.008 (0.029)
Experience	–0.030 (0.028)	0.022* (0.013)	0.026*** (0.008)
Experience^2	0.002*** (0.001)	–0.000 (0.000)	–0.001** (0.000)
PSU score	–0.002** (0.001)	0.001*** (0.000)	0.000 (0.000)
Tertiary education	0.059 (0.319)	0.030 (0.116)	–0.068 (0.076)
Tertiary education in other subjects	–0.050 (0.285)	–0.073 (0.088)	0.089* (0.048)
Master's degree	0.411 (0.349)	–0.065 (0.118)	0.102* (0.054)
Training (thousands of hours)	0.182*** (0.057)	–0.018 (0.013)	–0.042** (0.019)
Courses in methodology	0.216*** (0.050)	–0.035 (0.022)	0.000 (0.016)
Courses in curriculum	0.046 (0.069)	0.007 (0.021)	–0.005 (0.019)
Courses in educational management	0.228 (0.153)	0.031 (0.036)	0.021 (0.029)
Courses in disciplinary knowledge	–0.030 (0.085)	–0.022 (0.027)	0.010 (0.016)
Courses in teaching evaluation methods	–0.051 (0.127)	–0.071 (0.047)	0.015 (0.026)
Courses in personal development	–0.284** (0.122)	0.040 (0.047)	0.015 (0.022)
Observable characteristics of schools			
Vouchers for lunch or snack	–0.973*** (0.197)	0.022 (0.115)	0.145*** (0.034)
Resources for education of children	–1.824*** (0.405)	–0.396** (0.182)	0.043 (0.040)
Access to training courses	0.009 (0.169)	0.026 (0.099)	0.078*** (0.026)
Health insurance	–1.139*** (0.364)	0.095 (0.147)	0.097* (0.055)
Work environment 1	–0.053 (0.142)	0.036 (0.042)	0.022 (0.029)
Work environment 2	–0.326** (0.144)	0.045 (0.048)	–0.017 (0.028)
Work environment 3	0.480*** (0.148)	–0.047 (0.052)	–0.057 (0040)
Work environment 4	–0.341** (0.149)	0.061 (0.048)	0.040 (0.029)
Work environment 5	–0.176 (0.177)	0.022 (0.049)	0.105*** (0.032)
Work environment 6	–0.077 (0.143)	–0.041 (0.041)	–0.017 (0.032)
Work environment 7	0.014 (0.165)	0.060 (0.045)	–0.035 (0.033)
Work environment 8	0.422 (0.304)	–0.055 (0.071)	0.012 (0.062)
Characteristics of the student body			
Socioeconomic group of student body	1.091*** (0.219)	–0.069 (0.104)	–0.143 (0.124)
Rurality of student body	0.670*** (0.230)	–0.060 (0.071)	–0.114* (0.068)
Characteristics of school location			
Fraction of students with 450 or more on the PSU	–1.321** (0.652)	0.052 (0.206)	0.359* (0.189)
Poverty rate	–0.014 (1.704)	0.836 (0.531)	–0.109 (0.403)
Extreme poverty rate	–7.905* (4.585)	0.558 (1.290)	0.442 (0.870)
New buildings and infrastructure	–0.665 (16.418)	4.023 (4.816)	0.043 (4.889)
Unemployment rate	–0.994 (3.245)	–0.092 (0.779)	–0.477 (0.728)
Fraction of mothers in poverty	–5.244 (5.482)	–0.267 (1.897)	–0.344 (1.002)
Fraction of mothers in extreme poverty	9.164 (6.941)	–0.672 (2.093)	–0.559 (1.241)
Female population rate	6.886 (6.370)	1.783 (1.491)	–2.033 (2.886)
Senior population rate	7.912** (3.176)	–1.483 (1.107)	–1.548** (0.694)
Fraction of public schools located in rural areas	0.513 (0.724)	–0.074 (0.153)	0.043 (0.184)
Fraction of the population living in rural areas	–0.379 (0.121)	0.267 (0.269)	–0.017 (0.313)
Province fixed effect	Yes	Yes	Yes
Constant	–3.824 (4.139)	8.092*** (1.362)	9.817*** (1.689)
N	1.041	347	694
R^2: Pseudo R^2 for Probit and R^2 for OLS	0.37	0.50	0.29

Notes: *, **, *** indicate significance at the 10%, 5% and 1% level, respectively. Huber–White SE are in parentheses. Sample weights were used.

Table 6. Two-step estimates: public and semiprivate schools

	Probit (public schools)	OLS (Sector 1)	OLS (Sector 2)
Dependent variable:	Working at public school	Log of hourly wage	Log of hourly wage
Inverse Mills ratio		–0.190* (0.110)	0.306* (0.171)
Observable characteristics of teachers			
Male	0.145 (0.159)	0.056 (0.044)	–0.037 (0.031)
Mother with more than 12 years of schooling	0.403* (0.200)	0.053 (0.064)	–0.021 (0.058)
Father with more than 12 years of schooling	–0.242 (0.189)	–0.011 (0.049)	0.035 (0.040)
Experience	–0.020 (0.030)	0.021 (0.013)	0.030*** (0.010)
Experience^2	0.002** (0.001)	–0.000 (0.000)	–0.001* (0.000)
PSU score	–0.002* (0.001)	0.001*** (0.000)	0.000 (0.000)
Tertiary education	0.151 (0.348)	0.021 (0.115)	–0.047 (0.093)
Tertiary education in other subjects	–0.078 (0.300)	–0.073 (0.086)	0.048 (0.041)
Master's degree	0.260 (0.392)	–0.042 (0.116)	0.111** (0.053)
Training (thousands of hours)	0.178*** (0.066)	–0.016 (0.013)	–0.019 (0.024)
Courses in methodology	0.276*** (0.056)	–0.035 (0.022)	–0.019 (0.023)
Courses in curriculum	0.049 (0.074)	0.007 (0.021)	–0.015 (0.026)
Courses in educational management	0.297 (0.182)	0.028 (0.037)	0.018 (0.044)
Courses in disciplinary knowledge	–0.024 (0.091)	–0.023 (0.027)	–0.036 (0.028)
Courses in teaching evaluation methods	–0.035 (0.136)	–0.074 (0.047)	–0.034 (0.043)
Courses in personal development	–0.346*** (0.131)	0.040 (0.047)	0.032 (0.030)
Observable characteristics of schools			
Vouchers for lunch or snack	–0.880*** (0.234)	–0.014 (0.107)	0.144*** (0.036)
Resources for education of children	–1.935*** (0.417)	–0.440*** (0.171)	0.041 (0.063)
Access to training courses	0.080 (0.187)	0.023 (0.100)	0.060* (0.032)
Health insurance	–0.965* (0.550)	0.053 (0.144)	0.047 (0.089)
Work environment 1	–0.025 (0.155)	0.033 (0.042)	0.021 (0.035)
Work environment 2	–0.313** (0.151)	0.038 (0.047)	–0.023 (0.035)
Work environment 3	0.409*** (0.155)	–0.034 (0.049)	–0.075 (0.053)
Work environment 4	–0.306** (0.158)	0.055 (0.048)	0.025 (0.033)
Work environment 5	–0.202 (0.188)	0.020 (0.049)	0.109** (0.043)
Work environment 6	–0.053 (0.152)	–0.043 (0.041)	–0.053 (0.039)
Work environment 7	0.037 (0.172)	0.059 (0.046)	0.003 (0.040)
Work environment 8	0.625 ** (0.319)	–0.066 (0.072)	–0.018 (0.087)
Characteristics of the student body			
Socioeconomic group of student body	1.021*** (0.226)	–0.050 (0.104)	–0.112 (0.130)
Rurality of student body	0.723*** (0.244)	–0.052 (0.069)	–0.227** (0.099)
Characteristics of school location			
Fraction of students with 450 or more on the PSU	–1.468** (0.697)	0.058 (0.209)	0.364* (0.202)
Poverty rate	1.308 (1.935)	0.725 (0.532)	–0.513 (0.387)
Extreme poverty rate	–10.239** (5.080)	0.657 (1.294)	0.005 (1.005)
New buildings and infrastructure	4.015 (16.777)	3.723 (4.781)	–1.418 (6.528)
Unemployment rate	–2.037 (3.437)	–0.013 (0.774)	0.266 (0.655)
Fraction of mothers in poverty	–11.498* (6.757)	0.559 (1.918)	–0.634 (1.342)
Fraction of mothers in extreme poverty	14.547* (8.028)	–1.256 (2.122)	0.149 (1.523)
Female population rate	17.371** (7.129)	1.105 (1.605)	–5.228 (5.176)
Senior population rate	8.437** (3.403)	–1.372 (1.088)	–0.854 (0.800)
Fraction of public schools located in rural areas	0.677 (0.856)	–0.074 (0.153)	0.042 (0.256)
Fraction of the population living in rural areas	–0.075 (1.368)	0.222 (0.265)	0.067 (0.407)
Province fixed effect	Yes	Yes	Yes
Constant	–6.822 (4.662)	8.032*** (1.361)	11.396*** (2.860)
N	826	347	479
R^2: Pseudo R^2 for Probit and R^2 for OLS	0.34	0.49	0.23

Notes: *, **, *** indicate significance at the 10%, 5% and 1% level, respectively. Huber–White SE are in parentheses. Sample weights were used.

Table 7. Two-step estimates: public, semiprivate and private schools with exclusion restriction

	Probit (public schools)	OLS (Sector 1)	OLS (Sector 2)
Dependent variable:	Working at public school	Log of hourly wage	Log of hourly wage
Exclusion restriction	0.257** (0.115)		
Inverse mills ratio		–0.219** (0.105)	0.189** (0.089)
Observable characteristics of teachers			
Male	0.046 (0.146)	0.064 (0.042)	0.042* (0.025)
Mother with more than 12 years of schooling	0.382** (0.179)	0.046 (0.064)	0.048 (0.034)
Father with more than 12 years of schooling	–0.331** (0.165)	0.000 (0.052)	–0.003 (0.028)
Experience	–0.030 (0.028)	0.022* (0.013)	0.025*** (0.007)
Experience^2	0.002*** (0.001)	–0.000 (0.000)	–0.000 (0.000)
PSU score	–0.002** (0.001)	0.001*** (0.000)	0.000 (0.000)
Tertiary education	0.040 (0.322)	0.029 (0.114)	–0.076 (0.075)
Tertiary education in other subjects	–0.026 (0.291)	–0.072 (0.087)	0.082* (0.048)
Master's degree	0.327 (0.357)	–0.067 (0.117)	0.107** (0.052)
Training (thousands of hours)	0.185*** (0.058)	–0.018 (0.013)	–0.033* (0.017)
Courses in methodology	0.213*** (0.050)	–0.036 (0.022)	0.005 (0.018)
Courses in curriculum	0.043 (0.069)	0.006 (0.020)	–0.002 (0.019)
Courses in educational management	0.207 (0.153)	0.030 (0.036)	0.026 (0.028)
Courses in disciplinary knowledge	–0.018 (0.085)	–0.022 (0.027)	0.011 (0.016)
Courses in teaching evaluation methods	–0.038 (0.127)	–0.071 (0.047)	0.016 (0.026)
Courses in personal development	–0.290** (0.121)	0.040 (0.046)	0.006 (0.021)
Observable characteristics of schools			
Vouchers for lunch or snack	–0.969*** (0.197)	0.027 (0.115)	0.115*** (0.032)
Resources for education of children	–1.778*** (0.411)	–0.359** (0.179)	0.013 (0.036)
Access to training courses	–0.031 (0.170)	0.025 (0.099)	0.076*** (0.026)
Health insurance	–1.117*** (0.365)	0.100 (0.137)	0.079 (0.053)
Work environment 1	–0.092 (0.144)	0.036 (0.042)	0.019 (0.029)
Work environment 2	–0.332** (0.145)	0.045 (0.047)	–0.026 (0.029)
Work environment 3	0.489*** (0.150)	–0.048 (0.052)	–0.043 (0.038)
Work environment 4	–0.378** (0.149)	0.063 (0.046)	0.026 (0.028)
Work environment 5	–0.189 (0.177)	0.023 (0.050)	0.102*** (0.031)
Work environment 6	–0.111 (0.144)	–0.039 (0.041)	–0.021 (0.033)
Work environment 7	0.033 (0.165)	0.059 (0.046)	–0.030 (0.034)
Work environment 8	0.377 (0.302)	–0.060 (0.072)	0.028 (0.064)
Characteristics of the student body			
Socioeconomic group of student body	1.066*** (0.220)	–0.070 (0.097)	–0.096 (0.116)
Rurality of student body	0.713*** (0.232)	–0.057 (0.069)	–0.087 (0.070)
Characteristics of school location			
Fraction of students with 450 or more on the PSU	–1.261* (0.648)	0.069 (0.203)	0.304* (0.175)
Poverty rate	0.114 (1.725)	0.883* (0.537)	–0.116 (0.403)
Extreme poverty rate	–8.273* (4.591)	0.537 (1.283)	0.080 (0.928)
New buildings and infrastructure	–1.914 (16.386)	4.242 (4.701)	0.247 (4.883)
Unemployment rate	–0.892 (3.198)	–0.125 (0.772)	–0.563 (0.753)
Fraction of mothers in poverty condition	–5.451 (5.567)	–0.359 (1.920)	–0.571 (1.031)
Fraction of mothers in extreme poverty condition	9.560 (7.046)	–0.567 (2.115)	–0.147 (1.283)
Female population rate	7.356 (6.412)	1.731 (1.501)	–1.596 (2.780)
Senior population rate	8.108*** (3.164)	–1.432 (1.083)	–1.260* (0.737)
Fraction of public schools located in rural areas	0.514 (0.725)	–0.083 (0.153)	0.044 (0.181)
Fraction of the population living in rural areas	–0.305 (1.204)	0.280 (0.268)	0.008 (0.306)
Province fixed effect	Yes	Yes	Yes
Constant	–4.086 (4.158)	8.114*** (1.349)	9.809*** (1.665)
N	1041	347	694
R^2: Pseudo R^2 for Probit and R^2 for OLS	0.37	0.50	0.28

Notes: *, **, *** indicate significance at the 10%, 5%, and 1% level, respectively. Huber-White SE are in parentheses. Sample weights were used.

Table 8. Two-step estimates: public and semiprivate schools with exclusion restriction

	Probit (public schools)	OLS (Sector 1)	OLS (Sector 2)
Dependent variable:	Working at public school	Log of hourly wage	Log of hourly wage
Exclusion restriction	0.266** (0.122)		
Inverse Mills ratio		–0.203** (0.098)	0.151 (0.114)
Observable characteristics of teachers			
Male	0.154 (0.160)	0.054 (0.043)	–0.032 (0.030)
Mother with more than 12 years of schooling	0.391** (0.197)	0.047 (0.063)	0.005 (0.051)
Father with more than 12 years of schooling	–0.249 (0.187)	–0.008 (0.050)	0.020 (0.038)
Experience	–0.020 (0.029)	0.021 (0.013)	0.028*** (0.010)
Experience^2	0.002** (0.001)	–0.000 (0.000)	–0.001 (0.000)
PSU score	–0.002* (0.001)	0.001*** (0.000)	0.000 (0.000)
Tertiary education	0.135 (0.351)	0.018 (0.112)	–0.054 (0.092)
Tertiary education in other subjects	–0.063 (0.310)	–0.071 (0.086)	0.037 (0.045)
Master's degree	0.156 (0.395)	–0.044 (0.115)	0.118** (0.053)
Training (thousands of hours)	0.181*** (0.067)	–0.017 (0.013)	–0.003 (0.019)
Courses in methodology	0.274*** (0.057)	–0.037* (0.022)	–0.005 (0.029)
Courses in curriculum	0.043 (0.074)	0.006 (0.020)	–0.011 (0.025)
Courses in educational management	0.275 (0.181)	0.026 (0.036)	0.038 (0.040)
Courses in disciplinary knowledge	–0.009 (0.091)	–0.024 (0.027)	–0.038 (0.029)
Courses in teaching evaluation methods	–0.018 (0.135)	–0.074 (0.048)	–0.033(0.044)
Courses in personal development	–0.353*** (0.130)	0.042 (0.046)	0.010 (0.024)
Observable characteristics of schools			
Vouchers for lunch or snack	–0.887*** (0.235)	–0.006 (0.110)	0.095** (0.040)
Resources for education of children	–1.873*** (0.425)	–0.405** (0.167)	–0.025 (0.046)
Access to training courses	0.058 (0.189)	0.021 (0.098)	0.066** (0.032)
Health insurance	–0.939* (0.549)	0.060 (0.135)	0.024 (0.089)
Work environment 1	–0.068 (0.157)	0.033 (0.042)	0.018 (0.034)
Work environment 2	–0.323** (0.152)	0.039 (0.046)	–0.041 (0.040)
Work environment 3	0.419*** (0.156)	–0.036 (0.049)	–0.052 (0.047)
Work environment 4	–0.344** (0.157)	0.058 (0.046)	0.004 (0.035)
Work environment 5	–0.219 (0.188)	0.021 (0.050)	0.097** (0.039)
Work environment 6	–0.084 (0.154)	–0.041 (0.041)	–0.059 (0.041)
Work environment 7	0.058 (0.171)	0.057 (0.046)	0.010 (0.042)
Work environment 8	0.591* (0.313)	–0.074 (0.074)	0.023 (0.084)
Characteristics of the student body			
Socioeconomic group of student body	0.991*** (0.227)	–0.054 (0.097)	–0.044 (0.113)
Rurality of student body	0.780*** (0.248)	–0.052 (0.068)	–0.171* (0.088)
Characteristics of school location			
Fraction of students with 450 or more on the PSU	–1.402** (0.693)	0.081 (0.206)	0.271 (0.172)
Poverty rate	1.416 (1.981)	0.771 (0.535)	–0.442 (0.383)
Extreme poverty rate	–10.543** (5.103)	0.664 (1.281)	–0.638 (1.074)
New buildings and infrastructure	2.788 (16.781)	3.898 (4.681)	–1.189 (6.518)
Unemployment rate	–1.870 (3.381)	–0.040 (0.763)	0.104 (0.701)
Fraction of mothers in poverty	–11.372* (6.866)	0.504 (1.884)	1.241 (1.469)
Fraction of mothers in extreme poverty	14.656* (8.162)	–1.180 (2.099)	1.012 (1.622)
Female population rate	17.856** (7.232)	1.022 (1.603)	–4.046 (4.761)
Senior population rate	8.677** (3.394)	–1.343 (1.072)	–0.312 (0.923)
Fraction of public schools located in rural areas	0.617 (0.868)	–0.079 (0.153)	0.031 (0.252)
Fraction of the population living in rural areas	0.055 (1.363)	0.233 (0.266)	0.143 (0.383)
Province fixed effect	Yes	Yes	Yes
Constant	–7.253 (4.702)	8.072*** (1.352)	10.992*** (2.730)
N	826	347	479
R^2: Pseudo R^2 for Probit and R^2 for OLS	0.34	0.50	0.22

Notes: *, **, *** indicate significance at the 10%, 5%, and 1% level, respectively. Huber-White SE are in parentheses. Sample weights were used.

Discussion

The evidence found in this article documenting a negative coefficient of the inverse Mills ratio shows that (1) the estimated first-stage propensity to teach in public schools is associated with lower wages and (2) the unobservables determining a public school teaching position are negatively correlated with the unobservables determining wages. In principle, those unobservables may include ability and underlying teacher quality, as suggested by the model developed in Section III, but also preferences for compensating differentials that depress wages, such as job security, nonpecuniary benefits, and so forth. For instance, assume that all individuals are identical regarding their observable variables X. The observed lower wages in the public education sector could be explained by the fact that teachers that self-select into public schools have lower unobservable abilities than those working in private schools or, alternatively, by compensating differences. The latter explanation implies that even though teachers are identical in regard to their observable and unobservable characteristics, wages are lower in public schools to compensate for other positive aspects of working in public schools. However, two main elements potentially discard the compensating differences explanation as the most compelling explanation of our results.

First, the empirical model includes a rich set of covariates that allow us to control for relevant school characteristics. As discussed in Section IV, besides covariates to control for the observable characteristics of teachers, we include several covariates to control for pecuniary and nonpecuniary benefits provided by schools, characteristics of the student body and characteristics of the places where schools are located. When we control for those variables, the differential in wages between teachers who work in public schools and the average teacher in the population in that sector should be explained by differences in unobservable abilities. Second, for compensating differences to explain the negative sign of the coefficient of the inverse Mills ratio, it must be true that working in public schools provides higher nonpecuniary benefits than working in private schools. However, as discussed in Section IV and observed in Table 3, in general, public schools present a worse work environment, are located in poorer neighbourhoods and enrol lower-income students compared with private schools. In the same line, Chumacero *et al.* (2011) document that 'private schools are more concentrated in areas where students have a higher household income, which would imply that the working conditions and environment in private schools as well as the characteristics of the neighbourhoods where they are located are of a better quality than those where public schools are located'. Those pieces of evidence suggest that nonpecuniary benefits, if they exist, might be more relevant in private than in public schools. In that case, we would be underestimating the importance of the negative self-selection in public schools (by potentially omitting relevant variables of school characteristics).

The existence of negative self-selection based on unobservable skills indicates important implications for policy regarding how to attract better teachers to public education. The model developed in Section III and our empirical results suggest that an efficient way of attracting better teachers to public schools is by increasing the flexibility of the legal framework regulating teachers' salaries in public schools to produce higher wage dispersion, similar to that in the private sector. To further understand the implications of teachers' negative self-selection into public schools, we will go back to the equations of the model developed in Section III. The human capital of a student who attends a school in sector i depends on the sector-specific tasks employed in that sector. In turn, the number of sector-specific tasks depends on skills that have observed and unobserved components, as highlighted by Aaronson *et al.* (2007) and Lazear (2003).

For simplicity, we assume that there is no heterogeneity in observable skills. That is, all teachers have observable skills equal to $\bar{s}$. Define $\mu_1 = b_{1m}\bar{s}$ and $\mu_2 = b_{2m}\bar{s}$. Self-selection causes the mean of the log task employed in sector 1 to be less than the mean of log task 1 in the total population:

$$E(\ln t_1 \mid \ln w_1 > \ln w_2) = \mu_1 + \left(\frac{\sigma_{11} - \sigma_{12}}{\tilde{\sigma}}\right)\lambda(c) \tag{11}$$

$$E(\ln t_1) = \mu_1 \tag{12}$$

Therefore, teachers who work in sector 1 actually produce, on average, a lower amount of the task than average population members would produce if they worked there. Thus, students who attend public schools end up with a lower level of human capital

compared with the average population. That is because not only observed but also unobserved skills are important in the task production of education, as summarized in Equation 4.

Consider a policy that increases the flexibility of contracts that regulate salaries in sector 1. Assume that the regulatory framework in sector 1 is equalized to that of sector 2. In terms of the model, such a policy experiment implies an increase in σ_{11}. To make clear the effect of this change, we assume that $\sigma_{11} = \sigma_{22}$ after the implementation of the policy. Using Equation 10, we observe that positive selection is observed in both sectors and, thus, the mean log task in sector 1 increases after the implementation of this policy.

VII. Conclusions

Using data on Chilean teachers, we find evidence consistent with the existence of negative self-selection of teachers into public schools. A possible explanation for our results is the dichotomous labour regulation for public and private schools in Chile. On the one hand, the Teaching Statute sets the salaries of teachers in public schools and produces a very rigid wage structure heavily based on experience and training courses taken by teachers, with almost no compensation linked to the teachers' performance in the classroom. On the other hand, the private sector is regulated by the Labour Code, with very general and flexible rules for hiring, firing and setting salaries, in the same way that interactions between employers and employees are regulated in the other private markets of the economy. The flexible regulation in this sector produces higher wage dispersion than in public schools. Teachers with higher unobserved skills choose the sector with greater wage dispersion because their probability of earning a higher wage is greater. Thus, teachers with higher unobservable skills self-select into private schools, whereas teachers with lower unobservable skills self-select into public schools.

The importance of our results is twofold. First, given the importance of teaching to students' academic achievement, these results contribute to the understanding of why students who attend public schools have worse results than those attending private schools. Second, our results have direct policy implications. An efficient way of promoting better academic results in public schools would be by increasing the flexibility of the legal framework regulating teachers' salaries in public schools to produce higher wage dispersion, similar to that in the private sector. This policy might encourage teachers with higher unobservable abilities to migrate from private to public schools and, in the end, improve the human capital of children attending public schools.

An interesting extension of this article would be to measure how different rules in public schools affect teachers' behaviour. When salaries do not depend on performance measures, workers have an incentive to shirk, as long as they are not caught doing so (e.g. when it is costly for schools to monitor teachers' performance). For instance, Foster and Rosenzweig (1994) find that 'time-wage payment schemes and share-tenancy contracts reduce effort compared to piece-rate payment schemes' in the labour market. We can also find empirical evidence of shirking in publicly regulated sectors. Hall *et al.* (2010) show that locations with 'higher outside wages' may even have problems motivating highly qualified workers. The rigid wage structure of Chilean public schools provides an interesting hypothesis with which to test teachers' shirking behaviour.

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