

Inequality of opportunities in wages by school type attended in the childhood: a quasi-experimental study based on the Chilean school system

By VÍCTOR ITURRA¹ AND MAURICIO GALLARDO²

According to the equality of opportunity approach, inequality of welfare outcomes emerges from both the differences in the individual effort and in the circumstances of origin that are beyond the people control. However, to identify the effect of such circumstances on welfare achievements, the researchers have permanently faced a great empirical challenge, given the usual lack of observable data on the set of circumstances the nowadays adults have faced during their childhood. We perform a quasi-experimental identification strategy taking advantage of the Chilean school system implemented by law in 1981, which created three types of school establishments clearly differentiated according to the socioeconomic status of children. We use a longitudinal data survey of the Chilean labor market between 2002-2015 that contains detailed individual information including the school type individuals attended in childhood. Applying both parametric and nonparametric techniques we test how the socio-economics circumstances identified by the school type attended during childhood were translated into labor market outcomes in adulthood. Our main finding suggests that circumstances of having attended a private-voucher or private-paid schools increase the median Chilean wage return by approximately 31% and 45% respectively. We perform also a micro-simulation exercise that points out the policy implications of our main findings.

JEL Code: I24, I26, J24, J31.

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¹ Universidad Católica del Norte (UCN), Departamento de Economía-IDEAR, Av Angamos 0610, Antofagasta, Chile. E-mail: viturra@ucn.cl.

² Universidad Católica del Norte (UCN), Escuela de Ciencias Empresariales, Larrondo 1281, Coquimbo, Chile. E-mail: megallardo@ucn.cl.

1. INTRODUCTION

The inequality of opportunity (IO) approach has already strongly established in the economic research literature (e.g. Roemer, 1998; Roemer et al., 2003; Bourguignon et al., 2007; Lefranc et al., 2008; Lefranc et al., 2009; Checchi and Peragine, 2010; Dunnzlaff et al., 2011; Björklund et al., 2012; Yalonetzky, 2012; Fleurbaey and Peragine, 2013; Cuesta, 2014; Foguel and Veloso, 2014; Calo-Blanco and García-Pérez, 2014; Mahler and Ramos, 2019). Unlike the traditional view of inequality of outcomes, the IO approach is not focused only in the final distributive effects, but instead in how these outcomes were generated. Supported on the normative conception of social justice (Rawls, 1971; Sen, 1980; Dworkin, 1981a, 1981b; Cohen, 1989), the IO approach seeks to identify the deep sources of inequality, distinguishing between those that are fair from those that are unfair. From the ethical perspective, this makes a substantial difference in comparison with the traditional approach on inequality, in which the sources of inequality are not distinguished and therefore there is implicit an ethical judgment that all inequalities are unfair. In contrast, according to the IO approach, only those inequalities raised from circumstances of origin which are beyond the individual's control, should be considered unfair. Whereas those inequalities raised from differences in the individual effort should be considered fair.

The IO approach, however, has faced important constrains for its empirical application. Household surveys commonly performed by the official statistical institutions to measure the people's well-being, usually provide data on final welfare outcomes, but they are not informative enough about the set of circumstances the nowadays adults have faced during their childhood. Therefore, under the IO approach, the applied researchers face a great challenge to identify the effect of such circumstances of social origin on the welfare outcomes people achieve in adulthood. In this paper, we take advantage of an institutional feature of the Chilean school system to perform a quasi- experimental identification strategy on inequality of opportunities in wages returns.

The Chilean educational system was deeply modified in 1981, giving rise to the voucher school system. This system includes three types of school establishments clearly differentiated according to the socioeconomic status of children: public schools, voucher private school and fully paid private school. Since then, Chile became an empirical laboratory for assessing the effects of the new framework on several outcomes such as test scores, enrolment rate and academic stratification (Patrinos and Sakellariou, 2011). Among the numerous studies, an analysis carried out by Mizala and Torche (2012) draws a worrisome conclusion: the inequality in Chile departs at early stage of children development, and persistent levels of

educational inequality seem to be strongly conditioned by both family and school resources.

As the empirical evidence indicates (e.g. Carrasco et al, 2014, Valenzuela et al, 2014), the Chilean school system is characterized by a high segregation by socioeconomic level. While private schools concentrate children of higher socioeconomic status, public schools concentrate children of lower socioeconomic status and voucher schools concentrate children from middle class families. This segregation is partially explained by the fact that the voucher system, in practice, imposes entry barriers for children coming from poor families, because the voucher school are co-paid, and requires parents to assume some additional expenses for school supplies.

On the other hand, the issue addressed in this work is of great political relevance for Chile and the Latin American region, as this is the most unequal region in the world. At the end of the second decade of this century, the issue of social and economic inequality has become even more critical in Latin American. Several waves of massive civilian protests flourished in Venezuela, Nicaragua, Honduras, Haiti, Ecuador, Bolivia, Colombia and Chile. These protests raised claiming for improvement both in the political system and in the social configuration of educational services, health care and pension system in these countries.

Different waves of protests were triggered in Chile in 2006, 2011 and 2018 which finally lead to a social explosion that took place in 2019. The main citizen demand in these protests has been to overcome the great inequality prevailing in the country, including the inequality of the education system. Despite this recent social outburst, the Chilean inequality in income has been documented for a long time. Chile appears today as one of the countries with the highest level of income inequality in the OECD. Although several political initiatives, since the transition to democracy in 1990, Chile has not been able to reduce significantly individual income disparities (Sánchez-Ancochea, 2017), which might threaten seriously its economic growth (Cingano, 2014).

Under this scenario, boosting public education system has become as one of the key mechanisms to reduce income inequality, a challenging endeavor, because if educational inequality is highly dependent on family and school resources, the current level of income inequality can be strongly conditioned by the existing educational framework, affecting the outcomes of individuals when they enter the labor market. This matter gives rise to the central research question of this paper: To what extent does circumstances of childhood in Chile are translated to labor market inequality in the adulthood?

To answer this research question, we focus on a hardly addressed potential determinant of wages variability in Chile: administrative dependency of primary schools. To study the effect of school sectors on children's subsequent wages in Chile is a valuable task for several reasons. First, in so far as public, private-voucher, and private-paid schools enjoy from differentiated financial resources -a measure of school quality- the students' labor market success is expected to vary with school sector (Betts, 1995; Card and Krueger, 1996). Second, the voucher school system triggered a sorting of children according to their family resources, where parents of higher deciles of family resources distribution concentrating on private schools and, children located in the middle and lower deciles attending private-voucher and public schools respectively (Mizala and Torche, 2012). Under this scenario, the observed market outcome related to the type of school a child attended might be associated to both school quality and family background. Third, over the last years, Chilean governments have designed and launched several public policies aimed at improving the quality and coverage of the current public educational system. While the literature has mainly focused on the effect of the school system on children's schooling attainment and performance, to the best of our knowledge, there is a lack of empirical evidence assessing wage differences conditioned to the school sectors.

To perform our empirical analyses, we employ five waves of a very rich longitudinal survey called Social Protection Survey (Ministerio del Trabajo y Previsión Social, 2019) from 2002 to 2015.³ We employ two complementary empirical approaches to address our empirical question. First, we follow the equality of opportunity approach to test whether the type of school a child attended- a circumstance beyond the individuals' control conditioned by their parents' resources- affects their labor market outcome. To do so, we test the weak equality of opportunity hypothesis by applying non-parametric techniques of stochastic dominance. Second, we estimate the well-known Mincer wage equation to compute the impact of the social-background circumstances given by the school type attended in the childhood, over the wage returns in the adulthood. Both empirical methodologies take advantages of a quasi-experimental design based on the situation created by the administrative dependency of the Chilean school system.

The contribution of this study is twofold: first, as it is widely recognized among labor economists, wages and schooling are strongly positively correlated (Card, 1999). In Chile, however, schooling only explains about 40% of individual wage

³ The authors are grateful to the Subsecretaría de Previsión Social, the intellectual owner of the survey, for the authorization to use the database. All the results of the study are the responsibility of the authors and do not compromise the mentioned Under-secretary.

variance (Bayer, 2011). Hence, to test whether the school type might act as an additional mechanism that reproduces family resources advantages to explain wage variability, and even more, how it can determine the future distribution of wage under a scenario of a deep income inequality deserves special attention from academic communities and policy makers. Second, we analyze how the Chilean educational institutional framework could have served as a mechanism to reproduce existent inequalities among the Chilean population and translated into significant individual differences of wages. This contribution is even more important given the current questioning of the market mechanisms and their effect of population well-being. As mentioned, the Chilean educational system allows the market to participate in the allocation of resources, however, their outcomes are under scrutiny for the most Chilean society, which is a policy challenge that requires an analysis from several points of view, and among them, our study represents a piece of evidence aimed at enhancing our assessment of the voucher school system.

The rest of this paper is organized as follows. Section 2 provides a brief discussion of the most recent literature about Chilean school system, family socioeconomic status, and wages. Section 3 outlines the data set, indicating the main advantages of the EPS panel and sketches the empirical strategy and discusses some identification issues. Results are presented and discussed in Section 4. Section 5 presents a micro-simulation exercise, concluding the paper with some final remarks.

2. THE CHILEAN VOUCHER SCHOOL SYSTEM: A BRIEF REVIEW

The voucher school system dates back from 1981, launched under a military regime which established three types of schools: public schools financed by public resources, private-voucher schools which received public funding per student as public schools, and finally private-paid schools financed completely by household payments (Patrinos and Sakellariou, 2011). Also, there are several characteristics that make Chile a special case to be analyzed. Among them, the fact that this school system was applied to the whole country, lasting for a large amount of time. In addition to this, while both private paid and voucher schools could select their students, public schools could not reject an applicant unless in special circumstances (González et al, 2004).

Since then, the system has been modified in two opportunities. After 1993, voucher schools can charge additional fees to parents to complement government contribution. This new scheme was applied increasingly to reach about 80% in 1998. Finally, in 2008, there were additional modifications aimed at increasing the subsidy for those schools with an important enrollment of low income students and

at reducing some access constraints such as the use of parental interviews and admission tests for accepting new students (Mizala and Torche, 2012).

As mentioned, several studies have focused on analyzing how this new scheme of school system in Chile has affected educational performance. As Mizala and Torche (2012) state, when trying to assess the effects of voucher school system, the literature has focused on two issues. The first one is related to the comparison between public and private voucher schools in terms of educational achievement, and the second one tries to assess the student performance in a context of school competition.

Scholars agree that there is not conclusive empirical evidence to assert that students attending private-voucher schools display a significant higher performance compared to public schools (Patrinos and Sakellariou, 2011). Despite a more recent study found a positive effect on test scores, this is significantly lower than previous studies, casting doubt on the higher quality of private voucher schools (Lara et. al, 2011).

Among the comprehensive analyses of the Chilean voucher system, a noteworthy communality through some studies stands out: the major role played by both family socioeconomic status and financial resources of schools. In this vein, Torche (2005) analyzes educational stratification in Chile, focusing particularly on the time span that follows 1981 educational reform. She finds that Chile is characterized by a high educational inequality in terms of educational opportunities. More specifically, educational stratification persists across cohorts analyzed, and more importantly there are clear signs of increasing educational inequality. She also finds that the role played by father's education becomes more important in affecting the children's chances to continue studying secondary schooling. Also, students attending private-paid schools display a higher schooling attainment compared to the other two school sectors: private voucher and public schools. Furthermore, the author finds that school sector does not play a mediator role between socioeconomic status and educational attainment, rather, schools act as another source of educational stratification.

Educational stratification in the Chilean school context was also analyzed by Mizala and Torche (2012), but they focused on both between and within variation across Chilean schools. Interestingly, they arrive to a similar conclusion as Torche (2005), which points to the fact that social stratification represents one of the major component that might explain individual heterogeneity in student's attainment in Chile. Specifically, these authors suggest that while private paid schools focus on higher socioeconomic status families, and public schools serve less advantaged

population, private voucher schools seem to be specialized in diverse market targets. Additionally, when incorporating a measure of school-level socioeconomic status into the analysis, students' performance of private-voucher schools displays a strong association with the level of school resources. This result questions the importance of family socioeconomic status in affecting children outcomes and stresses the role played by school resources, which to some extent, gives some room to policies aimed at fostering investment in schools.

In summary, regardless of recent policies aimed at fostering public educational sector along with increasing the access to education to less advantaged families, a high level of educational inequality persists in the Chilean educational system. A worrying conclusion that stems from the empirical analysis is that the educational inequality that characterizes Chile displays a close relationship with family socioeconomic status.

In this context, while in the early stages of children development, family socioeconomic status explains several educational outcomes, one might have strong reasons to suspect that once individuals enter the labor market in Chile, family socioeconomic status still plays a significant role to explain individual wage differentials. This is a critical issue because some authors have remarked that under the voucher system the current level of inequalities in Chile can persist and moreover, they can be fostered by the new system (González et al, 2004).

The empirical literature in Chile has only partially addressed the association between school type and wages (Sapelli 2003, 2009). This is because of the lack of required data to perform the analysis. However, a recent study carried out by Rodrigo (2015), focuses on an alternative theoretical approach: the sociological paradigm of Social Reproduction, to understand the reasons behind individual wage differences in Chile. In doing so, the author centers his analysis on the existing conditions that characterize individuals and testing whether they can explain the Chilean wage distribution. His results strongly suggest that conditions related to family background such as parental schooling and parents' occupational status, display a higher power to predict individual future earnings. The author concludes that meritocracy does not seem to be the main mechanism by which the labor market rewards its employees, which is in line with some previous studies that focused on socioeconomic status and the role of family names when explaining wage differentials for specific professionals (Nuñez and Gutiérrez, 2004; Nuñez and Pérez 2007).

Overall, the literature review suggests that Chile, a developing country strongly oriented to market mechanisms, is characterized by higher levels of educational and

income inequalities. Furthermore, empirical studies also suggest that this can be explained by family socioeconomic status and financial resources. This represents a complex puzzle, and ever worse, a dead end for the Chilean society because the high-income inequality in Chile might be the main cause of persistent income inequality in Chile operating through –among other mechanisms- educational system.

3. RESEARCH AND DESIGN METHODS

3.1 Data source

Our analysis is performed using the Social Protection Survey (EPS, in its Spanish acronym)⁴ from 2002 to 2015. This survey was first conducted in 2002 on request the Ministry of Labor and Social Affairs to collect information aimed at gathering relevant information to analyze and design public policies. This survey is the first and the oldest panel data at individual level in Chile and its first round surveyed only individual affiliated to the Chilean pension system while subsequent rounds (2004, 2006, 2009, 2012 and 2015) spreads its scope by including non-affiliated individuals.

Our analysis includes five waves of the EPS (2002, 2004, 2006, 2009 and 2015), the 2012's round was discarded because this wave lacks statistical reliability. Besides being the first individual panel data, this survey has several advantages over similar survey conducted in Chile. First, it has detailed individual background information such as parental schooling, parental occupation, and the most important variable for our study: the type of primary of school (public, private-voucher, private-paid) individuals attended. Also, it contains their employment history starting from 1980, including unemployment spells, therefore we can reconstruct workers' labor history instead of relying on the proxy measure of potential experience. Finally, we have several individual traits that are important when estimating the wage equations such as years of schooling, marital status, gender, occupations, industrial sector and regions where the individual is located, among others.

The initial sample corresponds to 64,539 observations between 2002 and 2015, divided into 16,309, 16,727; 16,443; 14,463 and, 16,906 observations in 2002, 2004, 2006, 2009 and, 2015 respectively. From this sample, we select adult

⁴ The original name of this survey in Spanish is: 'Encuesta de Protección Social'.

individuals who have participated in the Chilean school system since 1981. Among them, there is a significant number of individuals who report zero monthly wage that are incorporated into the analysis when estimating the selection equation in the first stage. After applying several filters our final sample corresponds to 24,190 observations in total, which have at least two observations over time to conform a panel data set. However, only 22,173 observations were used in the estimates, given the constraints of data in some explanatory variables.

To perform the analysis, we control for several individual variables, such as actual experience (lineal and squared), gender and marital status. Importantly, we have information of the type of schooling individuals attended, divided into three groups: public, private-voucher and private-paid schools. Table 1 displays the description and summary statistics for variables used in the estimates divided into the school types.

As specified in Table 1, the average wage is observed to be higher for individuals who attended private-paid schools, following by those individuals attended voucher-private schools.

Table 1. Descriptive statistics of the main variables according to type of school

Variable	Mean				Std. deviation
	Public school	Voucher- private school	Paid- private school	Total sample	Total sample
Monthly Wage (CLP of 2002)	147,530	201,101	257,771	161,440	304,375
Years of schooling	11.254	13.347	14.519	11.746	3.362
Years of work experience	15.045	10.953	10.145	14.136	7.418
Married	0.560	0.447	0.421	0.534	0.499
Woman	0.486	0.548	0.481	0.497	0.500
Indigenous	0.092	0.085	0.027	0.090	0.286
Employed in agricultural sector	0.120	0.033	0.035	0.101	0.301
Employed in mining sector	0.020	0.011	0.018	0.018	0.133
Employed in manufacturing sector	0.141	0.124	0.111	0.136	0.343
Employed in construction sector	0.101	0.073	0.066	0.095	0.293
Number of children between 0-5 years old in the household	0.387	0.369	0.296	0.380	0.592
Number of children between 6-18 years old in the household	0.746	0.519	0.432	0.693	0.916
Other working people in the household	0.893	1.058	0.996	0.926	0.903
Number of observations	18,863	4,279	1,048	24,190	

Note: We also control for 13 dummy regional variables of individual is located.

Compared to those people who attended a public school the average wage of people who attended a voucher-private school is 36% higher, while the average wage of people who attended a paid-private school is 75% higher. Notice also that

people who attended public school have fewer years of schooling on average compared to those who attended the other two types of school.

3.2 Estimation strategy

3.2.1 Testing for equality of opportunity

According to the equality of opportunity approach (Roemer, 1998; Lefranc et al., 2008; Lefranc et al. 2009, Bourguignon et al. 2007, Checchi and Peragine, 2010, among others), the welfare gains that people obtain arise from two main sources: ‘efforts’ and ‘circumstances’. Efforts refers to the commitment and time people devote to their own will to achieve a welfare outcome, e.g. the hours and level of concentration dedicated to work, study and other activities. Meanwhile, circumstances are those characteristics acquired from birth and childhood, which are beyond the individuals’ control and cannot be chosen by them. However, they could affect the individual's development and preparation for later accessing a desired position in society. These circumstances are basically the social background (e.g. parental education or household income per capita) and the demographic characteristics (e.g. gender, ethnicity or family structure). But also, they can include genetic characteristics (e.g. cognitive abilities or physical traits), as discussed in Lefranc et al. (2009).

Each set of circumstances defines a ‘type’ of individuals, such that $t = 1, \dots, T$. The level of effort for each individual is measured by the position of his or her percentile in the distribution of welfare outcomes between individuals of the same type. In this vein, effort is assumed as relative to each type. But also, it is assumed that individuals of different types belonging to the same percentile within their type devote the same relative level of effort. This implies the omission of ‘later brute luck’ (see Lefranc et al. 2009, p. 1191). This assumption is justified by the Roemer’s (1998) argument with respect that the level of effort depends on the type to which the person belongs. That is, the effort required to obtain the same welfare achievement is greater for a person who is in a disadvantage situation according to their type, and it is less for a person who owns entry privileges from the cradle.

Equality of opportunity is achieved whenever the value of effort to achieve the same welfare level is equal for all types. However, the empirical criteria to determine whether the circumstances determine the welfare outcomes are not unique. In the literature, two methods prevail to solve this question. The first one, belongs to Roemer (1998). According to him, between a pair of circumstances denoted as c and c' , such that $c \neq c'$, there exist an equal opportunity to achieve the welfare outcome y , whenever $F(y|c) = F(y|c')$, where $F(y|s)$ is the

cumulative probability distribution conditional to the circumstance s . This criterion, in words of Lefranc et al. (2008) implies a *strong* equality of opportunity condition. The second criterion was proposed by Lefranc et al. (2008). In their view, there exists a *weak* equality of opportunity between circumstances c and c' , whenever a strict second-order stochastic dominance relation does not hold between the random outcomes conditional to such circumstances, i.e. whenever $F(y|c) \not\succ_{SSD} F(y|c')$ and $F(y|c') \not\succ_{SSD} F(y|c)$, where $\not\succ_{SSD}$ denotes the lack of strict second order dominance relationship $\succ_{SSD}$ defined as:

$$F(y|c) \succ_{SSD} F(y|c') \Leftrightarrow \int_0^z F(y|c) dy < \int_0^z F(y|c') dy, \forall z \in \mathbb{R}_+ \quad (1)$$

In this paper, we assess the weak equality of opportunity for the wage return achievement y given the circumstances of school type attended in the primary education, namely: public school, private voucher school or private-paid school. To perform this assessment, we take advantage of the Shorrocks (1983) results, regarding the equivalence between strict second order stochastic dominance $\succ_{SSD}$ and generalized Lorenz Dominance $\succ_{GLD}$:

$$F(y|c) \succ_{SSD} F(y|c') \Leftrightarrow F(y|c) \succ_{GLD} F(y|c') \quad (2)$$

Where in turns, generalized Lorenz Dominance $\succ_{GLD}$ is defined as follows:

$$F(y|c) \succ_{GLD} F(y|c') \Leftrightarrow GL_{F(y|c)}(p) \geq GL_{F(y|c')}(q), \forall q \in [0,1] \quad (3)$$

With $GL_{F(y|s)}(q)$, the value of the generalized Lorenz curve for the distribution $F(y|s)$ at quantile q . That is, we say that the circumstance c dominates over the circumstance c' in the sense of generalized Lorenz criterion $\succ_{GLD}$ whenever the generalized Lorenz curve of the distribution $F(y|c)$ is never below the generalized Lorenz curve of the distribution $F(y|c')$.

By plotting the generalized Lorenz curves one can verify by simple observation if one of them is located above the other. However, to be more rigorous and to be able to arrive at a conclusive result, it is necessary to apply a statistical test that allows to verify if such relationship is statistically robust to the observed sample. For this reason, the 95% confidence intervals were estimated also for differences in generalized Lorenz curves, following a strategy similar to that of the test proposed

by Araar (2006). In accordance with this procedure, the difference in generalized Lorenz curves is statistically significant whenever the above-mentioned confidence interval does not include the zero. A similar procedure was already implemented also to contrast equality of opportunity in the health outcomes from Chile (see Gallardo et al., 2017).

As a complementary analysis, we also perform a first order stochastic dominance assessment as proposed by Van de Gaer et al (2001). As it is well known from the expected utility theory, a rational individual will prefer a first order dominating distribution over a first order dominated one. The first order dominance relation, denoted as $\succ_{FSD}$ is defined as follows:

$$F(y|c) \succ_{FSD} F(y|c') \Leftrightarrow F(y|c) \leq F(y|c'), \forall z \in \mathbb{R}_+ \quad (4)$$

That is, the circumstance c first order dominates over the circumstance c' , whenever the cumulative distribution $F(y|c)$ is never above the cumulative distribution $F(y|c')$.

Before comparing the cumulative wage distributions of the individuals according the three types of school, it should be taken into account that there are unemployed and inactive individuals who do not register wages in the survey. That is, in the wage data we only observe the conditional wage for a person that participates in the labor market. In other words, in the observed data we only have truncated wage distributions. To avoid the possible selection bias that would arise when comparing such truncated distributions, prior to implementing the stochastic dominance analysis described above, an equation of participation in the labor market was estimated econometrically through a probit model. Once such probability was obtained, the observed truncated distributions were corrected by weighing them by the inverse of the probability to participate in the labor market.

3.2.2 Estimating the impact of school type on wage returns

To estimate the effect of school type on individual wage we face two empirical challenges, both related to endogeneity issues. First, we need to account for the selection bias given by the truncated observed wage distribution. Second, our key independent variable – school type-, is time invariant, this precludes us from using fixed effect estimates to account for the possible omitted variables bias, because our estimated parameters of interest are captured by individual fixed effects.

We solve the first challenge by implementing a variant of Heckman (1976, 1979) two stages procedure. Thus, in the first step, we estimate a participation equation using a probit model. After, we estimate the wage equation in a second stage applying the Heckman (1979) correction, by introducing the inverse of Mill's ratio as an additional explanatory variable. Importantly, instead of estimating the wage equation by ordinary least square, we take advantage of our panel data availability by applying the Hausman and Taylor (1981) estimator (HT). This allows us to solve the second challenge, since this estimator keeps the estimated coefficients for the time invariant variables. Specifically, we estimate the following empirical equations:

$$y_{it}^* = h_{it}'\varphi + r_i'\eta + u_i \quad (5)$$

$$w_{it} = x_{it}'\beta + z_i'\gamma + \alpha_i + \varepsilon_{it}. \quad (6)$$

Equation(4) represents the probit selection equation, y_{it}^* an indicator variable which is equal one whenever person i participates in the labor market in period t and is equal to zero otherwise; h_{it} and r_i are vectors of time-varying and time invariant explanatory variables respectively; u_{it} is a Gaussian distributed random error; whereas φ and η are vectors of parameters to be estimated. For the wage equation (6), the dependent variable is the natural log of hourly wage for worker i in period t . Vectors x_{it} and z_i include time-varying and time invariant explanatory variables, respectively; α_i is assumed to be a random time-invariant individual effect, distributed independently across individuals; ε_{it} is a random error assumed uncorrelated with x_{it} , z_i and α_i ; whereas β and γ are the vectors of parameters to be estimated. Both private-voucher and private-paid school types are included as dummy variables in vector z_i , whereas the public school type is the reference category.

In addition, for equation (6) we also perform some estimates of an improved variant of the HT estimator proposed by Amemiya and MaCurdy (1986). However, these estimates are only implemented with smaller biannual samples, given that the Amemiya and MaCurdy (AM) estimator only allows to be performed with balanced panel data.

4. MAIN RESULTS

4.1 Selection equation results

Table 2 presents the results for the selection equation estimate. For an easy interpretation, the probit results are presented in terms of marginal effects over the means.

Table 2. Labor market selection equation results

Variables	Coefficients
Years of schooling	0.191*** (0.00708)
Years of work experience	0.161*** (0.00815)
Years of work experience squared	-0.0014*** (0.000228)
Married	-0.149*** (0.0369)
Number of children between 0-5 years old in the household	0.387*** (0.0532)
Number of children between 6-18 years old in the household	0.114*** (0.0378)
Woman	-0.411*** (0.0497)
(Woman) x (Number of children between 0-5 years old in the household)	-0.937*** (0.0609)
(Woman) x (Number of children between 6-18 years old in the household)	-0.517*** (0.0423)
Other working people in the household	-0.0434*** (0.0162)
Voucher-private school	0.0901* (0.0503)
Private-paid school	-0.238*** (0.0900)
Constant	-2.321*** (0.117)
Observations	22,173
Number of individuals	6,729

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. The model also includes dummy region variables.

The signs and the magnitude of the coefficients are as expected. The years of schooling has a positive effect on the probability to participate in the labor market, while the work experience also exhibits a positive but a decreasing effect in such probability. While being a woman and having children imply a less probability to be employed, for men, the number of children encourages their probability to participate in the labor market. The presence in the household of other employed

adults provides a reservation wage that discourages the probability of participating in the labor market. Finally, those people who attended a voucher-paid school have a higher probability to participate in the labor market in comparison with those who attended a public school. By contrast, people who attended a private school have a less probability to be employed in the labor market. This seemingly counter intuitive result is fully understandable, since people who attended a paid-private school are more likely to be employers rather than salaried employees.

Before moving on to the main analyses, Table 3 presents the results of two statistical tests of equality of wage means according to the type of primary school. As the ANOVA test demands for wage to be normal distributed, we also offer the results of the non-parametric Kruskal-Wallis test, which is less demanded in terms of the probability distribution assumption. In both results, the null hypothesis of equality of means at 0.1% significance is rejected.⁵

Table 3. ANOVA and Kruskal-Wallis Tests

	Statistic	p-value
ANOVA	$F = 133.28$	0.0000
Kruskal-Wallis	$\chi^2 = 557.865$	0.0001

Note: the ANOVA test was implemented corrected by truncation, using as expansion factors the inverse of the probability to participate in the labor market obtained in the probit estimate. The Kruskal-Wallis statistic instead was calculated without applying this correction, since the corresponding command in Stata does not allow the weighting option.

4.2 Stochastic Dominance Analysis

Figure 1 shows the Generalized Lorenz (GL) curve comparison of the wage distributions for the types of primary school attended during the childhood. As described in Sub-section 3.2.1, second order dominance holds between two types of circumstances whenever one GL curve is always located above another. Therefore, as observed in Figure 1, private-paid school type dominates over the other two primary school circumstances in the Lorenz sense. Furthermore, the public school type is dominated by both the voucher-paid and private-paid school types.

⁵ Although it is not presented here, we also implemented the Scheffe test for pairwise mean comparison of mean wages between the school types and in all cases the null hypothesis is also rejected.

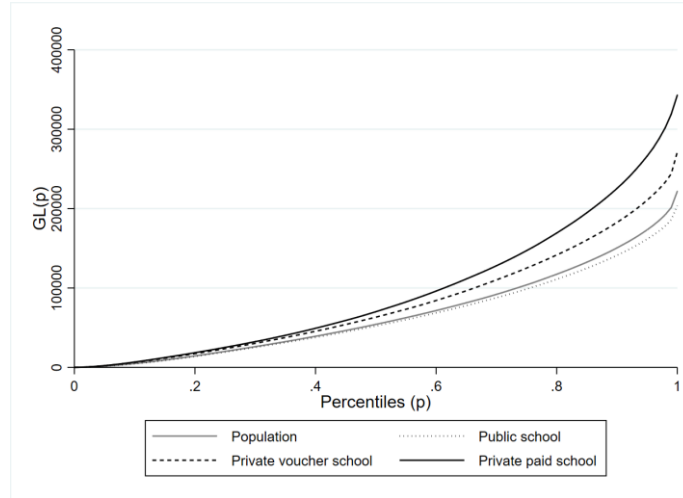


Figure 1. Generalized Lorenz Curves by type of primary school

To be more confident about this result, as explained above, 95% confidence intervals were estimated for the differences of Generalized Lorenz Curves. These confidence intervals are presented below in Figure 2. We observe that for the three comparisons the zero is outside the confidence interval for the difference of GL curves. Therefore, the hypothesis of absence of strict second-order stochastic dominance in all three comparisons is rejected. This result, as was explained in the Methodological Section, is equivalent to the rejection of the hypothesis of weak equality of opportunities for a wage achievement between the three circumstances of the primary school attended during childhood.

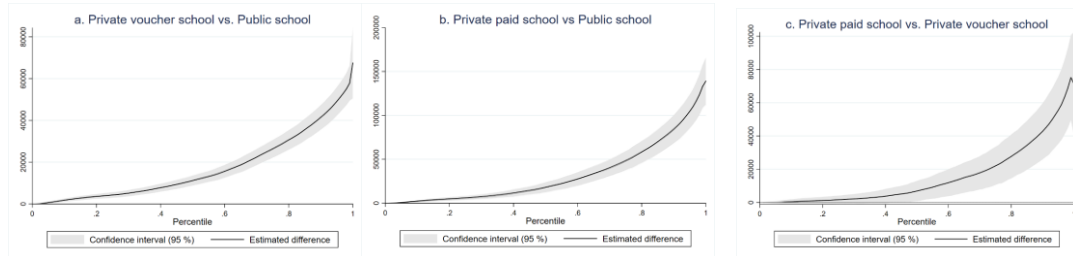


Figure 2. Confidence intervals for GLC differences (95%).

To conclude this Sub-section, we also present the result of the first-order stochastic dominance analysis, implemented by comparing the cumulated probability distributions of salaries conditional to the type of primary school attended in childhood. As we can see in the Figure 3, the circumstance of having attended a private-paid primary school dominates the other two circumstances, given that its conditional cumulative distribution is always located below the cumulative

distributions conditional on the other two circumstances. In the opposite situation are encountered the people who experienced the circumstance of having attended a public primary school. This circumstance is the dominated by the other two, since their cumulative conditional distribution is always located above the cumulative distributions conditional on the other two circumstances. Meanwhile, in an intermediate situation are those people whose circumstance during childhood was to have attended a voucher-paid primary school.

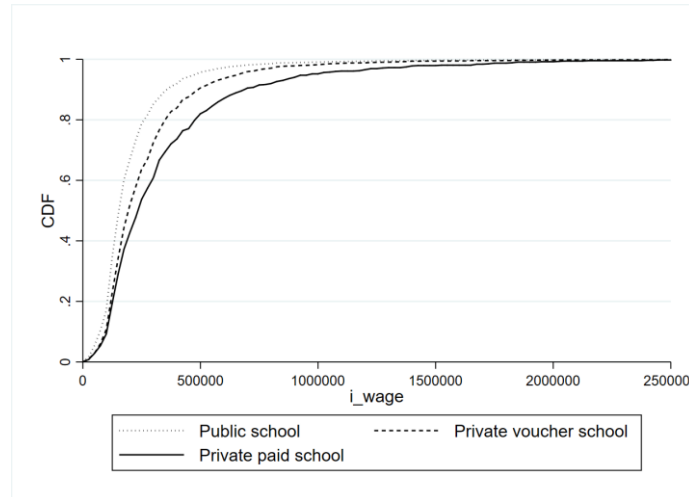


Figure 3. Wages' cumulative distributions by type of primary school

4.3 Wage equation results

Following a standard procedure of the econometric estimation with panel data, as a first step, we applied the Breusch and Pagan Lagrangian multiplier test for random effects, to determine if its suitable to consider the specific effect in the equation (6) in confront to the pooled regression model. The null hypothesis of this test was rejected and then, the pooled regression model was discarded. The next step was to implement the Hausman test to compare the fixed-effects and random-effects models. The test result conducted to the rejection of the null hypothesis about no systematic difference between the coefficients of the two models. Therefore, the pertinence of the fixed-effects model was validated, and then, it allowed concluding that the Hausman and Taylor estimator is a statistical suitable option to perform our econometric estimation with this panel data set. Table 4 presents all econometric estimates performed for assessing the impact of the school type's circumstances in the childhood, over the wage returns in the adulthood.

Before going any further, let us briefly discuss some additional interesting results. The estimate of private return to schooling in Chile has been addressed by several

scholars using different data sets and econometric techniques. As it is well-known, in a Mincer equation, this coefficient is likely to be upwardly biased due to omitted variables. One source of a potential bias is related to omitted information of school quality, if more educated individuals attended better quality schools, the estimated parameter associated to schooling would be upwardly biased. Our results suggest that OLS estimates of the return to schooling is indeed severely biased. Compare with fixed effect estimates, the upward bias accounts for more than 40%, going from 10,5% to 6,3% respectively. Interestingly, the remaining models display rather similar results, with estimates fluctuating between 5,53% and 7,32%. It is important to mention that these estimates are significantly lower than previous estimates in Chile, which range from 10% to 15% (Psacharopoulos & Patrinos, 2004; Sapelli, 2009), but they are close to the IV estimate around 7% estimated by Patrinos & Sakellariou (2011).

In addition to this, our results also confirm that being a woman is associated with a negative premium in the Chilean labor market, a robust result across the estimated model, with a negative impact on the wage rate larger than 21%. Similarly, the estimates suggest that people who self-identified as indigenous earn a less wage compared with the reference group.

Moving on to the results associated to the research question of this study, we observe that the previous analysis, which tested the equality of opportunity are supported by the new models. Specifically, compared to public schools, individuals who attended private-paid and private-voucher schools are rewarded with a higher wage, an effect that is systematically larger for the former group, being significantly lower for the latter individuals. As mentioned, we take advantage of the panel data, therefore, the main econometric result is given by the HT estimator (column 3). This estimator yields a result of 0.27 for the estimator of the parameter associated with the voucher school and a value of 0.373 for the estimator of the parameter associated with the circumstance of a private-paid school. Interestingly, using the AM estimator yields rather similar results, with small differences for every time span, but being qualitatively alike.

It has been found that in Chile, the circumstance of having attended a voucher-paid school during the primary education, provides a greater return of the median wage in the adulthood in the order of 31%⁶ compared to the circumstance of having attended a public school. Moreover, in Chile, the circumstance of having attended a private-paid school during the primary education provides a greater return of the

⁶ This percentage effect and the following indicated below correspond to the semi-elasticity calculated as follows: $(e^{\beta} - 1) \times 100$.

median salary in the order of 45% for the same comparison with respect to the baseline circumstance.

Overall, we can see that while the return of an additional year of schooling is around 7%, the most conservative results suggest that the reward for attending a private-paid school is higher than 25% compared with public school. This positive reward is also important for voucher school with a value as high as 22%. As mentioned, we take these results with caution because the type of a school a child attended might be related to two childhood circumstances: a better quality school and additional advantages stemming from parents with better resources. In either case, the main results of this study are worrying because the educational institutional framework in Chile has played a major role in affecting the current level of wage inequality. Moreover, the voucher design is acting as an additional source of educational and wage inequality.

Table 4. Wage equation results: Dependent variable: log of hourly wage

VARIABLES	OLS 2002-2015	FE 2002-2015	HT 2002-2015	AM 2002-2004	AM 2004-2006	AM 2006-2009	AM 2009-2015
Years of schooling	0.105*** (0.0029)	0.0627*** (0.0045)	0.0657*** (0.0035)	0.0732*** (0.0122)	0.0553*** (0.0099)	0.0683*** (0.0108)	0.0666*** (0.0059)
Years of work experience	0.0019 (0.0036)	0.0522*** (0.00451)	0.0522*** (0.00371)	0.0831*** (0.0151)	0.0615*** (0.0135)	0.0416*** (0.0145)	0.0510*** (0.0079)
Years of work experience (Sq.)	0.0005*** (9.23e-05)	-0.0003*** (0.0001)	-0.0003*** (8.82e-05)	-0.0006 (0.0005)	-0.0012*** (0.0004)	-0.0007* (0.0004)	-4.40E-05 (0.0002)
Married	0.0788*** (0.0123)	0.0496*** (0.0163)	0.0405*** (0.0137)	-0.0568* (0.0297)	0.02 (0.0248)	0.0305 (0.0262)	0.0452* (0.0244)
Woman	-0.263*** (0.0177)		-0.242*** (0.0259)	-0.208*** (0.0597)	-0.192*** (0.0515)	-0.275*** (0.0479)	-0.259*** (0.0411)
Indigenous	-0.0561** (0.0220)		-0.0808** (0.0399)	-0.118* (0.0636)	-0.0205 (0.0583)	-0.0903* (0.0530)	-0.184*** (0.0606)
Employed in agricultural sector	-0.0118 (0.0207)	0.0351 (0.0290)	-0.0379 (0.0231)	-0.143*** (0.0485)	-0.0534 (0.0331)	-0.0536 (0.0403)	-0.126*** (0.0452)
Employed in mining sector	0.403*** (0.0447)	0.285*** (0.0549)	0.315*** (0.0438)	0.357*** (0.105)	0.280*** (0.0725)	0.262*** (0.0802)	0.278*** (0.0739)
Employed in manufacturing sector	0.0477*** (0.0163)	0.0500** (0.0208)	0.0333* (0.0176)	0.0345 (0.0325)	0.0184 (0.0272)	-0.00918 (0.0312)	-0.0511 (0.0334)
Employed in construction sector	0.115*** (0.0205)	0.0499* (0.0270)	0.0409* (0.0223)	-0.0123 (0.0466)	-0.0345 (0.0358)	0.0391 (0.0387)	0.007 (0.0389)
Voucher-paid school	0.0963*** (0.0167)		0.270*** (0.0306)	0.206*** (0.0507)	0.231*** (0.0459)	0.198*** (0.0418)	0.294*** (0.0475)
Private-paid school	0.176*** (0.0405)		0.373*** (0.0635)	0.321*** (0.119)	0.331*** (0.0950)	0.224*** (0.0829)	0.423*** (0.0928)
Inverse Mill's ratio	-0.219*** (0.0399)	-0.205*** (0.0519)	-0.108*** (0.0376)	0.00809 (0.106)	-0.043 (0.106)	-0.00857 (0.112)	-0.0823 (0.0914)
Constant	10.84*** (0.0624)	10.66*** (0.0939)	10.70*** (0.0673)	10.41*** (0.236)	10.91*** (0.212)	10.99*** (0.234)	10.63*** (0.135)
Observations	9,345	9,345	8,815	2,244	2,658	2,550	2,688
Number of individuals		3,055	2,525	1,122	1,329	1,275	1,344

OLS: Ordinary Least Square; FE: fixed effects; HT: Hausman and Taylor; AM: Amemiya and MaCurdy.
Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

5. A MICRO-SIMULATION EXERCISE

To push our analysis even further and with the interest of exploring the effect of an equalizing public policy would have in the playing field, by eliminating the advantages of primary school type, we performed a micro-simulation exercise.

To place ourselves in a scenario in which all Chilean children receive an education equal to that of those who attended private school, we have eliminated the disadvantages of workers who attended both public and voucher schools. This scenario is represented through a salary adjustment of 45.21% upwards for those who attended the public schools and 14.21% upwards for those who attended the voucher schools. This salary adjustment is equivalent to the median advantage of those who attended the private-paid school, measured by the coefficients of the type of school variables that were obtained in the salary equation performed with the Hausman and Taylor estimator.

Our main results are displayed in Figure 4 and 5, while the remaining figures can be found in the appendix. As can be seen in Figure 4, under a fair scenario in terms of educational establishment, advantages associated to private school sector virtually disappear. That is, Figure 4 shows that, judging by the observed comparison of generalized Lorenz curves, the second order stochastic dominance disappears when we simulate to eliminate the advantage of the primary school type.

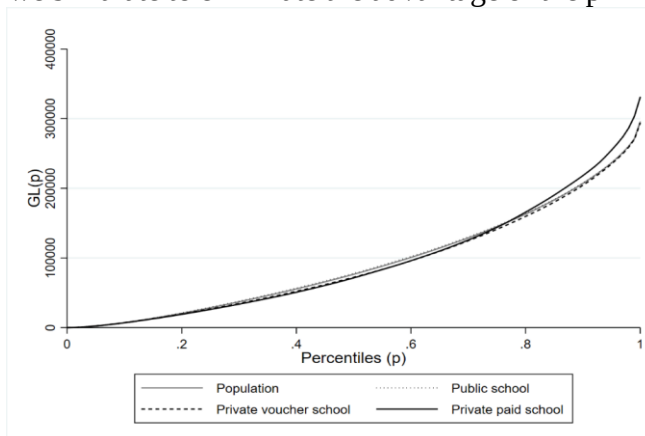


Figure 4. Generalized Lorenz Curves by type of primary school. A micro-simulation adjusting for wage gaps

Figure 5 on the other hand, shows also that there is not statistical evidence of second order stochastic dominance under this simulated scenario, i.e. there is not statistical evidence that the differences in the Lorenz curves presented in Figure 4 are different than zero (the confidence intervals cross the zero). Although we

recognize that the advantaged position of individuals who attended private school do not only stem from school quality but also from unobservable family background, sorting process triggered by voucher school system seems to make existent differences broader by creating a framework where poor families are meant to reach a systematically lower reward in labor market, this is an unfortunate result from several points of view, but even more from a policy perspective, because education should represent a key mechanism by which poorer families can improve their well-being in a society of a deep inequality.

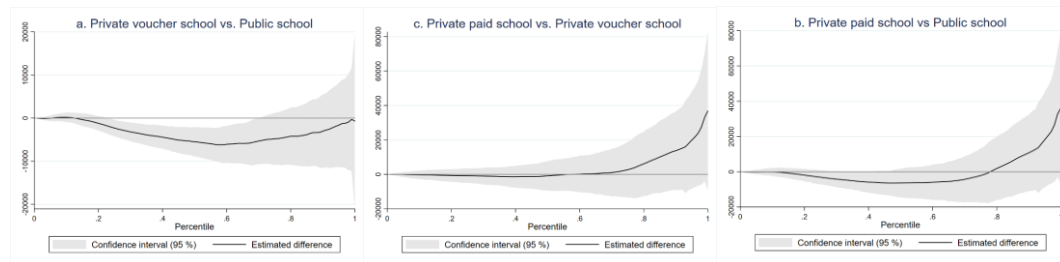


Figure 5. Confidence intervals for GLC differences. A micro-simulation adjusting for wage gaps

5. CONCLUDING REMARKS

In this paper, we have assessed the weak equality of opportunity hypothesis to obtain a wage return in the Chilean labor market, conditional to the circumstances of social background in childhood. To perform the assessment, we have taken advantage of the institutional conditions given by the Chilean school system implemented since 1981 that introduced three types of schools: public, voucher and private. To perform our empirical investigation we used a longitudinal data survey of the Chilean labor market between 2002- 2015 that contains detailed individual information including the type of school individuals attended in childhood.

Through our first set of results by applying nonparametric techniques of second order stochastic dominance, we demonstrated the rejection of the weak equality of opportunity hypothesis to obtain a wage return in the Chilean labor market, conditional to the circumstances given by the school type attended during childhood. The second results suggest that the impact of such circumstances on the wage returns is significant. The most conservative finding implies that the circumstances of having studied in a voucher-paid type school or a private-paid school, increase the median Chilean wage return by approximately 22 and 25% respectively.

The results of this study go beyond a mere empirical analysis and reach the core of the current institutional framework of the Chilean educational system. In a context of social crisis, where the level of inequality spreads out massively across different spheres, the voucher system emerges as an additional mechanism by which existing differences persist. As the final simulation stresses, in terms of wage inequality, the fact that a Chilean child born within a family that cannot afford a private education is destined to a wage trajectory systematically well-below a similar child but born within a rich family. The question that arises is then: Does the personal effort play a decisive role in this framework? A policy concern that deserves not only the attention of scholars and policy makers but also of the whole civil society.

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Appendix A

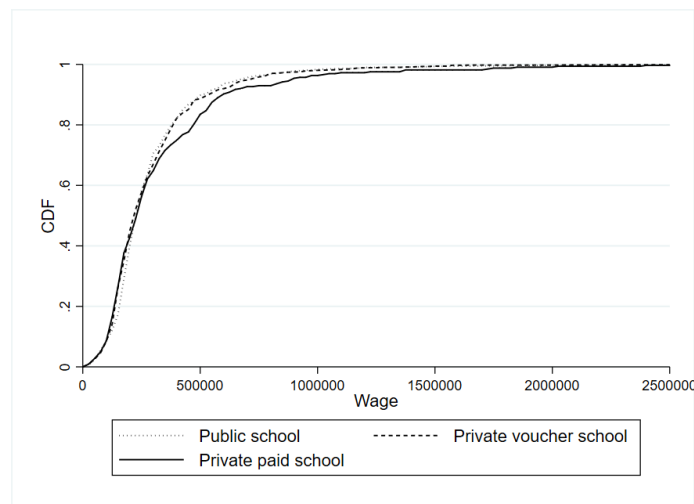


Figure A1. Wages' cumulative distributions by type of primary school. A micro-simulation adjusting for wage gaps