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Abstract

We use data from Chile's conditional voucher program to test the effects of vouchers on academic achievement. Conditional vouchers have delivered extra resources to low-income, vulnerable students since 2008. Moreover, under this scheme, additional resources are contingent on the completion of specific scholastic goals. Using a difference-in-differences approach, we find a positive and significant effect of vouchers on standardized test scores. Additionally, our results highlight the importance of conditioning the delivery of resources to some specific academic goals when frictions exist in the education market.

Keywords: vouchers, school choice, academic achievement
JEL Classification: H4; I2

I. Introduction

A central question in education economics is how to increase the quality of schools that low-income students attend. Since Friedman wrote his 1955 essay on the role of government in education, many have considered the use of vouchers to be a promising way to increase the education quality supplied by schools (Friedman, 1955). However, at the empirical level, the literature is far from reaching a consensus. This paper contributes

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to the literature by providing additional empirical evidence on the effects of vouchers on academic achievement. Our results show that vouchers have a positive and significant effect on standardized test scores. Additionally, we show that focusing resources on specific scholastic commitments enhances the efficacy of vouchers in promoting a higher quality of education. Therefore, some conditionality in the delivery of resources seems to be an effective way of increasing students' academic achievement in markets where some frictions may exist.

At a theoretical level, vouchers can raise the academic results of low-income students through three main channels. First, simply, they allow low-income students to migrate from bad public schools to good private schools (if private schools indeed offer a higher quality of education than public schools). Second, vouchers introduce competition to public schools when they are inefficient local monopolies. When subsidies are allocated only to public schools, they face a fixed demand and thus have no incentives to supply a high education quality. Vouchers allow low-income students to migrate to private schools; the demand for public schools is no longer fixed. Therefore, if parents were allowed to choose freely among schools, vouchers should raise the education quality supplied by public schools in an environment where schools compete through quality supplied to the market. Third, if the incidence of the demand subsidy (the voucher) on the supply of education is nonzero, vouchers (or an increase in the resources delivered by vouchers to schools) increase the margin per enrolled students (the difference between the total monetary payments and the cost of educating a student) and thus encourage schools to attract more students. If there is competition, education quality increases within both public and private schools even if there is no migration of students from public to private schools (there would be greater competition within school types).

In 1981, Chile's government began to provide vouchers to any student wishing to attend a private school (called *voucher private schools* in this paper). Chile's voucher experiment can be easily used to test the first channel mentioned above by looking at two pieces of data: first, the strength of the migration of students from public to private schools and, second, the difference in the academic performance in those types of schools.

Figure 1 shows a strong migration of students from public schools to private schools. Additionally, Figure 2 shows significant unconditional differences in the average results on a standardized test (SIMCE)[1] between public and voucher private schools, although those results could be simply explained by differences in the socioeconomic background of students attending different public and private schools.

Up to 2000, the literature had found that after properly controlling for students' socioeconomic backgrounds, public and voucher private schools saw a similar performance on achievement tests. For instance, Elacqua and Fabrega (2004) find that students attending voucher private schools do not necessarily outperform public school students and

[1]The SIMCE (Sistema de Medición de la Calidad de la Enseñanza) is a mandatory national standardized test designed to evaluate the quality of the content taught in primary and secondary education in math, language, geography, and science. It is administered annually to fourth, eighth, and tenth graders through a system in which grades are chosen to be evaluated by turns.

that competition has not necessarily improved the test results of both types of schools. Elacqua and Fabrega (2004) argue that the only thing that can be concluded from the Chilean experience is that free choice and competition have led to a further segmentation of the education system. However, these studies faced important limitations associated with the lack of control for selection bias, the estimation of homogeneous treatment effects across students with different characteristics, and the assumption that all publicly subsidized schools operate with the same budget (Sapelli and Vial, 2002). Subsequent studies show that after selection bias is controlled for, there is a significant difference in the academic performance of public and voucher private schools (Contreras, 2001; Tokman, 2002). Sapelli and Vial (2002) find that when they control for selection bias and student characteristics, there is a positive effect on standardized test scores in favor of voucher private schools.[2]

Therefore, the migration of students from public to private schools, where there is a difference in the education quality supplied by both types of schools, seems to be a valid channel through which the Chilean voucher system should have increased the academic achievement of low-income students.

When scholars have tried to use Chile's voucher program to evaluate the second and third channels described at the beginning of this section, the lack of a control group is one of the main empirical problems that they have faced. Since 1981, more than 90% of schools have received vouchers. Therefore, there is no control group to build a counterfactual for the treatment group.

However, in 2008, the Chilean government implemented a new type of voucher program in which extra resources were provided for low-income students, conditional on the achievement of some specific scholastic goals. This conditional voucher program provides a unique opportunity to build empirical evidence on how vouchers affect academic achievement by (1) forcing public schools to compete with private schools and (2) increasing the profit margin per enrolled student in both public and private schools. Additionally, this voucher program offers an opportunity to empirically evaluate the importance of conditioning the delivery of resources to some specific academic goals in education markets with frictions that prevent students' mobility across schools.

The conditional voucher program aims to improve the quality of education by giving an additional per-student subsidy to schools that voluntarily enroll vulnerable students. Under this scheme, additional resources are contingent on the completion of specific academic goals (the so-called Educational Improvement Plan [EIP]). In exchange for these additional resources, schools face two costs by joining this scheme. First, they must accept vulnerable students, who are more costly to educate. Second, they are not allowed

[2]International evidence supports the results of Sapelli and Vial (2002). Some studies on voucher programs show how achievement growth among economically disadvantaged African-American children in U.S. cities rises if students are able to attend private schools instead of public schools. For instance, Howell and Peterson (2002) find evidence that African-American children benefit from access to private schools. Pooling African-American children at all grade levels, they find that private schooling enhances one- and two-year total achievement gains by 3.9 and 6.3 percentiles, respectively. Further, in New York and Washington, D.C., they find that the comparable three-year gain estimate is 6.6 percentiles.

to charge a co-payment. This trade-off (more resources in exchange for educating more costly students and the prohibition of charging a co-payment) implies that only a fraction of schools decide to receive the conditional vouchers, thus generating a control group. Therefore, this new subsidy offers us a better opportunity to evaluate the empirical effects of vouchers on education quality.

Before conditional vouchers were implemented, low-income, vulnerable students attended free public schools only. Public schools were forced by law to enroll students who wished to attend and were not allowed to charge any co-payment to them. Therefore, public schools faced a fixed demand by vulnerable students because those students did not have any alternative. Thus, public schools represented the kind of local monopolies argued by Hoxby (2003).

When the new voucher system was implemented, public schools received an extra amount of resources for each enrolled vulnerable student. In addition, a significant fraction of private schools became receptors of conditional vouchers and, thus, began to enroll vulnerable students. The appearance of private schools enrolling low-income, vulnerable students broke the local monopolies of public schools on those students. The demand by vulnerable students for public schools was no longer rigid and became responsive to changes in quality. Therefore, the conditional vouchers introduced in the Chilean education market in 2008 should have encouraged public schools to supply a higher education quality to avoid a massive migration of vulnerable students toward private schools.[3]

Additionally, in public schools, the extra resources delivered by the conditional voucher increase the margin per enrolled vulnerable student and thus encourage schools to attract more of those students by increasing the education quality supplied to the market. The same happens in private schools that become receptors of this voucher (those that charge a low co-payment, as we both theoretically and empirically show in this paper). Therefore, an increase in the academic achievement of students within public and private schools should be observed when the conditional voucher system is implemented, even if the migration of students from public to private schools would not exist.

Finally, some frictions (lack of information or geographic constraints) could prevent students from moving across schools. In that case, the demand is fixed (changes in quality are irrelevant) and the extra resources delivered by vouchers only represent economic rents for the owners of the schools. Therefore, a different contract must be signed in order to guarantee improvements in school education quality. Chile's conditional voucher program introduces a simple contract in which resources are contingent on the achievement of some minimum required quality. We show that conditionality encourages the supply of a high education quality in markets where some frictions may exist.

Therefore, we expect conditional vouchers to have positive effects on academic achievement. We test those effects empirically in this paper. However, some empirical difficulties arise. The migration of students from public to private schools could, by

[3]Of course, this conclusion holds as long as the total resources delivered by the conditional voucher and the flat voucher existing since 1981 are greater than the cost of educating a vulnerable student.

itself, affect the average academic achievement. For instance, assume that some vulnerable students with very low human capital migrate to private schools. If public/private schools are more/less effective in educating students with lower human capital, the average academic results could change even if nothing more happens. Additionally, the increase in education attainment for vulnerable students could also affect the average academic results of schools. To solve those difficulties, we first control for students' socioeconomic backgrounds, which allows us to put aside the effect of changes in the composition of students attending public and private schools. Second, we include school-level fixed effects to control for potential self-selection of schools into the new voucher program. Third, we use a difference-in-differences approach. It allows us to remove the biases that result from the comparison of both groups in the second period and that can be explained by permanent differences between them and differences across time due to group-specific trends.[4]

We first use a sample of public and private schools. Controlling for students' socioeconomic backgrounds and for national trends, we find a positive and significant effect of conditional vouchers on standardized test scores for math. For language, we find no significant effect under some specifications. These positive effects of vouchers on academic achievement (mainly in math test scores) are explained by a mix of higher competition for public schools and a higher margin per enrolled vulnerable student for both public and private schools. Moreover, after including school progress in the EIP, we find that a higher degree of accomplishment further raises test scores, in addition to the direct effect. Therefore, conditionality matters. Our results show that focusing resources on specific scholastic commitments (i.e., the EIP in the Chilean system) enhances the efficacy of vouchers in promoting a higher quality of education in markets in which some frictions may exist.

Next, we use a sample of only private schools. Even though two channels (more competition and a greater margin per enrolled student) operate for public schools and just one (a greater margin per enrolled student) operates for private schools, the magnitude of the effects is slightly greater for private schools. Our interpretation of these results is that public schools could face incentives different from the textbook case in which schools simply maximize profits. Sapelli (2003) indicates that a key element to evaluating the results of the Chilean voucher system is its design, which is far from the ideal case in which both public and voucher private schools operate under the same internal and external rules (i.e., under the same budgets and regulatory frameworks). In the Chilean case, public schools are regulated by a Teaching Statute and receive additional funds from municipalities when necessary. Together, these differences would determine the budget constraints of public and voucher private schools and, hence, the effect of competition on their academic achievement. Along the same line as Sapelli (2003), Hsieh and Urquiola (2006) show that despite extensive private entry and sustained declines in public enrollments, the aggregate number of municipal schools has barely fallen. Hsieh and Urquiola (2006) argue that municipal officials seem to have been unable or unwilling

[4]Therefore, treatment and control schools are identical except for the fact that, after the implementation of the conditional voucher system, the treatment schools face more competition (public schools) and receive a higher margin per enrolled student (public and voucher private schools).

to close public schools and, thus, public schools seem to not face strong incentives to compete. This is reinforced by the fact that, for these schools, revenue losses are mediated by municipal educational budgets, which makes it possible for them to lose students without automatic consequences on their resources. Thus, "soft budget constraints" for public schools could explain why the conditional voucher program has increased academic achievement in public schools but not by the magnitude suggested by our theoretical analysis. However, overall, our results confirm the positive effects of vouchers on academic achievement and the importance of conditioning the delivery of resources to some specific academic goals when frictions exist in the market.

Our results are line with those in Hoxby (2003) and Neal (2002). Hoxby (2003) analyzes the impact that different programs had on school productivity: specifically, the effect of vouchers on achievement in Milwaukee public schools and the effect of charter schools on achievement in Michigan and Arizona public schools. Hoxby concludes that the regular public schools boosted their productivity when exposed to competition and that they responded to competitive threats that were surprisingly small. Neal (2002) concludes that while it is difficult to predict the outcome of any large-scale voucher experiment, voucher systems targeted toward large cities with a history of public school failure may have the greatest potential for yielding large benefits. Based on the work of Nechyba (1999) and Epple and Romano (2002), Neal conjectures that it is possible to design targeted voucher systems that would result in better outcomes for most if not all students in large urban school districts like those in Chicago and New York.[5]

On the other hand, our findings oppose those presented in Hsieh and Urquiola (2006). Those authors use the differential impact on enrollment that the introduction of a nationwide voucher has in Chilean communities to measure the effects of unrestricted choice on educational outcomes. Using panel data for about 150 municipalities, they find no evidence that choice improved average educational outcomes in Chile. Two main factors could help to reconciliate our results with those of Hsieh and Urquiola (2006). First, Hsieh and Urquiola (2006) do not control for changes in the composition of students within municipalities, which could understate the effect of competition on school outcomes. Second, the outcome measure used by the authors is the test score in the PER (Programa de Evaluación del Rendimiento Escolar). Different from the SIMCE, the PER did not make the results of schools available to the public. Therefore, the environment in which vouchers operated in Hsieh et al.'s period of analysis could have been much more frictional than the environment in which the conditional vouchers evaluated in this paper were implemented.

The rest of the paper is organized as follows. Section 2 reviews the institutional details of the conditional voucher system in Chile. Section 3 develops a theoretical model that analyzes the effects of vouchers on the quality of education supplied by schools in

[5]Rau et al. (2012) use a sequential model of schooling decisions and academic outcomes to investigate the relative effectiveness of private-voucher schools in Chile. They analyze two particular outcomes of interest: the probability of taking college admission tests; and, conditional on having taken these tests, the performance on them. They find mixed results for the outcome of taking college admission tests, and strongly positive and significant effects on test scores.

different competition environments. Section 4 discusses the empirical strategy used to test the main predictions of the theoretical model, and section 5 describes the data. Section 6 presents and discusses the results. Finally, section 7 concludes.

II. Chile's Conditional Voucher Program

A. The Educational System before the Conditional Vouchers

In 1980, Chile implemented several educational reforms seeking to improve education quality and the efficient use of resources by fostering competition between schools. Before these reforms, Chile had a centralized education system whereby the vast majority of schools were publicly financed and the Ministry of Education was directly responsible for designing and overseeing the implementation of all education policies, both substantive and administrative.[6] Three main changes were particularly transformative. First, administrative responsibility over public schools was transferred from the Ministry of Education to each municipal government, resulting in a more decentralized configuration. Second, a new scholastic subsidy system was introduced as the principal financing mechanism. Subsidized private schools began to receive exactly the same per-student payment as the public (municipal) schools. To distinguish these institutions from the subsidized private schools that existed before the reforms (mainly religious), we will call them voucher private schools. The subsidy was calculated as a function of total student enrollment and average student attendance. Third, the government moved to actively encourage the participation of private entities in the financing and administration of educational institutions (Larranaga, 1995; Vial, 1998; González et al., 2002; Hsieh and Urquiola, 2003).

By making public funding directly contingent on student enrollment and retention, schools should compete for a larger share of the student body by offering a better education. However, in their efforts to minimize educational costs and maximize funding, private and voucher private schools employed competitive admission processes to admit only the most promising applicants (Hsieh and Urquiola, 2003; Elacqua and Fabrega, 2004). In contrast, public schools with vacancies were legally obliged to admit all applicants regardless of their academic potential or socioeconomic backgrounds. As a result, those students who displayed more academic potential became increasingly enrolled in private or voucher private schools, while those who displayed less academic promise were forced to enroll in municipal schools that, paradoxically, also received less funding. Because academic potential tends to be positively correlated with socioeconomic background, this segmentation resulted in the concentration of wealthier students in wealthier private or voucher private schools and more vulnerable students in poorer municipal schools.

In 1993, voucher private schools were allowed to charge students an additional tuition

[6] At the beginning of 1980, more than 90% of all Chilean students were enrolled in institutions directly dependent on the Ministry of Education, and only the remaining 10% were enrolled in completely private institutions.

fee to complement the state subsidy (Larranaga, 1995; González et al., 2002).[7] This system of shared financing encouraged schools with a better academic record to charge higher fees than their less successful counterparts, leading to increased socioeconomic segmentation and greater funding inequality.

Therefore, since 1993, the Chilean primary and secondary education system has been 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 by co-payments made by parents (voucher private schools); and (iii) private schools financed exclusively by parents (private schools).[8]

B. The Conditional Voucher Program (SEP)

Created in 2008, the conditional voucher program (SEP[9]) aims to improve the quality of education of the most vulnerable students by giving an additional per-student subsidy to schools that voluntarily enter the SEP program. By providing additional resources to less advantaged students, named *priority students*, the additional subsidy aims to both improve the quality of education received by priority students and decrease socioeconomic inequality in the academic performance of students from different socioeconomic backgrounds, through a combination of individually allocated additional funds and an incentive-based school reform program. Moreover, for the first time, under this scheme additional resources are contingent on the completion of specific scholastic reforms and improvements in school academic performance on a standardized test (SIMCE).

B..1 Who Are Priority Students?

The fundamental basis of the SEP is the targeted support of a specific group of underprivileged and vulnerable students through additional subsidies. To automatically qualify as *priority*, a student must meet one of the following criteria in order, proceeding to further criteria if and only if the preceding one is not applicable: (i) participation in the Chile Solidario program (a social welfare program protecting those in extreme poverty), (ii) being in the most vulnerable third of the population according to the latest measurement instrument, or (iii) belonging to the most vulnerable group in the National Health Fund (FONASA). If none of the preceding criteria are available, the student's position can also be temporarily established according to their family socioeconomic background.

[7] Subsidy law limited the family contribution to no more than US$153 per month (in 2012 values).

[8] Public, voucher private schools, and private schools represented 40.71%, 50.73%, and 8.56%, respectively, of the total enrollment in primary and secondary education in 2010.

[9] SEP stands for *Subvención Escolar Preferenial*, the official name in Chile for the conditional voucher program.

B..2 The Educational Improvement Plan

To receive SEP funds, schools are classified into three categories according to their academic performance on the SIMCE and the socioeconomic characteristics of their students.[10] After a school is classified, it has to present an Educational Improvement Plan (EIP) to the Ministry of Education, which details educational reforms that the school will undertake to improve SIMCE results and how SEP funds will be spent to improve the academic performance of priority students. Although the amount of resources distributed to each priority student is the same for all schools and varies only by educational level, the autonomy of schools to decide how to use those resources and under what level of supervision will depend on the school's classification.[11]

While the EIPs form the central aspect of the incentives system inherent in the SEP law, in practice, they are only a part of the Equality of Opportunity and Educational Excellence Agreement (Convenio de Igualdad de Oportunidades y Excelencia Educativa) that each institution must sign. In addition to a commitment to produce and complete an EIP, the agreement also mandates that schools report the use of all resources received under the program and the status of specific projects, that all priority students must be allowed to attend free of tuition and costs (they cannot be required to pay any co-payment), that all admissions must be open to any prospective student,[12] and that schools must retain all students, even those with poor academic performance. These limitations on SEP funding and requirements for participation in the program are designed primarily to ensure that high-performing schools are accessible to all low-income students and that schools are not allowed to give preference to highly qualified priority students.

Additionally, according to SEP law, schools cannot select students between preschool and sixth grade on the basis of their academic performance or family socioeconomic background. If the demand surpasses the number of available spots, students will be admitted through a public and transparent application process that will not consider the student's socioeconomic status or their past or potential academic performance.

B..3 Funds

SEP funding is allotted per priority student and is delivered directly to the school instead of to any municipal funding system. It is calculated based on the average attendance rate of priority students over the previous three months, the school's classification as

[10] Depending on their performance on the SIMCE, schools could be classified as *autonomous* (if their performance is at or above the median for their SIMCE group), *emergent* (if their performance is below the median for their SIMCE group), or *in recuperation* (applied to emergent institutions that fail, after four years, to meet the quantitative goals required by the program).

[11] For instance, emergent schools receive half of their funding as a subsidy and the other half as a contribution of additional resources to design and execute their EIP, and schools that are in recuperation receive all of their funding as a contribution of additional resources to their EIP.

[12] In cases where selectivity is requisite, schools may not take into account past academic performance, current academic ability, or socioeconomic status.

autonomous or emergent, the grade level of the priority student (younger students receive more resources), and the concentration of priority students in the school. Table 1 shows the monthly subsidy delivered per priority student in 2012.

In addition to the regular SEP funds, schools qualify for a subsidy if priority students make up more than 15% of the student body. Table 2 presents the concentration subsidy amount.

In relation to the flat voucher based on student attendance, the SEP increases the resources given to schools for priority students by 70%. Table 3 presents the amount of additional resources given by the SEP.

III. The Model

In this section we build a model to analyze how conditional vouchers affect the quality of education supplied by schools. We first assume an environment of no frictions, in which schools must offer a higher level of quality in order to attract more students. In this scenario we study how vouchers affect academic achievement by (1) forcing public schools to compete with private schools and (2) increasing the profit margin per enrolled student in both public and private schools. After doing so, we introduce frictions; for example, parents' lack of information and/or some geographical constraints may prevent students from moving across schools and thus produce a school-specific demand that is fixed. In this second model, we study the role that conditionality in the delivery of resources has on promoting a higher quality of education.

A. No Frictions

We assume that two types of schools exist: public and voucher private schools. Public schools are not allowed to charge any fee. On the contrary, voucher private schools charge a private co-payment that complements the resources delivered by a flat voucher. Voucher private schools are heterogeneous in the amount of the co-payment they charge to parents. Denote by p_i the co-payment required by school i. We assume that p_i has a continuous uniform distribution with a support $p_i \in (0, \overline{p}]$. Therefore, for public schools $p_i = 0$, and for voucher private schools $p_i > 0$.

We assume the following demand function of education:

$$n_i(q_i) = \beta q_i, \tag{1}$$

where q_i denotes the quality supplied by school i. Therefore, the higher the quality supplied by a school, the greater the demand for that school. Assume that $q_i \geq 0$; that is, schools cannot supply a "negative quality."

On the demand side, there are two groups of students. The first group is composed of students from families who have zero income. Because their families have zero income,

those students must attend free public schools. The second group is made up of students from high-income families. Those families have the resources to make co-payments and, therefore, can choose among any type of school. We assume the following cost function of providing a quality q_i to high-income (h) and low-income (l) students:

$$c_h(q) = \underline{\alpha} q_i, \tag{2}$$
$$c_l(q) = \overline{\alpha} q_i; \tag{3}$$

$\forall\ \overline{\alpha} \geq \underline{\alpha}$. We assume a segregated education market in which low-income students attend free public schools and high-income students attend voucher private schools that require co-payments. Figure 3 shows the average family income by school dependence. We can observe that segregation indeed exists in the Chilean education market.

Because low-income students do not have another alternative, the demand for public education by those students is fixed. Denote by $\overline{n}_p$ the fixed demand for public education. Public schools choose the quality level, q_p, that maximizes their profits:

$$\max_{q_p} \left\{ \left(v - c_l\left(q_p\right) \right) \overline{n}_p \right\} \tag{4}$$

where v is the flat voucher received by both public and voucher private schools. It is clear that public schools have incentives to offer $q_p = 0$.

Voucher private schools charge a co-payment and thus receive only students from high-income families. The maximization problem, which a voucher private school i must solve, is the following:

$$\max_{q_i} \left\{ \left(v + p_i - c_h\left(q_i\right) \right) n_i\left(q_i\right) \right\}. \tag{5}$$

Therefore, the quality supplied by school type i is:

$$q_i = \frac{v + p_i}{2\underline{\alpha}} \tag{6}$$

Notice that $\partial q_i / \partial p_i > 0$. Moreover, it is straightforward to conclude that $q_i > q_p$ for all i. Therefore, voucher private schools offer a higher quality than public schools; and the higher the co-payment charged, the higher the quality supplied. Two main reasons explain why the quality of education in voucher private schools is higher than in public schools. First, positive co-payments in voucher private schools bring extra resources, so it becomes profitable to attract more students by increasing quality. Second, given that low-income students cannot afford a private education, public schools are local monopolies for that type of student. That is, the demand for those schools by low-income students is fixed. Therefore, total demand for public schools is nonresponsive to changes in quality, and, as a consequence, public schools do not have incentives to increase quality. The reason why voucher private schools with higher co-payments offer a higher quality is that higher co-payments increase the resources per student and thus encourage schools to attract more students by increasing quality.

Figure 2 shows that the average SIMCE score is higher in voucher private schools than in public schools. Additionally, Figure 4 plots the correlation between the co-payment level and the SIMCE score in voucher private schools. We observe a positive correlation, as predicted by the model. Therefore, the previous predictions of the model are indeed observed in the data.

A..1 The Conditional Voucher Program (SEP)

We now assume that the conditional voucher program is implemented. As described in section 2, schools that join the program must sign a contract that conditions the delivery of extra resources to the achievement of some specific academic goals. Assume a very simple contract to emulate the EIP, described in section 2: in exchange for new resources, schools must warrant a quality equal to or greater than $\overline{q}$. Denote the total amount of resources (the flat voucher plus the extra resources) received by a school that signs the contract by v_{SEP}.

Only schools that accept low-income students receive the voucher v_{SEP}. Additionally, SEP private schools are not allowed to charge co-payments to vulnerable students. Therefore, the maximization problem for SEP private schools can be expressed as follows:

$$\max_{q_{SEP}} \left\{ \left(v_{SEP} - c_l \left(q_{SEP} \right) \right) n_{SEP} \left(q_{SEP} \right) \right\} \tag{7}$$

Therefore, the optimal choice of quality is:

$$q_{SEP} \quad = \quad \frac{v_{SEP}}{2\overline{\alpha}} \tag{8}$$

Assuming that $q_{SEP} > \overline{q}$ we have that the conditionality imposed by the program would not be binding in an environment where competition freely operates.

Schools that do not receive the SEP maximize the profits function (5); thus, they offer a quality level given by equation (6).

Voucher private schools that choose to receive the SEP are those ones for which benefits (the greater voucher) overcome costs (the loss of the co-payment and the higher cost of educating low-income students). Therefore, we can have a co-payment level p^*, such that schools that charge a co-payment p^* are indifferent between becoming or not becoming SEP schools. Schools charging a co-payment lower than p^* become SEP schools, whereas schools with a higher co-payment choose not to receive the SEP. The co-payment level p^* is given by the following expression:

$$p^* \quad = \quad v_{SEP} \left(\underline{\alpha} / \overline{\alpha} \right)^{\frac{1}{2}} - v. \tag{9}$$

We now impose the following constraint on v_{SEP}, such that a positive number of SEP and non-SEP schools exist:

$$0 < p^* < \overline{p}. \tag{A.1}$$

Therefore, we have that

$$v\left(\frac{\overline{\alpha}}{\underline{\alpha}}\right)^{\frac{1}{2}} < v_{SEP} < (\overline{p}+v)\left(\frac{\overline{\alpha}}{\underline{\alpha}}\right)^{\frac{1}{2}}. \tag{10}$$

As long as the value of v_{SEP} satisfies inequality (10), some voucher private schools become SEP receptors and compete with public schools for low-income students. Additionally, all public schools have incentives to become SEP receptors and get the additional resources delivered by the SEP. Table 4 shows that this prediction is indeed observed in the data. Almost all public schools subscribed to the SEP, whereas around half of voucher private schools became SEP receptors.

Under the SEP system, the maximization problem of public schools is given by equation (7), and the education quality supplied to the market is given by equation (8).

A..2 Supply of Education Quality

The type of conditional vouchers analyzed in the previous sections introduce three fundamental changes in the education market. First, they break the monopoly of public schools on low-income students by allowing them to migrate to voucher private schools. Second, they increase the margin per enrolled student as long as the extra resources outweigh the differential cost of educating low-income students. Third, they introduce conditionality in the delivery of resources. Even though the latter channel could be less relevant in an environment of no frictions, the first two channels change the incentive of public as well private schools when deciding what level of education quality to offer to the market.

Before and after the introduction of the SEP, public schools receive only low-income students. However, when the SEP is implemented, low-income students have the chance to attend those voucher private schools that become SEP receptors. Therefore, the demand for public schools by low-income students is no longer fixed but is responsive to changes in quality. Additionally, the SEP delivers extra resources to public schools, and, thus, the margin per enrolled student is higher under the SEP system. Both facts imply that public schools have incentives to supply a higher education quality under an SEP system than under a non-SEP system. That conclusion is straightforward when we compare equation (8) with our previous conclusion that public schools supply a quality level $q_p = 0$ when the SEP does not exist.

On the other hand, by comparing equations (6) and (8), we can establish that voucher private schools that charge a co-payment lower than some level p^{**} supply a higher education quality under an SEP system than under a non-SEP system. p^{**} is the co-payment level that equals equations (6) and (8):

$$p^{**} \;=\; v_{SEP}\left(\underline{\alpha}/\overline{\alpha}\right) - v \tag{11}$$

Figure 5 shows the relationships between p^{**}, p^{*}, q_i and q_{SEP}.[13] From this figure, we

[13]Notice that $p^{**} < p^{*}$.

can extract four main conclusions.

First, voucher private schools that choose to be SEP receptors are those that charge a co-payment lower than p^*. Voucher private schools must agree to receive private co-payments from parents. That cost is higher for schools that charge a higher co-payment. For this reason, the lower the co-payment, the greater the profitability of becoming an SEP receptor.

Second, voucher private schools that charge a low co-payment increase the education quality supplied under an SEP system more than under a non-SEP system. As discussed in the introduction, the receipt of more resources per enrolled student means it is profitable to attract more students, which encourages schools to supply a higher education quality. Under an SEP system, the margin per enrolled student increases more for schools that initially charged a low co-payment. That explains why those schools experience greater increases in their education quality.

Third, the unconditional effect of the SEP on the education quality supplied by voucher private schools is, in principle, ambiguous. As shown by Figure 5, there are some schools (those that charge a co-payment between p^{**} and p^*) that decrease their education quality compared with their counterfactual scenario (the non-SEP system). The optimal choice of education quality corresponds to the level at which the marginal cost of further increases in quality equals the marginal benefit. For schools with a middle-level co-payment (between p^{**} and p^*), the SEP system increases marginal benefits by a relatively small amount because co-payments were relatively high under the non-SEP system. However, those schools could still have incentives to become SEP receptors.[14]

Fourth, notice that as the difference between educating low-income and high-income students decreases, it is more likely to find a positive effect of the SEP on the average education quality supplied by voucher private schools. In terms of Figure 5, the difference between p^{**} and p^* decreases when $\underline{\alpha}/\overline{\alpha}$ tends to one. For instance, if the difference in the cost of educating low-income and high-income students is null ($\underline{\alpha}/\overline{\alpha} = 1$), schools that choose to be SEP receptors are exactly those that would increase their education quality under an SEP system (with respect to the non-SEP scenario). A direct implication of the latter result is that, controlling for the socioeconomic background of students, we should expect an unambiguous positive effect of the SEP on the education quality of voucher private schools (keeping the composition of students constant is similar to imposing $\underline{\alpha} = \overline{\alpha}$ in terms of the model). In section 6, we test all those empirical predictions of the model.

B. Frictions

In this subsection we deviate from the no-frictions environment. Indeed, we assume that both public and voucher private schools face a fixed demand $\overline{n}$. Some factors that may explain this school-specific rigid demand could be some lack of information for parents

[14] This conclusion is straightforward when we observe the equilibrium profits and the optimal choice of quality.

about school quality or students' mobility constraints. Both factors imply that an increase in the quality supplied may not attract more students. We can immediately conclude that the quality supplied by all school types will be the minimum-in this case, zero. Moreover, because the quality supplied is zero, the SEP will be ineffective in promoting a higher quality of education. The extra resources would only be economic rents for the owners of SEP schools.

Schools will choose to receive the SEP voucher if the following condition is satisfied:

$$p_i < v_{SEP} - v. \tag{12}$$

Therefore, as long as $v_{SEP} > v$, there will be some schools that choose to receive the SEP voucher. In these schools, the delivery of extra resources will not be effective in promoting a higher quality of education and would only increase profits. A different type of contract must be designed to promote education quality.

The SEP contract establishes that schools must warrant a quality equal to or greater than $\overline{q}$. Schools that subscribe to this type of contract face the following maximization problem:

$$\max_{q_{SEP}} \left\{ \left(v_{SEP} - \overline{\alpha} q_{SEP} \right) \overline{n} \right\}, \tag{13}$$

such that

$$q_{SEP} \geq \overline{q}. \tag{14}$$

Therefore, SEP schools choose to offer the minimum required quality $\overline{q}$, which is greater than zero.

As before, we can have a co-payment level p^*, such that schools charging a co-payment lower than p^* choose to receive the SEP:

$$p^* \quad = \quad (v_{SEP} - v) - \overline{\alpha q}. \tag{15}$$

As in the previous section, we impose assumption [A.1], which grants that a positive number of SEP and non-SEP schools exist. Assumption [A.1] imposes a limit to the value of v_{SEP}, as the following inequality shows[15]:

$$v + \overline{\alpha q} < v_{SEP} < \overline{p} + v + \overline{\alpha q}. \tag{16}$$

The quality supplied by schools when the SEP does not exist is simply zero. However, as long as the amount of the voucher satisfies the lower limit of inequality (16), there will be a positive number of SEP schools, and the average quality supplied by schools will be higher compared with that when the SEP does not exist. Therefore, when some frictions limit competition among schools, a contract conditioning resources to the accomplishment of some minimum quality level is effective in promoting a higher quality of education among schools.

[15] As in the previous analysis, inequality (16) implies that all public schools subscribe to the SEP contract.

IV. Empirical Strategy

We use a difference-in-differences approach to evaluate the effects of the SEP on academic achievement. According to this methodology, there are two groups observed in two time periods, where one is exposed to a treatment in the second period but not in the first (treatment group). The other group is not exposed to a treatment during either period (i.e., the control group). If the same units of the treatment and the control groups are both in the first and second periods, the effect of the treatment could be obtained by subtracting the average gain of the control group from the average gain of the treatment group. This approach allows us to remove the biases that result from the comparison of both groups in the second period and that can be explained by permanent differences between them and differences across time due to group-specific trends.

For two periods and a treatment that occurs only in the second period, we have the following expression:

$$y_{it} = \beta_0 + \beta_1 d2_t + \beta_2 w_{it} + u_{it}, \quad \forall t \in 1, 2; \tag{17}$$

where y_{it} is the outcome and $d2_t$ is a dummy variable that takes the value of one for the second period and zero otherwise. Also, w_{it} is a binary program indicator that is equal to one if unit i receives the treatment in period t, and u_{it} is an error term. Taking differences, we have:

$$\Delta y_i = \beta_1 + \beta_2 \Delta w_i + \Delta u_i. \tag{18}$$

In this framework, β_2 is the treatment effect. Moreover, if the changes in the treatment status are not correlated with the error term (i.e., $E[\Delta w_i \Delta u_i]$), the OLS estimation of equation 18 will produce consistent parameters. In the case where there are no units treated in the first period, the OLS estimation can be obtained as:

$$\beta_2 = \Delta \bar{y}_{treated} - \Delta \bar{y}_{control}, \tag{19}$$

where $\bar{y}_{treated}$ and $\bar{y}_{control}$ are the sample averages of the outcome variable (y) for the treatment and control groups, respectively.

We use a panel of schools in which we can identify those that signed the Equality of Opportunity and Educational Excellence Agreement and received SEP funds from 2009 to 2011 (i.e., the treatment group) and those that decided not to participate in this program during this period (i.e., the control group).[16] In our model, the pre-treatment period is

[16]Because SIMCE only evaluates students from the fourth, eighth, and tenth grades by turns, we can only use the data at the school level. Ideally, we would like to use the individual data of students attending SEP and non-SEP schools, but we cannot follow the same cohort of students each year and use their SIMCE scores in our analysis. However, since 2006 SIMCE has evaluated fourth graders each year, which allows us to use school-average SIMCE scores for schools that have participated in the SEP and have not participated in the SEP and compare their academic performance by using a difference-in-differences approach.

defined as the time before the SEP was implemented (i.e., from 2006 to 2008), and the post-treatment period as the time in which the SEP was in effect (i.e., from 2009 to 2011). We use the following baseline specification to estimate the effects of the SEP on academic achievement, in a context of panel data:

$$SIMCE_{it} = \beta_1 \lambda_t + \beta_2 w_{it} + \beta_3 X_{it} + \beta_4 EIP_{it} + c_i + u_{it}, \quad \forall t \in [1, T]; \tag{20}$$

where $SIMCE_{it}$ corresponds to the average score that school i obtained on the SIMCE (math and language, depending on the econometric specification) in the period t, λ_t is a time trend, and w_{it} is a binary program indicator that equals one if the school i participates in the program at time t and equals zero otherwise. EIP_{it} is the proportion of the Educational Improvement Plan accomplished by schools in math and language. This is a measure of the educational reform progress required by the SEP contract. This variable is always zero during the pre-treatment period (and during the post-treatment period for non-SEP schools) and goes from zero to 100 during the post-treatment period for SEP schools.

Additionally, we include a vector of school characteristics, X_{it}, which contains the average gross family income and the education level of the parents of the students attending school i at time t. Finally, we include a fixed individual effect c_i and an idiosyncratic error term u_{it}.

Equation (20) constitutes our baseline empirical model. It allows for aggregate time effects and controls. We estimate equation (20) using fixed effects to obtain the policy effect estimator associated with w_{it}.[17] We interpret it as the average effect of the SEP on a schools' academic achievement. By using this approach, we are estimating a causal effect of SEP on school's academic achievement that could be attributable to the three channels previously discussed as well as other effects (such as peer effects).

The key identifying assumption is that the trend in test scores would be the same in both SEP and non-SEP schools in the absence of treatment. Although the treatment and control individual schools can differ, this difference is meant to be captured by the school fixed effects. Figure 6 shows the SIMCE scores in the treatment and control groups. We observe that the trends followed by those school groups are fairly similar until 2008.[18] Treatment induces a deviation from this common trend. The treatment is composed by a higher margin per enrolled student and more competition (in the case of public schools). Therefore, when we control for fixed effects and observable characteristics of schools, treatment and control schools are identical except for the fact that, after the SEP, the treatment schools face more competition (public schools) and receive a higher margin per enrolled student (public and voucher private schools).

[17] We estimate equation (20) by OLS using robust standard errors. Considering that in our case observational units are schools (not individuals), we do not use clusters to estimate standard errors. Even though we could use clusters at the level of regions, there are no apparent reasons to believe that there are region's specific characteristics that may be affecting the effect of SEP.

[18] Moreover, an important assumption behind specification (20) is that changes in the trend are exclusively explained by (1) the treatment and/or (2) changes in the covariates that control for omitted school-specific trends.

V. Data

Our sample is composed of public and voucher private schools that were and were not exposed to the SEP from 2009 to 2011. This database contains information about students' socioeconomic backgrounds, including variables such as gross family income and the education level of the students' parents. Our database also includes information about the proportion of the EIP accomplished by schools that participated in the SEP in 2010. As we previously explained, the EIP is a plan that details educational reforms intended to improve SIMCE scores and establishes how financial resources provided by the SEP will be spent to improve the academic performance of priority students. Because schools define their EIPs over a period of four years,[19] the Ministry of Education decided to carry out an evaluation before the end of the agreement. In 2010, the ministry evaluated the goals accomplished by schools in math, language, and management. We use the proportion of the EIP accomplished in math and language in 2010 as a measure of the educational reform progress.

We link this information with school academic performance. In particular, we include the yearly average score that a school obtained on the SIMCE during the period 2006-2011.[20] Considering that the SEP was progressively implemented in preschool and primary education (and only since 2012 in secondary education), we use schools' average scores obtained by fourth graders in math and language, which are the only measures of school performance available for the levels under the SEP.

Using this information, we build a panel for public and voucher private schools that allows a pre-SEP period and a post-SEP period. We define the pre-SEP period, or the pre-treatment period, as the three years before the implementation of the SEP (2006-2008). The post-SEP period, or the post-treatment period, corresponds to the three years in which schools could receive the SEP by signing an Equality of Opportunity and Educational Excellence Agreement (2009-2011). By signing the agreement, schools agreed to carry out specific measures oriented to improve the quality of the education provided and perform specific actions to encourage the school's retention and academic performance of priority students. Therefore, our panel links not only the participation status of schools in the SEP but also their academic performance on the SIMCE, the socioeconomic backgrounds of their students, and a measure of relative efficiency of the goals proposed in their EIP. Tables 5 and 6 show summary statistics of treated and untreated schools for each year.

[19] At the end of the four-year period, schools are evaluated on the basis of their performance on the SIMCE.

[20] Notice that schools offer a unique quality for all students enrolled at some moment of time. In this sense, the average score obtained by each school is the relevant outcome to empirically evaluate the forces analyzed in section 3.

VI. Results

Table 7 presents the results of equation (20). Columns (1) and (7) show that the effect of the SEP on math and language is positive, statistically significant (at the 1% level), and higher for math than for language, when only the time trend (λ_t) and the policy indicator (w_{it}) are considered. Despite the fact that the point estimate associated with math is higher than that for language, the trend coefficient associated with language is higher than that for math. This could be explained by specific reforms carried out to increase the quality of the language education content. As a result, SIMCE scores for language showed an increasing tendency attributable to curriculum reforms that were not implemented in math. Columns (2) and (3) and (8) and (9) show the estimated coefficients for math and language when family background is controlled for. After family income and the years of schooling of both parents are controlled for, the policy indicator is positive and statistically significant (1%) and remains higher for math than for language.

The next three columns include the proportion of the EIP accomplished by schools in 2010 in math and language. This variable gives us an idea of how EIP reforms affect school performance. According to the model developed in section 3, in an environment of no frictions, this variable should be statistically insignificant. Schools compete through quality, and the equilibrium education quality supplied to the market should be higher than the minimum required by the EIP. However, when some frictions exist in the market, a higher minimum education quality required by the SEP contract should produce higher improvement in academic achievement in schools that join the SEP system. Therefore, if the Chilean education market is competitive, we expect that the coefficient of the policy indicator w_{it} is statistically different from zero but that the coefficient of the proportion of the EIP accomplished is statistically insignificant. The opposite conclusion is expected if the Chilean market is not competitive. Of course, a mix of results is also possible. A positive and significant coefficient of the policy indicator and the proportion of the EIP accomplished should be a signal of a not fully competitive market where the EIP is, in some degree, binding with respect to the free-market equilibrium quality.

In all cases, the effect of the SEP on SIMCE scores, as well as the level of completion of the EIP, remains positive and significant (with the exception of the policy indicator for language in column [12], which is not significant). According to results in column (6), if a school accomplished 100% of its math-specific goals proposed for 2010, its average SIMCE score would rise 4.7 points, in addition to the 2.6-point increase associated with the policy indicator (w_{it}). For language, a full completion of the reforms implies, on average, 4.1 more points on SIMCE, in addition to the points attributable to the direct effect of the SEP on the school's academic performance (see column [12]).[21]

An additional question is whether or not the SEP has a cumulative effect on school

[21] In additional regressions, we included dummy variables that equal one for SEP schools one and two years before the introduction of the SEP system. In this way, we test whether our results can be simply explained by schools that choose to be SEP receptors changing their behavior before signing the SEP contract. The conclusions do not change using this specification.

academic achievement, considering that, in our sample, all schools signed the agreement in 2009 and remained in the program until 2011. It is possible that the SEP has an additional effect for each additional year in the program. That lag in the effect of the SEP on academic achievement could exist for two reasons. First, it is possible that there are some adjustment costs. For instance, vouchers could increase competition for public schools and increase the margin per enrolled student for both public and voucher private schools. Both school types would have incentives to increase their quality. However, because of some adjustment costs (for instance, the construction of new infrastructure), the increase in quality would not materialize until some future period. Second, it is possible that students must be exposed to more than one period of investments in order to experience improvements in academic achievement.

Table 8 presents the results of equation (20), including the interaction of the policy indicator and a trend variable $\lambda_t^{'}$ that takes a value of zero during the pre-treatment period and the values of one, two, and three during the post-treatment period for both SEP and non-SEP schools. By doing this, we capture the average effect of an additional year in the SEP on SIMCE scores. Columns (1) and (7) indicate that an additional year increases SIMCE scores by 4.1 points in math and 1.6 points in language, values that are statistically significant at the 1% level. After including school socioeconomic background variables (family income and parents' schooling), results remain positive and significant and are higher in math than in language. Moreover, when we include the percentage of EIP completion specific to each subject (columns [4]-[6] for math and [10]-[12] for language), our results indicate that each additional year of the SEP increases SIMCE scores by approximately 3.5 points in math and 0.9 points in language. Therefore, a school that has received SEP funds for three consecutive years and has completed all of the reforms proposed in its EIP by 2010 would increase its SIMCE score by 13.7 points in math and 6.6 points in language. To have an idea of the impact of the SEP, we can consider a school in the 50th percentile of the SIMCE score distribution-254 points in math and 264 points in language. An increase of 13.7 points would place the school in the 71st percentile in the math score distribution, while an increase of 6.6 points would put the school in the 62nd percentile in the language score distribution.

Tables 9 and 10 present the results of the same empirical models of tables 7 and 8, but only using a sample of voucher private schools. In general, we can observe that the coefficient on the policy indicator is slightly greater than in the model with both public and voucher private schools. However, as discussed in section 3, a smaller coefficient was expected. That is because two channels (more competition and a greater margin per enrolled student) operate for public schools, but just one (a greater margin per enrolled student) operates for private schools. We interpret this result as preliminary evidence that public schools could face incentives and budget constraints that cause those types of schools to deviate from the profit-maximization goal. Sapelli (2003) shows that public schools are regulated by a Teaching Statute and receive additional funds from municipalities when necessary. Additionally, Hsieh and Urquiola (2006) show that despite extensive private entry and sustained declines in public enrollments, the aggregate number of municipal schools has barely fallen. Hsieh and Urquiola (2006) argue that municipal officials

seem to have been unable or unwilling to close public schools, and, thus, public schools seem to not face strong incentives to compete. This is reinforced by the fact that, for these schools, revenue losses are mediated by municipal education budgets, which makes it possible for them to lose students without automatic consequences on their resources. The analysis in Sapelli (2003) and Hsieh and Urquiola (2006) could explain why the SEP has increased academic achievement in public schools, but not by the magnitude expected according to the theoretical analysis of section 3.

Finally, notice that another testable implication of the model discussed in section 3 is that the effects of the SEP on academic achievement might be lower for schools receiving higher co-payments. Table 11 presents the estimated coefficients of equation (20), including the interaction of the policy indicator and the shared financing made by parents. We conduct this exercise only for voucher private schools, considering that public schools are not allowed to charge any co-payment to parents. Columns (1) to (12) show that, as our theoretical model predicts, the coefficient associated with the interaction is negative and statistically significant at the 1% level. This implies that the SEP increases academic achievement in voucher private schools that charge a lower co-payment more than in schools that receive a higher co-payment. Our theoretical model also predicts that schools that received a lower co-payment before 2008 have more incentive to enroll in the SEP program. Table 12 shows that, indeed, voucher private schools that enrolled in the SEP program charged a lower co-payment than did non-SEP schools before the introduction of the subsidy.

Overall, our results confirm the positive effects of vouchers on academic achievement. Additionally, we present novel evidence supporting the importance of conditioning the delivery of resources to some specific academic goals. According to our findings, this conditionality has a positive and significant effect on academic achievement in addition to the direct effect of vouchers. Conditional vouchers could be particularly relevant when frictions exist in the market.

VII. Conclusions

This paper provides empirical evidence of (1) the effects of vouchers on the academic achievement of students and (2) the importance of conditioning the delivery of resources to some specific academic goals. We focus on the conditional voucher program (SEP) implemented in Chile in 2008. Different from the previous flat voucher system introduced in 1981, this new demand subsidy allows us to have a control group to evaluate the effects of the program. Our empirical strategy considers a difference-in-differences approach that allows us to remove the biases that result from the comparison of both groups in the second period and that can be explained by permanent differences between both groups and differences across time due to group-specific trends.

We find a positive effect of the SEP on standardized test scores. In an environment of no frictions, the positive effect of vouchers on academic achievement should operate mainly through two channels. First, the freedom of parents of low-income students to

choose schools introduces competition for public schools. Second, if the incidence of the demand subsidy (the voucher) on the supply of education is nonzero, vouchers (or an increase in the resources delivered by vouchers to schools) increase the margin per enrolled student (the difference between the total monetary payments and the cost of educating a student), which encourages schools to attract more students. If there is competition, education quality increases within both public and private schools through this second channel.

Additionally, our results highlight the importance of conditioning the delivery of resources to some specific academic goals. Our findings show that this conditionality has a positive and significant effect on academic achievement in addition to the direct effect of vouchers. Conditional vouchers could be particularly relevant when frictions exist in the market.

Finally, we find a greater effect of the SEP when we consider only a sample of voucher private schools than when we include both public and voucher private schools. This result can be explained by the existence of "soft budget constraints" for public schools, which means that public schools do not face strong incentives to compete.

An interesting avenue for future research is related to the differential effects that the SEP had on math and language. That is, why did competition promote a higher supply of education quality in math than in language? One possible explanation is that parents value a scientific education relatively more than a humanistic education. Therefore, the demand for schools is more elastic to quality increases in scientific than in humanistic education. In this scenario, it is more effective for schools to increase the quality of their math education rather than their language education to attract more students. Another possible explanation is related to the amount of time required to train students in math skills and language skills. Many of the skills tested in standardized language tests are related to reading comprehension and vocabulary acquisition, which require more instruction time compared with some math skills and whose results take more time to be observed. A formal empirical test of this hypothesis constitutes an interesting and important avenue to explore in the future.

References

Contreras, D. (2001). Evaluating a Voucher System in Chile. Individual, Family and School Characteristics. *Facultad de Ciencias Económicas y Administrativas, Universidad de Chile,* Documento de trabajo *175*.

Elacqua, G. and R. Fabrega (2004). El Consumidor de la Educación: El Actor Olvidado de la Libre Elección de Escuelas en Chile. *PREAL, Universidad Adolfo Ibañez*.

Epple, D. and R. E. Romano (2002). Educational Vouchers and Cream Skimming. *NBER, Working Paper 9354*.

Friedman, M. (1955). The Role of Government in Education In: Robert A. Solo (Ed.), Economics and the Public Interest. New Brunswick, Rutgers University Press, NJ.

González, P., A. Mizala, and P. Romaguera (2002). Recursos Diferenciados a la Educación Subvencionada en Chile. *Serie Economía, Centro de Economía Aplicada Universidad de Chile, Working paper 150*.

Howell, W. G. and P. E. Peterson (2002). The Education Gap: Vouchers and Urban Schools (with Patrick J. Wolf and David E. Campell). Washington, DC: Brookings Institution Press.

Hoxby, C. M. (2003). School Choice and School Productivity. Could School Choice Be a Tide that Lifts All Boats? In: Hoxby, C. (Ed.), The Economics of School Choice. University of Chicago Press, Chicago, IL. the for NBER.

Hsieh, C.-T. and M. Urquiola (2003). When Schools Compete, How do they Compete? An Assessment of Chile's Nationwide School Voucher Program. *NBER, Working paper 10008*.

Hsieh, C.-T. and M. Urquiola (2006). The Effects of Generalized School Choice on Achievement and Stratification: Evidence from Chile's Voucher Program. *Journal of Public Economics 90*, 1477–1503.

Larranaga, O. (1995). Descentralización de la Educación en Chile: Una Evaluación Económica. *Estudios Públicos 60*, 243–281.

Neal, D. (2002). How Vouchers Could Change the Market for Education. *The Journal of Economic Perspectives 16*(4), 25–44.

Nechyba, T. J. (1999). School Finance Induced Migration Patterns: The Impact of Private School Vouchers. *Journal of Public Economic Theory 1*(1), 5–50.

Rau, T., C. Sánchez, and S. Urzúa (2012). The Effects of Vouchers on Academic Achievement: New Evidence from Chile. *Manuscript*.

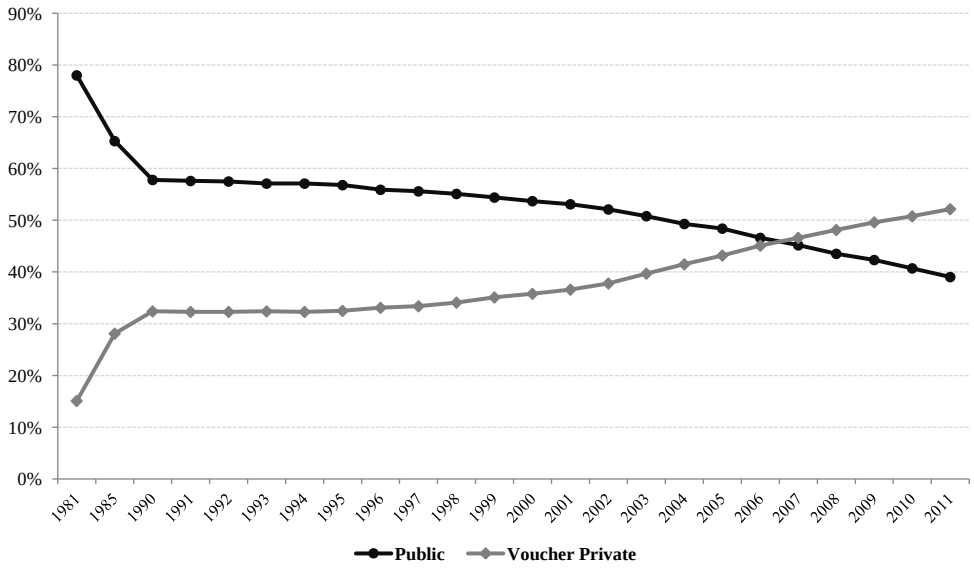
Sapelli, C. (2003). The Chilean Voucher System: Some New Results and Research Challenges. *Cuadernos de Economía 40*(121), 530–538.

Sapelli, C. and B. Vial (2002). The Performance of Private and Public Schools in the Chilean Voucher System. *Cuadernos de Economía 39*(118), 423–454.

Tokman, A. (2002). Is Private Education Better? Evidence from Chile. *Central Bank of Chile, Working Paper 147*.

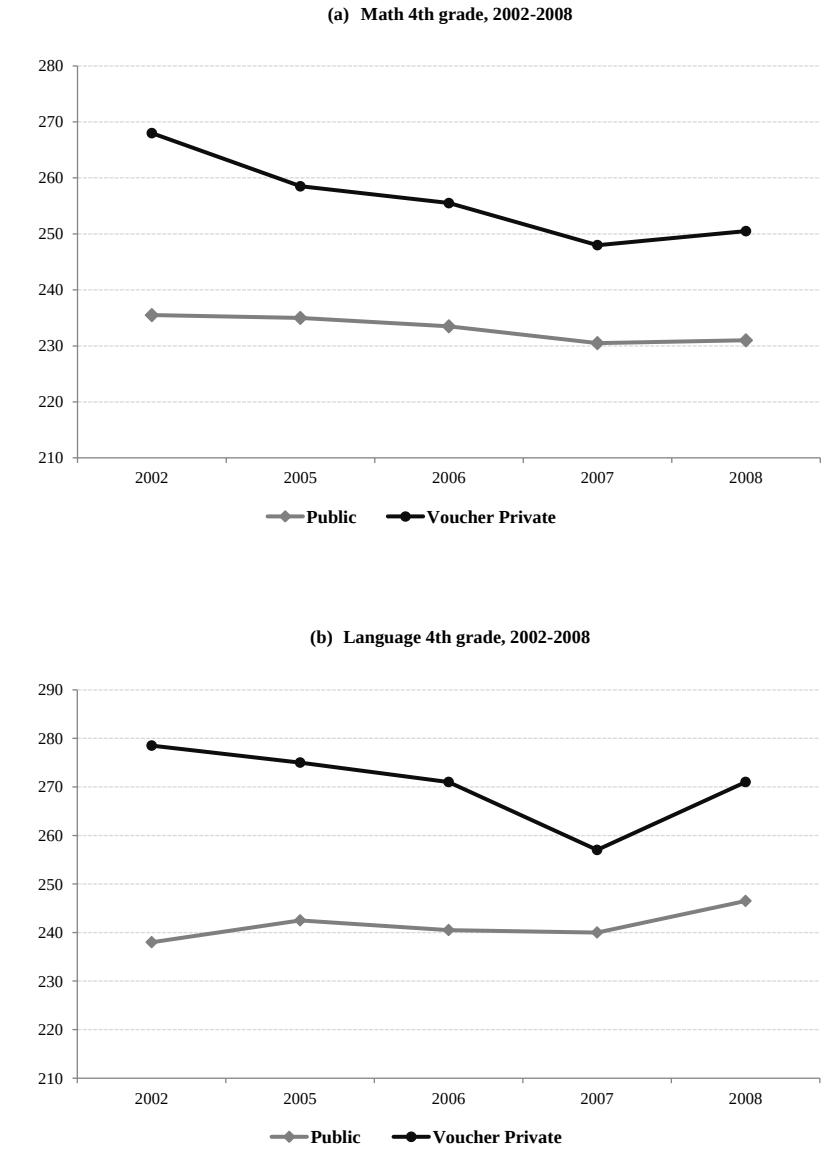
Vial, B. (1998). Financiamiento Compartido de la Educación. *Cuadernos de Economía 35*(106), 325–342.

Figure 1: Enrollment Share by Type of School



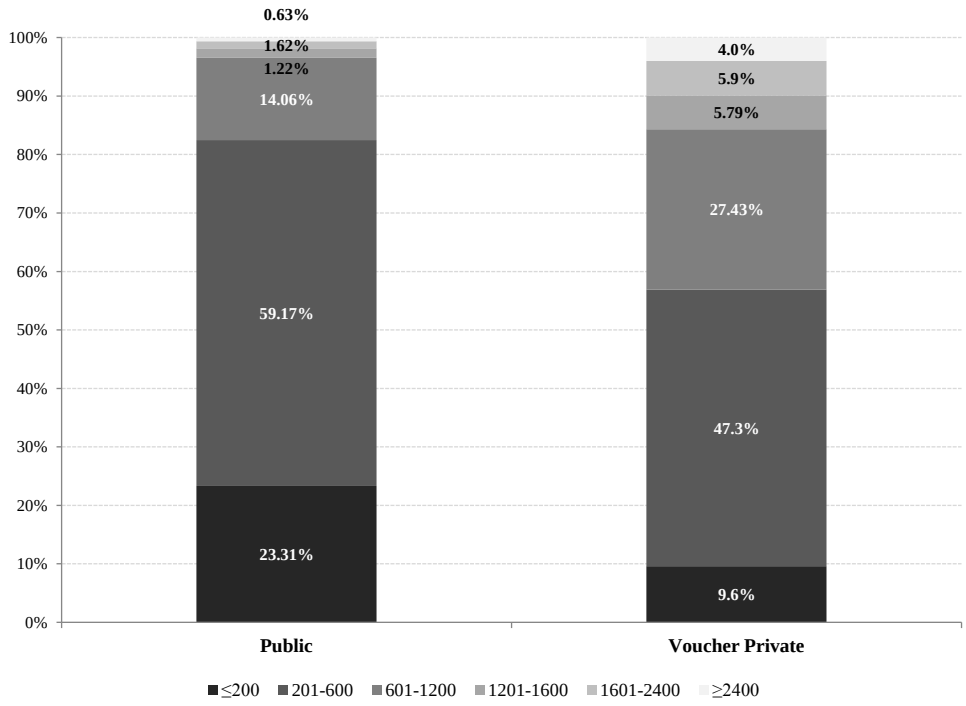
Source: Ministry of Education.

Figure 2: SIMCE Scores by Type of School



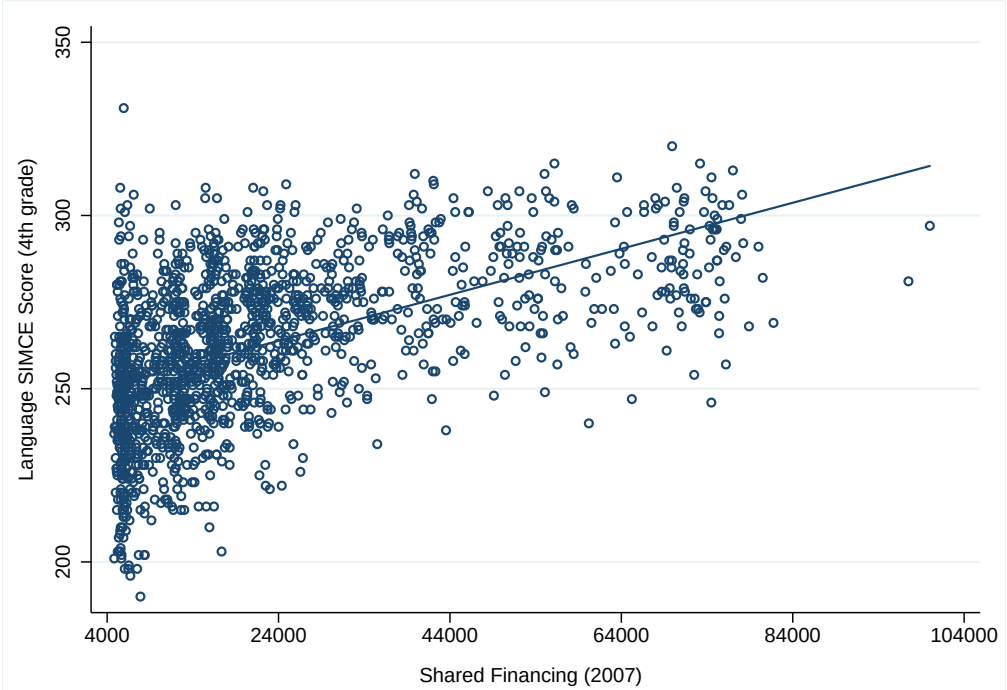
Source: SIMCE 2002-2008.

Figure 3: Family Income by School Dependence



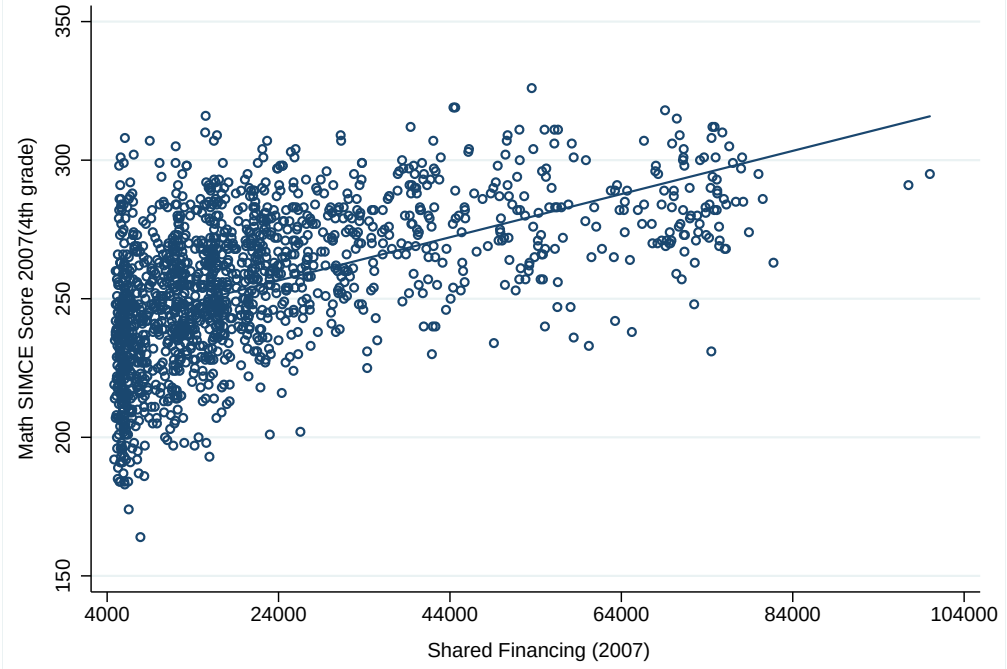
Source: SIMCE 2008. Notes: Gross family income is expressed in US dollars.

Figure 4: Shared Financing and SIMCE Scores (2007)



Source: SIMCE 2007, 4th grade.

(a) Language



Source: SIMCE 2007, 4th grade.

(b) Math

Figure 5: Supply of Quality in a SEP System and a Non-SEP System

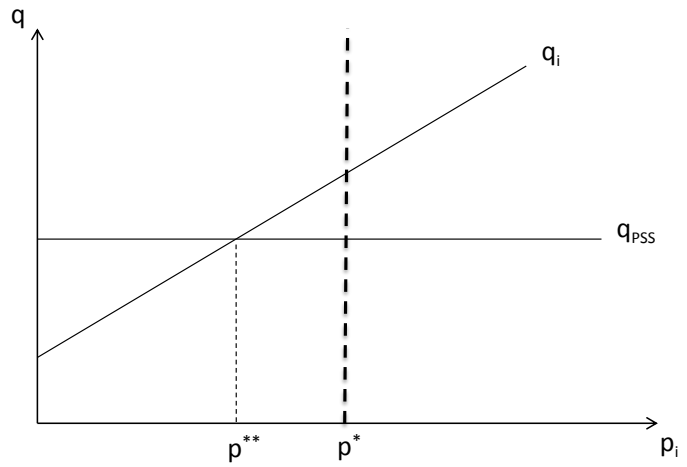
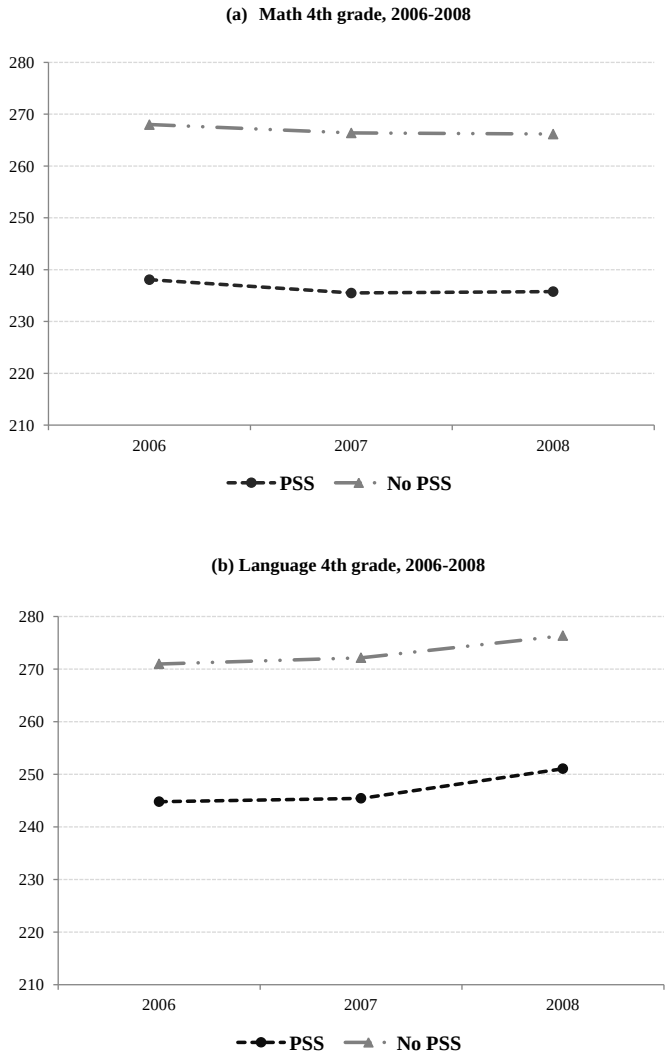


Figure 6: SIMCE Scores in the Treatment and Control Groups



Source: SIMCE 2006-2008.

Table 1: Monthly Subsidy per Priority Student (US$)

	Pre-Kindergarten to 4th Grade	5th and 6th Grades	7th to 12th Grades
Monthly per-student subsidy	86.6	57.6	29.1

Source: Ministry of Education (Chile). Notes: Values are for 2012 and are adjusted by purchasing power parity.

Table 2: Monthly Concentration Subsidy per Priority Student (US$)

Concentration of Priority Students	Pre-Kindergarten to 4th Grade	5th and 6th Grades	7th to 12th Grades
15%-30%	6	4	2
30%-45%	10.3	6.9	3.4
45%-60%	13.8	9.2	4.6
$\geq$60%	15.4	10.3	5.2

Source: Ministry of Education (Chile). Notes: Values are for 2012 and are adjusted by purchasing power parity.

Table 3: Flat Voucher and SEP for Pre-Kindergarten and Fourth Graders (US$)

Category	Subsidy
Flat voucher	143
SEP	86.6
Concentration subsidy	13.8
Total	243.4

Source: Ministry of Education (Chile). Notes: Values are for 2012 and are adjusted by purchasing power parity.

Table 4: Number of School Types

Year	Funding Type	With SEP	Without SEP
2009	Public	4,387 (89.17%)	533 (10.83%)
	Voucher private	1,766 (51.65%)	1,653 (48.35%)
2010	Public	4,366 (89.42%)	513 (10.58%)
	Voucher private	1,907 (56.30%)	1,480 (43.70%)
2011	Public	4,309 (90.54%)	450 (9.46%)
	Voucher private	2,064 (61.47%)	1,294 (38.53%)

Source: Ministry of Education.

Table 5: Summary Statistics: Public Schools

Year	Variable	With SEP	Without SEP
2006	Math SIMCE	233.11	203.33
	Language SIMCE	240.13	216.67
	Gross family income (US$)	373.53	408.12
	Mother's education	9.63	10.25
	Father's education	9.73	10.48
2007	Math SIMCE	229.55	226
	Language SIMCE	240.12	229
	Gross family income (US$)	397.25	445.31
	Mother's education	9.69	9.78
	Father's education	9.78	10.2
2008	Math SIMCE	229.96	215
	Language SIMCE	245.78	223.33
	Gross family income (US$)	409.99	456.89
	Mother's education	9.60	9.73
	Father's education	9.65	10.02
2009	Math SIMCE	234.59	218.33
	Language SIMCE	246.37	235
	Gross family income (US$)	396	513.69
	Mother's education	9.69	9.92
	Father's education	9.75	10.38
2010	Math SIMCE	235.83	214
	Language SIMCE	256.37	252.67
	Gross family income (US$)	451.96	378.11
	Mother's education	9.78	10.09
	Father's education	9.80	10.32
2011	Math SIMCE	244.76	239
	Language SIMCE	254.07	253
	Gross family income (US$)	468.55	495.47
	Mother's education	9.81	10.3
	Father's education	9.83	10.11

Source: SIMCE 2006-2011 and Ministry of Education (Chile).

Table 6: Summary Statistics: Voucher Private Schools

Year	Variable	With SEP	Without SEP
2006	Math SIMCE	246.64	268.27
	Language SIMCE	252.81	271.21
	Gross family income (US$)	503.72	926.68
	Mother's education	11.13	13.13
	Father's education	11.15	13.4
2007	Math SIMCE	245.76	266.56
	Language SIMCE	254.58	272.32
	Gross family income (US$)	535.58	968.39
	Mother's education	11.16	13.15
	Father's education	11.16	13.31
2008	Math SIMCE	245.82	266.39
	Language SIMCE	260.17	276.56
	Gross family income (US$)	545.47	1,002.87
	Mother's education	11.07	13.09
	Father's education	11.06	13.2
2009	Math SIMCE	251.09	270.31
	Language SIMCE	260.83	276.76
	Gross family income (US$)	522.93	980.79
	Mother's education	11.1	13.11
	Father's education	11.08	13.23
2010	Math SIMCE	251.07	267.98
	Language SIMCE	270.37	283.71
	Gross family income (US$)	600.26	1130.90
	Mother's education	11.2	13.21
	Father's education	11.15	13.29
2011	Math SIMCE	257.26	268.62
	Language SIMCE	266.29	276.78
	Gross family income (US$)	622.46	1173.91
	Mother's education	11.21	13.18
	Father's education	11.14	13.24

Source: SIMCE 2006-2011 and Ministry of Education (Chile).

Table 7: Effects of the SEP on School Academic Achievement (1): Public and Voucher Private Schools

Variable	SIMCE 4^{th}-Grade Math						SIMCE 4^{th}-Grade Language					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
λ_t	0.8632***	0.7382***	0.8274***	0.7632***	0.8464***	0.9429***	2.4463***	2.2876***	2.4144***	2.3084***	2.4320***	2.4389***
	(0.100)	(0.107)	(0.099)	(0.108)	(0.100)	(0.108)	(0.090)	(0.096)	(0.090)	(0.098)	(0.091)	(0.097)
w_{it}	4.7634***	4.9283***	4.4684***	3.1235***	2.7505***	2.6013***	2.8204***	3.0297***	2.5897***	1.1458**	0.7415*	0.7313
	(0.394)	(0.397)	(0.388)	(0.489)	(0.479)	(0.483)	(0.358)	(0.361)	(0.354)	(0.457)	(0.449)	(0.453)
Gross family		0.0100***		0.0091***		-0.0077***		0.0128***		0.0121***		-0.0005
income		(0.003)		(0.003)		(0.003)		(0.002)		(0.002)		(0.002)
Mother's years			3.2819***		3.2697***	3.3727***			2.7572***		2.7532***	2.7605***
of schooling			(0.300)		(0.301)	(0.303)			(0.269)		(0.272)	(0.275)
Father's years			2.0068***		1.9680***	2.1027***			1.4507***		1.3863***	1.3958***
of schooling			(0.257)		(0.261)	(0.268)			(0.239)		(0.243)	(0.247)
Completion of				0.0487***	0.0466***	0.0467***				0.0422***	0.0414***	0.0414***
EIP (%)				(0.007)	(0.007)	(0.007)				(0.006)	(0.006)	(0.006)
Constant	241.6349***	238.8951***	184.1378***	238.7856***	184.3773***	183.8976***	248.0087***	244.5302***	202.2803***	244.3855***	202.7510***	202.7170***
	(0.271)	(0.743)	(3.125)	(0.753)	(3.158)	(3.166)	(0.242)	(0.675)	(2.942)	(0.686)	(2.980)	(2.990)
Observations	18,203	18,203	18,203	17,651	17,651	17,651	18,203	18,203	18,203	17,651	17,651	17,651

Source: SIMCE 2006-2011 and Ministry of Education (Chile). Notes: (a) Gross family income corresponds to the average family income that students report at the moment of taking SIMCE. It is expressed in thousands of Chilean pesos (CLP) for each one of the years considered in the sample (1 US$ = 520 CLP). (b) As we describe in the text, we include the proportion of the Educational Improvement Plan (EIP) accomplished by schools in 2010 in math and language. In 2010, schools under the SEP were visited by Ministry of Education personnel to determine the percentage of accomplishment of the measures defined in their EIP. Standard errors in parentheses. *** p<0.01. ** p<0.05. * p<0.1.

Table 8: Cumulative Effects of the SEP on School Academic Achievement (2): Public and Voucher Private Schools

Variable	SIMCE 4^{th}-Grade Math						SIMCE 4^{th}-Grade Language					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
λ_t	-0.1639	-0.4129***	-0.1362	-0.4481***	-0.1790*	-0.1761	2.2270***	2.0051***	2.2470***	1.9363***	2.1713***	2.1495***
	(0.108)	(0.116)	(0.107)	(0.118)	(0.109)	(0.119)	(0.097)	(0.105)	(0.097)	(0.107)	(0.098)	(0.107)
$\lambda_t^{'} * w_{it}$	4.0698***	4.2698***	3.8264***	3.9233***	3.5040***	3.5014***	1.6065***	1.7848***	1.4076***	1.2850***	0.9203***	0.9397***
	(0.195)	(0.197)	(0.192)	(0.214)	(0.208)	(0.213)	(0.177)	(0.180)	(0.176)	(0.196)	(0.191)	(0.195)
Gross family		0.0166***		0.0158***		-0.0002		0.0148***		0.0142***		0.0014
income		(0.003)		(0.003)		(0.003)		(0.002)		(0.002)		(0.002)
Mother's years			3.1524***		3.1558***	3.1584***			2.7151***		2.7218***	2.7023***
of schooling			(0.297)		(0.300)	(0.302)			(0.269)		(0.272)	(0.275)
Father's years			1.8815***		1.8400***	1.8433***			1.4235***		1.3538***	1.3286***
of schooling			(0.256)		(0.259)	(0.266)			(0.239)		(0.242)	(0.247)
Completion of				0.0332***	0.0320***	0.0320***				0.0379***	0.0376***	0.0376***
EIP (%)				(0.006)	(0.006)	(0.006)				(0.005)	(0.005)	(0.005)
Constant	243.9290***	239.5116***	189.0671***	239.3818***	189.1991***	189.1844***	248.6247***	244.6871***	203.5352***	244.5749***	204.0082***	204.1188***
	(0.286)	(0.747)	(3.108)	(0.760)	(3.140)	(3.155)	(0.255)	(0.673)	(2.944)	(0.684)	(2.984)	(2.998)
Observations	18,203	18,203	18,203	17,651	17,651	17,651	18,203	18,203	18,203	17,651	17,651	17,651

Source: SIMCE 2006-2011 and Ministry of Education (Chile). Notes: (a) Gross family income corresponds to the average family income that students report at the moment of taking SIMCE. It is expressed in thousands of Chilean pesos (CLP) for each one of the years considered in the sample (1 US$ = 520 CLP). (b) As we describe in the text, we include the proportion of the Educational Improvement Plan (EIP) accomplished by schools in 2010 in math and language. In 2010, schools under the SEP were visited by Ministry of Education personnel to determine the percentage of accomplishment of the measures defined in their EIP. Standard errors in parentheses. *** p<0.01. ** p<0.05. * p<0.1.

Table 9: Effects of the SEP on School Academic Achievement (1): Voucher Private Schools

Variable	SIMCE 4th-Grade Math						SIMCE 4th-Grade Language					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
λ_t	0.5162***	0.3657***	0.4945***	0.4096***	0.5304***	0.5816***	2.0932***	1.9483***	2.0717***	1.9823***	2.0980***	2.1027***
	(0.115)	(0.124)	(0.114)	(0.126)	(0.115)	(0.128)	(0.103)	(0.112)	(0.103)	(0.114)	(0.104)	(0.115)
w_{it}	5.5154***	5.7414***	5.4242***	4.2095***	3.9893***	3.9062***	3.6935***	3.9112***	3.6261***	2.8009***	2.5601***	2.5529***
	(0.550)	(0.554)	(0.541)	(0.670)	(0.654)	(0.662)	(0.492)	(0.498)	(0.486)	(0.641)	(0.626)	(0.635)
Gross family		0.0099***		0.0088***		-0.0033		0.0095***		0.0087***		-0.0003
income		(0.003)		(0.003)		(0.003)		(0.003)		(0.003)		(0.003)
Mother's years			2.9579***		2.8152***	2.8816***			2.5048***		2.4612***	2.4672***
of schooling			(0.406)		(0.411)	(0.416)			(0.370)		(0.377)	(0.382)
Father's years			1.6374***		1.6506***	1.7405***			1.0854***		1.0122***	1.0204***
of schooling			(0.354)		(0.362)	(0.376)			(0.337)		(0.345)	(0.354)
Completion of				0.0567***	0.0539***	0.0539***				0.0303***	0.0294***	0.0294***
EIP (%)				(0.012)	(0.011)	(0.011)				(0.010)	(0.010)	(0.010)
Constant	254.5086***	251.0293***	199.2113***	251.1992***	200.4914***	199.7780***	259.3754***	256.0246***	216.1968***	256.1487***	217.3962***	217.3312***
	(0.342)	(1.035)	(4.913)	(1.058)	(4.987)	(5.074)	(0.306)	(0.931)	(4.615)	(0.957)	(4.715)	(4.780)
Observations	9,312	9,312	9,312	8,910	8,910	8,910	9,312	9,312	9,312	8,910	8,910	8,910

Source: SIMCE 2006-2011 and Ministry of Education (Chile). Notes: (a) Gross family income corresponds to the average family income that students report at the moment of taking SIMCE. It is expressed in thousands of Chilean pesos (CLP) for each one of the years considered in the sample (1 US$ = 520 CLP). (b) As we describe in the text, we include the proportion of the Educational Improvement Plan (EIP) accomplished by schools in 2010 in math and language. In 2010, schools under the SEP were visited by Ministry of Education personnel to determine the percentage of accomplishment of the measures defined in their EIP. Standard errors in parentheses. *** p<0.01. ** p<0.05. * p<0.1.

Table 10: Cumulative Effects of the SEP on School Academic Achievement (2): Voucher Private Schools

Variable	SIMCE 4^{th}-Grade Math						SIMCE 4^{th}-Grade Language					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
λ_t	0.2140*	0.0101	0.2223*	0.0132	0.2140*	0.219	2.0714***	1.9036***	2.0737***	1.8864***	2.0459***	2.0379***
	(0.120)	(0.131)	(0.119)	(0.132)	(0.120)	(0.135)	(0.108)	(0.119)	(0.107)	(0.120)	(0.108)	(0.121)
$\lambda_t^{'} * w_{it}$	3.1261***	3.2885***	3.0056***	2.8813***	2.6291***	2.6248***	1.5739***	1.7076***	1.4794***	1.3165***	1.0995***	1.1064***
	(0.257)	(0.261)	(0.255)	(0.288)	(0.281)	(0.288)	(0.231)	(0.236)	(0.230)	(0.263)	(0.257)	(0.264)
Gross family		0.0123***		0.0114***		-0.0003		0.0101***		0.0094***		0.0005
income		(0.003)		(0.003)		(0.003)		(0.003)		(0.003)		(0.003)
Mother's years			2.8610***		2.7381***	2.7441***			2.4563***		2.4255***	2.4157***
of schooling			(0.407)		(0.411)	(0.417)			(0.371)		(0.377)	(0.383)
Father's years			1.5770***		1.5988***	1.6069***			1.0677***		0.9980***	0.9850***
of schooling			(0.352)		(0.359)	(0.374)			(0.338)		(0.345)	(0.354)
Completion of				0.0516***	0.0501***	0.0501***				0.0355***	0.0355***	0.0355***
EIP (%)				(0.011)	(0.010)	(0.010)				(0.009)	(0.008)	(0.008)
Constant	255.3628***	251.0745***	201.8996***	251.1851***	202.8491***	202.7817***	259.6028***	256.0748***	217.1714***	256.1660***	218.2096***	218.3181***
	(0.352)	(1.038)	(4.906)	(1.062)	(4.974)	(5.068)	(0.315)	(0.932)	(4.625)	(0.956)	(4.721)	(4.793)
Observations	9,312	9,312	9,312	8,910	8,910	8,910	9,312	9,312	9,312	8,910	8,910	8,910

Source: SIMCE 2006-2011 and Ministry of Education (Chile). Notes: (a) Gross family income corresponds to the average family income that students report at the moment of taking SIMCE. It is expressed in thousands of Chilean pesos (CLP) for each one of the years considered in the sample (1 US$ = 520 CLP). (b) As we describe in the text, we include the proportion of the Educational Improvement Plan (EIP) accomplished by schools in 2010 in math and language. In 2010, schools under the SEP were visited by Ministry of Education personnel to determine the percentage of accomplishment of the measures defined in their EIP. Standard errors in parentheses. *** p<0.01. ** p<0.05. * p<0.1.

Table 11: Effects of the SEP on School Academic Achievement (3): Voucher Private Schools

Variable	SIMCE 4th-Grade Math						SIMCE 4th-Grade Language					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
λ_t	0.5162***	0.3622***	0.4956***	0.4073***	0.5311***	0.5736***	2.0932***	1.9448***	2.0728***	1.9802***	2.0988***	2.0943***
	(0.115)	(0.124)	(0.114)	(0.126)	(0.115)	(0.128)	(0.103)	(0.112)	(0.103)	(0.114)	(0.104)	(0.115)
w_{it}	9.3954***	9.6528***	8.7657***	8.0127***	7.1983***	7.1071***	7.4931***	7.7411***	7.0049***	6.7826***	6.0597***	6.0690***
	(0.918)	(0.921)	(0.905)	(1.041)	(1.023)	(1.034)	(0.786)	(0.793)	(0.782)	(0.936)	(0.921)	(0.934)
Shared	-0.2965***	-0.2985***	-0.2551***	-0.2808***	-0.2372***	-0.2355***	-0.2903***	-0.2922***	-0.2579***	-0.2894***	-0.2545***	-0.2546***
financing·w_{it}	(0.055)	(0.055)	(0.054)	(0.060)	(0.059)	(0.059)	(0.044)	(0.044)	(0.043)	(0.049)	(0.048)	(0.048)
Gross family		0.0101***		0.0089***		-0.0028		0.0097***		0.0088***		0.0003
income		(0.003)		(0.003)		(0.003)		(0.003)		(0.003)		(0.003)
Mother's years			2.8406***		2.7149***	2.7707***			2.3861***		2.3487***	2.3428***
of schooling			(0.404)		(0.409)	(0.414)			(0.368)		(0.375)	(0.381)
Father's years			1.5914***		1.6088***	1.6837***			1.0389***		0.9693***	0.9614***
of schooling			(0.353)		(0.361)	(0.375)			(0.336)		(0.343)	(0.352)
Completion of				0.0508***	0.0490***	0.0491***				0.0241**	0.0239**	0.0239**
EIP (%)				(0.012)	(0.011)	(0.011)				(0.010)	(0.010)	(0.010)
Constant	254.5086***	250.9477***	201.1757***	251.1456***	202.2034***	201.5992***	259.3754***	255.9447***	218.1831***	256.1014***	219.2678***	219.3318***
	(0.340)	(1.037)	(4.896)	(1.061)	(4.977)	(5.068)	(0.304)	(0.930)	(4.609)	(0.956)	(4.712)	(4.779)
Observations	9,312	9,312	9,312	8,910	8,910	8,910	9,312	9,312	9,312	8,910	8,910	8,910

Source: SIMCE 2006-2011 and Ministry of Education (Chile). Notes: (a) Gross family income corresponds to the average family income that students report at the moment of taking SIMCE. It is expressed in thousands of Chilean pesos (CLP) for each one of the years considered in the sample (1 US$ = 520 CLP). (b) As we describe in the text, we include the proportion of the Educational Improvement Plan (EIP) accomplished by schools in 2010 in math and language. In 2010, schools under the SEP were visited by Ministry of Education personnel to determine the percentage of accomplishment of the measures defined in their EIP. (c) Shared financing corresponds to the interaction between the payment made by parents (in thousands of Chilean pesos) and the treatment variable (w_{it}). Standard errors in parentheses. *** p<0.01. ** p<0.05. * p<0.1.

Table 12: Shared Financing Charged by SEP and Non-SEP Schools (US$)

School Category	Mean	SD
SEP Schools	26.2	41.1
Non-SEP Schools	66.2	17.1

Source: SIMCE 2007.