PEER EFFECTS AND RELATIVE PERFORMANCE OF VOUCHER SCHOOLS IN CHILE

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Abstract

The empirical literature developed to evaluate the voucher system in Chile faced, up until late 1999, methodological and/or data limitations. Since then, the literature has used individual data and introduced a correction for selection bias. However, the treatment parameters do not take into account that voucher schools work with different budgets. Also, the importance of the peer effect has not been discussed in the treatment literature.

In the first section of this paper we control for the amount of additional per capita government funds received by public schools. We find that when public and private voucher schools receive similar per capita subsidies, the effect of treatment on the treated (where treatment is attendance to a private voucher school) is large in magnitude and statistically significant.

Since this result could be the consequence of sorting and the peer effect, and not of the effectiveness of private voucher schools, in the second section of the paper we estimate new treatment parameters, controlling for peer group characteristics. However, even when we condition on peer group characteristics, we find a treatment parameter that is positive, large in magnitude and statistically significant (when public and private voucher schools receive similar per capita subsidies). Hence, positive treatment effects are not due to the peer effect and/ or sorting.

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INTRODUCTION

In Chile a voucher system was introduced in education in 1982. This is the only education voucher system established at a national scale and that has data for more than 15 years. Its evaluation is of great interest to evaluate the arguments of the theoretical literature on the advantages and disadvantages of the voucher system (and on the proper design of a voucher system, an issue whose importance is not sufficiently emphasized in the literature). The lack of sufficient empirical evidence on the effects of vouchers has hindered the advance of knowledge in this area[1].

The empirical literature developed to evaluate the voucher system in Chile, in many cases faced methodological and/or data limitations[2]. Up until late 1999 there was no individual data available, and papers used the school as a unit of study (see for example Mizala and Romaguera (2000)). Additionally, these studies lacked good information on the socioeconomic characteristics of the students, and they were unable to correct for selection bias in the estimation of the treatment effects[3]. Only the most recent literature (see for example Contreras (2001), Tokman (2002)) use individual data and introduce a correction for selection bias. In general these papers found significant differences in test scores between public and private

[1] See Sapelli (2002).
[2] For a discussion of the empirical literature in Chile, see Sapelli and Vial (2002).
[3] Another usual methodological problem in this empirical literature, is the inclusion of school inputs in the estimation, confounding the estimation of production functions with the estimation of treatment effects.

voucher schools. However, they did not take into account that some public schools receive additional resources from the government, through municipal transferences or through the participation in special government programs.

In the first section of this paper we present results on the treatment effect associated with the attendance to a private voucher school instead of a public one. The novelty of our estimation is that we separate geographical areas according to the amount of per capita funds received by the public schools from the government. In areas where public and private voucher schools receive similar per capita subsidies (i.e., where private voucher schools receive up to 25% less funds than public schools), we find that the effect of treatment on the treated (TT) is large in magnitude and statistically significant.

Some fear that this result may be the consequence of sorting and the peer effect, and not the consequence of the effectiveness of private voucher schools (see for example, Mc Ewan and Carnoy (1998) and Hsieh and Urquiola (2002)). The key problem with those studies is the issue of causality. Hsieh and Urquiola show that higher enrollment in private schools coexists with lower test scores in public schools in the same municipality. This could be proof of the peer effect, and that is their conclusion. However, an alternative explanation is that entry is endogenous and occurs first where municipal schools are doing a poor job (see Hoxby (2001)). However, the authors do not perform a test that explicitly controls for endogeneity. Gallego (2002) finds that the issue is crucial: results with and without controlling for endogenous entry differ significantly. After controlling for

endeogeneity, he finds that competition from private subsidized schools *increase* the test scores of municipal schools[4].

To analyze the importance of peer effects on our results, in the second section we estimate new treatment parameters controlling for peer group characteristics. If the positive treatment effect estimated in the first section were exclusively the result of a sorting process and the peer effect, this new treatment parameter should be zero. Actually, even when we condition on peer group characteristics, we find a positive TT in geographical areas where public and private voucher schools receive similar per capita subsidies. In general this new estimation is an underestimate of the treatment parameter we would find if we were able to perform the proper experiment (see section II). The new treatment parameters estimated corroborate the robustness of our previous results.

I. ESTIMATING TREATMENT EFFECTS

In this section we estimate treatment parameters using the normal model[5]. We use individual data for the test taken in 1998 to the second grade of secondary school[6]. A parallel survey that can be matched to test results, produced the data on individual socioeconomic characteristics. We also use information on the characteristics of the schools and the centrally designed programs in which they participate, and in the transfers they receive from municipalities.

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[4] Note that Gallego obtains the same results as HU when not controlling for endogenous entry.

[5] For an explanation of the normal model, see Heckman, Tobias and Vytlacil (2000).

[6] We present results based on language test scores. The results obtained with math test scores are similar.

Normal Model

We assume that, given school characteristics, potential test scores in public and private voucher schools (Y_0 and Y_1 correspondingly) are determined by student's characteristics (including income group, mother and father education, and a dummy indicating whether the child comes from an indigenous family). Public and private voucher schools exploit differently those characteristics; so potential test scores in each type of school are different.

We assume that potential test scores can be represented as:

$Y_D = X\beta_D + u_D$

Where D is defined as D=1 if the student chooses a private voucher school, and D=0 if the student chooses a public school. The selection rule is defined as follows:

$D=1$ *if* $D^*=Z\theta+u>0;$ $D=0$ *otherwise*

Where D^* denotes the net gain associated with the attendance to the private voucher school.

The vector of observable characteristics affecting school choice, Z, includes the variables of the outcome equation, X, in addition to other variables that are supposed to affect choice without affecting test scores[7]. We assume that the error

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[7] Those exclusion restrictions are supposed to capture the effect of school availability on the school selection. See Sapelli and Vial (2002) for a discussion about the assumptions behind those exclusion restrictions.

terms are normally distributed, $\begin{bmatrix} u_0 \\ u_1 \\ u \end{bmatrix} \sim \sigma\left(0, \begin{bmatrix} \sigma_{00} & \sigma_{10} & \sigma_{u0} \\ \sigma_{10} & \sigma_{11} & \sigma_{u1} \\ \sigma_{u0} & \sigma_{u1} & 1 \end{bmatrix}\right).$

Then, the average treatment effect (*ATE*) and the effect of treatment on the treated (*TT*) conditional on *X* are defined as follows:

$$ATE(X) = X(\beta_1 - \beta_0)$$

$$TT(X, Z, D = 1) = X(\beta_1 - \beta_0) + (\rho_1\sigma_1 - \rho_0\sigma_0)\lambda(-Z\theta)$$

Unconditional parameters are obtained as the average of the conditional parameters over the relevant sample as an approximation. Standard errors are computed using parametric bootstrapping[8].

Controlling for per capita subsidies

In Chile some schools receive financial assistance from the government above and beyond the value of the voucher. Thus, not all the schools considered in the estimation are working with the same per capita subsidy. To try and solve this problem, we separate the geographical areas according the per capita subsidy received[9].

We first separate the data set by area of residence, and we estimate the average municipal funds transferred to public schools in each geographical area. We then estimate the funds received from the central government by public schools in each area. Finally, we sort the geographical areas according to the per

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[8] See Heckman, Tobias and Vytlacil (2000)

[9] For this purpose we use SUBDERE information on municipal funds transferred to municipal schools, and MINEDUC information on school participation in the two most important central government programs for High School (Montegrande and PME). See Sapelli and Vial (2002).

capita subsidy received by public schools, and we construct quintiles (each quintile with approximately 20% of High School students)[10]. The weighted average (by number of students) of annual transfers per student is US$48 in the first quintile; US$64.9 in the second; US$95.6 in the third; US$135.4 in the fourth; and US$278.8 in the fifth quintile. This implies, using US$393.5 as the annual standard voucher transfer in 1998, an increase that ranges from 12% in the first quintile and of 71% in the fifth[11].
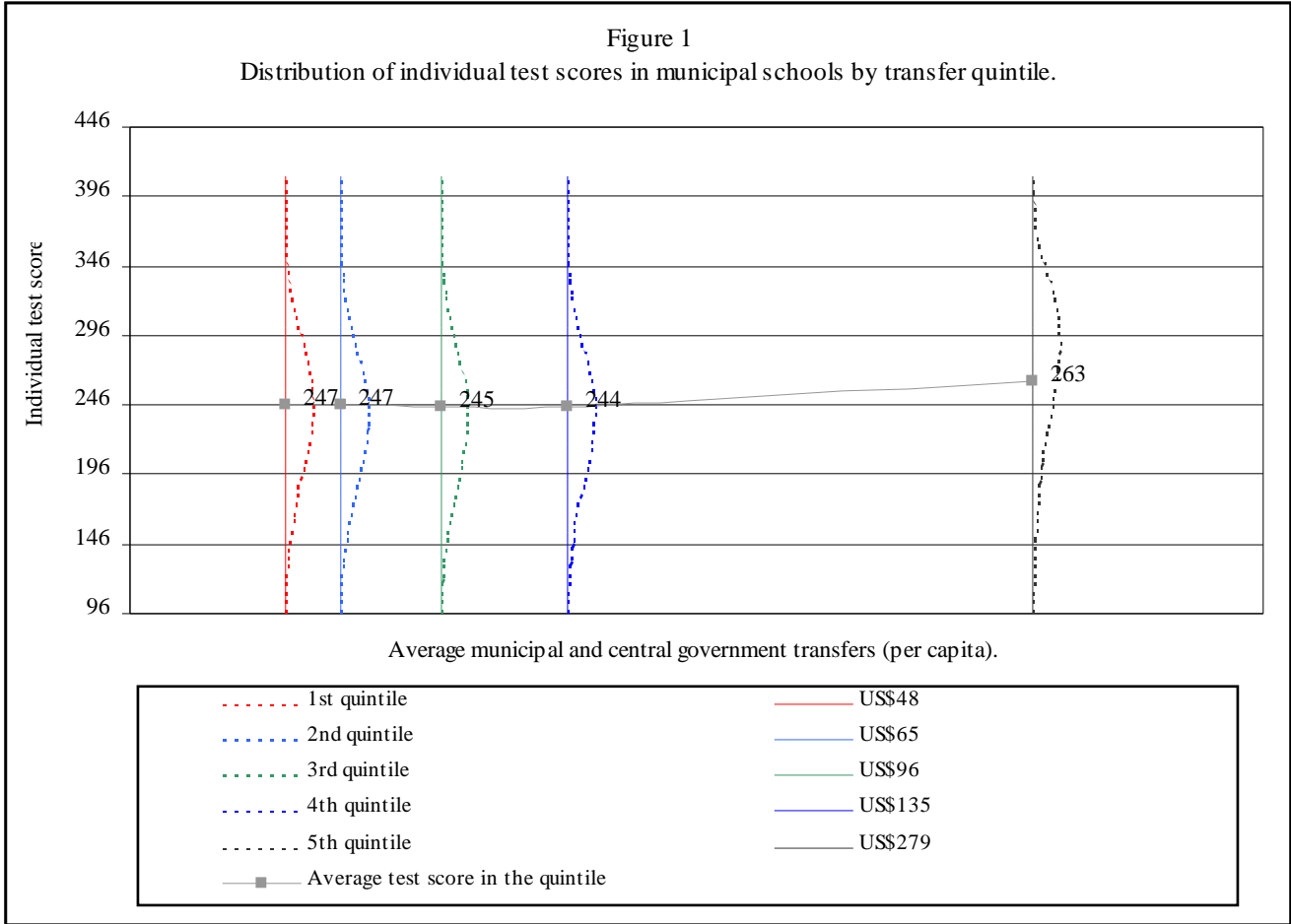
Figure 1 shows the distribution of language test scores by transfer quintile. As we can see in the figure, in the first four quintiles the average scores are similar. However, students attending public schools in the fifth quintile seem to obtain significantly greater test scores.

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[10] We try alternative groups, using information on the funds received by voucher schools. The results obtained with those groups are similar to those presented here.

[11] The transfers increase the budget by 12% in quintile 1, 16% in quintile 2, 24% in quintile 3, 34% in quintile 4 and 71% in quintile 5.

Figure 1
Distribution of individual test scores in municipal schools by transfer quintile.

...... 1st quintile	—— US$48	
...... 2nd quintile	—— US$65	
...... 3rd quintile	—— US$96	
...... 4th quintile	—— US$135	
...... 5th quintile	—— US$279	
■ Average test score in the quintile		

Since the first quintile includes public and private voucher schools that work approximately within the voucher value, it gives us the most "pure" voucher comparison. A possible criticism to this approach is that private voucher schools also receive additional financing. In effect, they can charge fees up to a limit (through a system known as "Financiamiento Compartido" (FC), or shared financing). However, in our data set (1998), 62% of the voucher students attend a FC school; but in the first quintile only 36% of the voucher students do. According to the Ministry of Education of Chile[12], the average annual fee charged through FC

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[12] See the web page, www.mineduc.cl.

was Ch$55,000 (approximately US$ 121 per year). Hence, the average per student contribution received through FC, in the first quintile, was Ch$19,800 (approximately US$ 44 per year). The additional funds received by public schools from the government in the first quintile amount to US$ 48 per student, on average[13]. Therefore, it is clear that, in the first quintile, public and private voucher schools operate with similar budgets even when we include resources received through FC.

Results

When we run regressions by quintile (see Table 1), we find that students in the first 3 quintiles have TT results that are positive and statistically significant (i.e. voucher students get higher test scores when they attend a private voucher school instead of a public one). Even ATE estimates are statistically significant in the first 3 quintiles on average. However, for the fifth quintile we obtain ATE and TT estimates that are substantially negative. That is, the public schools that receive the most transfers perform substantially better than PS schools. This result shows the importance of attempting to appropriately incorporate the differences in the supply side.

The case that most approximates a "pure" voucher system, that of the first quintile, shows a TT of 23.7 (0.5 SDs, an effect considered large in the literature). In the second and third quintile we still find an effect of TT that is considered

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[13] See Sapelli and Vial (2002).

moderate in the literature.

Table 1: ATE and TT on 1998 Language Test Scores
by transfer quintile (or geographical areas).
PS-MUN

	ATE	TT
Average Test Score (ATS)	248.7	248.7
Test Score Standard Deviation (TSSD)	47.6	47.6
ATE, 1st quintile	5.7	23.7
standard deviation*	(3.0)	(7.4)
% of the TSSD	12%	50%
ATE, 2nd quintile	6.1	14.0
standard deviation*	(1.4)	(3.0)
% of the TSSD	13%	29%
ATE, 3rd quintile	7.4	16.0
standard deviation*	(1.5)	(4.2)
% of the TSSD	16%	34%
ATE, 4th quintile	-3.6	-2.0
standard deviation*	(1.7)	(2.9)
% of the TSSD	-7%	-4%
ATE, 5th quintile	-75.2	-97.6
Standard deviation*	(2.9)	(3.1)
% of the TSSD	-158%	-205%

*Standard Errors are estimated using parametric bootstrapping

When we replicate these estimations using 1999 data (for fourth grade of elementary school), we obtain a similar pattern of results. Indeed, we find an even larger TT for the first quintile, of 42.2 (almost one standard deviation).

II. EVALUATING THE IMPORTANCE OF PEER EFFECTS

The results described in the preceding section tell us that in areas where public and private voucher schools receive similar subsidies, voucher students get higher test scores when they attend a private voucher school instead of a public one. Thus, if we imagine an experiment moving a student from a private voucher school to a public school (Experiment 1), our findings show that his/her test score will be reduced.

Some analysts fear that those results are the consequence of the sorting process and the peer effects associated, and not the consequence of a better performance of private voucher schools. In this section we test and reject this hypothesis.

Test formulation

Consider first two polar scenarios:

- Case1: Public and Private voucher schools are equally effective providers of education, and peer group quality is an important determinant of the student achievement. Thus, private voucher schools get better results only due to the sorting process and the peer effect associated. Case 1 is consistent with Epple and Romano (1998), who assume that achievement, $a = a(b, \bar{b})$, is an increasing function on the student's ability and the mean ability of the student body in the school attended, s (see Epple and Romano (1998), pp. 36)[14].

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[14] Sapelli (2003) discusses the assumption that only the mean of peer's ability is important. He argues that other moments of the distribution of peer's ability should affect the student's achievement. He finds that a larger standard deviation (SD) of ability in schools, implies lower test

- Case 2: Private voucher schools are more effective in the production of education. Peers' abilities do not affect the student achievement, i.e., $a = a(b, s)$ in the previous notation. Thus, private voucher schools get better results because they *are* better. This case is consistent with the hypothesis that, since both types of schools face different incentives, they exploit differently the student's characteristics, so potential test scores in each type of school are different.

If Case 1 is true, the positive TT we found in the previous section is the result of the sorting process. Since voucher students get better results in private voucher schools only due to the class composition, if we imagine an experiment moving a voucher student *with all his classmates* to a public school (Experiment 2), we would find no effect on test scores. This is the motivation for our test: we control for peer group characteristics in the regression (we include mean and standard deviation of mother's education in the class) and estimate new treatment effects (denoted ATE_{PEERS} and TT_{PEERS}). When we estimate TT_{PEERS} we use classmate's characteristics in the private voucher school to predict test scores in the municipal school. Therefore, with TT_{PEERS} we obtain an estimation of the result of Experiment 2[15]. Then, if Case 1 were true, TT_{PEERS} should be zero.

If Case 2 is true, the positive TT we found in the previous section reflects that Private voucher schools are better (at least for voucher students). But if more educated parents choose better schools, we will find better peers attending to

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scores, ceteris paribus. The issue is important, since we cannot change the mean by sorting, but we can lower the average of all schools SD by sorting (i.e. average class SD can be much lower than population SD).

[15] A positive TT_{PEERS} shows that the students' test score should *decrease* as a result of the Experiment 2.

better schools. Thus, peer group characteristics are related to school type. It follows that when we control for peer group characteristics in the regression, we are violating the no-feedback condition for treatment effect estimation (see Heckman (2001)). The violation of the no-feedback condition implies that if Case 2 were true, TT_{PEERS} should be lower than the treatment parameter that was correctly estimated in the previous section. The reason is that better peers are related to better schools, so when we condition on peers' characteristics, part of the treatment effect is lost[16].

If the true case is neither Case 1 nor Case 2 but an intermediate one, TT_{PEERS} is still an *underestimate* of the treatment parameter that we would find if we were able to perform Experiment 2. Therefore, in general TT_{PEERS} is neither a good estimate for the treatment parameter we are looking for in this section (Experiment 2), nor for the treatment parameter we were looking for in the previous section (Experiment 1)[17]. But we can think on TT_{PEERS} as a lower bound of the treatment parameter that we would find if we were able to perform Experiment 2 (which we will denote TT_2 from now on).

Results

Table 2 shows the treatment parameters obtained when we control for mean and standard deviation of mother's education in the class[18]. The most important

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[16] In the fifth transfer quintile, where municipal schools obtain better results, we expect that TT_{PEERS} will be higher than TT estimated in the previous section, because in this case better parents choose municipal schools instead of voucher schools.

[17] Note that both experiments a constitute a partial equilibrium analysis.

[18] We also tried with other specifications, and we found similar results.

result is that we still obtain a large and statistically significant TT_{PEERS} in the first transfer quintile. Thus, we reject the hypothesis that Case 1 is the true scenario.

The estimated treatment parameters are remarkably similar to those obtained in the previous section, considering that in this estimation we are violating the no-feedback condition. As we expected, for the transfer quintiles where we obtained positive TT estimates in the previous section (which we will denote TT_1 from now on), we obtain $TT_{PEERS} < TT_1$[19]. As we noted before, we expect that in those quintiles $TT_{PEERS} < TT_2 < TT_1$.

Table 2: ATE and TT on 1998 Language Test Scores
by transfer quintile (or geographical areas), controlling for peers.
PS-MUN

	ATE	TT
Average Test Score (ATS)	248.7	248.7
Test Score Standard Deviation (TSSD)	47.6	47.6
1st quintile	1.5	18.7
Standard deviation*	(2.5)	(7.7)
% of the TSSD	3%	39%
2nd quintile	2.1	6.1
Standard deviation*	(1.3)	(3.1)
% of the TSSD	4%	13%
3rd quintile	3.7	5.9
Standard deviation*	(2.1)	(4.7)
% of the TSSD	8%	12%
4th quintile	-8.3	-11.6

[19] And in the fifth quintile, where TT_1 was negative, we obtain $TT_{PEERS} > TT_1$.

Standard deviation*	(1.9)	(3.2)
% of the TSSD	-17%	-24%
5th quintile	-43.1	-54.5
Standard deviation*	(4.5)	(5.6)
% of the TSSD	-90%	-114%

*Standard Errors are estimated using parametric bootstrapping

III. FINAL REMARKS

The evaluation of a voucher system includes the consideration of several aspects. We focus our attention on the relative performance of private and public voucher schools. To evaluate the effectiveness of private versus public voucher schools, it is important to compare schools with similar budgets. For this purpose we separate geographical areas according to the funds received from local and central government in addition to the voucher, and we estimate treatment parameters by geographical areas.

In the second section of the paper we evaluate the importance of peer effects on the treatment parameters. We estimate a new treatment effect, the result of an experiment moving a student with a all his/her classmates from a private to a public voucher school. This new treatment parameter answers a different question (the outcome of a different experiment). Hence, it cannot be considered as a better estimate of the treatment parameter estimated in the first section. If the treatment parameter estimated in the first section were exclusively the result of the sorting process and the peer effect, the new treatment parameter should be zero. This hypothesis is rejected with our data.

It is worth noticing that we are not trying to estimate peer effects and our results do not imply that the peer effect does not exist. We believe that there is a lot of work to do on this topic.

Concluding, after controlling for budget differences and for socioeconomic characteristics of the students and their peers, we find a new treatment parameter that is positive, large in magnitude and statistically significant. Taking into account peer effects does not invalidate the results. Hence, it is shown that positive treatment effects are not due to the peer effect and sorting.

REFERENCES

Contreras, Dante. "Evaluating a Voucher System in Chile. Individual, Family and School Characteristics", Working Paper No. 175, Facultad de Ciencias Económicas y Administrativas, Universidad de Chile, March 2001.

Epple, Dennis and Richard Romano. "Competition between Private and Public Schools, Vouchers, and Peer Group Effect", *The American Economic Review*, Vol. 88, No.1, March 1998, pp. 32-62.

Gallego, Francisco. "Competencia y Resultados Educativos: Teoría y Evidencia para Chile", *Cuadernos de Economía*, No. 118, December 2002.

Heckman, James, "Micro Data, Heterogeneity, and the Evaluation of Public Policy: Nobel Lecture", Journal of Political Economy 109 (4)673-748, 2001.

Heckman, James, Justin Tobias and Edward Vytlacil, "Simple Estimators for Treatment Parameters in a latent variable framework with an application to estimating the returns to schooling", NBER Working Paper 7950, 2000

Hoxby, Caroline "Do Private Schools Provide Competition for Public Schools?" Working Paper 4978, NBER, December 1994.

Hoxby, Caroline, "Does Competition Among Public Schools Benefit Students and Tax Payers?", American Economic Review, 9 (5): pp. 1209-1238, December 2000.

Hoxby, Caroline, School Choice and School Productivity (Or Could School Choice be a Tide that Lifts All Boarts?), NBER Working Paper No. 8873, 2001.

Hsieh, C. and M. Urquiola (2002), "When Schools Compete, How Do They Compete? An Assessment of Chile's Nationwide School Voucher Program", NBER Working Paper 10008, 2003.

Mc Ewan, P. and M. Carnoy (1998), "Competition and Sorting in Chile's Voucher System", mimeo, Stanford University.

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

Sapelli, Claudio and Bernardita Vial. "The Performance of Private and Public Schools in the Chilean Voucher System", *Cuadernos de Economía*, No. 118, December 2002, pp. 423-454 (see volcan.facea.puc.cl/economia/publicaciones/cuadernos/cuadernos118.htm).

Sapelli, Claudio. "La Economía de la Educación y el Sistema Educativo Chileno", *Cuadernos de Economía*, No. 118, December 2002, pp. 281-296. (see volcan.facea.puc.cl/economia/publicaciones/cuadernos/cuadernos118.htm)

Sapelli, Claudio. "The Chilean Voucher System: some new results and research challenges", *Cuadernos de Economía,* No. 121, Diciembre 2003, pp. 530-538.

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