CEA

CENTRO DE ECONOMÍA APLICADA

INGENIERÍA INDUSTRIAL · UNIVERSIDAD DE CHILE

DOCUMENTOS DE TRABAJO
Serie Economía

Nº 220   USING SCHOOL SCHOLARSHIPS TO ESTIMATE THE EFFECT OF PRIVATE EDUCATION ON THE ACADEMIC ACHIEVEMENT OF LOW INCOME STUDENTS IN CHILE

PRIYANKA ANAND - ALEJANDRA MIZALA - ANDREA REPETTO

fcfm FACULTAD DE CIENCIAS FÍSICAS Y MATEMÁTICAS UNIVERSIDAD DE CHILE

Using School Scholarships to Estimate the Effect of Private Education on the Academic Achievement of Low Income Students in Chile

Priyanka Anand
Department of Economics, Yale University

Alejandra Mizala[1]
Center for Applied Economics, Department of Industrial Engineering, University of Chile

Andrea Repetto
Center for Applied Economics, Department of Industrial Engineering, University of Chile
School of Government, Universidad Adolfo Ibañez

March 2008

Forthcoming Economics of Education Review

Abstract

This paper estimates the impact of private education on the academic achievement of low-income students in Chile. To deal with selection bias, we use propensity score matching to compare the test scores of reduced-fee paying, low-income students in private voucher schools to those of similar students in public schools and free private voucher schools. Our results reveal that students in fee-charging private voucher schools score slightly higher than students in public schools. The difference in standardized test scores is approximately 10 points, a test score gain of 0.2 standard deviations. We find no difference in the academic achievement of students in the private voucher-fee charging treatment group relative to their counterparts in free private voucher schools.

---

[1] Corresponding author: Alejandra Mizala, Center for Applied Economics Department of Industrial Engineering, University of Chile, República 701, Casilla 86 D, Santiago, Chile. Fax: (56-2) 978-4011. E-mail address: amizala@dii.uchile.cl.
Author: Priyanka Anand, Department of Economics, Yale University, 28 Hillhouse Avenue, New Haven CT 06511.
Author: Andrea Repetto, Center for Applied Economics Department of Industrial Engineering, University of Chile, República 701, and School of Government, Universidad Adolfo Ibáñez, Santiago, Chile.

Using School Scholarships to Estimate the Effect of Private Education on the Academic Achievement of Low Income Students in Chile

I. Introduction

School choice is a topic of vigorous debate among academics and policy makers worldwide. The fundamental theory behind school choice is that private schools are more efficient than public schools; therefore, giving parents the option of sending their children to private schools creates a competitive market that improves the quality of both private and public schools. There have been many evaluations of experimental school choice programs, such as the Milwaukee Parental Choice Program (Rouse, 1998; Greene, Peterson and Du, 1998), the New York City school voucher experiment (Howell and Peterson, 2002; Krueger and Zhu, 2004), and the PACES program in Colombia (Angrist et. al, 2002).[2] The findings of these studies suggest that students who used vouchers to attend private schools perform better on standardized tests than students attending public schools who would have used vouchers had one been offered to them. The test score improvements tend to be small, and the effects depend on gender and race and are sensitive to important decisions about the sample used in the study.[3]

Of all of the school voucher experiments that have been conducted, Chile stands out because it is one of the few countries in the world that has had a universal voucher system intact for over

---

[2] The Colombian program PACES is a large scale program that awarded over 125,000 private-school vouchers to secondary school pupils from poor neighborhoods.
[3] A review of the literature on the impact of private school vouchers can be found in McEwan (2004).

twenty five years.[4] In contrast to voucher programs that are limited to a certain number of students who are selected to participate, Chile's school choice program gives all students the option of attending public schools or private schools that are subsidized by the government with a per-student voucher.

This paper uses the Chilean educational system to estimate the effect on academic achievement that results from moving a low-income student from one type of school to another. Since 1993, private voucher schools have been allowed to charge a fee on top of the voucher; however, schools that charge fees must allocate a percentage of the funds to scholarships to students based on their economic need.[5] This paper uses these scholarships to identify the effect on tests scores of moving children of low-income families from a public or a free private voucher school to a fee-charging private voucher school.

There are several important challenges that must be addressed when estimating the academic effects of private education (Goldhaber and Eide, 2003). The first is a missing counterfactual problem: it is impossible to simultaneously observe the outcome of a student that attends a private voucher school as well as the outcome of that same student attending public school. A second challenge addressed in this paper is selection bias. Although all students in Chile have the option of attending private voucher schools, those that choose to take advantage of the vouchers may have unobserved characteristics that are correlated with academic achievement. Furthermore, past

---

[4] The Netherlands and Sweden are other examples of countries with wide school choice programs, although the motivation for and the functioning of these educational systems are different from the Chilean case.
[5] Florida's McKay Scholarship Program also allows schools to charge fees on top of the voucher. The amount of the voucher is equal to the amount the student would have received in the public school to which the student is assigned or the amount of the private school's tuition and fees, whichever is less. See http://www.floridaschoolchoice.org/Information/McKay/.

research indicates that an additional bias may arise from the manner in which schools select the students (Gauri, 1998; McEwan, 2001; and Hsieh and Urquiola, 2006).

Lacking panel data or an experimental design, we have taken a two-step approach to deal with the econometric issues discussed above. The first, as already mentioned, is to use the provision of scholarships for low-income students to attend private voucher schools that charge fees as a method of controlling for the selection bias that occurs in private school education. That is, this paper uses scholarships to identify students for a treatment group.

The second step of our approach is to use propensity score matching as a non-parametric estimator of the impact of fee-charging private voucher school education on academic achievement. Matching allows us to infer the public school and free private voucher school outcomes for scholarship students in fee-charging private voucher schools, and then use this information to estimate the average treatment effect on the treated students. In other words, we use propensity score matching to directly compare the test scores of low-income students in fee-charging private voucher schools with those of similar students in public and free private voucher schools. Dehajia and Wahba (2001) show that this method yields accurate estimates of the treatment effect in non-experimental settings where corrections for sample selection bias due to observable differences between treatment and comparison groups are needed.

At the heart of our identification strategy is whether scholarships are awarded in a random fashion. According to information gathered in a number of interviews we conducted, in choosing low-income students to award scholarships, schools tend to give preference to the children of

families going through a period of economic difficulty and to the sons and daughters of school employees (such as the school administrators, janitors, etc.). Since these children might be different in several ways, we correct our propensity score – the probability of attending fee-charging private voucher schools – for the probability of a student getting a scholarship, which is a function of multiple student, family and school characteristics.

The main drawback of our identification strategy is the possibility that the children who receive the scholarships may be different from otherwise similar students in other schools in unobservable ways; i.e., our methodology overestimates the effect of fee-charging private voucher education whenever scholarships are granted on the basis of unobserved ability. With this caveat in mind, our results reveal that students in fee-charging private voucher schools score slightly higher than students in public schools, a result that is robust to various sample and data definitions. The difference in scores in the standardized tests is approximately 10 points, a test score gain of 0.2 standard deviations. A similar result was obtained by Angrist et al (2002) when comparing test scores of lottery winners and losers in the PACES program in Colombia. Moreover, in an analysis of ten Latin American countries, Somers, McEwan and Willms (2004) find an average private school effect of 0.3 standard deviations after controlling for individual characteristics such as socioeconomic status. They find that this average effect drops to 0.04 standard deviations after controlling for the mean socioeconomic status of peer groups. Our findings are nevertheless larger than the effect of Catholic schooling on educational achievement in the US and Chile, an estimated effect smaller than 0.1 standard deviations.[6]

---

[6] See Neal (1997) and McEwan (2001).

We also compare the performance of students in fee-charging private voucher schools to students in free private voucher schools. Although students in fee-charging private voucher schools appear in most cases to very slightly outperform students in free private voucher schools, the differences in test scores are not statistically significant.

Our results imply that private education, both free and fee-charging, has a small positive impact on the performance of low income students. In other words, our findings suggest that low income students who typically attend public schools can benefit from attending fee-charging and free voucher private schools. Our identification strategy, however, does not allow us to determine what causes the differences in test scores. Better peers, superior teachers, more involved parents, and a more effective management, can all explain this paper's findings. Alternatively, it is possible that public schools do not compete on an even playing field with private voucher schools in Chile due to public school regulations. In particular, public schools are not allowed to charge fees on top of the voucher. In addition, while public schools must admit all their applicants (as long as there are vacancies) and have serious constraints on expelling students, private subsidized schools are free to establish their own admission and expulsion policies. Only oversubscribed public schools are allowed to administer admission tests. Moreover, teachers' contracts in public schools are governed by a special legislation that involves a centralized collective-bargaining process, with wages based on uniform pay-scales, and face tough restrictions on teacher's dismissal. In contrast, teachers' contracts at private subsidized schools are regulated by the more

flexible general Labor Code. These institutional constraints might be at the heart of the observed differentials in student achievement.

The paper is organized as follows: Section II provides a general overview of the Chilean educational system and reviews the recent literature on school choice in Chile. Section III explains our identification strategy and its main limitations. Section IV describes the data sources used in this study. Section V discusses the methodology, and presents our main results and a number of robustness checks. Section VI provides the conclusion.

II. The Chilean Educational System[7]

In the early 1980s, sweeping reforms were made to Chile's educational system, in which the public sector school system was decentralized and school management was delegated to local government (municipal) authorities. A system of standardized tests for measuring educational attainment, known as the SIMCE (Educational Quality Measurement System), was established to evaluate the success of the reforms, inform parents about the quality of their schools, and provide a basis for future policy decisions. The reform also paved the way for the private sector to enter the market as a provider of education by introducing a voucher-type demand subsidy to finance municipal and private voucher schools. The voucher, which is paid directly to schools on a per-student basis, is intended to cover running costs and generate competition between schools to

---

[7] A large portion of this description of the Chilean educational system is from Mizala and Romaguera (2000).

7

attract and retain students, thus promoting more efficient and better quality education services.[8]

The monthly voucher for primary school students amounted to approximately \$51 in 2002.[9]

Since 1993, private voucher schools have been permitted to charge a fee on top of the voucher received from the state. The conditions under which a school may charge students fees are that 1) the amount of the voucher is reduced according to the fee charged and 2) the schools allocate a percentage of the fee charged, in addition to a percentage of the voucher money that is given by the state, to a scholarship fund for students. Two-thirds of the scholarships must be given to students based on their economic need, while the remaining third may be distributed at the discretion of the school.[10] Schools are allowed to define the criteria used to classify students according to economic need, but must use objective information and procedures, and must report parents and the government about their scholarship policies.[11]

Table 1 shows the amount of the voucher that schools are eligible to receive depending on the fee charged, the number of schools operating in Chile and the Metropolitan Region of Santiago that charge each fee amount, as well as the amount of money allocated for scholarships. As shown in the table, any school that charges over 4 USE (Unidad de Subvención Escolar)[12] per month in

---

[8] Although highly effective in terms of coverage, the education system has not delivered relatively high quality services. For instance, Chilean eighth-graders stood in the 40th place in a ranking of students from 46 countries in the 2003 TIMSS test (Trends in International Math and Science Study). See Martin et al. (2004).

[9] We use the 2002 SIMCE database on fourth-graders to perform our analysis. As a reference, the 2002 average monthly wage in Chile was about \$550 according to the CASEN Household Survey.

[10] In section V, we go into greater detail about the characteristics of the students who receive scholarships.

[11] If all students come from well-off families, the school must inform the government. The scholarship fund must still be distributed to the children of the less-well off families within the school, even if they are able to afford the fees.

[12] USE (Unit of Student Subsidy) is the monetary unit used for distributing the vouchers to schools. In 2002, the value of the USE was 11,747 pesos (approximately 21 dollars). This figure is re-adjusted every year to account for inflation. The voucher is equal to 2.41 USE.

fees (roughly 84 dollars) does not receive a subsidy from the government and is considered a private non-voucher school.

As a result of these reforms, the number of new schools in the private sector has increased rapidly over the past twenty years. In 1985, there were 2,643 private voucher schools in Chile; this number grew to 3,640 in 2002 and to 4,084 in 2003. The resulting four-legged school system comprises of:

1. Private non-voucher schools, which are financed by fees paid by parents and guardians. In 2002, approximately 8.5 percent of all students in Chile attended private non-voucher schools, and 12.7 percent of all students in the Metropolitan Region of Santiago.

2. Fee-charging private voucher schools, which are co-financed by the per-student voucher provided by the government and the monthly fees paid by the parents. These schools are run by the private sector and account for 25.3 percent of total enrollment in Chile and for 41.2 percent in Santiago.

3. Free private voucher schools, which are financed by the per-student voucher provided by the government, but are owned and run by the private sector. These account for 12.5 percent of total enrollment in Chile and for 6.4 percent in Santiago.

4. Public schools, which are also financed by the voucher but are owned and managed by municipal authorities. They represent 52.1 percent of the enrollment in Chile and 37.6 percent in Santiago.

The remaining of the school population attends schools run by educational corporations linked to business organizations or schools governed by Decree 3166, which administers professional-technical secondary schools belonging to the Ministry of Education with lump-sum financing granted in a concession contract.

Although the private voucher school sector has grown significantly, the distribution of this type of school throughout the country is uneven. In general, there are very few private schools in rural areas, and nearly 80 municipalities out of 344 have no private voucher schools at all. Of the total enrollment in rural areas, municipal schools account for 77.7 percent, private voucher schools 20.3 percent and private non-voucher schools 1.3 percent.

Despite the establishment of a non-discriminatory subsidy per enrolled student both at public and private voucher schools, different regulations shape the participation of these types of schools in the educational market. Other than the permission to charge fees on top of the voucher, the most important differences between public and private voucher schools relate to the students' admission process, and the teachers' job contracts and pay. While public schools must admit all their applicants (as long as there are vacancies) and have serious constraints on expelling students, private voucher schools are free to establish their own admission and expulsion policies. In fact, they intensively use selection mechanisms such as entrance exams and parental interviews to screen-out students. Only oversubscribed public schools are allowed to administer admission tests.

Another difference is that teachers' job contracts in public schools are regulated by a special legislation, the Teachers' Statute, which involves a centralized collective-bargaining process, with wages based on uniform pay-scales and special bonuses for training and experience. In contrast, private voucher schools operate as a business, and thus hire and fire teachers according to the more flexible Labor Code that regulates all other private-sector workers in the country. In addition, private voucher schools can select, hire and dismiss their teachers, while municipal authorities, which centrally hire and assign teachers to public schools, find it a lot more difficult to dismiss teachers due to the Teachers' Statute. Nonetheless, some legal changes since 1995 have brought more flexibility into the public school sector.

a. Literature Review

A number of papers have examined the Chilean educational system. Most of these have studied the relative effectiveness of private versus public schools, while others have investigated the effect of school competition on student academic outcomes. The literature on the effects of attending a Chilean private voucher school is non-experimental because Chile has a nationwide school choice system, where parents are free to choose whether to participate or not and private schools are free to be selective in their admissions.

In general, all of the studies conclude that the socioeconomic characteristics of families are statistically significant in order to explain student performance in the different types of school. Nonetheless, when the performance of public and private schools is compared, the studies arrive

at different conclusions, depending on the aggregation level of the data (i.e., student vs. school level data).

Until 1998, data on socio-economic characteristics was only available at the school level; as a result, all research conducted on the subject used the school as the unit of analysis. Using school-level data, McEwan and Carnoy (2000) concluded that, on average, non-religious private voucher schools produce lower academic achievement than public schools, while Catholic private voucher schools produce higher achievement outcomes by spending more money than their non-religious equivalents. Mizala and Romaguera (2000) argued that when sufficient control variables and the whole universe of schools are taken into account, there are no consistent differences in achievement between public and private voucher schools; Bravo, Contreras, and Sanhueza (1999) replicated Mizala and Romaguera's results using data on different grades. Moreover, Tokman (2002), also working with aggregate school level data, found that public schools are not consistently better or worse than private voucher schools, although public schools did show evidence of being more effective for students from disadvantaged family backgrounds.

Student level analysis became possible when the Ministry of Education began to administer a questionnaire to all parents of students who participated in the country's standardized Education Quality Measurement System (SIMCE) test. This individual data allowed controlling for students characteristics and for selection bias correction to be implemented. McEwan (2001), using student level data, found that there is no consistent difference between student achievement in public and non-religious private voucher schools, although fee-paying private schools and

Catholic private voucher schools have higher achievement levels than public schools. Moreover, Mizala and Romaguera (2001) and Sapelli and Vial (2002, 2005) found that students attending private voucher schools have higher educational outcomes than those from public schools.

Other papers have tried to identify the effect of inter-school competition on students' achievement in Chile with controversial results. Hsieh and Urquiola (2006) estimated regressions for municipality-level outcomes for the 1980s, and determined the effects of competition to be negligible. They found that private voucher schools "cream skim" high income students while relegating disadvantaged students to the public school sector. In contrast, Gallego (2002), using school-level standardized test results for the 1994-97 period, identified significant effects of inter-school competition, finding that the effects are greater for private voucher schools than for public schools. Subsequently, Gallego (2006), using student-level data, examined the effects of inter-school competition on student outcomes and concluded that greater competition significantly raises test scores while having no influence on educational spending.[13]

This study is innovative in a number of important respects. First of all, given the absence of panel data or an experimental design, it uses a novel identification strategy to address the selection bias that has posed a significant challenge to studies that estimate the effect of private education. Moreover, it uses propensity score matching to identify comparable treatment and control groups. As stated earlier, this method alleviates the bias due to systematic, observable differences

---

[13] There also exists a related literature that analyzes public and private school enrollment practices in response to vouchers (Elacqua, 2006). Other papers study whether private school networks have an academic advantage over public schools, once student characteristics, selectivity and peer attributes are controlled for (Contreras, Elacqua and Salazar, 2006).

between the treated and comparison groups (Dehejia and Wahba, 2001). Finally, this paper differentiates between fee-charging and free private voucher schools and compares their academic performance.

In the next section, we explain how the provision of school scholarships creates treatment and control groups that allow us to measure the effect of government subsidized private education on academic achievement in Chile. We also discuss the main limitations of our estimation strategy.

III. Identification Strategy

As stated previously, the goal of this paper is to estimate the average effect on academic achievement that results from moving a student from a public to a fee-charging private voucher school.[14] We consider fee-charging private voucher school education to be the treatment, and the evaluation parameter that we focus on is the average effect of the treatment on the treated. Since it is impossible to observe the same student in two different school types, we use a methodology that allows us to infer the academic achievement that would be produced if a fee-charging private voucher school student had instead attended a public school or a free private voucher school. We also attempt to account for selection bias, which results from the fact that students are free to choose what type of school they would like to attend and private voucher schools are free to be selective in their admissions.

---

[14] We also estimate the effect of moving a student from a free private voucher school to a fee-charging private voucher school.

Scholarships give students that would normally attend public schools or free private voucher schools the opportunity to attend fee-charging private voucher schools. If these scholarships are uncorrelated with the prior academic achievement of students, then they can be used to perform a quasi-experimental research design that compares the educational outcomes of scholarship and non-scholarship students.

In order to gain a better understanding of the scholarship system, we conducted interviews with school directors, social workers, and other important participants in the Chilean education system. The interviews were conducted from October 2004 through January 2005 and included visits to 11 private voucher schools and to CONACEP, Corporación Nacional de Colegios Particulares, an association of private voucher schools that represents over 800 schools attending more than 600 thousand students.[15] The interviews revealed that the two primary reasons for which schools award scholarships to students are either that their family is going through a period of financial difficulty or that they are the son or daughter of a school employee.[16] Particularly the latter category of students is of interest because 1) children of school employees (such as the administrators, janitors, etc.) should display characteristics typical of students in public schools; 2) it is likely that had these children not been given scholarships, their families would have sent them to a public or free private voucher school and 3) they are usually given a preference during

---

[15] We also visited 9 private-non voucher schools which are not required to allocate resources to scholarships. Those that grant scholarships tend to use similar criteria as fee-charging private voucher schools.

[16] The interviews also revealed that schools that award scholarships based on financial need tend to give these scholarships to students who are in the ninth grade or higher. The primary reason for this preference is that older students will be graduating in a few years and will not need the financial assistance for a long period of time. Moreover, students who have spent more years at the school are better known by the school administrators. Since our database is limited to fourth graders, students with these types of scholarships are probably less frequently observed in our sample; however, our logit results discussed in section V below show that the number of years the student has attended a school is a statistically significant determinant of a scholarship. See below for further discussion.

the student selection process or in many cases, are automatically admitted into the school. This preference may eliminate the selection bias observed by Gauri (1998), McEwan (2001) and Hsieh and Urquiola (2006), who all suggested that private schools admit students with unobserved characteristics that are correlated with high academic achievement. Unfortunately, the sons and daughters of school employees can not be directly identified in our database.

A number of caveats have the potential to limit the validity of scholarships in our identification strategy, as the children of school employees – and all other scholarship students –may be different in unobservable ways. First, it is possible that the most motivated parents look for jobs at schools that award scholarships to offer their children the education that fee-charging private voucher schools provide. High unemployment rates in Chile over the past few years may have reduced the ability of parents to choose the job they like, as it limited the bargaining power the typical school worker had. For instance, according to the University of Chile Employment Survey (2003), the aggregate unemployment rate in Santiago reached 12.7 percent in years 2000-2001 and the unemployment rate of workers in service sectors was 10.8 percent. Still, it is possible that parents take into account the reduced fee as a non-wage benefit when they search for a job.

An additional concern refers to whether parental motivation is affected by the scholarship. For instance, the possibility of losing the scholarship gives parents an incentive to focus more on school. Similarly, school employees might care more about their children's performance due to reputation concerns. In our estimation procedure below, we add parental input variables (such as

the frequency that parents study and read with their children) in our logit model for the probability of attending each school type as an effort to account for this potential problem.

Additionally, administrators and teachers may engage in activities that increase the test scores of the children of school employees. However, the test is administered by public officials and graded by external institutions. Moreover, schools and parents only observe average test scores, as the information on each child's performance is not publicly available. There could be incentives to inflate the school's test scores, as observed in Jacob and Levitt (2003), but there is no reason to believe that scholarship students are systematically favored by cheating practices.

As stated in footnote 16, our logit results discussed in section V show that the number of years the student has attended a school is a statistically significant determinant of a scholarship. This result might suggest that schools may use the scholarships to retain good employees from switching jobs. A subsequent concern is the possibility that the characteristics of these employees may be correlated with the educational outcomes of their children. Similarly, the finding might suggest that schools award scholarships to students with low turnover, which in some cases may perform better than their peers who move more often (Hanushek et al, 2004).

The scholarship students may also include students that are suffering short-term financial problems, such as an illness in the family or temporary unemployment. This is a concern for schools that have a requirement regarding the minimum number of years that the student must attend the school before they are permitted to apply for a scholarship. Ideally, these students

would not be included in the treatment group since we are interested in students whose decision to attend the school was largely influenced by the scholarships, but unfortunately, it is impossible to distinguish the longevity of the financial problems. To partially account for this problem, in our matching procedure we control for the level of education of the parents by only including students whose parents have less than a university degree in both the treatment and control groups. Parents with low income and high education are most likely to suffer a transitory income drop. Thus, this exclusion removes a number of observations that may not represent valid treatment cases.

The exclusion of students with parents with high levels of education also solves a second concern: it allows us to eliminate scholarship students whose parents are teachers at the school. There are several reasons why these students should not remain in the treatment group. First of all, while it is unlikely that a teacher's salary is high enough to pay private non voucher school fees[17], teachers are well educated and have often exceptionally invested in the education of their children. These characteristics of the children of teachers distinguish them from most children who attend public schools and make them unsuitable to be considered in the treatment group.

With these caveats in mind, this paper uses the provision of scholarships for low-income students to attend fee-charging private voucher schools to identify the effect of private voucher education on student outcomes. This strategy is valid as long as scholarships are distributed independently of academic ability and also influence the decision to attend a fee-charging private voucher

---

[17] Most of these schools charge a fee over 260 dollars per month.

school. This phenomenon creates a treatment group because most of these students would have been likely to attend a public or a free private voucher school had they not been allowed to pay a reduced fee. In the following section, we will describe the data used in this study followed by an empirical analysis of school scholarships.

IV. Data

The empirical data used in this study come primarily from two sources. The first source is a standardized test called the SIMCE, which is administered annually throughout Chile to a specified grade level that rotates every year between the fourth, eighth, and tenth grades.[18] This paper uses the 2002 SIMCE data, which was administered to fourth graders. The young age of the students in the database implies that schools have less evidence of the student's academic abilities to consider when awarding scholarships, relative to older students who have much longer academic records that schools may use as criteria for receiving a scholarship.[19]

The second data source is the questionnaire that is answered by the parents of students that participated in the SIMCE in 2002. This questionnaire provides information on the socio-economic characteristics of each student, such as their family income and the education of the

---

[18] This rotation implies that the SIMCE tests do not track students over time.

[19] The use of information on fourth graders does not guarantee that scholarship awards are not based on merit. Schools may be able to predict the students' long term performance observing their early achievement. They may also gather information by meeting the parents. Still, ability based selection is easier among students in higher grades.

parents. Although it is not mandatory for parents to complete the questionnaire, there is an extremely high response rate for most of the key variables used in this analysis.[20]

In addition to these two primary database, we also used data from the Ministry of Education and the Under-secretary of Regional Development to calculate the per pupil resources that were available to each school, a principal survey from 1999 to determine the religious affiliation of schools, a list of the schools that were registered in 2000 by the Ministry of Education to determine which schools were new in 2002, and the 2000 SIMCE data to build a ranking of schools.

Once these data sources were combined into a comprehensive database, several modifications were made to target the population that we are interested in studying. First of all, the average age for a student in fourth grade is 10 years old; consequently, all students that reported being younger than 6 years old or older than 14 years old were removed from the database.[21]

Secondly, we only analyze students that reside in the Metropolitan Region of Santiago because this is the region in Chile where students have the greatest opportunity to attend private voucher schools. Particularly in rural areas or other urban areas, students have limited school choice as a result of geographic and other constraints. For instance, in 2002, 52.1 percent of Chilean students

---

[20] For students in the Metropolitan Region of Santiago that have SIMCE scores available, the response rate for the key student-level variables used in this analysis ranges from 81 percent to 93 percent. To perform our analysis, we only used the observations that had complete information; no data was imputed for missing observations.
[21] These exclusions involved 145 students older than 14 and 29 students younger than 6. We believe these observations may represent typographical errors. Still, we performed the analysis including these students to find that our results are robust to this sample decision. The results are available upon request.

attended public schools, whereas only 37.6 percent did so in the Metropolitan Region of Santiago, where almost 40 percent of the population resides. In the southern Region of Bío-Bío, the second largest in terms of population, 64.5 percent of students were enrolled in public schools.

Third, as mentioned earlier, we included students whose parents have a university degree in the first stages of our analysis, but excluded them in the final propensity score matching stage, in order to eliminate scholarship students whose parents are teachers at the school and those who received the scholarship because of a transitory income drop. [22]

Finally, we chose to exclude students in private non-voucher schools from the analysis because these schools typically only serve the most elite families in Chile. Private non-voucher schools are not a realistic educational option for the average student in Chile because the typical fee charged at private non-voucher schools is over five times the per-student voucher paid by the state and much higher than the cost of attending a fee-charging private voucher school.[23]

Modifications were also made to some of the variables in the database in order to make them compatible with our analyses. For example, on the parental questionnaire, parents reported the highest level of education that they had attended. These levels were converted into the

---

[22] Our results are robust to excluding these observations from the first stage. See the robustness checks below.
[23] We conducted two different analyses including students in private non-voucher schools to see how including them would alter the results. First, we included them only in the first stage (the multinomial logit estimation). The results are provided below. In a second exercise, we generated an alternative treatment group that included all students in private non-voucher schools with scholarships. The results for private voucher schools did not change dramatically from those presented here. The results for private non-voucher schools were highly imprecise because only 16 students with complete scores and background variables information had a scholarship in private non-voucher schools.

corresponding number of years they had been in formal education: the maximum time a parent could spend in basic education is 8 years, high school is 12 years, professional or technical institute is 16 years, college is 17 years, a masters degree is 19 years, and a doctoral degree is 22 years. Parents also reported their monthly income and the amount of fee they pay for the school as a range (for example, a parent could report that their income is between 400,000 to 500,000 pesos and they pay between 5,000 to 10,000 pesos each month in fees). These ranges were replaced with the midpoint of the range, which means in the prior example the parent would have an income of 450,000 pesos and pay 7,500 pesos per month in fees. Furthermore, the income was divided by 100,000 to simplify the interpretation of results. The monthly fee charged by the school was calculated as the mode of the fee reported by parents of students that attend the school. Some fees were confirmed through telephone calls to a selection of private voucher schools. The number of years that the child had been in the school was calculated from a variable in which the parents indicated the grade level that the student first attended the school. This calculation may be an underestimation if the student has repeated a grade; however, this should not be a problem since this variable is only used to test the hypothesis that students that have attended the school longer are more likely to receive school scholarships.

Appendix Table 1 provides a complete list of variables used in this paper, along with their definition and data source; Table 2 summarizes the basic statistics for these variables, and Table 3 presents some basic statistics by school type in order to characterize the students attending different types of schools in the Metropolitan Region of Santiago in our database. On average, students in fee-charging private voucher schools pay over 13 thousand pesos per month (about 24

dollars), roughly 6 percent of their mean family income. Fee-charges vary widely, from 0 to 110 thousand pesos per month (0 to 196 dollars).

Table 3 shows that, without controlling for student- or school-level characteristics, students in the treatment group tend to score better than the students in the free private voucher and public schools, but worse than students in the fee-charging private voucher schools. The parents of the treatment students have similar education levels than those at the free private voucher and public schools. Finally, the families of scholarship students earn less income on average than the families of the rest of the students.

V. Empirical Strategy and Results

We estimate the effect of fee-charging private voucher education on student performance in a three step strategy. First, we estimate a model for the probability of receiving a scholarship. Then, we estimate a school choice model that controls for the likelihood of being awarded a fee reduction. Finally, we match propensity scores to compare the outcomes of students in the treatment and control groups.

a. Who receives a scholarship?

According to the law, schools must use objective information and procedures when awarding scholarships. In practice, scholarships are awarded on the basis of a number of family and student characteristics. According to the results of school interviews, schools tend to offer fee reductions to the children of employees and students who suffer from financial difficulties. For the main analysis, a school scholarship is defined as a 50 percent or more reduction in the fee. Robustness

checks are conducted later that define scholarships as a 75 percent or more reduction in the fee, and a reduction that is equal to or greater than 5 percent of the family's monthly income.

We first conduct a maximum-likelihood model to identify the characteristics of students that are likely to receive a scholarship to a fee-charging private voucher school. The results in Table 4 reveal that, as would be expected, students likely to receive scholarships have lower family income. The estimated effect of income is non linear. In addition, students who are older than their peers, have attended the school for a greater number of years, have siblings who attend school, whose parents have slightly lower educational expectations, or have not attended preschool also tend to be awarded scholarships more often. Parental education variables do not seem to matter. Finally, students who attend religious schools are more likely to receive a scholarship than those who attend non-religious schools. These regression results are consistent with the information gathered in the school interviews we performed: students from lower income families and those that have been in the school for longer periods of time are more likely to have a scholarship.

Our model for the probability of a scholarship can only account for observable characteristics of the students and their families, and of the schools. Nevertheless, at the heart of our estimation strategy is whether scholarships are awarded in a manner that is not related to student achievement through unobserved variables. Unfortunately, we do not have panel data to control for unobservable characteristics nor information on the students' prior academic records to test this hypothesis. Instead, as a simple correlation test, we re-estimated our logit models including

the student's SIMCE scores as an explanatory variable. Two separate logits were estimated: one for fee-charging private voucher schools and another for fee-charging private voucher schools that were ranked in the top 10 percent of schools in Santiago in 2000. This second logit was conducted based on the observation that there is more demand for higher ranked schools and therefore scholarships may be more selectively distributed to students.

However, it should be kept in mind that a number of biases may come from using the SIMCE scores from the same year that the scholarship was awarded in determining whether achievement is a significant predictor of being awarded a scholarship. Thus the results reported below should be interpreted with care. For instance, if scholarships actually improve the academic achievement of students that lag behind, we may find no statistically significant relationship between SIMCE scores and the likelihood of having a scholarship. Similarly, the regressions may uncover a negative correlation with tests scores if scholarships are awarded based on need and not on merit.

Table 5 shows the results adding math, language and science (which includes the natural and social sciences) SIMCE scores to the logits.[24] We find that there is no statistically significant correlation between language or science SIMCE scores and the probability of obtaining a scholarship in all schools or in schools that rank in the top 10 percent of all private voucher schools in Santiago. However, the analyses using math SIMCE scores do show a significant, positive relationship between test scores and the probability of receiving a scholarship when the data on all schools is used, although this relationship is not significant in the top 10 percent of

---

[24] The coefficients on the other control variables are practically unaffected when we add the test scores to the regression. These results are available upon request.

private voucher schools in Santiago. This correlation is consistent with a positive effect of scholarships on students' outcomes, but is also consistent with scholarships being awarded to the best students. Moreover, these results are unusual because one would expect the top 10 percent of private voucher schools to be more selective with their scholarships than all the private schools together. Given that this correlation may invalidate the use of scholarships to identify treatment and control groups, in what follows we focus the analysis on language and science SIMCE scores.

b. School choice

Having predicted the likelihood that any given student will receive a scholarship, we next estimate a multinomial logit model for school choice to calculate a propensity score for each student. Each student has three choices for school type: public school, free private voucher school and fee-charging private voucher school.[25] The model includes a number of school- and student-level characteristics as controls, as well as the predicted probability of a scholarship in order to control for the characteristics that make students likely to have a scholarship. We did not include the same variables in the multinomial logit as we did in the logit for the probability of a scholarship. Additional variables used in the multinomial logit are the total number of schools and private schools in the student's neighborhood of residence, a second degree polynomial in the average education of mothers in the school to account for peer effects, the reasons the parents listed for choosing the school, and the frequency that the parents read or study with their child. We use school level peer effects rather than classroom level because parents can anticipate school

_____

[25] In the robustness section, we add the possibility of choosing a private non-voucher school.

and not classroom level characteristics when choosing school type.[26] In addition, the last two variables are included to control for the motivation and involvement of the parents in the education of their children. Variables that affect the probability of a scholarship but do not influence the school choice decision are not included in the multinomial logit.[27]

The results of this model, displayed in Table 6, show some interesting characteristics of students in each school type. The negative coefficient for the probability of a scholarship to a private voucher school for both types of private voucher schools indicates that students that have a high probability of a scholarship have characteristics that are more typical of public school students, as already suggested by the statistics presented in Table 3. Having controlled for the probability of a scholarship to a fee-charging private voucher school, we find that students with a high income are less likely to attend private voucher schools than public schools, whereas those who pick their school due to socio-cultural reasons, teacher quality, or values are more likely to go to private voucher schools. Also, students are more likely to attend private voucher schools whenever there are more private schools in their neighborhood. Students are also more likely to attend private voucher schools that are religious and where the mothers of the students in the school have more years of education, which may reflect a desire for anticipated peer effects on their children.

---

[26] There is evidence that little tracking is used in the Chilean educational system in order to assign students to different classrooms. According to Mullis et al (2000), only 15 percent of Chilean 8th graders attended schools that taught different mathematics material across classrooms, whereas 37 percent did so in the US. Our results are robust to using classroom level peer effects. Results are available upon request.

[27] The excluded variables are whether the student has siblings that also attend school, the standard deviation of income within the school, the student's distance from the school's average income, the school's rank in 2000, whether the school is new, the number of years the student has been at the school, and the total number of schools and the number of private schools in the school's neighborhood.

c. Propensity score matching and the average treatment on the treated

The coefficients that are produced in the multinomial logit model are used to calculate a propensity score for each student, which reflects each student's probability of attending fee-charging private voucher schools, conditional on the likelihood of being awarded a scholarship. We then use propensity score matching to estimate the average treatment on the treated (ATT).

Propensity score matching is a technique used for non-experimental data to identify a control group that exhibits the same distribution of covariates as the treatment group. In this paper, we use this method to identify a group of students in public schools and free private voucher schools that display the same observable characteristics as the students that have scholarships to attend fee-charging private voucher schools. Propensity score matching is often used by statisticians and is becoming increasingly popular among economists as a method to measure the impact of training programs. The most common application of propensity score matching is to estimate the impact of job training programs (Heckman et al., 1997; Dehejia and Wahba, 2001).

The treatment group used in the benchmark case is students in fee-charging private voucher schools who receive scholarships that are between 50 and 100 percent of the fee. As discussed earlier, we also control for the level of education of the parents by only including students whose parents have less than a university education in both the treatment and control groups.

As outlined by Dehajia and Wahba (2001), there are three main issues to be considered when implementing matching: 1) whether or not to match with replacement, 2) how many comparison

units to match to each treated unit, and 3) which matching method to use.[28] In this study, we implement a range of estimators (one-to-one with replacement, 5-nearest neighbor with replacement, kernel, and local linear regression) in order to gauge the effect of using a particular matching estimator on the outcome:. All four matching estimators were conducted using common support. After the matches are made, we use a difference in means test to estimate whether there exists a statistically significant difference in the academic achievement of the control groups compared to their match in the treatment group.

The results of the four matching estimators can be found in Table 7, along with the average propensity score. All estimators reveal statistically significant differences in the language and science SIMCE scores of students in public schools compared to scholarship students in fee-charging private voucher schools. The scores of scholarship students in fee-charging private voucher schools are higher than those of students in public schools, with the estimated differences ranging from 8.96 to 11.52 points. These estimated differences are not large considering the average score on the language and science SIMCE is 249 points with a standard deviation of 53 points (Table 3). The estimated effect of 17 percent to 22 percent of one standard deviation is similar to the order of magnitude as the estimated effect of vouchers in Colombia (Angrist et al., 2002).

The performance gap between scholarship students in fee-charging private voucher schools compared to students in free private voucher schools is positive and small, but not significant.

---

[28] Todd (1999), Leuven and Sianesi (2003), Dehejia and Wahba (2001) and Abadie et al. (2004) describe in further detail the different types of matching estimators that can be used.

One should also note that using a common support changes the composition of the treatment group for the two control groups by eliminating students who were outside of the designated range.

In summary, we have found that students that are moved from public schools to fee-charging private voucher schools through a scholarship score better in language and science standardized tests. The outcome differences are statistically significant, ranging from 17 percent to 22 percent of one standard deviation. The difference between private schools with and without fees is not statistically significant.

These results suggest that low income students who typically attend public schools can benefit from attending fee-charging and free private voucher schools. There are a number of potential sources for the differential outcomes. A more effective and more flexible management, better peers, superior teachers, and more involved parents can all explain these findings. It is interesting to note, though, that the similarity of results among children in private voucher schools with and without fees suggests that differences in the availability resources do not account for the superior performance of students in fee-charging private voucher schools.

An alternative explanation for these findings is that scholarship students have unobservable characteristics that allow them to perform better in standardized tests. Unfortunately, given the available data, we cannot rule out this possibility, as the controls we use may not fully capture unobserved student ability.

d. Robustness checks

We next conduct a series of robustness checks to see the effect that changing our assumptions and models has on the results. The first robustness check is to match the scholarship students to non-scholarship students in fee-charging private voucher schools (both with limited parental education) in order to check differences in their test scores. That is, we create a new control group composed of students attending fee-charging private voucher schools that did not report having a scholarship.

Table 8 shows the results from this test. The differences in the language and science SIMCE scores of the treatment and control groups are not statistically significant, which indicates that scholarship and non-scholarship students are not performing differently.[29] This finding suggests support for the assumption that schools do not award scholarships based on academic achievement. However, it may also suggest that scholarships do improve test scores, allowing scholarship students to catch up with classmates that perform better.

The second robustness check repeats the analysis conducted in the main study, but limits the parental education of the students included in the analysis from the first stage, instead of in the last stage. In other words, only students whose parents' highest level of education is high school are included in the logit for the probability of receiving a scholarship, the multinomial logit for the probability of attending each school type, and the propensity score matching. The results of

---

[29] The same results were found when this test compared the percentile rankings of the students as the outcome measure. These results are available from the authors upon request.

this analysis can be found in Table 9.[30] The results from the propensity score matching when conducting this robustness check confirms the results of the main analysis of the study: students in fee-charging private voucher schools tend to outperform their counterparts in public schools by approximately 8 to 15 points in the language and science SIMCE. Again, the differences were not significant for students in free private voucher schools.

The third and fourth robustness checks conduct the original analysis that included all students, but use an alternate definition of a scholarship. In one test, a scholarship was defined as a reduction in the school fee that is equivalent to five percent or more of the student's family income. In the other test, the scholarship amounts to a 75 percent or more reduction in the school's fee.

The results from the propensity score matching of the third and fourth robustness checks can be found in Tables 10 and 11 respectively.[31] These are similar to the results found when using the original definition of a scholarship. The language and science SIMCE scores of students in public schools are lower than those of their counterparts in fee-charging private voucher schools typically by 7.6 to 12.9 points. The difference in SIMCE scores for students in fee-charging private voucher schools compared to students in free private voucher schools is not significant using any of the matching estimators or any of the scholarship definitions.

---

[30] For the sake of brevity, we only show the average treatment on the treated results. The logit and multinomial logit results do not change from the main analysis. Detailed results are available upon request.

[31] Again, logit and multinomial logit results are not reported but are very similar to the benchmark case. Detailed results are available upon request.

Our final robustness check consists of including students attending private non-voucher schools in the first stages of the analysis (i.e., in the probability of being awarded a scholarship and the choice of school type which now also includes the option of attending a private non-voucher school). Once again, our results are robust, finding that students in the treatment group score about 10 points more in the SIMCE tests than students in the public school control group. Similarly, we find no statistical difference between scholarship students and free private-voucher schools' students. This result is consistent with the hypothesis that private non-voucher schools belong to a separate market that serves the children of the highest income families in Chile. In practice, and because of high fees, private non voucher schools do not represent a realistic educational option for most students in Chile.

VI. Conclusions

This paper uses scholarships to identify the effect on tests scores that results from moving children of low-income families from a public or a free private voucher school to a fee-charging private voucher school. This identification strategy is limited as it can only account for observable characteristics of students, their families and the schools they attend. Unfortunately, we cannot completely rule out the possibility that the controls we use may not capture unobserved student characteristics that might be correlated with both fee reductions and test scores. For example, the results of the paper may overestimate the effect of private voucher education if the most motivated parents look for jobs at schools that grant scholarships, scholarships affect parental motivation, or fee reduction offers alter student school turnover and parental job turnover. Ideally, experimental or panel data will become available in the future, allowing future researchers to control for unobserved student characteristics.

With these caveats in mind, the results of our paper have shown that low income students who attend fee-charging private voucher schools attain higher test scores than similar students that attend public schools. All the robustness checks we performed show that their scores are higher by approximately 10 points, which is equal to 0.2 standard deviations. These findings are consistent with other studies that also found test score gains due to vouchers of about 0.2 standard deviations (Angrist et al, 2002). The performance of low income students in fee-charging private voucher schools compared to similar students in free private voucher schools is not statistically significant.

These results imply that low income students who typically attend public schools can benefit from attending fee-charging and free private voucher schools. The difference in test scores between private voucher schools and public schools could potentially be attributed to a variety of reasons. The first may be that private voucher schools provide a better quality of education than public school, perhaps because they run the schools under better and more flexible management, since they do not face the same regulations public schools have, or because market competition has forced fee-charging private voucher schools to improve their quality of education in order to attract students. The latter hypothesis is supported by Gallego (2006) who presents evidence that greater competition increases test scores, particularly when the schools are subject to financial consequences.

Another possible explanation for the difference in test scores is that there are positive peer effects that occur in private voucher schools – captured partially in our models by the mothers' average education. Although the students in our analysis are typically from low-income families with low parental education, it is likely that their friends and classmates come from families that have higher incomes and more parental education. These positive peer effects could have an impact on the education of the scholarship students.

Finally, the differences in test scores could be partially caused by the higher motivation of parents who send their children to private voucher schools. We have attempted to control for the involvement of parents in the education of their children by including variables that measure the frequency that parents study and/or read with their children; however, as mentioned earlier, it is possible that we have not entirely captured the parental involvement and motivation that may influence academic achievement.

It is interesting to note, though, that the similarity of results among children in private voucher schools with and without fees suggests that differences in the availability resources do not account for the superior performance of students in fee-charging private voucher schools. An interesting future research question is why fee-charging private voucher schools are able to collect resources from parents if their students do not outperform their free private voucher schools' counterparts. In other words, an unanswered question is what additional products that are valued by families –other than academic achievement– are provided by fee-charging private voucher schools.

Regardless of what specific factors cause the difference in test scores, the findings of this paper confirm that it is possible to create an environment in which the academic achievement of low-income students can be improved. Disentangling exactly which factors contribute to a better education for low-income students is an important issue that should be carefully examined in future work.

References

Abadie, A., D. Drukker, J. Herr, and G. Imbens. (2004), "Implementing Matching Estimators for Average Treatment Effects in Stata," *The Stata Journal*, vo1 4(3): 290-311

Angrist, J. D., E. Bettinger, E. Bloom, E. King, and M. Kremer. (2002). "Vouchers for Private Schooling in Colombia: Evidence from a Randomized Natural Experiment," *American Economic Review*, Vol. 92(5): 1535-1558.

Contreras, D., Elacqua, G. and F. Salazar, 2006. "School Choice in Chile: Scale Matters" mimeo Universidad de Chile, Santiago, Chile.

Dehejia, R.H, and S. Wahba (2002), "Propensity Score Matching Methods for Non-Experimental Causal Studies," *Review of Economics and Statistics*, Vol. 84(1): 151-161.

Elacqua, Gregory. (2006), "Public, Catholic, and For-Profit School Enrollment Practices in Response to Vouchers: Evidence from Chile" mimeo Universidad Adolfo Ibañez, Santiago, Chile.

Gauri, V. (1998), *School Choice in Chile: Two Decades of Educational Reform* (Pittsburgh, PA: University of Pittsburgh Press).

Gallego, F. (2002). "Competencia y Resultados Educativos: Teoría y Evidencia para Chile." *Cuadernos de Economía 39(118)*: 309-352.

Gallego, F. (2006). "Voucher-school Competition, Incentives and Outcomes: Evidence from Chile." Mimeo Department of Economics, MIT.

Goldhaber, D. and E. Eide (2003). "Methodological Thoughts on Measuring the Impact of Private Sector Competition on the Educational Market place", *Educational Evaluation and Policy Analysis* 25(2): 217-232.

Greene, J.P., Peterson, P.E. and J. Du (1998). "School Choice in Milwaukee: A Randomized Experiment," P.E. Peterson and B.C. Hassel (eds) *Learning from School Choice,* pp. 335-356, Brookings Institute, Washington DC.

Hanushek, E, J. Kain and S. Rivkin (2004), "Disruption versus Tiebout improvement: The costs and benefits of switching schools". *Journal of Public Economics* 88(9): 1721-1746.

Heckman, J.J., H. Ichimura, and P. Todd (1997), "Matching as an Econometric Evaluation Estimator: Evidence from Evaluating a Job Training Program," *Review of Economic Studies* 64: 605-654.

Howell, W. and P.E. Peterson (2002). *The Education Gap: Vouchers and Urban Schools,* Brookings Institute, Washington DC.

Hsieh, C., and M. Urquiola (2006), "The Effects of Generalized School Choice on Achievement and Stratification: Evidence from Chile's School Voucher Program" *The Journal of Public Economics* 90: 1477-1503.

Jacob, B.A. and S. D. Levitt (2003). "Rotten Apples: An Investigation of the Prevalence and Predictors of Teacher Cheating," *Quarterly Journal of Economics*, Vol. 118(3): 843-77.

Krueger, A. and P. Zhu (2004). "Another Look at the New York City School Voucher Experiment," *American Behavioral Scientist* Vol 47: 699-717.

Leuven, E. and B. Sianesi (2003). "PSMATCH2: Stata Module to Perform Full Mahalanobis and Propensity Score Matching, Common Support Graphing, and Covariate Imbalance Testing." Available at http://ideas.repec.org/c/boc/bocode/s432001.html. Version 1.2.3.

Martin, M.O., I.V.S.Mulis, and S.J. Chrostowski (2004). *TIMSS 2003 Technical Report*, Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.

McEwan, P.J. and M. Carnoy (2000). "The Effectiveness and Efficiency of Private Schools in Chile's Voucher System," *Educational Evaluation and Policy Analysis*, 33: 213-239.

McEwan, P.J (2001). "The Effectiveness of Public, Catholic, and Non-Religious Private Schools in Chile's Voucher System," *Education Economics*, Vol. 9(2): 103-128.

McEwan, P. (2004). "The Potential Impact of Vouchers," *Peabody Journal of Education 79(3)*: *57-80.*

Mizala, A. and P. Romaguera. (2001). "Factores Socioeconómicos Explicativos de los Resultados Escolares en la Educación secundaria en Chile," *El Trimestre Económico* 68(4): 515-549.

Mizala, A. and P. Romaguera. (2000). "School Performance and Choice: The Chilean Experience," *Journal of Human Resources,* Vol 35(2), pp: 392-417.

Mullis, I., Martin M., González, E., Gregory, K., Garden, R., O'Connor, K. Chrostowski, S. and T. Smith, (2000). *TIMMS 1999 International Mathematics Report.* Boston: International Study Center, Lynch School of Education. Boston College.

Neal, D. (1997), "The effects of Catholic secondary schooling on educational achievement", *Journal of Labor Economics*, 15: 98-123.

Rosenbaum, P.R., and D.B. Rubin (1983), "The Central Role of the Propensity Score in Observational Studies for Causal Effects," *Biometrika* 70: 41-55.

Rouse, C.E. (1998), "Private School Vouchers and Student Achievement: An Evaluation of the Milwaukee Parental Choice Program," *Quarterly Journal of Economics*, 113: 553-602.

Sapelli, C., and B. Vial. (2002), "The Performance of Private and Public Schools in the Chilean Voucher System," *Cuadernos de Economia*, Vol 118: 423-454.

Sapelli, C. and B. Vial (2005), "Private vs public voucher schools in Chile: New evidence on efficiency and peer effects" Working Paper Nº 289 Instituto de Economía, Catholic University of Chile; Santiago, Chile.

Somers, M.A., McEwan, P.J. and D. Willms (2004). "How Effective are Private Schools in Latin America?" *Comparative Education Review, 48*: 48-69.

Todd, Petra. (1999), "A Practical Guide to Implementing Matching Estimators." Mimeo presented at the IADB meeting in Santiago, Chile, October 1999.

Tokman, Andrea. (2002), "Is Private Education Better? Evidence from Chile." Central Bank of Chile Working Paper Nº 147.

University of Chile (2003), "Informe Trimestral de Empleo: Marzo 2003", Department of Economics, Santiago, Chile.

Table 1: Voucher Payments According to Fees Charged

Fee paid by parents	Number of private voucher schools that charge this fee		Voucher reduction	Scholarship Fund[b]	
	Santiago[a]	Chile		State contribution (percentage of voucher reduction)	School contribution (percentage of fee)
0 to 0.5 USE[c]	99	1055	0 %	0%	5%
0.5 to 1 USE	238	496	10%	100%	5%
1 to 2 USE	187	391	20%	50%	7%
2 to 4 USE	127	226	35%	20%	10%

[a] Schools in the Metropolitan Region of Santiago.
[b] The scholarship fund provides either full or partial scholarships to students in the school. The amount of money contributed by the state and the school depends on how much fee is paid by parents – schools that charge large fees are required to contribute a larger percentage to the scholarship fund and receive a smaller percentage of the subsidy from the state.
[c] USE (Unidad de Subvención Escolar) is the monetary unit used for distributing the vouchers to schools. The USE is re-adjusted every year to account for inflation; in 2002, the value was 11,747 pesos (approximately $21).
Source: Ministry of Education and SIMCE 2002 data base.

Table 2: Summary statistics for the database [a]

Variable	Observations	Mean	SD	Min	Max
Student characteristics					
SIMCE math	77,921	244.9	52.3	94	379
SIMCE language	77,880	249.1	53.4	101	376
SIMCE science	77,976	248.5	52.5	94	386
# of schools in neighborhood of residence	78,184	53.3	32.6	4	125
# of private voucher schools in neighborhood of residence	78,184	36.6	28.1	0	99
Male	83,540	0.5	0.5	0	1
Mother's education (years)	78,868	10.6	3.2	1	22
Father's education (years)	76,490	11.2	3.1	1	22
Mother's education if single (years)	17,039	10.9	3.2	1	22
Siblings	81,606	0.6	0.5	0	1
Single mother	81,606	0.2	0.4	0	1
Parents' educational expectations: university	81,147	0.4	0.5	0	1
Parents' educational expectations: technical or professional school	81,147	0.2	0.4	0	1
Income (divided by 100,000)	81,326	2.1	2.1	0.5	20
Distance from school's income	81,326	0.000	1.8	-18.9	9.7
Fee paid by students in fee-charging private voucher schools (pesos)	38,509	13,346.3	13,124.1	0	110,000[b]
Scholarship (defined as 50% of fee)	82,777	0.054	0.2	0	1
Scholarship (defined as 75% of fee)	82,777	0.032	0.2	0	1
Scholarship (defined as 5% of income)	80,836	0.042	0.2	0	1
Repeated grade	81,899	0.1	0.3	0	1
Age if repeated a grade	6,624	10.7	0.8	8	14
Difference from average age (10 years old)	82,427	-0.4	0.7	-4	4
Preschool	81,557	0.5	0.5	0	1
# years attended school	79,419	3.9	1.5	1	6
Reason for school choice: proximity	71,814	0.4	0.5	0	1
Reason for school choice: family members	71,814	0.1	0.3	0	1
Reason for school choice: academic prestige	71,814	0.1	0.4	0	1
Reason for school choice: socio-cultural	71,814	0.03	0.2	0	1
Reason for school choice: teacher quality	71,814	0.1	0.3	0	1
Reason for school choice: values	71,814	0.1	0.3	0	1
Reason for school choice: full day schedule	71,814	0.02	0.1	0	1
Reason for school choice: low cost	71,814	0.05	0.2	0	1
Reason for school choice: only option	71,814	0.02	0.1	0	1
Parent studies with their child	78,731	2.6	0.6	1	3
Parent reads with their child	79,028	2.0	0.8	1	3

Table 2 Contd: Summary statistics for the database

School characteristics					
Variable	**Observations**	**Mean**	**SD**	**Min**	**Max**
# of schools in school's neighborhood	1,415	49.9	32.2	4	125
# of private voucher schools in school's neighborhood	1,415	34.0	27.4	0	99
Monthly fee of school	1,414	6,373.8	10,826	0	110,000[b]
Per pupil resources	1,271	27,181	10,559	5260	274,497
Average mothers' education in the school	1,414	10.5	1.7	5	15.7
SD of school's income (heterogeneity)	1,411	165,121	94,723	0	700,476
Religious	1,256	0.1	0.3	0	1
New school	1,415	0.1	0.2	0	1
School's rank in 2000 SIMCE	1,415	755.9	480.9	0	1,551
School ranked in top 10% of private voucher schools in 2000	617	0.1	0.3	0	1

[a] Summary statistics are for students in the Metropolitan Region of Santiago who are between the ages of 6 and 14 and attend public schools, free private voucher schools or fee-charging private voucher schools.
[b] This maximum amount corresponds to a middle-income private voucher school that has differentiated fees depending on the students' family income.

Table 3: Basic statistics by school type for 4th graders in 2002^a

Variable	Public	Private voucher		Scholarship students[b]
		No fee	Fee-charging	
SIMCE math	233	237	258	252
SIMCE science	235	242	263	256
SIMCE language	236	241	263	256
Father's education (years)	10.5	10.6	11.9	10.5
Mother's education (years)	9.7	10.0	11.6	9.9
Family income (Ch pesos)	164,090	176,400	267,701	147,754
Fee by student (Ch pesos)	0	0	13,346	2,182

Source: SIMCE Parental Questionnaire, Ministry of Education.

[a]Metropolitan Region of Santiago only.

[b] Students in the treatment group; i.e, students in fee-charging private voucher schools, that report paying 50% or less of the fee in their school. It excludes the children of highly educated parents.

Table 4: Estimation of the probability of receiving a scholarship to a fee-charging private voucher school

Variable	Coefficient
# schools in school's neighborhood	-0.005 (0.004)
# private voucher schools in school's neighborhood	0.008 (0.005)
Male	-0.008 (0.041)
Father's education	0.005 (0.008)
Mother's education	-0.018 (0.009)
Single mother	-0.089 (0.200)
Single mother's education	0.020 (0.017)
Siblings	0.218 (0.042)***
Expectations - university	-0.020 (0.053)
Expectations - technical or professional institute	-0.132 (0.065)*
Income	-0.728 (0.060)***
Income squared	0.093 (0.007)***
Income cubed	-0.003 (0.0003)***
Per pupil resources of the school	2.39×10^{-7} (3.63×10^{-6})
SD income	0.066 (0.049)
Distance from average income	0.182 (0.044)***
Repeated grade	2.428 (1.307)
Age if repeated	-0.219 (0.125)
Difference from average age	0.109 (0.039)**
Preschool	-0.086 (0.042)*
School's ranking in 2000	0.0003 (7×10^{-5})***
New school	0.742 (0.440)
Religion	0.318 (0.055)***
# years attended school	0.079 (0.015)***
Constant	-1.756 (0.177)***
Pseudo R^2	0.058
Number of observations	26,062

Standard errors are in parentheses.
* Significant at 5%; ** significant at 1%.

45

Table 5: Estimation of the probability of receiving a scholarship to each school type, including SIMCE scores as control variables

Variable	Language SIMCE		Science (natural and social) SIMCE		Math SIMCE	
	Fee-charging private voucher	Fee-charging private voucher in top 10%	Fee-charging private voucher	Fee-charging private voucher in top 10%	Fee-charging private voucher	Fee-charging private voucher in top 10%
SIMCE score	0.001	0.002	0.001	-0.001	0.001	-0.002
	(0.0005)	(0.002)	(0.0005)	(0.002)	(0.0005)**	(0.002)
Number of observations	24457	3062	24486	3060	24473	3062
Pseudo R^2	0.058	0.115	0.058	0.121	0.059	0.118

Standard errors are in parentheses. ** Significant at 1%.
The regression includes all control variables in Table 4. Detailed results are available upon request.

Table 6: Estimation of the probability of attending each school type compared to public school

Variable	Free private voucher	Fee-charging private voucher
# schools in student's neighborhood	-0.040 (0.004)***	-0.004 (0.003)
# private voucher schools in student's neighborhood	0.050 (0.004)***	0.014 (0.003)***
Probability of scholarship to a fee-charging private voucher	-6.387 (0.729)***	-6.555 (0.542)***
Male	-0.006 (0.038)	0.047 (0.027)
Father's education	0.0001 (0.007)	0.004 (0.006)
Mother's education	-0.012 (0.008)	-0.025 (0.006)***
Single mother	-0.103 (0.178)	-0.027 (0.136)
Single mother's education	0.011 (0.016)	0.008 (0.012)
Expectations - university	-0.003 (0.049)	0.107 (0.035)**
Expectations - technical or professional institute	-0.096 (0.056)	-0.061 (0.042)
Income	-0.546 (0.088)***	-0.574 (0.061)***
Income squared	0.057 (0.012)***	0.063 (0.008)***
Income cubed	-0.002 (0.0005)***	-0.002 (0.0003)***
School per pupil resources	1.51×10^{-6} (4.51×10^{-6})	0.0002 (3.12×10^{-6})***
Mothers' education in the school	3.007 (0.189)***	5.763 (0.162)***
Mothers' education in the school squared	-0.145 (0.009)***	-0.227 (0.007)***
Repeated grade	0.791 (0.976)	1.632 (0.866)
Age if repeated	-0.052 (0.092)	-0.131 (0.082)
Difference from average age	0.107 (0.037)**	-0.015 (0.027)
Preschool	-0.033 (0.040)	-0.095 (0.029)***
Religion	7.500 (0.363)***	5.281 (0.359)***
Reason for choosing school: proximity	-0.009 (0.146)	-0.079 (0.096)
Reason for choosing school: family	0.443 (0.152)**	0.062 (0.102)
Reason for choosing school: academic prestige	0.645 (0.151)***	0.012 (0.100)
Reason for choosing school: socio-cultural	0.534 (0.192)**	0.532 (0.129)***
Reason for choosing school: teacher quality	0.566 (0.151)***	0.207 (0.101)*
Reason for choosing school: values	1.476 (0.162)***	0.948 (0.114)***
Reason for choosing school: full day option	0.003 (0.200)	-0.640 (0.133)***
Reason for choosing school: low cost	0.202 (0.161)	-0.749 (0.111)***
Parent studies with their child	0.008 (0.032)	0.081 (0.023)***
Parent reads with their child	-0.027 (0.027)	0.008 (0.019)
Constant	-15.443 (1.043)***	-38.527 (0.919)***
Pseudo R^2	0.362	0.362
Number of observations	44932	44932

Table 7: Matching results for scholarship students in fee-charging private voucher schools

Panel A. Comparison: students in public schools

Sample		Matching estimator	Number of observations	Mean propensity score	Language SIMCE score	Science SIMCE score
Treatment group	Scholarship students in fee-charging private voucher schools		**1,384**	**0.625**	**259.6**	**259.5**
					Language SIMCE ATT	Science SIMCE ATT
Matched comparison	Students in public schools	One-to-one replacement	1,384	0.625	11.520 (3.098)**	9.215 (2.944)**
		Nearest neighbor (5)	3,064	0.625	11.083 (2.442)**	10.916 (2.405)**
		Kernel	14,036	0.621	10.703 (2.156)**	9.668 (2.120)**
		Local Linear Regression	14,036	0.625	10.072 (2.195)**	8.963 (2.158)**

Standard errors in parentheses.

Panel B. Comparison: students in free private voucher schools

Sample		Matching estimator	Number of observations	Mean propensity score	Language SIMCE score	Science SIMCE score
Treatment group	Scholarship students in fee-charging private voucher schools		**1,353**	**0.617**	**259.1**	**259.1**
					Language SIMCE ATT	Science SIMCE ATT
Matched comparison	Students in free private voucher schools	One-to-one replacement	1,353	0.617	3.022 (3.861)	3.143 (3.764)
		Nearest neighbor (5)	1,983	0.616	0.882 (3.350)	1.793 (3.224)
		Kernel	3,028	0.610	1.182 (2.621)	2.826 (2.509)
		Local Linear Regression	3,028	0.617	3.422 (3.599)	3.278 (3.428)

Standard errors in parentheses.
* Significant at 5%; ** significant at 1%.

Table 8: Robustness check #1 - Matching results for scholarship versus non-scholarship students in fee-charging private voucher schools

Sample		Matching estimator	Number of observations	Mean propensity score	Language SIMCE score	Science SIMCE score
Treatment group	Scholarship students in fee-charging private voucher schools		**1,461**	**0.644**	**260.4**	**260.4**

Sample		Matching estimator	Number of observations	Mean propensity score	Language SIMCE ATT	Science SIMCE ATT
Matched comparison	Non-scholarship students in fee-charging private voucher schools	One-to-one replacement	1,461	0.644	2.980 (1.949)	1.534 (1.932)
		Nearest neighbor (5)	5,180	0.644	2.415 (1.517)	2.383 (1.494)
		Kernel	11,724	0.645	1.765 (1.393)	1.768 (1.369)
		Local Linear Regression	11,724	0.644	1.819 (1.395)	1.726 (1.372)

Standard errors in parentheses.

Table 9: Robustness check #2 - Matching results for scholarship students in fee-charging private voucher schools, limiting parental education in the first stage

Panel A. Comparison: students in public schools

Sample		Matching estimator	Number of observations	Mean propensity score	Language SIMCE score	Science SIMCE score
Treatment group	Scholarship students in fee-charging private voucher schools		**1,412**	**0.633**	**259.8**	**259.7**
					Language SIMCE ATT	Science SIMCE ATT
Matched comparison	Students in public schools	One-to-one replacement	1,412	0.633	13.757 (3.605)**	15.313 (3.511)**
		Nearest neighbor (5)	3,143	0.633	11.733 (2.836)**	12.438 (2.762)**
		Kernel	14,036	0.629	9.562 (2.190)**	8.711 (2.149)**
		Local Linear Regression	14,036	0.633	9.576 (2.247)**	8.569 (2.205)**

Standard errors in parentheses.
** Significant at 1%.

Panel B. Comparison: students in free private voucher schools

Sample		Matching estimator	Number of observations	Mean propensity score	Language SIMCE score	Science SIMCE score
Treatment group	Scholarship students in fee-charging private voucher schools		**1,362**	**0.620**	**259.1**	**259.2**
					Language SIMCE ATT	Science SIMCE ATT
Matched comparison	Students in free private voucher schools	One-to-one replacement	1,362	0.620	2.838 (3.946)	2.725 (3.900)
		Nearest neighbor (5)	1,981	0.619	-0.679 (3.458)	1.264 (3.301)
		Kernel	3,028	0.613	0.623 (2.819)	2.104 (2.693)
		Local Linear Regression	3,028	0.620	2.546 (3.706)	2.666 (3.527)

Standard errors in parentheses.

Table 10: Robustness check #3 - Matching results for scholarship students in fee-charging private voucher schools using alternate definition of scholarship (5% of family income)

Panel A. Comparison: students in public schools

Sample		Matching estimator	Number of observations	Mean propensity score	Language SIMCE score	Science SIMCE score
Treatment group	Scholarship students in fee-charging private voucher schools		**1,065**	**0.677**	**260.2**	**260.7**
					Language SIMCE ATT	Science SIMCE ATT
Matched comparison	Students in public schools	One-to-one replacement	1,065	0.677	12.634 (3.809)**	10.906 (3.706)**
		Nearest neighbor (5)	2,246	0.676	12.922 (2.967)**	10.940 (2.939)**
		Kernel	14,036	0.673	10.936 (2.568)**	10.055 (2.518)**
		Local Linear Regression	14,036	0.677	9.790 (2.611)**	8.943 (2.560)**

Standard errors in parentheses.
** Significant at 1%.

Panel B. Comparison: students in free private voucher schools

Sample		Matching estimator	Number of observations	Mean propensity score	Language SIMCE score	Science SIMCE score
Treatment group	Scholarship students in fee-charging private voucher schools		1,028	0.665	259.6	260.6
					Language SIMCE ATT	Science SIMCE ATT
Matched comparison	Students in free private voucher schools	One-to-one replacement	1,028	0.665	3.633 (4.932)	1.239 (4.765)
		Nearest neighbor (5)	1,688	0.664	3.487 (4.275)	2.941 (4.121)
		Kernel	3,028	0.658	0.016 (3.261)	2.532 (3.109)
		Local Linear Regression	3,028	0.665	3.189 (4.581)	3.311 (4.354)

Standard errors in parentheses.

Table 11: Robustness check #4 - Matching results for scholarship students in fee-charging private voucher schools using alternate definition of scholarship (75% reduction of school fee)

Panel A. Comparison: students in public schools

Sample		Matching estimator	Number of observations	Mean propensity score	Language SIMCE score	Science SIMCE score
Treatment group	Scholarship students in fee-charging private voucher schools		**786**	**0.578**	**254.0**	**255.9**
					Language SIMCE ATT	Science SIMCE ATT
Matched comparison	Students in public schools	One-to-one replacement	786	0.578	8.858 (3.262)**	11.832 (3.160)**
		Nearest neighbor (5)	2,201	0.578	8.518 (2.715)**	9.315 (2.619)**
		Kernel	14,001	0.573	7.570 (2.409)**	9.054 (2.349)**
		Local Linear Regression	14,001	0.578	10.085 (2.537)**	11.123 (2.476)**

Standard errors in parentheses.
** Significant at 1%.

Panel B. Comparison: students in free private voucher schools

Sample		Matching estimator	Number of observations	Mean propensity score	Language SIMCE score	Science SIMCE score
Treatment group	Scholarship students in fee-charging private voucher schools		804	0.587	254.5	256.0
					Language SIMCE ATT	Science SIMCE ATT
Matched comparison	Students in free private voucher schools	One-to-one replacement	804	0.587	-1.685 (3.765)	1.459 (3.609)
		Nearest neighbor (5)	1,616	0.587	-2.551 (1.337)	1.337 (2.935)
		Kernel	3,028	0.582	-2.232 (2.636)	1.435 (2.529)
		Local Linear Regression	3,028	0.587	-0.933 (3.056)	1.514 (2.922)

Standard errors in parentheses.

Table 12: Robustness check #5 - Matching results for scholarship students in fee-charging private voucher schools including private non-voucher schools in first stage

Panel A. Comparison: students in public schools

Sample		Matching estimator	Number of observations	Mean propensity score	Language SIMCE score	Science SIMCE score
Treatment group	Scholarship students in fee-charging private voucher schools		**1,438**	**0.632**	**260.2**	**260.2**
					Language SIMCE ATT	Science SIMCE ATT
Matched comparison	Students in public schools	One-to-one replacement	1,438	0.632	12.902 (3.092)**	12.143 (3.095)**
		Nearest neighbor (5)	3,085	0.632	9.737 (2.469)**	9.514 (2.435)**
		Kernel	14,036	0.628	10.587 (2.226)**	9.615 (2.189)**
		Local Linear Regression	14,036	0.632	9.977 (2.295)**	9.029 (2.256)**

Standard errors in parentheses.
** Significant at 1%.

Panel B. Comparison: students in free private voucher schools

Sample		Matching estimator	Number of observations	Mean propensity score	Language SIMCE score	Science SIMCE score
Treatment group	Scholarship students in fee-charging private voucher schools		1,423	0.628	260.0	260.0
					Language SIMCE ATT	Science SIMCE ATT
Matched comparison	Students in free private voucher schools	One-to-one replacement	1,423	0.628	-1.359 (4.631)	-1.419 (4.438)
		Nearest neighbor (5)	2,013	0.627	-0.697 (3.581)	0.565 (3.481)
		Kernel	3,028	0.621	1.237 (2.731)	3.031 (2.612)
		Local Linear Regression	3,028	0.628	3.761 (3.909)	3.649 (3.720)

Standard errors in parentheses.

Name of Variable	Description	Source
Student characteristics		
SIMCE math score	Student's score on the math section of the SIMCE	SIMCE database
SIMCE language score	Student's score on the language section of the SIMCE	SIMCE database
SIMCE science score	Student's score on the science section of the SIMCE	SIMCE database
# schools in student's neighborhood	Number of schools in the student's neighborhood of residence	Parental questionnaire
# private schools in student's neighborhood	Number of private schools in the student's neighborhood of residence	Parental questionnaire
Male	1 if the student is male, 0 if female	Parental questionnaire
Father's education	Number of years of education for the student's father	Parental questionnaire
Mother's education	Number of years of education for the student's mother	Parental questionnaire
Single mother's education	Number of years of education for student's mother if she is single	Parental questionnaire
Siblings	1 if the student has siblings that attend school, 0 if not.	Parental questionnaire
Single mother	1 if the student lives with the mother only, 0 if not	Parental questionnaire
Expectations: university	1 if the parents expect student to attend college, 0 if not	Parental questionnaire
Expectations: technical or professional institute	1 if the parents expect student to attend a technical or professional institute, 0 if not	Parental questionnaire
Income (divided by 100,000)	Family income divided by 100,000 pesos	Parental questionnaire
Distance from school's income	Difference between the student's income and the average income of the school	Parental questionnaire
Fee paid by student	Monthly fee paid by the student	Parental questionnaire
Scholarship	1 if the student has a school scholarship, 0 if not	Parental questionnaire
Repeated grade	1 if the student has repeated a grade, 0 if not	Parental questionnaire
Age if repeated	Age of the student if she/he has repeated a grade	Parental questionnaire
Difference from average age (10 years old)	Difference between the student's age and the average age of a student in 4th grade (10 years old)	Parental questionnaire
Preschool	1 if the student attended preschool, 0 if not	Parental questionnaire
# years attended school	The number of years the student has attended the school	Parental questionnaire
Reason for school choice: proximity	1 if the student's primary reason for attending the school is proximity	Parental questionnaire
Reason for school choice: family members	1 if the student's primary reason for attending the school is other family members attended school	Parental questionnaire
Reason for school choice: academic prestige	1 if the student's primary reason for attending the school is for its academic prestige	Parental questionnaire
Reason for school choice: socio-cultural	1 if the student's primary reason for attending the school is for socio-economic reasons	Parental questionnaire
Reason for school choice: teacher quality	1 if the student's primary reason for attending the school is because of the quality of teachers	Parental questionnaire
Reason for school choice: values	1 if the student's primary reason for attending the school is because of the value-based teachings	Parental questionnaire
Reason for school choice: full day schedule	1 if the student's primary reason for attending the school is because it has a full day schedule (from 8 am to 4 pm)	Parental questionnaire
Reason for school choice: low cost	1 if the student's primary reason for attending the school is because of the low cost	Parental questionnaire
Reason for school choice: only option	1 if the student's primary reason for attending the school is because it was the only option	Parental questionnaire
Parent studies with their child	1 never, 2 sometimes, 3 always	Parental questionnaire
Parent reads with their child	1 never, 2 sometimes, 3 always	Parental questionnaire
School characteristics		
School type	School type (0 if public, 1 if free private voucher and 2 if fee-charging private voucher)	SIMCE database
# of schools in school's neighborhood	Number of public and private voucher schools in the school's neighborhood	SIMCE database
# of private schools in school's neighborhood	Number of private voucher schools in the school's neighborhood	SIMCE database
Monthly fee	Monthly fee of the school	Phone calls and parental questionnaire
Per pupil resources of the school	Amount spent per pupil (includes school and state resources)	Min.of Educ. and Under-secret. of Reg.Develop.
Average mothers' education in the school	Average number of years of education for the mothers of students in the school	Parental questionnaire
SD of school's income (heterogeneity)	Standard deviation of the students' income in the school	Parental questionnaire
Religious	1 if school is religious, 0 if not religious	Survey of principals (1999)
New school	1 if school students' did not complete the 2000 SIMCE test, 0 if they did	Ministry of Education
School's rank in 2000	The school's rank among schools according to its average SIMCE score in 2000 (0 if school is new)	SIMCE database (2000)
School ranked in top 10% of private voucher schools in 2000 if not new	1 if school was in the top 10 percent of private voucher schools in 2000, 0 if not	SIMCE database

Centro de Economía Aplicada
Departamento de Ingeniería Industrial
Universidad de Chile

2006

220. Using School Scholarships to Estimate the Effect of Government Subsidized Private Education on Academic Achievement in Chile
Priyanka Anand, Alejandra Mizala y Andrea Repetto

219. Portfolio management implications of volatility shifts: Evidence from simulated data
Viviana Fernandez y Brian M Lucey

218. Micro Efficiency and Aggregate Growth in Chile
Raphael Bergoeing y Andrea Repetto

2005

217. Asimetrías en la Respuesta de los Precios de la Gasolina en Chile
Felipe Balmaceda y Paula Soruco

216. Sunk Prices and Salesforce Competition
Alejandro Corvalán y Pablo Serra

215. Stock Markets Turmoil: Worldwide Effects of Middle East Conflicts
Viviana Fernández

214. The Competitive Role of the Transmission System in Price-regulated Power Industries
M. Soledad Arellano y Pablo Serra

213. La Productividad Científica de Economía y Administración en Chile. Un Análisis Comparativo (Documento de Trabajo Nº 301. Instituto de Economía, Pontificia Universidad Católica de Chile)
Claudia Contreras, Gonzalo Edwards y Alejandra Mizala

212. Urban Air Quality and Human Health in Latin America and the Caribbean
Luis A. Cifuentes, Alan J. Krupnick, Raúl O'Ryan y Michael A. Toman

211. A Cge Model for Environmental and Trade Policy Analysis in Chile: Case Study for Fuel Tax Increases
Raúl O'Ryan, Carlos J. de Miguel y Sebastian Millar

2004

197. Reformando el sector eléctrico chileno: Diga NO a la liberalización del mercado spot
M. Soledad Arellano

196. Risk, Pay for Performance and Adverse Selection in a Competitive Labor Market
Felipe Balmaceda

195. Vertical Integration and Shared Facilities in Unregulated Industries
Felipe Balmaceda y Eduardo Saavedra

194. Detection of Breakpoints in Volatility
Viviana Fernández

193. Teachers' Salary Structure and Incentives in Chile
Alejandra Mizala y Pilar Romaguera

192. Estimando la demanda residencial por electricidad en Chile: a doña Juanita le importa el precio
José Miguel Benavente, Alexander Galetovic, Ricardo Sanhueza y Pablo Serra

191. Análisis y Recomendaciones para una Reforma de la Ley de Quiebras
Claudio Bonilla, Ronald Fischer, Rolf Lüders, Rafael Mery, José Tagle

190. Trade Liberalization in Latin America: The Case of Chile
Ronald Fischer

189. Time-Scale Decomposition of Price Transmission in International Markets
Viviana Fernández

188. Slow Recoveries. (Por aparecer en Journal of Development Economics)
Raphael Bergoeing, Norman Loayza y Andrea Repetto

187. Market Power in Mixed Hydro-Thermal Electric Systems
M. Soledad Arellano

186. Efectos de la privatización de servicios públicos en Chile: Casos sanitario, electricidad y telecomunicaciones
Ronald Fischer y Pablo Serra

185. A Hierarchical Model for Studying Equity and Achievement in the Chilean School Choice System
Alejandra Mizala, Pilar Romaguera y Carolina Ostoic

* Para ver listado de números anteriores ir a http://www.cea-uchile.cl/.