# School Performance Evaluation under the Voucher System: the Case of Chile

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## Abstract

*Education plays an important role in the economic and social development of countries. Myriad studies show that education is one of the best ways to offer increased socio-economic opportunities, social mobility and wages. Not only is universal education important but more significant is the quality of the education. Traditionally, educational policy looks to increase resources, a practice that has not empirically demonstrated satisfactory results. When addressing the problem from an economic standpoint, scholars consider why some schools are "better" than others and examine whether school administration influences results. In 1962, Milton Friedman introduced the voucher system into public education. Vouchers are simply the introduction of incentives as market forces, creating competition to improve educational results. In other words, introducing these incentives creates competition in student recruitment, directly influenced by the academic results of the school – ideally allowing only those institutions with good results to survive "in the market" and closing those schools that cannot "compete" against higher-quality establishments. Unfortunately, sufficient data do not exist to endorse the assertion that vouchers yet impact "the market" in this form. However, I will use the empirical evidence that the Chilean case provides and try to determine if this voucher system works as the theory claims. This study will help to interpret this system, the operation of free choice and how the market forces act to increase the quality of education. Three types of variables exist and are used to explain the educational results of each student; they are the individual and family characteristics as well as the characteristics of the educational establishment. Many variables previously mentioned are endogenous. One of the most important variables for this analysis is the selection of the school, and therefore the traditional mechanism of ordinary least square (OLS) will bias the results. However, by predicting the probabilities of selecting a particular educational establishment, using instrumental variables, and then estimating a two stage least-square model, the bias problem will disappear. The article will be organized in the following way: Section I: Introduction, section II will describe the Chilean education system. Section III describes the dataset and the methodology will be explained. Section IV describes the data and results and later on finally, section V contains the conclusion and recommendations.*

# I. Introduction

Increasing economic resources for schools is the most commonly implemented approach to improving educational outcomes. However, studies have shown that this strategy does not always work efficiently. For instance, a meta-analysis by the World Health Organization (WHO) of over 400 student achievement studies concludes that there is no consistent evidence supporting the direct relationship between increasing resources and enhancing student performance.[1] Other studies have analyzed discrepancies in school outcomes by focusing on how different approaches to school administration and financing influence results.

In 1962, Milton Friedman proposed subsidizing the cost of education by issuing vouchers.[2] His framework was designed to introduce market-based competition to increase educational quality among schools. The lack of conclusive support for this theory necessitates an evaluation of the Chilean voucher system that provides policymakers with evidence on the level of success or failure of the system. This study aims to contribute to the understanding of the voucher system and education policy in Chile.

Contreras (2001) and Contreras, Arzola and Bronfman (2001) use standardized tests, specifically the Sistema de Medición de la Calidad de la Educación (SIMCE)[3] dataset for the year 1999, as a proxy of achievement and school quality to establish whether or not the Chilean voucher system delivers better educational results than the public schools. This article applies their methodology to the latest available SIMCE dataset (2003) for second-year high school students. This paper's contribution lies in its analysis of empiric evidence from Chilean schools at the national level to further explore how free choice and market forces facilitate better outcomes and a higher quality of education.

Information about the student, his or her family, and the school's characteristics from the SIMCE dataset was used to develop variables for an analysis of individual results on the Language & Communication and Math tests. The model used is based on the equation below:

$$\mathbf{Y_i = \beta_0 X_0 + \beta_1 X_1 + \beta_2 X_2 + \varepsilon_i}$$

[1] (Hanushek 1986)
[2] (Friedman 1962)
[3] Sistema de medición de la calidad de la educación, Measurement System of education quality .

$Y_i$ is the individual test score for each of the tests. $X_0$ corresponds to individual characteristics, and $X_1$ to family characteristics. $X_2$ represents school information. $\beta_n$ are the associated parameters and $\varepsilon_i$ is the error term.

When using ordinary least-square (OLS) regressions, a number of problems typically arise. Some issues involve the estimation of the parameters. In other cases, important variables are omitted and some included variables are endogenous, or have values determined by the states of other variables in the system. One of the most critical of these variables is school choice. First, I will estimate an OLS model and then a two-stages least-squares (TSLS) model. In the TSLS model, I will predict the probability of enrolling in a public, private subsidized or private-paid school, based on availability at a community level, then include predicted probability into the first model to address selection bias.

The TSLS model used by Contreras (2001) and later Contreras, Arzola and Bronfman (2001) deals effectively with the problem of endogenous variables. This method is groundbreaking because it addresses selection bias by using instrumental variables to predict a probability of attending each of the different school types. By using instrumental variables and a predicted probability for the endogenous variable that captures the school decision, the new model remedies the bias problem.

## II. Chilean Education System

Since the establishment of Chile as a nation, widespread education has been a high priority for its government. Under colonial rule, the Catholic Church administered the education system and the availability of formal schooling was limited and directly related to wealth and socioeconomic status. The 1833 Constitution later consigned the government with responsibility of the education system. Schools and universities were managed by the state and had very low enrollment. President Gabriel Gonzáles Videla (1946-1952) initiated a program to improve educational outcomes through the provision of monetary subsidies that covered half of the tuition at some private schools. Subsequent administrations focused on expanding access to education and mandatory length of years of enrollment rather than improving educational quality.

Prior to 1980, the government defined curricula and supervised administration of more than 80% of schools.[4] Chile instituted an educational voucher system in the early 1980's under Augusto Pinochet's military regime. The vouchers consisted of a monetary subsidy that varied in value depending upon whether students were attending primary or secondary school. After families designated schools for their children, the schools received the subsidy directly. As part of this reform, control over school administration shifted from the central government to municipalities. Chile's current education system consists of three types of schools that grew out of these reforms: public schools, subsidized private schools, and private schools. Generally, low-income families choose between public schools and subsidized private schools. Private schools draw students primarily from medium-high- and high-income families.

## III. Evaluation Measures

Chile began using standardized tests in 1983 as a proxy to evaluate the performance of schools. Test results enable the government to assess school performance and provide families with important information on the quality of the schools available to them. Since the initial voucher reforms, the production function model has been the most common way to analyze school performance. This model uses standardized test results along with family and school characteristics to explain each individual's achievement.

Starting in 1987, the government began to administer the Measurement System of Quality of Education (SIMCE) annually to all fourth-, eighth-, and tenth-grade students. Its primary objective is to generate reliable indices that can guide policy to improve the quality of education, and give information to families about student performance both within and across schools.

## IV. Literature Review

When looking at the available literature analyzing school success, the results of the voucher system are inconclusive. Educational voucher studies using OLS models suggest that the per-student subsidy increases student achievement, but its impact is small. Other

[4] (Nuñes 1993)

studies have focused on the role of alternative factors, such as parental education and school type, in determining educational outcomes.[5]

A central shortcoming of OLS models is the selection bias produced by endogenous variables. School selection is an endogenous variable because it varies depending on family preference, resources, religious beliefs, and school availability thus, the OLS model, will be biased. This bias problem is addressed in Contreras (2001) and Contreras, Arzola and Bronfman (2001). Both studies identify school choice as an endogenous factor and use a supply-side instrument to model this decision. The instrument used is the accessibility of the three school types to the community. Using the 1998 academic achievement test (PAA) results, Contreras (2001) finds vouchers to have a significant and positive impact on student achievement. However, using the same methodology over the SIMCE dataset for 1999, Contreras, Arzola and Bronfman (2001) do not find the same results. Their study finds that vouchers have a positive yet non-significant impact on educational outcomes and concludes that subsidized schools do not perform better than public schools.

Rodríguez (1988) uses a sample of 281 schools located in Santiago and the results of the PER test, a standardized test used prior to SIMCE that measures results of the Chilean education system during 1984. The study concludes that the educational gap between schools is statistically significant by 7 to 8 points, favoring the private ones (Rodríguez 1988). Aedo and Larrañaga (1994) employ a broader dataset than Rodríguez, sampling 500 schools and using the 1990 and 1991 SIMCE dataset. This study also includes socioeconomic information from the National Socioeconomic Characteristics Survey (CASEN, 1990). Aedo and Larrañaga find similar evidence to Rodriguez: students at subsidized schools obtain higher average test scores than do public school students. Using a SIMCE panel data set for the years 1988 and 1996, Carnoy and McEwan (1998) analyzes the impact of voucher-induced competition on the Chilean education system, measuring the impact of competition based on the change in student distribution across different school types. This study finds that competition reduces the overall SIMCE test result.

On average, these studies find a difference of roughly 7% in test scores across public, subsidized and private schools. However, these findings are not consistent when

[5] (Mizala & Romaguera 2000)

using different datasets and school levels, and the explanation for this difference changes when a greater number of control variables is included. Significant control variables include class size, teacher/student ratio, mother's level of education, school revenue, poverty index, and a rate of failing years of school. All other studies relied on OLS models since there was no instrumental variable available to address the bias problem.

## V. Methodology

Estimation of a standard OLS model will be presented and contrasted with results of the instrumental variable (IV) and two-stages least-square (TSLS) models. However, such estimation and modeling have limitations: some of the variables are correlated; and the dataset does not permit inclusion of some relevant variables that may help to better understand the task at hand. The TSLS model included in this paper is set up in the following way: In the first stage, an estimate of a Multinomial Logit model is used to predict the probability of choosing one of the three different schools types using the public schools as a reference. This model assumes that school selection is a function of family income, as well as some other restrictions such as availability of schools at the community level, and control variables. Availability is used as an instrument under the assumption that this variable is correlated with the decision of enrollment but not with student capacities. Therefore, this model addresses the bias problem by estimating a probability of enrollment that is not determined by the state of the other variables on the model.

## VI. Data and Analysis

This study uses the SIMCE test for the year 2003, administered on a national level to students in their second year of high school. Initially, an estimation of an OLS model will determine whether there is a selection bias when regressing the scores of both tests by the variables presented above. Results of the OLS are presented in the following table.

Table Nº1: SIMCE scores ordinary least-squares.

| | Mathematics scores | Language & Communication scores |
|---|---|---|
| Family income (natural logarithm) | 12.23<br>(58.43)** | 7.82<br>(45.27)** |
| Books available in home | 5.43<br>(49.71)** | 5.08<br>(54.55)** |
| Father's years of education | 1.31<br>(33.06)** | 1.14<br>(33.42)** |
| Mother's years of education | 1.66<br>(40.39)** | 1.49<br>(42.33)** |
| Gender (female=1) | -8.87<br>(-37.30)** | 5.35<br>(26.24)** |
| Subsidized school | 5.09<br>(18.97)** | 3.73<br>(16.21)** |
| Private school | 17.21<br>(40.51)** | 7.83<br>(22.29)** |
| Pre-school sducation (yes=1) | -3.37<br>(-8.73)** | -0.77<br>(-2.24)** |
| School failing proxy | -29.26<br>(-103.76)** | -22.98<br>(-90.25)** |
| Employment of householder (employed=1) | -4.85<br>(-14.24)** | -2.64<br>(-8.89)** |
| Selection process (yes=1) | 14.47<br>(55.38)** | 10.28<br>(45.06)** |
| Constant | 53.16<br>(23.78)** | 110.53<br>(59.78)** |
| Number of observations | 177,491 | 177,493 |
| $R^2$ | 0.312 | 0.27 |

Robust t-statistics in parentheses, * significant at 5%; ** significant at 1%

Source: SIMCE, 2003.

All coefficients estimated are statistically significant at 99% level of confidence. Both subsidized and private schools perform better than public schools on the math test

than on the language test. All other variables held constant, a student attending a subsidized school will score an average of three to five points higher than if he or she attended a pubic school.

A few other factors have a significant impact on student performance. For example, each additional year of paternal education increases students' test scores by 1.3 and 1.1 points in math and language, respectively. The employment status of the head of the household negatively affects scores by reducing the average test scores by an average of four points.

In addition, availability of books in the house adds more than five points to students' test scores for each incremental increase in level of availability. Interesting but not surprising is that students who went through a selection process, such as an admission test, do better on this test. On average, they score 14.5 points higher on math and10.2 more on language. Students who have failed any level of school before taking the test are more likely to get an average of 30 points less on math and 23 lower on language.

The model and estimations presented above, as explained before, do not recognize or account for the presence of endogenous variables or the problem of school selection. This selection bias necessitates additional analysis.

The next step is to estimate a Multinomial Logit that predicts the probability of attending each type of school, using school availability at the community level as an instrument, and other variables such as family and school characteristics. This methodology prevents biased estimations by including endogenous variables. Results of this model are presented in the following table.

Table Nº 2: Predicted probabilities of attending each type of school, using a Multinomial Logit model.

| Variable | Mean | Std. Dev. |
|---|---|---|
| Probability of attending a public school | 0.4625 | 0.2029 |
| Probability of attending a subsidized school | 0.4051 | 0.1389 |
| Probability of attending a private school | 0.1325 | 0.1712 |

Instrument used: Availability at a community level; Number of observations: 179,678

With the predicted probabilities as dependent variables, estimations of a TSLS model eradicate the endogenous bias caused by the non-random decision of attending variable. The fact that enrollment is a household non-random decision, biases any attempt of estimation. In this way, the probability (random by nature) estimated in the Logit model controls the bias. The following table presents the results of the TSLS model.

Table Nº 3: SIMCE scores using a two-stage least-square model.

| | Mathematics scores | Language & Communication scores |
|---|---|---|
| Family income (natural logarithm) | 10.22<br>(14.85)** | 7.45<br>(16.18)** |
| Books available in home | 5.54<br>(20.53)** | 5.02<br>(25.59)** |
| Father's years of education | 1.32<br>(21.07)** | 1.11<br>(26.33)** |
| Mother's years of education | 1.69<br>(25.42)** | 1.47<br>(28.26)** |
| Gender (female=1) | -8.69<br>(-9.08)** | 5.38<br>(8.90)** |
| Subsidized school | -1.93<br>(-0.46) | 5.42<br>(1.84) |
| Private school | 27.16<br>(6.39)** | 10.45<br>(3.68)** |
| Pre-school education (yes=1) | -2.79<br>(-3.85)** | -0.71<br>(-1.32) |
| School failing proxy | -29.78<br>(-34.79)** | -23.21<br>(-39.98)** |
| Unemployment of householder (employed=1) | -4.09<br>(-10.11)** | -2.57<br>(-7.93)** |
| Selection process (yes=1) | 15.63<br>(14.14)** | 10.74<br>(14.74)** |
| Constant | 76.39<br>(10.01)** | 114.22<br>(22.26)** |
| Number of observations | 177,491 | 177,493 |
| $R^2$ | 0.31 | 0.27 |

Source: SIMCE, 2003.

Robust t-statistics in parentheses * significant at 5%; ** significant at 1%

The estimation presented above confirms the selection bias generated by an OLS model by comparing the impact of school choice on test scores as predicted by OLS and TSLS estimations. The TSLS model, using the probability predicted of attending one of the three types of school, shows new coefficients that explain the differences in results without the selection bias. The most remarkable change using the TSLS model is the private schools results. The estimated performance of private school students is ten points higher on math tests and three points higher on language tests than that of public school students. Thus, the OLS estimation underestimates the impact on test scores of attending to private schools.

In the OLS model, subsidized schools show better test score results than public schools. Controlling for school selection bias, using the TSLS model, subsidized schools do not show a statistically significant difference in student performance compared to public schools.

## VII. Results and Conclusion

Many studies have tried to identify the impact of the educational voucher system. This analysis finds similar results to its predecessors' but maintains the accountability of the educational system and updates the dataset. Using a two-stages least-square model and estimating the differences between the results of the three school administrations co-existing in Chile, private education emerged as superior, but subsidized and public schools came up with statistically equal results in both mathematics and language tests.

Of the other variables included, income and parental education appear to be strong predictors of student performance. Gender also plays a role: girls perform worse in math but better in language than do boys, *ceteris paribus.* Availability of books in the house again proves important in determining better test scores. School selection processes increase the scores by 15.6 and 10.7 in math and language, respectively.

The results presented above are similar to the Contreras, Arzola and Bronfman (2001) findings. These results could suggest that the voucher system did not work as expected. The two school types that provide education to the poor and low-middle class

students performed the same regardless of their administration. The quality of education they provide is the same, and competition does not seem to improve results. Alternatively, one could argue that the competition level introduced to the system did work. The right incentive could equalize education, pooling its quality upward, and ultimately stabilize the education system at a level that uses its scarce resources most effectively. Both alternatives are plausible; however, the second seems more likely, since public schools have not performed as well as subsidized schools in recent years. Assuming that the voucher system does improve the quality of public and subsidized schools, there is still much to be done to improve the overall performance results of the Chilean education system.

In summary, the incentives and the level of competition introduced to the Chilean education system by vouchers, as well as the availability of both public and subsidized schools, at a community level, helps closing the gap of education quality among school types. Subsidized private schools and public schools increase competition for students, which allows the system to reach a higher steady state of quality that would not otherwise exist.

Regarding policy recommendations, a good idea is to look at outliers, subsidized, and public schools that are doing better than others, conduct internal evaluations to measure absolute progress, and try to duplicate their models of education. Since private education is substantially superior, more liberalization and a final privatization of schools may benefit the whole system. Privatizing the system and providing both a broader voucher system and direct subsidies to families can also improve competition. It would likely increase the quality of education by supplying a higher level of choice to low-income families, who currently cannot choose between subsidized and public schools, while also raising the quality of private education.

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# Annex 1: Descriptive Statistics

Table 4: Mean and standard deviation of used variables.

| Variable | Mean |
|---|---|
| Mother's education (years) | 10.3 (4.07) |
| Father's education (years) | 10.8 (4.35) |
| Family income (natural Logarithm) | 12.21 (0.85) |
| Books available (levels 0-6) | 2.9 (1.37) |
| Gender (female=1 Male=0) | 0.49 (0.49) |
| Dummy unemployed householder (employed=1) | 0.78 (0.41) |
| Dummy failing level (failed once or more=1) | 0.26 (0.43) |
| Dummy selection process (yes=1) | 0.68 (0.46) |
| Dummy pre-school education (yes=1) | 0.82 (0.39) |
| Math results for public schools | 230.00 (55.14) |
| Language and Communication scores for public schools | 241.42 (47.98) |
| Math results for subsidized schools | 250.26 (57.35) |
| Language and Communication scores for subsidized schools | 257.32 (48.49) |
| Math results for private schools | 286.57 (62.35) |
| Language and Communication scores for private schools | 279.73 (49.09) |
| Public Schools | 0.46 (0.49) |
| Subsidized Schools | 0.41 (0.49) |
| Private Schools | 0.13 (0.34) |

Number of observations: 241,796. Source: SIMCE, 2003