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Central Mandates and Local Incentives: The Colombia Education Voucher Program

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In decentralized education systems programs that promote central mandates may have to be devolved to local governments, communities, and providers. When participation by local governments and providers is voluntary rather than compulsory, the determinants of program placement are important in predicting potential benefits to individuals. This article analyzes incentives for municipalities and private schools to participate in Colombia's voucher program. It finds that the demand for secondary education relative to the capacity of public schools and the availability of spaces in private schools in the municipality were key predictors of municipal participation, whereas the number of underserved students had a nonlinear effect on participation. Schools whose educational quality was moderate and charged moderate tuition fees were the most likely to participate; the program was less attractive to schools whose quality and fees were high and to schools whose quality and fees were low.

The debate regarding the use of vouchers for private schools, whether in industrial or developing countries, centers on issues of equity and efficiency (see Levin 1991, 1992; Henig 1994; and CERI, OECD 1994 for a summary of the arguments). Proponents claim that vouchers provide the poor with a way out of overcrowded or low-quality schools by allowing them to enroll in private schools that they would otherwise not be able to attend. Furthermore, if competition for voucher students impels both private and public schools to improve, then vouchers make the delivery of education per public dollar spent more efficient.[1] Proponents also see vouchers as a means of transferring some control over educational resources from the central or local government to parents and students. In countries where educational policy decisions are heavily

1. Moreover, there is consistent evidence that children perform better in private schools than in public schools in developing countries, even when accounting for selection. See Jimenez, Lockheed, and Paqueo (1991) and Lockheed and Jimenez (1994) for reviews of this literature.

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centralized, vouchers represent a dramatic shift in the locus of decisionmaking, with great potential to improve efficiency.

Opponents counter that vouchers rob public schools of much-needed resources, that vouchers are used by richer students who would have paid for private school anyway, and that private schools can pick and choose among students, leaving public schools with the worst students. Winkler and Rounds (1993) find that parents select private schools based on the characteristics of the students already enrolled. As a result private schools tend to have a continuing advantage in attracting students with higher socioeconomic status. Opponents also counter that unless an efficient information system is developed to publicize the relative quality of different private schools, parents and students will make uninformed choices—a situation not likely to induce schools to improve their performance.

These efficiency issues are important for assessing the role of vouchers in industrial countries; however, they may be only secondarily so in developing countries, where the education choice is not whether to attend public school or private school, but whether or not to attend school at all, given the absence of a nearby school. Expanding access to any school—not widening the choice of school—is probably the best argument in favor of vouchers in these countries. Partnerships with the private sector, which could lead to huge gains in enrollment, are a pragmatic response to strained or inadequate public school capacity, especially in poor rural areas or in overpopulated cities. High population growth rates will only exacerbate the problem over time. Without private schools, many children will not be able to attend school at all. Indeed, the proportion of secondary students in private schools in developing countries is roughly double the median in industrial economies (James 1993).

Previous research on vouchers has concentrated almost exclusively on evaluating the benefits of giving parents and students greater choice by comparing students' performance in public and private schools. Witte's (1996) review of the literature contends that there is no evidence of increased achievement in private schools, once we control for private schools' nonrandom selection of students with potentially higher abilities. In fact, Hoxby (1996), simulating the effect of vouchers on student achievement, argues that vouchers would improve test scores averaged across all schools, but would lower test scores in private schools. Average scores would rise because of improved public school efficiency, necessitated by greater competition for students. However, Murnane, Newstead, and Olsen (1985), Sander (1996), Neal (1997), Sander and Krautmann (1995), and Witte (1996) find that attending Catholic school improves student achievement, even after controlling for selection, and raises the probability of attending college. Hoxby's (1996) and Lankford and Wyckoff's (1992) simulations based on school choice models predict that vouchers would increase private school enrollment, but would not affect private school students who were poor or whose parents had less education.

The evaluation of Chile's voucher program, one of the oldest voucher programs in the developing world, has been the subject of debate as well. Winkler

and Rounds (1996) and Gauri (1998) find that students with higher socioeconomic status were significantly more likely to enroll in better-performing schools than were students from lower-income families. Rodríguez (1988, as cited by Gauri) concludes that private subsidized or voucher schools in Santiago outperformed the public centralized schools that still existed at that time. Parry (1993, as cited by Gauri) regresses schools' average scores in a national standardized test on average characteristics of the students and finds that, although municipal schools scored higher than voucher schools when parents had relatively little education, voucher schools scored higher when parents were relatively more educated.

This research, however, generally ignores the supply response of providers, assuming that students are able to find space in a private school with attributes equal to those of the average private school. In reality, private schools may refuse to participate in a voucher program, as may local school boards, if participation is voluntary. Hence, the subset of participating providers may differ significantly from the full population of private schools. The potential benefits of the program, whether in terms of enrollment or student learning, will then depend on the willingness of local communities and schools to participate.[2]

In this article we examine the extent to which a central government is able to attain a national goal of expanding enrollment, especially among the poor, even as it transfers power to local governments and private providers. Voluntary program participation and cost-sharing schemes between the central government and local governments are gaining currency in developing countries and are consistent with shifts toward more decentralized delivery systems. We study Colombia's national voucher program for secondary education, which the government launched in late 1991 and terminated in 1997.

True to Colombia's broad decentralization reforms of the early 1990s (Montenegro 1995; Hanson 1995), municipalities and schools participated in this voucher program voluntarily, and municipalities assumed part of the cost of the program. Two key assumptions of the program were that public schools, especially those in large cities, were overcrowded and that private schools had excess capacity. Vouchers for use in private schools were viewed as a means to expand enrollment in secondary schools at relatively low cost, while reducing the

2. The absence of a broad-based voucher program has made it impossible to estimate the supply response of private schools and municipalities to such a system. Witte (1996: 170) argues, "Nearly all quantitative estimates of [voucher effects on] school selection and the effects of school choice on performance are based on extrapolations from the current system of education. However, a broad based voucher system . . . might create such a different market for education that estimates based on the current arrangements would be meaningless."

To develop reasonable estimates of the effects of a voucher program, it is important to observe how schools respond to the existence of a voucher program, but "current experiments with vouchers . . . are simply too small to provide evidence of market reactions by either the public or private sectors" (Witte 1996: 172). Witte contends that the crucial information on how schools respond to vouchers will be available only when a large-scale voucher program is implemented. Until then, researchers will not be able to establish the validity of simulations based on existing schools.

enrollment pressure on public schools.[3] In addition, encouraging more private provision without directly subsidizing specific schools was seen as a way to elicit better performance from private schools. Vouchers could also improve the quality of public schools by reducing overcrowding, thereby easing the pressure on resources in public schools.

We examine whether the decision of municipalities and private schools to participate in Columbia's voucher program was consistent with stated national objectives. In particular, did municipalities' excess demand for secondary education or private schools' desire to reach poorer households significantly influence participation?

I. Colombia's Voucher Program

Colombia launched its national voucher program near the end of 1991 as part of a broader transformation, begun in the late 1980s, to decentralize the organization and management of its education system. Hanson (1995) traces the impetus for decentralization to the growing awareness among Colombia's elite of the need to establish the legitimacy of the government and its institutions as a means to deal with the country's increasing violence. The strategy for establishing legitimacy hinged on giving people participatory control over public institutions. By the late 1980s several government institutions, including the educational system, had begun to decentralize. The new constitution of 1991 codified and integrated these initiatives.

Together with other reforms, the voucher program was meant to address deficiencies in the performance of the public education system, especially the low transition rate from primary to secondary school among the poor. In 1992 only 51 percent of 13–19-year-old urban youths belonging to the poorest quintile were enrolled in school, compared with 75 percent of those in the richest quintile (World Bank 1994). The shortage of space in public schools, especially in large cities, where demand was thought to be greatest, was seen as a real problem.

The Ministry of Education initially targeted the country's 10 largest cities for participation in the program. Adoption was ultimately voluntary, although the Ministry may have pressured cities to join. In 1991 the Ministry of Education held a meeting with the heads of departments (states) to announce the program. The meeting elicited subsequent letters of intention to participate from departments and municipalities, as well as statements about which municipalities were not able or likely to join. The program grew nationally and during its most active year, 1995, had 217 participating municipalities in 27 of the country's 30 departments. In 1995 the government awarded about 90,000 vouchers to students in 1,800 private schools. Voucher students made up 8 percent of all students in

3. Limited evidence supports the conclusion that vouchers raise enrollment. Ribero and Tenjo (1997) find that in Bogotá, where there were too few vouchers to meet demand, enrollment rates for students who received vouchers were 12 percentage points higher than for students who qualified for but did not receive vouchers.

private secondary schools. Student applicants had to have graduated from primary school (completed fifth grade) and been admitted to a participating private school. Awardees could renew their vouchers in the subsequent year only if they were promoted to the next grade. Dropouts and repeaters automatically lost their vouchers.

Although participation in the program was widespread, most of the vouchers were issued in large urban areas, where private schools are concentrated. Ten departments absorbed more than 70 percent of all vouchers issued, with the capital city of Bogotá alone taking 13 percent.[4] Participation was contingent on the municipality's willingness to cofinance and administer the program. The municipality provided 20 percent of the funds for the vouchers issued in its area, and the central government provided the remaining 80 percent.[5]

By design, Colombia's program avoided two common criticisms of voucher programs. First, the program did not threaten the resources available to existing public schools. The government assured public schools that current levels of funding would not decrease. This promise eliminated competition over finances, although public and private schools still had to compete for voucher students, especially because municipalities were able or willing to fund only a limited number of vouchers. In fact, each year the demand for vouchers exceeded the supply in nearly all participating municipalities. Conversations with officers from the administering agency, the Colombian Institute for Education Credit and Training Abroad (ICETEX), suggested that anywhere from 20 percent (in the department of Atlántico) to 90 percent (in Antioquia) of qualifying applicants received vouchers. In many cases where supply exceeded demand, a lottery was used to select beneficiaries. Because this lottery randomized the selection of students for the program, it provided a valuable mechanism for assessing the program's impact on individual students. Angrist and others (1999) examine this.

Second, only the poor qualified for vouchers, countering the claim that vouchers amount to a net subsidy for the wealthy at the expense of the poor. The targeting criterion used was based on a neighborhood stratification scheme that ranks neighborhoods on a scale of 1–6, from poorest to richest. A national poverty map, derived from five poverty indicators and used to distribute other transfers, established the socioeconomic status of different neighborhoods.[6] Only stu-

4. See King and others (1997) for more details about the program.

5. The agreement included additional conditions that did not relate directly to the program but were part of the decentralization reform. Municipalities had to agree to the terms of Law 160, which transferred responsibility for maintaining public schools from the central to the municipal government, and had to maintain a system of accounts that satisfied nationally prescribed standards.

6. The poverty map index, *Necesidades Básicas Insatisfechas,* was computed on the basis of five indicators: the proportion of households living in inadequate homes (such as homes without walls), the proportion of households without an adequate water supply or sanitation services, the proportion of households living in overcrowded quarters (defined as an average of more than three people per room), the proportion of households with high economic dependency (defined using the ratio of all household members to employed household members and the educational attainment of the household head), and the proportion of households with children between the ages of 6 and 12 years who were not enrolled in school (Colombia, Department of National Planning 1994).

dents residing in neighborhoods ranked 1 or 2 were eligible to receive a voucher. Morales-Cobo (1993) and Ribero and Tenjo (1997) conclude that the program's geographical targeting mechanism was accurate in delivering vouchers to poor students.[7] In order to establish a student's socioeconomic status, and thus eligibility, the program required that each applicant present a national identification card or utility bills to verify residence.

The voucher covered the cost of tuition—the yearly entrance fee plus monthly fees—for students in sixth to eleventh grade, subject to an upper limit. ICETEX, which administered the program for the Ministry of Education, set the maximum value of the voucher each year. In 1995 the voucher was worth a maximum value of Col$145,307 (Colombian pesos) or about $180 (U.S. dollars), with the actual value of each voucher depending on the prevailing tuition fee in the school in which the voucher was to be used.[8] This upper limit met or exceeded the annual fees of lower-priced schools, but covered less than half of the cost of the highest-priced schools.

Since the voucher did not make all private schools affordable to poor parents, interest was greatest in the lower-cost schools. In our sample of schools the voucher covered only one-fifth of the annual fees of the highest-priced private school. In theory, parents could have used the voucher to pay for part of the fee and paid the balance themselves. However, ICETEX administrators discouraged this practice, fearing that private schools might raise their fees in response, thus transferring part of the effective subsidy from the students to the schools.

II. Municipal Program Participation

In this section we introduce a model that estimates the probability that a municipality will participate in the voucher program. Underlying the model is the assumption that the municipality is responsible for providing secondary schooling, subject to a fiscal constraint. To fulfill this responsibility, the municipality can build public schools or subsidize private schools.

In 1991 Colombia's central government transferred the responsibility for maintaining school facilities to departments and municipalities (Hanson 1995). Each municipality thus inherited a supply gap in secondary schooling, which we call underserved students, $S_U = S_D - S_S$, where S_D is demand for secondary schooling

7. Morales-Cobo (1993) finds that, at least in Bogotá, the program reached its intended beneficiaries. Ribero and Tenjo (1997) find similar success, except that students in neighborhoods ranked 3 received 9–17 percent of the vouchers, depending on the particular municipality. Because residents of these neighborhoods still had below-average incomes, Ribero and Tenjo confirm that the program was relatively well targeted. Under this system of geographical targeting, leakage to unintended beneficiaries is likely, since low-income neighborhoods may have better-off residents. The higher cost of finer targeting, however, justifies a certain degree of leakage.

8. The voucher's maximum value was adjusted annually according to the estimated national inflation rate. The same adjustment was made to the voucher for each participating school, irrespective of changes in fees in those schools. In 1994, for example, the mean value of the voucher ranged from Col$59,700 in the department of Choco to Col$119,100 in Quindío.

and S_S is the sum of secondary enrollment capacity in public and private schools. If $S_U \leq 0$, then secondary schooling capacity exceeds demand, and there is no need to expand supply. If $S_U > 0$, then the municipality must decide how to expand secondary school capacity, conditional on having the funds to finance that expansion.[9]

Model

If the municipality chooses to participate in the voucher program, it faces a cost, v, per student for the voucher plus administration and advertising costs of $a(t)$ per student. We assume that these administrative and advertising costs decrease in the taste for private school, t, because there would be less need to motivate parents of underserved students to participate in the voucher program if there were a strong tradition of private education in the municipality. As an alternative to the voucher system, the municipality has the option of increasing public school capacity.[10] This strategy has very high fixed costs relative to the voucher program. However, as the number of underserved students increases, the average cost of this option, $C(S_U)$, declines. If it falls below $v + a(t)$ over the range $(0, S_U)$, the municipality's cost-minimizing choice would be to increase public school capacity.

The municipal choice is illustrated in figure 1. Assume initially that the average cost of providing a voucher is $v + a(t_0)$. The average cost of expanding public school capacity is given by $C(S_U)$. If the number of underserved students is positive but below S_U^0, and there is no capacity constraint on private schools, the municipality will opt for the voucher program, it being the least-cost means of adding secondary school capacity. Beyond S_U^0 and up to S_U^1, the municipality will reject the voucher program in favor of providing additional space in public schools. But municipal choices are not limited to one or the other. If $S_U > S_U^1$, the municipality will provide more public schools up to capacity S_U^1 and then vouchers for $S_U - S_U^1$.

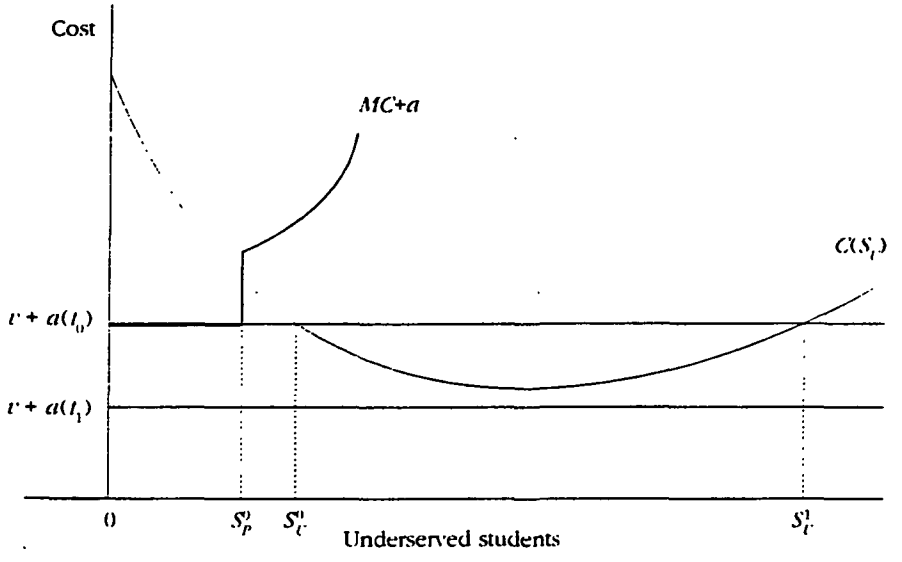
Thus far we have assumed that the municipality knows $v + a(t)$ and $C(S_U)$ with certainty. More realistically, there will be uncertainty regarding the average cost of expanding capacity. Let u_V be a random additive error to the average cost of the voucher, and let u_C be a random additive error to the average cost of school construction. Let V^G be the number of vouchers issued by the municipal government. The probability that the municipality will participate in the voucher program is

$$P(V^G > 0) = P[(S_U > 0) \wedge \{[v + a(t) - C(S_U)] < (u_c - u_v)\}] \tag{1}$$

9. Ministry of Education and departmental officials informed us that the central government had targeted some municipalities for participation, but targeted municipalities could and did turn down the invitation. Furthermore, municipalities that the central government did not target could and did enter the program. Therefore, it is reasonable to model municipal choice as a local decision.

10. Of course, municipalities could reject vouchers and any other role in secondary education. Thus municipalities that opted not to participate in the voucher program did not necessarily expand secondary school capacity by other means.

Figure 1. *The Average Cost of Vouchers Compared with the Average Cost of Increasing Public School Capacity When There Is No Private School Constraint*



Note: S_t is the number of underserved students, and $C(S_t)$ is the average cost of the voucher program. S_P^0 is the number of primary school students. v is the per student cost of the voucher, and $a(t)$ are the administrative and advertising costs. t is the taste for private school.

If S_U is less than 0, $P(V^G > 0) = 0$. In addition, assume that at $S_U = 0$, $C(0) + u_C > v + a_G(t) + u_V$, so that the average cost of increasing public school capacity exceeds the cost of the voucher program at the lowest values of S_U. As a consequence, $P(V^G > 0)$ rises initially as S_U increases from negative to positive values. However, in its most general form, $C(S_U)$ is a convex function, so that $C'(S_U) < 0$ and $C''(S_U) > 0$. Thus as S_U rises above 0, $C(S_U)$ falls, but at a decreasing rate. We would then expect the probability of a municipality participating in the voucher program to vary with S_U according to $dP/dS_U > 0$, $d^2P/dS_U^2 < 0$, and $d^3P/dS_U^3 > 0$.

As familiarity with or taste for private education increases from t_0 to t_1 in figure 1, the unit cost of vouchers falls to $v + a(t_1)$. In this case the voucher program dominates expansion of public school capacity for all levels of S_U, when the average cost of adding public school spaces is given by $C(S_U)$. In general, the lower is $v + a(t)$, the smaller is the range of students (S_U^0, S_U^1) for which $C(S_U) < v + a(t)$, and the higher is the probability that the municipality will opt for the voucher program. In terms of equation 1, $dP/dt > 0$.

Another assumption we have made is that the supply of space in private schools is perfectly elastic, given the voucher price of v. If, instead, space in private schools is limited, then the private capacity to absorb students will also influence the municipality's decision to participate. The marginal cost of expanding private schools will increase when existing capacity is exceeded. If, for example, excess

capacity of existing private schools is S_P^0, the supply curve will have a discontinuous jump at that point, and the number of vouchers offered by the municipality will be less than if supply were perfectly elastic. Therefore, if S_P is excess capacity in existing private schools, we expect $dP/dS_P > 0$.

We have also assumed thus far that municipalities do not face budget constraints. However, as a condition of participation, municipalities had to demonstrate that they had the fiscal capacity to take over the maintenance of public schools. Municipalities with little ability to raise public revenues, B, would be constrained from participating, so that $dP/dB > 0$.

The model of a municipality that minimizes costs suggests that the probability of participation in the voucher program as defined by equation 1 can be operationalized as:

$$P(V^G > 0) = f[\underset{+}{C(S_U)}, \underset{+}{S_P}, \underset{+}{t}, \underset{+}{B}, \underset{-}{v}, \varepsilon] \tag{2}$$

where $\varepsilon = u_C - u_V$, and the expected signs of the partial derivatives of $P(V^G > 0)$ with respect to the explanatory variables are indicated.

Data

We estimate equation 2 using data for 923 municipalities in Colombia, 208 (or 23 percent) of which opted to participate in the program. The 923 represent all of the municipalities in the 28 of 30 departments for which we had the necessary data. We collected program administrative data from ICETEX central and regional offices over 1995–97, and we found data on the characteristics of municipalities from other existing databases (table 1). Since the variables that we are treating as exogenous in the equation could themselves change in response to a municipality's decision to participate or not in the program, we measure all such variables as of 1991, before the voucher program was implemented.

The number of underserved students is the difference between the number of primary school students, S_{1-5}, and the number of secondary school students, S_{6-11}, measured before implementation of the voucher program. Given the goal of universal secondary enrollment, primary enrollment measures the population of potential secondary students. The total number of private and public secondary school students is a measure of existing secondary school capacity. We divide the difference between the number of potential secondary school students and the number of current secondary school students by the number of public secondary school teachers. This measure suggests how many additional students would need to be placed per public classroom in order to cover all potentially underserved students. The resulting measure is

$$S_U = \frac{S_{1-5} - S_{6-11}}{T_{6-11}^G}, \tag{3}$$

Table 1. *Sample Statistics for Participating and Nonparticipating Municipalities*

Variable	*Total*	*Nonparticipants*	*Participants*
Endogenous variable			
Participation decision	0.22	0	1
	(0.41)		
Exogenous variables			
Underserved students (S_U)[a]	12.16	11.27	15.31
	(24.84)	(23.60)	(28.65)
Basic needs index (N)	0.60	0.63	0.51
	(0.21)	(0.20)	(0.20)
Underserved students interacted with basic needs index ($S_U * N$)	8.03	7.72	9.14
	(17.93)	(17.64)	(18.93)
Ratio of secondary private teachers to primary students	0.0052	0.0025	0.015
	(0.012)	(0.0097)	(0.015)
Proportion of private primary students	0.052	0.028	0.14
	(0.10)	(0.07)	(0.13)
Per capita taxes paid (Col$10,000)	0.29	0.22	0.44
	(0.67)	(0.39)	(0.66)
Proportion of primary schools that are rural	0.30	0.31	0.29
	(0.34)	(0.35)	(0.31)
General information			
Pupil-teacher ratio			
Private secondary	15.16	13.06	16.42
Public secondary	18.46	17.49	21.90
Number of students			
Primary	3,537	1,131	12,107
Secondary	3,022	792	10,963
Number of municipalities	923	715	208

Note: Values given are means. Standard deviations are in parentheses.

a. Underserved students = (number of primary students − number of secondary students)/number of secondary public teachers.

Source: Authors' calculations based on program administrative data from ICETEX central and regional offices, 1995–97, and SABER data, 1992–93.

where T^{G}_{6-11} is the number of full-time public secondary school teachers. Larger values of S_U will make it harder for existing public schools to absorb the additional students. Consistent with that presumption, measured S_U was 36 percent higher in participating than in nonparticipating municipalities.

Because vouchers were targeted toward poor students, we use the basic needs index (see footnote 6). This index, N, measures the proportion of the municipal population that is considered poor according to five different poverty indicators. Fifty-one percent of the population in participating municipalities was considered poor, compared to 63 percent in nonparticipating municipalities.

It is possible that existing public schools may have been to provide spaces for poor children in some municipalities. Thus we interact N with S_U to generate a proxy measure of needy underserved students per public secondary school teacher. This measure is 18 percent higher on average in participating than in nonpartici-

pating municipalities. Consequently, before the voucher program began, participating municipalities had a smaller proportion of needy households but a larger proportion of needy underserved students relative to existing public school capacity.

We measure the capacity of private schools to absorb additional students by T^{p}_{6-11} / S_{1-5}, where T^{p}_{6-11} is the number of secondary school teachers (and, presumably, classrooms) in existing private schools. Before the voucher program was established, this ratio was six times higher in participating than in nonparticipating municipalities. In addition, the proportion of primary school students in private school was 0.14 in participating municipalities, five times higher than the proportion in nonparticipating municipalities.

We use two measures of government capacity to raise revenue. The first is the proportion of poor people in the municipality, as measured by the needs index. Poorer municipalities have less capacity to raise revenue, although the average poverty indexes for participating and nonparticipating municipalities were virtually identical. The second measure is 1991 per capita income taxes paid in the municipality. This was two times higher in participating than in nonparticipating municipalities. Participating municipalities also had larger populations of school children. Primary enrollment was nearly 11 times higher in participating municipalities. However, the proportion of rural schools, as designated by the Ministry of Education, was nearly identical across the two groups.

Estimation and Results

The most important parameters in the probit model of voucher participation (equation 2) pertain to the measure of underserved students (table 2). We expect S_U to affect participation in a nonlinear fashion, initially raising and then lowering the probability of participating. We first include a cubic form of S_U. Although the sign pattern corresponds to our expectations, the third-order term is not significant. The results reported in table 2 use a quadratic approximation of S_U. At sample means the marginal effect of this variable is positive. The elasticity implies that a 10 percent increase in the number of underserved students per secondary school teacher would increase the probability of municipal participation by 2.8 percent.

We also trace out the nonlinear effect of S_U using a spline function. The coefficients on the dummy variables representing whether the measure of underserved students was positive, in the upper 50 percent, upper 30 percent, upper 20 percent, and upper 10 percent of the distribution of S_U or NS_U are cumulative (columns 2 and 4 of table 2).[11] That is, other things constant, the total effect of being in the upper 30 percent of the distribution of S_U is the sum of the coefficients on

11. Municipalities that attracted students from surrounding towns show negative values of S_U. The distributional information on S_U and NS_U (table 1) shows that they both turn positive at the thirtieth percentile, so the first dummy variable represents the upper 70 percent of the distribution of underserved students.

Table 2. *Probit Estimates for Municipal Participation in the Voucher Program*

Variable	*1*	*2*	*3*[a]	*4*[a]
$S_U/100$	1.779***		2.667***	
	(3.800)		(3.503)	
	[0.285]		[0.285]	
$(S_U/100)^2$	-0.743***		-1.600**	
	(-2.436)		(-2.277)	
$S_U \geq 0$		-0.0288		-0.034
		(-0.174)		(-0.206)
		[-0.001]		[0.0004]
Municipality is in the fiftieth percentile of S_U distribution		0.327		0.368
		(1.900)		(2.109)
		[0.040]		[0.239]
Municipality is in the seventieth percentile of S_U distribution		0.268		0.249
		(1.360)		(1.262)
		[0.066]		[0.037]
Municipality is in the eightieth percentile of S_U distribution		0.196		0.103
		(0.922)		(0.472)
		[0.075]		[0.025]
Municipality is in the top ninetieth percentile of S_U distribution		-0.105		0.058
		(-0.486)		(0.262)
		[-0.082]		[-0.031]
Secondary private teachers/primary students/100	0.342***	0.341***	0.341***	0.343***
	(8.718)	(8.651)	(8.691)	(8.687)
	[0.265]	[0.264]	[0.264]	[0.268]
Proportion of private primary students	4.091***	4.011***	4.061***	4.006***
	(7.476)	(7.291)	(7.384)	(7.251)
	[0.315]	[0.309]	[0.313]	[0.311]
Proportion of primary schools that are rural	-0.125	-0.161	-0.093	-0.124
	(-0.634)	(-0.797)	(-0.481)	(-0.633)
	[-0.056]	[-0.072]	[-0.042]	[-0.056]
Per capita taxes paid (Col$10,000)	0.0363	0.0566	0.0272	0.024
	(0.448)	(0.640)	(0.340)	(0.296)
	[0.015]	[0.024]	[0.012]	[0.010]
Needs index	-0.966***	-0.960***	-1.224***	-1.368***
	(-3.642)	(-3.577)	(-4.278)	(-4.445)
	[-0.856]	[-0.853]	[-1.087]	[-1.222]
Constant	-0.87***	-0.963***	-0.716***	-0.736***
	(-4.856)	(-4.732)	(-3.837)	(-3.315)
Sample size	923	923	923	923
Log-likelihood	-358.097	-355.594	-358.196	-355.195
Pseudo *R*-squared	0.2729	0.2780	0.2727	0.2766

** Significant at the 5 percent level.

*** Significant at the 1 percent level.

Note: S_U, the number of underserved students, equals (number of primary students – number of secondary students)/number of secondary public teachers. *z*-statistics are in parentheses. Elasticities are in brackets and are computed at the median of the range for the dummy variables.

a. S_U is interacted with the needs index.

Source: Authors' calculations based on program administrative data from ICETEX central and regional offices, 1995–97, and SABER data, 1992–93.

S_U when S_U is positive, in the upper 50 percent of the distribution, and in the upper 30 percent of the distribution. The results suggest a rising probability of participation between the fiftieth and ninetieth percentiles.

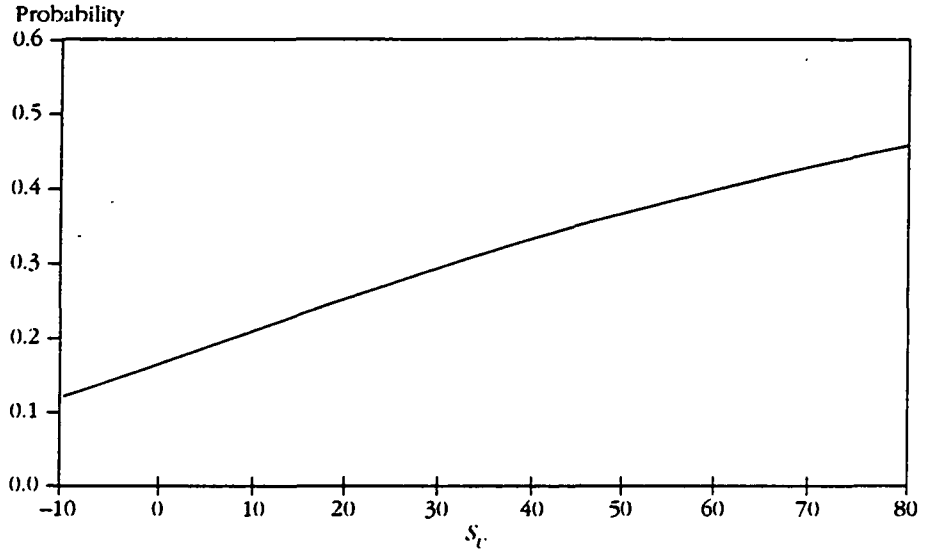
The relationship between $P(V^G > 0)$ and S_U as captured by the equations in columns 1 and 2 are shown in figures 2 and 3. In the quadratic representation (figure 2) the probability rises throughout the sample range of underserved students. The spline function (figure 3) peaks at just over 20 underserved students per teacher, although we cannot reject the hypothesis that the probability of participation is equal for municipalities that fall in the upper half of the range of underserved students.

The model of program participation suggests that municipalities would be more likely to participate if private schools had excess capacity and if the population were already familiar with private schools. Both of these predictions are borne out by the estimates. In all four specifications the ratio of private secondary school teachers to current primary students (a measure of the number of classrooms available for future secondary students) has a strong positive effect on municipal participation. The elasticity suggests that a 10 percent increase in private capacity raises the probability of municipal participation by about 2.6 percent. The elasticity of municipal participation with respect to private schools' share of primary students is 0.32. We speculate that municipalities whose populations are already familiar with private schools would need to exert less effort to promote voucher applications.

We anticipate that municipalities with more limited fiscal resources would be unable to meet the financial requirements of the voucher program. Our results show that higher per capita tax payments increase the probability of voucher participation, although the coefficients are never precisely estimated and imply very small elasticities. Municipalities with a higher proportion of poor people (as measured by the needs index) are significantly less likely to participate, with an elasticity of –0.86. We also expect that the proportion of primary schools that are rural would be associated with lower costs of building new schools and thus a weaker incentive to participate in the voucher program. All four specifications show a smaller probability of participation in more rural municipalities, but the elasticities are extremely low.

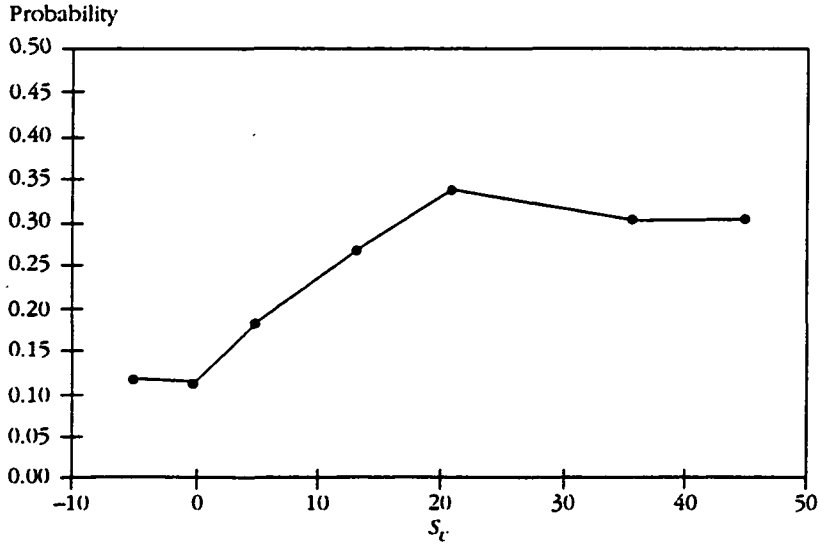
Overall, the results in table 2 are strongly consistent with a model of municipal cost minimization given an obligation to provide secondary schooling to underserved students. To determine if participation was influenced by central government pressure on certain municipalities, we estimate the equation again after eliminating the 10 largest municipalities that were initially invited to participate. The coefficients and significance levels change very little, and signs do not change at all. Thus it seems that municipalities were in fact most likely to use vouchers to address the needs of their students if private schools had excess capacity and if the cost of the voucher program was lower than the cost of expanding public secondary schools.

Figure 2. *Probability of Municipal Participation in the Voucher Program, Quadratic Specification*



Note: S_t = (primary students – secondary students)/secondary public teachers.
Source: Authors' calculations.

Figure 3. *Probability of Municipal Participation in the Voucher Program, Spline Specification*



Note: S_t = (primary students – secondary students)/secondary public teachers.
Source: Authors' calculations.

III. School Program Participation

A school could participate in the voucher program only if its municipality agreed to participate. All private schools were eligible to join. The number of private schools that participated increased steadily between 1992 and 1997. By mid-1995, 1,795 private schools were accepting voucher students. In this section we examine the school's participation decision both theoretically and empirically.

Model

We assume that private schools compete on both quality, q, and price, f, but that public schools offer uniform quality, q_G, at near-zero cost, f_G.[12] Given the available public school, parents will select the ith private school when

$$U(q_i, f_i; Z) \geq U(q_G, f_G; Z) \tag{4}$$

where $U(.)$ is parents' indirect utility, and Z are factors that enter utility and are separable from school quality and price. We assume that school quality raises utility ($U_q' > 0$), school fees lower utility ($U_f' < 0$), and private school fees exceed public school fees ($f_i > f_G$). Therefore, parents must believe that the quality of private schools exceeds that of public schools ($q_i > q_G$) for the condition in equation 4 to hold.

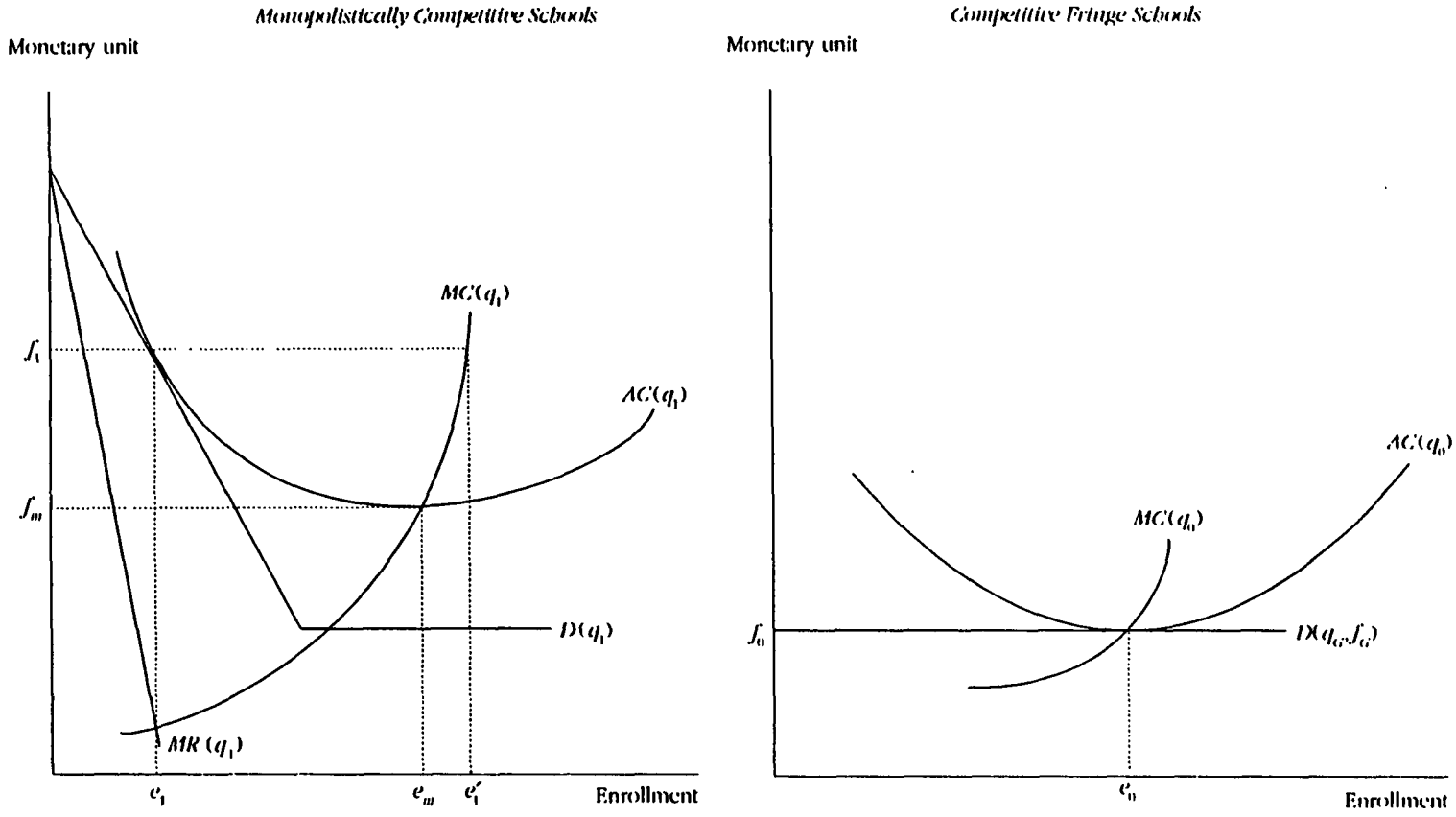
Since barriers to entry for new private schools appear to be low, we assume that private schools will earn no economic profits in the long run. Thus $f_i = AC(q_i)$, the school's average cost of producing quality q_i. Consequently, school fees must increase with school quality to enable the school to break even.[13] There will be a level of school quality, q_0, and fees, f_0, $= AC(q_0)$, that will satisfy condition 4 with equality. These levels will define the competitive fringe of private schools. For competitive schools, f_0 and q_0 are dictated by the market, conditional on the availability of public schools of quality q_G charging f_G.

We illustrate the private school market in figure 4. Competitive fringe schools must provide at least quality q_0 to lure parents away from public schools and must charge fees of f_0 to break even (the right panel of figure 4). Schools could also offer quality above q_0 and then compete on both price and quality as in a monopolistically competitive market. In equilibrium such a school offers quality $q_1 > q_0$ (the left panel of figure 4). Enrollment demand increases as the school lowers its fees and becomes perfectly elastic as the fees approach f_0. However, the

12. This specification contrasts with Manski's (1992) simulation model, which assumes that all private schools charged the same price and offered the same quality. However, Manski (1992: 360) points out that his assumption is too restrictive and that "a more realistic model would permit private schools to set different tuition levels, with associated differences in the quality of the schooling that they offer."

13. In Colombia the correlation coefficients between private tuition fees and average mastery levels in math and language examinations of ninth-grade students are 0.55 and 0.52, respectively. Presumably, there are other school products, such as students' civic awareness or physical safety, that distinguish schools and are not captured by these test scores.

Figure 4. *Representative School Demand and Cost Curves for Minimum- and Intermediate-Quality Private Schools*



Note: f represents school fees, and q represents school quality.

school's optimum fee is f_1. Because entry is easy, the school cannot earn economic profits in the long run, so $f_1 = AC(q_1)$ at an enrollment level of e_1. If all schools decide to offer quality above q_0, then all will be monopolistically competitive.

The voucher program may alter school incentives, depending on school quality and fees. Let v_M represent the maximum value of the voucher allowed. If $v_M < f_0$, no private school could recoup its marginal cost if it offered the minimum quality.[14] If $v_M = f_0$, fringe schools would be indifferent between participating and not participating. Because they can enroll as many students as they want at f_0, they have no need to acquire additional students through the voucher program. In fact, schools on the minimum-quality fringe have no capacity to absorb additional students. Voucher students would have to displace nonvoucher students to leave the school with enrollment e_0 and no economic profits.

Even if $v_M > f_0$, schools in existence when the program was initiated could not benefit from the program. Rules prevented schools from raising fees in the first year of participation. In subsequent years schools were allowed to raise fees only according to an officially sanctioned adjustment for inflation. Thus minimum-quality schools could not raise fees above f_0, which meant that they could not profitably raise enrollment beyond e_0.

For the monopolistically competitive schools whose quality is higher than q_0, the voucher program may provide an incentive to add students. These schools have excess capacity because they can lower their average costs by enrolling more students. If the voucher is equal to f_1, such a school will expand enrollment to e_1' and earn higher economic profits than it did before the voucher program. Even if $v_M < f_1$, the school could profit from the voucher program by lowering its fees to v_M and expanding enrollment according to $v_M = MC(q_1)$, provided v_M is higher than $f_m = \min AC(q_1)$. If this school participates, it will increase its enrollment to at least e_m.[15]

Monopolistically competitive schools will not participate if $v_M < f_m(q)$. Because f_m increases as quality increases, the highest-quality schools will be those for which $v_M < f_m$. For these schools the marginal cost of adding a student exceeds the maximum value of the voucher. Of course, high-quality private schools that already offer need-based scholarships might still participate. The voucher program would allow these private schools to admit poor students using a cofinancing scheme that reduces the burden to their own scholarship program.

14. We assume that schools were not allowed to charge parents more than the amount of the voucher, and, in fact, schools were discouraged from demanding that parents "top up" the voucher. Since vouchers were targeted to the poorest segments of the population, many families did not have much more to offer.

15. In the long run schools will not be able to earn positive economic profits from the vouchers. New schools will enter. If parents can easily obtain and understand information on school quality, a new set of voucher schools will emerge that select quality such that $v_M = \min AC(q) > f_0$. Therefore, in the long run the voucher program should increase the number of intermediate-quality schools. However, the poorest-quality schools will exit because they are now inferior to voucher schools and are excluded from the voucher subsidy.

The simple model illustrated in figure 4 can incorporate cofinancing. Costs of many private schools are partially offset by monetary or in-kind assistance from sponsoring religious or nonsectarian organizations. These transfers lower the schools' average costs by the value of the donation, d, per student. We can also adjust the model to incorporate school administrative costs, a_S. In order to participate in the voucher program, schools had to attract students, elicit applications from families in the lowest income groups, and cooperate with the regional program agency to verify the continued attendance of each voucher student.

The donations and administrative costs are observed with error, u_S. The probability that a school offers a positive number of vouchers is

$$(5) \qquad P(V_i^S > 0) = P\{[v_m - f_m(q_i) - a_s + d > u_s] \wedge [f_i > f_0]\}$$

Equation 5 states that the ith private school will participate when the maximum value of the voucher plus any per-pupil external support covers the average cost of a voucher student, provided that the school is not a minimum-quality private school charging f_0.

Equation 5 can be operationalized by noting the implied participation incentives for a continuum of schools sorted according to fees and quality from lowest to highest. Schools that offer the lowest quality, q_0, and charge the lowest fees cannot profit from expanding enrollment because rules prevent them from raising their fees in response to the voucher program. Schools that offer intermediate quality and fees can profitably expand enrollment as long as the value of the voucher exceeds their minimum average costs. Eventually, as we move to schools with progressively higher fees and quality, the voucher will fail to cover the marginal cost of an additional student. This suggests a probit equation of the form

$$(6) \qquad P(V_i^S > 0) = q(\underset{+}{f_i}, \underset{-}{f_i^2}, \underset{+}{q_i}, \underset{-}{q_i^2}, \underset{+}{d}, \underset{-}{a_s}, u_s)$$

where the expected signs are included below the explanatory variables.[16] The theory suggests a nonlinear relationship between participation and school fees or quality so that schools with intermediate fees and quality will be the most likely to participate. Because fees and measured quality are not perfectly correlated, we incorporate both in the analysis. Holding the two constant, schools will be more likely to participate if they have access to external support and if they face lower costs of administering the voucher program.

Data

The Ministry of Education collected data on schools and students as part of its *Sistema Nacional de Evaluación de la Calidad de la Educación* (SABER). The Ministry collected the data in late 1992 or early 1993, the first year in which it was

16. Note that v_M is the same for all schools, and so it cannot explain variation in the probability of participation across schools. Its influence is captured in the constant term.

expanding the voucher system nationally. At that time municipalities could have been participating in the program for one year, but most had not yet adopted the program. The data on students cover only seventh and ninth graders, none of whom qualified to receive the vouchers, since the program was restricted to new sixth graders in 1992–93. Since schools were not allowed to change their fees in the first year of the program, the data on schools and students predate the influence of the vouchers on school or household attributes.

The sample consists of 71 participating private schools and 77 nonparticipating private schools. The ratio of participation is larger in our sample than in the population of private schools overall because the SABER sampling design is skewed toward more urban areas.[17] Consequently, the results should be interpreted as reflecting the decision process of private urban schools.

Monthly fees for schools that participated in the voucher program averaged about 60 percent of the fees in nonparticipating private schools (table 3). The nonparticipating schools were also of higher quality, as indicated by higher average scores on the nationwide school-leaving exam given to eleventh-grade students. Average test scores in the public schools were also higher than those in participating private schools, albeit by only a small and insignificant margin. There were other indications that the quality of program schools was lower on average than that of nonprogram schools. Participating schools were more likely to offer nonacademic (vocational or technical) tracks and had higher pupil-teacher ratios than did nonparticipating schools. In terms of quality, participating private schools were more similar to public schools than to nonparticipating private schools.

Promotional costs of administering the voucher program are likely to differ across schools. Schools that cater to poorer families will have an advantage in identifying potential voucher recipients. Using counts of household durable goods to measure household wealth, we find that the wealthiest households tended to be in nonparticipating schools. Public schools had the lowest average value of this indicator.

Estimation and Results

Table 4 reports three sets of probit estimates of the school participation function. Since only schools in participating municipalities could join the voucher program, we first investigate whether a school's participation decision was related to the municipality's participation decision. We introduce a correction for possible selection bias in equation 6, using the inverse Mills ratio derived from the estimated municipal participation equation (see table 2). The results, which we do not report here, indicate that the probability of municipal participation is

17. Also, the SABER sample includes only schools that educate students through eleventh grade, the terminal year of secondary education. Many schools, primarily in rural areas, educate students only through ninth grade.

Table 3. *Means and Standard Deviations of Variables Used in School Participation Function*

Variable	*Participating private schools*	*Nonparticipating private schools*	*Public schools*
Monthly fee per student (Colombian pesos)	7,777.1	13,161.5	626.9
	(4,643.1)	(11,140.29)	(1,582.8)
Average school-leaving test score	47.6	52.8	49.2
	(5.1)	(7.4)	(5.1)
Nonprofit school	0.51	0.53	n.a.
	(0.50)	(0.50)	n.a.
Offers academic education	0.75	0.92	0.71
	(0.44)	(0.27)	(0.46)
Pupil-teacher ratio	21.9	17.6	20.5
	(9.7)	(8.8)	(7.5)
Household assets of students	9.9	10.9	9.1
	(1.3)	(1.6)	(1.2)
Sample size	71	77	112

n.a. Not applicable.

Note: Standard deviations are in parentheses.

Source: Authors' calculations based on program administrative data from ICETEX central and regional offices, 1995–97, and SABER data, 1992–93.

not correlated with the regressors in the school participation equation.[18] Thus we can interpret the results of the school participation equation as holding for private schools generally and not just for those in participating municipalities.

The main variables of interest are tuition fees and average test scores. Both have the predicted quadratic sign pattern: the probability of participation first rises and then falls as the variables increase in value. This pattern holds regardless of whether fees and test scores enter the specification jointly or separately. We take this result as strong support for the presumption that schools make participation decisions at least partially according to the profit-maximizing model described above.

The implied impact of fees and test scores on school participation is traced out in figure 5. Participation is highest in the lower half of the range of values for both fees and test scores. The peak for fees corresponds almost exactly to the maximum value of the voucher and drops off sharply thereafter. Almost no schools with fees in the upper half of the tuition range opted to participate. Participation was more broadly dispersed across school quality as measured by test scores, with many schools in the upper half of the range participating.

These results suggest that the participation decision was tied to a school's prior fee structure, so that higher-quality schools still participated if they charged

18. The corresponding probit coefficients (and z-statistics) for the inverse Mills ratio for two specifications similar to those shown in table 4 are 0.332 (0.92) and 0.218 (0.60). We also employ an alternative procedure, using the variables in table 2 as instruments for the unknown selection process. None of the school participation coefficients was sensitive to alternative specifications in terms of sign, significance, or magnitude.

Table 4. *Probit Estimates of School Participation Function*

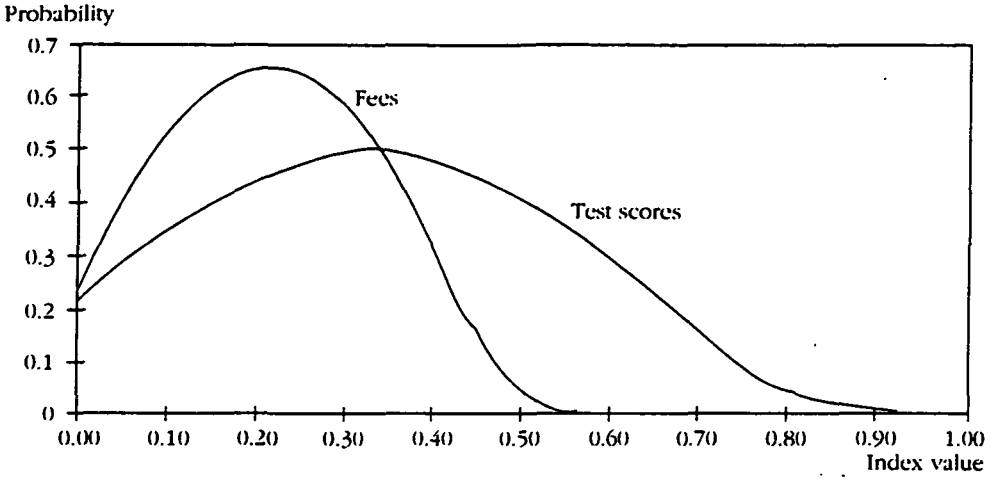
Independent variable	*1*	*2*	*3*
Monthly fee per student ($\times 10^3$)	0.240	0.275	
	(2.39)	(2.71)	
	[0.25]	[0.21]	
Monthly fee squared ($\times 10^6$)	−0.011	−0.021	
	(−2.56)	(−3.01)	
School-leaving test score	0.561		0.703
	(1.55)		(2.07)
	[6.76]		[11.34]
Test score squared	−0.006		−0.008
	(−1.70)		(−2.31)
Nonprofit school	0.624	0.480	0.512
	(2.18)	(1.90)	(1.87)
	[0.17]	[0.12]	[0.19]
Offers academic stream	−0.546	−0.620	−0.482
	(−1.60)	(−1.81)	(−1.49)
	[−0.26]	[−0.28]	[−0.29]
Pupil-teacher ratio	0.007	0.013	0.009
	(0.53)	(1.00)	(0.66)
	[0.08]	[0.13]	[0.12]
Average assets of students	−0.142	−0.206	−0.095
	(−1.03)	(−2.08)	(−0.76)
	[−0.79]	[−1.05]	[−0.71]
Constant	−12.217	−1.115	−14.81
	(−1.41)	(−1.16)	(−1.81)
Sample size	139	146	139
Log-likelihood	−73.2	−79.9	−78.2
Pseudo *R*-squared	0.240	0.209	0.188

Note: *z*-statistics are in parentheses, and elasticities, evaluated at the mean, are in square brackets. The specification also includes a dummy variable indicating if the school fee is missing (9 percent of the sample).
Source: Authors' calculations based on program administrative data from ICETEX central and regional offices, 1995–97, and SABER data, 1992–93.

relatively low fees. Such schools were likely to depend on external support, which enabled them to provide quality at low cost. Nonprofit schools were more likely to participate, as were schools that served students with below-average wealth. Apparently, vouchers did encourage higher-quality schools catering to poorer families to expand their services.

Other variables supported the general finding that schools in the lower half of the quality distribution were more likely to participate. Schools offering nonacademic, vocational programs and schools with higher pupil-teacher ratios were

Figure 5. *Estimated Probability of School Participation over the Range of School Fees and Test Scores*



Note: The horizontal axis is normalized to range from 0 to 1 where 1 corresponds to the highest test score or fees in the sample and 0 corresponds to the smallest. If f_{max} is the largest fee in the sample and f_{min} the smallest, the fee index is defined as $(f_i - f_{min})/(f_{max} - f_{min})$. Similarly, the test score index is $(q_i - q_{min})/(q_{max} - q_{min})$. The probabilities are estimated with all other variables fixed at their sample means.
Source: Authors' calculations.

more likely to admit voucher students. These coefficients were not precisely estimated, however.

The results show that the attributes of participating schools did not reflect the average of all private schools. Peak participation occurred in schools at the twentieth percentile in the range of fees and at the thirty-fifth percentile in the range of test scores. Therefore, assuming that private school averages apply to voucher students generally overstates the potential gains of the program.

IV. Conclusions

Colombia's national voucher program demonstrates how a central government can effectively mobilize local government resources and private providers to alleviate constraints to public provision of education. At the end of five years the program had given vouchers to more than 100,000 secondary school students throughout the country. However, even with financial incentives from the central government, national programs do not necessarily beget universal adoption. Only 25 percent of Colombia's municipalities joined the voucher program. Adoption was most likely in municipalities where existing private schools could expand capacity, where a large proportion of students were already enrolled in private school, and where there was a limited number of underserved students. Municipalities with a very large number of underserved students or whose existing private schools had relatively little capacity opted not to participate in the

voucher program, presumably because the cost of participating would have exceeded the cost of building additional public schools.

Only about half of all private secondary schools participated in the program. Participation was not random; the characteristics of participating schools differed from those of private schools overall. Schools that responded to the program typically served students from poorer households, and voucher recipients generally came from the poorest socioeconomic strata of the country. The lowest- and highest-quality schools were less likely to participate than intermediate-quality schools, suggesting that private schools did not exploit voucher recipients by offering inferior quality at a publicly subsidized price. The rule preventing schools from raising tuition fees in response to the voucher program may have limited the participation of the lowest-quality schools.

Colombia terminated its national voucher program in 1997, with the youngest cohort of new recipients awarded vouchers in 1996. Although the program was successful in many dimensions—implementing a fairly accurate targeting system, attracting thousands of students, gaining support from municipalities and schools with characteristics consistent with program objectives—several factors conspired against it. For one, the monitoring system, even for a geographically targeted program, proved to be quite costly. To guard against "ghost" voucher awardees, four times a year the regional offices of the administrative agencies obtained the signature of each voucher student prior to releasing funds. The program's success in expanding the number of voucher students increased its total cost, if not its average cost. Delays in compiling students' signatures and in obtaining the appropriate officials' signatures at the designated disbursement junctures delayed payments to schools and created difficulties for school operators and principals. This tardiness worsened over the years, primarily because of increasing difficulty in securing the necessary central funds on time. The frequent turnover of leadership at the Ministry of Education slowly eroded support for the program. By 1997 the department of Antioquia had piloted and adopted a different form of subsidy to private schools. Also by 1997 the Ministry had announced the end of the voucher program and was discussing the elements of another demand-based system of subsidies.

In this article we raised one set of questions about a voucher program that allows voluntary participation at the municipal and school level. Other aspects of Colombia's voucher program deserve attention, but these require student-level data that were not available to us at the time of this study. Several questions warrant further research. Did the program increase net enrollment in the participating areas, or did it simply allow students to transfer from public schools to private schools? Was the program successful in keeping its focus on the poor beyond its first years? Controlling for individual characteristics, did voucher students learn better than public school students? Did voucher students have higher graduation rates than public school students? Because schools lost a voucher if a student failed or left, schools had an incentive to retain voucher students. Although Colombia's 1991 program no longer exists, answers to these questions

would provide useful (and rare) evidence about the potential benefits—as well as the pitfalls—of similar programs in the future.

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