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Central Mandates and Local Incentives: The Colombia Education Voucher Program

Elizabeth M. King[a]
Peter F. Orazem[b]
Darin Wohlgemuth[b]

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Development Research Group
Development Economics
The World Bank

[a]Development Research Group, The World Bank. [b]Iowa State University.
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Abstract

This study examines the incentives for municipalities and private schools to participate in a national voucher program. Cost-minimizing municipalities are predicted to participate when they have relatively few students who are under-served by existing public schools and when there is an elastic supply of private school spaces. Private schools are assumed to be monopolistically competitive with fees rising with service quality. Schools of moderate quality and tuition fee are predicted to participate with the greatest frequency, while schools with the lowest and highest fee levels are not expected to profit from the program and thus do not join. Empirical investigation using data on program participation by municipalities and schools strongly support the predictions of the participation models. These findings demonstrate that heterogeneity across municipalities and across private schools affect the degree to which vouchers increase enrollment and school quality for poor children. And when program participation among providers is voluntary rather than mandatory, empirical work that assumes that voucher students will receive schooling equal to the average quality of private schools will yield biased predictions.

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In developed countries, the debate concerning the use of vouchers for private schools centers on the issues of equity and efficiency of educational delivery. Proponents claim that vouchers provide the poor access to private schools which they would be unable to attend without a subsidy. If private schools produce better educated students than do public schools with the same inputs, or if competition with private schools for vouchers pressure public schools to improve, then vouchers may result in more efficient delivery of educational services per public dollar expended. Opponents counter that the wealthy would benefit the most from a voucher program, and that the productivity advantages for private schools are modest or nonexistent.[1]

These issues are also important when assessing the role of vouchers for developing countries, but most parents in these countries face limited educational choices when compared to parents in more affluent countries. Rather than not having a choice between public or private schools, families in developing countries often do not have access to any school at all. They are more dependent on the private sector for secondary education because of inadequate public school capacity, especially in poor, remote areas, and without private schools, many children would be out of school. The proportion of secondary students in private schools is roughly double the median in industrialized economies (James 1993).

Moreover, in many developing countries, the problem of excess schooling demand relative to existing capacity is likely to get worse over time. High population growth rates will greatly expand the number of children of school age, requiring a similarly rapid expansion of school supply just to keep enrollment rates constant. Limited governmental resources to finance this expansion threaten to increase the gap between supply and demand. Thus, the turn toward vouchers and other efforts to encourage private sector delivery of education is a pragmatic

response in settings where the potential gains in student achievement, whether by allowing students to switch from public to private schools or by raising public school efficiency, are of secondary importance to the potential gains of allowing them access to schools of any type.[2]

Vouchers are also a means of decentralizing the control of educational resources, but this role again varies for developing and industrialized countries. In the United States where decisions regarding the administration of public schools are already made locally, vouchers which foster parental choice are an instrument for further devolving power from local school boards or teachers to individual parents. In developing countries, educational policy decisions are still typically made by the central government, with little local control of schools of any sort, and so the shift in the locus of decision-making is much greater and the potential efficiency gains from vouchers, larger. However, if teachers, local school administrators, or parents are not prepared to use their new-found power to control resources effectively, then the potential efficiency losses are greater as well.

Previous work on vouchers has concentrated almost exclusively on parental incentives to participate or on differences in educational outcomes between public and private schools. Children who are predicted to switch from public to private schools are assumed to be able to find adequate space in a private school with attributes equal to the average private school. This assumption is off the mark when private schools and local school boards can refuse to participate in a voucher program. When participation is voluntary, the population of participating private schools may differ greatly from the universe of private schools. As a consequence, the ability of the central government to transfer authority through a voucher program, and the benefits from this transfer, are dependent upon the willingness of municipalities and schools to participate.

The absence of previous broad-based voucher implementation, however, has made it impossible to estimate school and/or municipal private school supply responses to a voucher system. [3]

This study examines the extent to which a central authority is able to attain its own goals as it transfers power to local governments and to the private sector. The context is Colombia's national voucher program. Program participation by municipalities and schools is voluntary and can be predicted. We find that the probability of municipal participation is consistent with that of a cost-minimizing municipality facing the need to provide educational services to all its constituents. The probability of private school participation is consistent with that of a profit-maximizing school in a monopolistically competitive market where schools are differentiated by quality. The results suggest that heterogeneity among municipalities and among schools are important factors to consider in predicting the potential benefits of a voucher program, particularly if participation by providers by choice.

I. The Colombia Voucher Program for Secondary Schools

Colombia launched a national voucher program in late 1991 in its ten largest cities, with the first students being admitted in 1992. Since then, the program has been expanded nationally, with participating municipalities in 27 of the 30 departments (states). In 1995, about 90,000 vouchers were being used by students in 1,800 private schools in 217 municipalities. Voucher students comprised 8 percent of all students in private secondary schools. While participation in the program is widespread, the majority of the vouchers were issued in large urban areas where private school capacity is concentrated. Ten departments accounted for over 70 percent of all vouchers issued, with the capital city of Bogotá alone accounting for 13 percent. [4]

The primary aim of the program is to raise the transition rate from primary to secondary education, especially among the poor, by expanding secondary school capacity in areas with insufficient public secondary school supply. Because the wealthy can afford private secondary tuition, the vouchers are targeted to the poorest students where socioeconomic status is designated geographically, based on Census data on neighborhood poverty levels. A student's socioeconomic eligibility is ascertained using a national identification card or utility bills which verify residence and specify the poverty status of the student's neighborhood. Only primary school graduates who have been admitted to a participating private school can apply for the voucher for the first time. Awardees can renew the voucher in subsequent years if they are promoted to the next grade.

The voucher covers the cost of tuition -- the yearly entrance fee plus monthly fees -- for sixth-graders to eleventh-graders, subject to an upper limit. The Colombian Institute of Educational Credit and Training Abroad (or ICETEX), which administers the program for the Ministry of Education, determines the maximum value of the voucher yearly. In 1995, the voucher was worth a maximum of Col$145,307 (or about US$180). This upper limit meets or exceeds the annual fees at lower-priced schools, but covers less than half of the cost of the highest-priced schools.[5] Since the voucher does not make all private schools affordable to poor parents, interest in the program is likely to be greatest among the lower-priced schools.

By design, Colombia's program avoids some of the criticisms commonly made against voucher plans. By law, only the poor can qualify, countering the claim that vouchers are a net subsidy of the wealthy by the poor. Indeed, an early evaluation found that, at least in Bogota, the program was reaching its intended beneficiaries (Morales-Cobo 1993). Rather than threaten public schools with lost resources, the Colombia program guarantees that current levels of funding for

public schools would not decrease, even were public school enrollments to fall. Because public schools were already overcrowded and there was a presumption of excess capacity in private schools, the program represents a means to expand total secondary enrollments at relatively low cost while reducing the enrollment pressure on public schools. Finally, by encouraging more private provision without directly subsidizing particular schools, it enables parents to choose schools and thus demand better performance from them.[6]

Participation by schools or students is contingent upon the municipality's willingness to co-finance and administer the program. The municipality must provide 20 percent of the cost of the voucher while the central government provides the remainder. Furthermore, municipalities must agree to the terms of Law 160 which transfers the responsibility for maintenance of public schools from the central to the municipal government. In addition, the municipality must maintain a system of accounts which satisfies nationally prescribed standards (King et al. 1996).

Heterogeneity among municipalities and among schools influences their incentives to participate. Municipalities differ in their need to expand secondary school capacity, the capacity in their existing private schools, the costs of new public school construction, and the ability to finance their share of the voucher costs. Schools differ in their per-pupil instructional costs, tuition and other fees, costs of accepting additional students, and the socioeconomic composition of their students. We will examine these incentives theoretically and empirically in the next two sections.

II. Municipal Participation

A. Model

This section introduces a model that predicts the probability of a municipality to participate in the voucher program. Underlying the model is the assumption that the municipality has the

responsibility to provide secondary schooling for its citizens, subject to a fiscal constraint. It can provide secondary school services by direct provision of public schools or by subsidizing private school services.

When Colombia's central government transferred responsibility for the maintenance of school facilities to departments and municipalities in 1991, each municipality inherited a level of under-served students, $S_U = S_D - S_S$, where S_D is demand for secondary schooling and S_S is the sum of public and private secondary enrollment capacity. If $S_U \leq 0$, then secondary schooling capacity exceeds demand and there is no need to expand supply. If $S_U > 0$, the municipality must choose how to expand secondary school capacity, conditional on having the funds to finance that expansion.[7]

If the municipality chooses the voucher program, it faces a cost per student, v, for the voucher plus administration and advertising costs of $a_G(t)$ per student. These administrative and advertising costs are assumed to decrease in tastes for private education, t, because there would be less need to motivate parents of under-served 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 building additional public school spaces. This strategy has very high fixed costs relative to the vouchers. However, as the number of under-served students increase, the average cost of this option, C(S), declines. If it falls below $v+a_G(t)$ over the range $(0, S_U)$, the municipality's cost-minimizing choice of providing additional secondary school services will involve increasing public school capacity.

The municipal choice is illustrated in Figure 1. Assume initially that the average cost of providing a voucher is $v+a_G(t_0)$, where t_0 is the taste for private education. If the number of under-served students is below S_U^0 and there is no private school capacity constraint, the municipality will

opt for the voucher program as the least cost option for delivery of secondary education. Beyond S_U^0 and up to S_U^1, the municipality will reject the voucher program in favor of providing additional public school spaces. But the municipal choices are not limited to either/or. If $S_U > S_U^1$, the municipality will provide both more public schools up to capacity S_U^1, and then vouchers for $S_U - S_U^1$. If the average cost curve does not slope back upward (e.g. cost curves such as $\tilde{C}(S_U)$ rather than $C(S_U)$), then the municipality will expand capacity either through vouchers or through public school construction, but never both.

Thus far we have assumed that the municipality knows $v+a_G(t)$ 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

$$P(V^G > 0) = P[\{S_U > 0\} \wedge \{(v + a_G(t) - C(S_U)) < (u_C - u_V)\}] \qquad (1)$$

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 adding public school spaces exceeds the cost of a voucher at the lowest values of S_U. As a consequence, $P(V^G>0)$ rises initially as S_U increases. However, in its most general form, $C(S_U)$ is a convex function so that $C'(S_U) < 0$ and $C''(S_U) > 0$. Therefore, as S_U rises above 0, $C(S_U)$ falls, but at a decreasing rate. As a consequence, the probability of a municipality participating in the voucher program is expected 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 $v+a_G(t_1)$. As illustrated, in this case the voucher program dominates

expansion of public 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 $v+a_G(t)$, the smaller is the range of students (S_U^0, S_U^1) for which $C(S_U) < v+a_G(t)$, and the higher the probability that the municipality will opt for the voucher program. In terms of equation (1), $dP/dt > 0$.

We have been assuming a perfectly elastic supply of spaces in private schools at a voucher priced at v. If instead, the supply of spaces in private schools is an upward sloping function of the value of the voucher, then the available private capacity to absorb students would also influence the municipality's decision to participate. In particular, a low maximum value of the voucher would mean an inadequate supply of private school spaces relative to the municipal demand.

The case of an increasing marginal cost of private school expansion is shown in Figure 2. Initially, the marginal cost of accommodating voucher students is given by $MC^0(S_U)$ which corresponds to a willingness to supply S_U^0 spaces at a voucher value of v_0^0.[8] However, since the marginal cost of the voucher to the municipality is $v^0(S_U)+a_G(t)$, the municipality will fund no more than S_p^0 vouchers and will pay for vouchers worth $v_1^0 < v_0^0$. For $S_U > S_p^0$, the municipality will opt for expanding public school capacity.

More private school spaces will shift the marginal cost curve of admitting voucher students downward and to the right. This will lower the municipality's marginal cost of the voucher to $v^1(S_U)+a_G$, which will then increase the maximum number of vouchers to S_p^1. The value of the voucher offered to schools will fall to v_0^1.

Regulating the maximum value for the voucher has served the purpose of limiting municipal program costs and potential abuses by participating schools. However, this ceiling may have also induced municipalities to choose to expand public school capacity at a lower level of under-served

students than they would have had the value of the maximum voucher payment been higher. In Figure 2, the maximum value is set at v_M. Assuming that the marginal cost curve $MC^0(S_U)$ reflects private supply, the government will be forced to switch to public school expansion at $S_U > S_p^{00}$ rather than at $S_U > S_p^0$. Ironically, if the voucher value limit were above v_M, the municipality would save money over the range $S_U \in (S_p^{00}, S_p^0)$ by using vouchers rather than building additional public schools. If S_P is a measure of private sector supply at the maximum voucher level v_M, then $dP/dS_P>0$.

Thus far, we have assumed unlimited municipal capacity to expand public school spaces. In reality, municipal participation is constrained by its fiscal budget. Faced with this constraint, the municipality is willing to ration access to its expanded school capacity such that S_U children have S_B/S_U probability of attending school, where S_B is max $(B/(v+a_G(t)), B/C(S_B))$ and B is the municipal budget available for expanding public capacity. The budget constraint limits municipalities to the lower range of S_U where vouchers are likely to have lower average cost; hence, $dP/dB < 0$.[9]

The model of a cost-minimizing municipality suggests that the probability of municipal participation as defined by equation (1) can be operationalized as

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

where $\varepsilon = u_C - u_V$. Imposing a cubic approximation for $C(S_U)$ and allowing for potential lower fixed costs of providing additional public school capacity in rural areas, the probability of participating in the voucher program becomes

$$P(V^G > 0) = f(\underset{+}{S_U}, \underset{-}{S_U^2}, \underset{+}{S_U^3}, \underset{+}{S_P}, \underset{+}{t}, \underset{-}{v}, \underset{-}{B}, \underset{-}{R}, \varepsilon) \qquad (3)$$

where R is a measure of the extent to which the municipality is rural. The expected signs of the partial derivatives of $P(V^G > 0)$ with respect to these variables are indicated.

B. Data

We estimate equation (2) using data for 917 municipalities in Colombia, 201 (or 22 percent) of which have opted to participate in the program. Means of the dependent and independent variables are reported separately for participating and non-participating municipalities in Table 1. Program administrative data were collected from ICETEX central and regional offices over the period 1995-97. Data on the characteristics of municipalities were derived from other existing databases, as described below.

Since what we are treating as exogenous variables in the equation could themselves change in response to a municipality's decision to participate or not in the program, all such variables are measured as of 1991, *before* the voucher program was implemented. Relative to nonparticipating municipalities, participating municipalities were more populous, had more tax revenues per capita, and relied more heavily on private school delivery even before the voucher program was put in place. Participating municipalities also had higher levels of under-served students.

The number of under-served students is the difference between the number of primary students in grades one to five, $S_{1\text{-}5}$, and the number of secondary students in grades six to eleven, $S_{6\text{-}11}$, measured before the implementation of the voucher program. Primary enrollments are an approximate measure of the population of potential future secondary students, while the total number of private and public secondary students is a measure of existing secondary school capacity. The difference is divided by the number of public secondary school teachers to

establish the number of public classrooms that were available to absorb potentially under-served students. The resulting measure is

$$S_U = \frac{S_{1-5} - S_{6-11}}{T^G_{6-11}} \tag{4}$$

where T^G_{6-11} is the number of full-time public secondary school teachers before the program. This measure of under-served students was 36 percent higher in the participating municipalities.

Since the vouchers are targeted toward poor students, we include need into the measure of under-served students. We use an index available from the Department of National Planning which is used as an indicator of the proportion of the population who qualify for public assistance.[10] This measure, N, was interacted with S_U as a proxy measure of needy under-served students per secondary teacher, $N \bullet S_U$. Participating municipalities had just over half their populations designated as needy; non-participating municipalities had a higher proportion (63 percent) in need.

Private school capacity to absorb additional students is measured by T^P_{6-11} / S_{1-5}, where T^P_{6-11} is the number of secondary teachers (and presumably, classrooms) in existing private schools. Before the voucher program was established, this ratio was six times higher in participating than in non-participating municipalities. In addition, the proportion of private primary students was five times higher in the participating municipalities. Government capacity to raise revenue, as measured by per capita income taxes paid in the municipality, was nearly two times higher in participating than in non-participating municipalities. Participating municipalities also had larger populations of school children. Primary enrollments were nearly eleven times higher in program municipalities. However, the proportion of rural schools, as designated by the Ministry of Education, was almost identical across the two groups.

C. Estimation and Results

Equation (3) suggests a probit model of voucher participation. Table 2 reports the estimates. The most important parameters pertain to the measure of under-served students. S_U was expected to affect participation in a nonlinear fashion, initially increasing and then decreasing the probability of participating. The sign pattern of the cubic form of S_U corresponds to these expectations. At sample means, the marginal effect of this variable is positive. The elasticity implies that a ten percent increase in the number of under-served students per secondary teacher would increase the probability of municipal participation by 3.5 percent.

The nonlinear effect of S_U was also traced out by using a spline function. Dummy variables representing whether the measure of underserved students was positive[11] in the upper half, upper 30 percent, upper 20 percent, and upper 10 percent of the distribution of S_U or $N \bullet S_U$ are reported in columns two and four of Table 2. The coefficients of these dummy variables are cumulative in the sense that, other things constant, the total effect of being in the upper 30 percent of S_U is the sum of the coefficients on $S_U \geq 0$, $\geq 50^{th}$ percent of S_U, and $\geq 70^{th}$ percent of S_U. The results suggest a rising probability of participation until S_U reaches the 90^{th} percentile.

The relationship between $P(V^G > 0)$ and S_U as captured by the estimates in columns one and two of Table 2 are shown in Figures 3 and 4. The cubic representation is shown in Figure 3. As can be seen, the probability first rises and then falls. The peak occurs at 15.5 under-served students per public secondary teacher and then declines at a decreasing rate thereafter. The average public secondary school class size is 18, so municipal participation begins to decline as

the number of under-served students per teacher approaches the number of students necessary to justify adding an additional classroom. This is consistent with the model which suggests that municipalities will switch to adding more public classrooms rather than paying for vouchers if S_U becomes sufficiently large. The spline function in Figure 4 shows a similar pattern, though the peak is at over 20 underserved students per teacher.

The model of program participation by municipalities suggested that municipalities would be more likely to participate if the 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, higher ratios of private secondary teachers relative to current primary enrollment (a rough measure of the number of classrooms available for the future populations of 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. Similarly, greater awareness of or taste for private education, as indicated by the share of private primary students of total primary students, also sharply increases the probability of municipal participation. The elasticity of municipal participation with respect to this share is 0.35. We speculate that municipalities whose populations were already familiar with private schools would need to exert less effort to promote voucher applications.

The other variables did not have statistically significant effects. The proportion rural was expected to 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 elasticity is extremely small. We also anticipated that municipalities with more limited fiscal resources would find the voucher

program to be a more attractive option. However, the results show that higher per capita tax payments actually increase the probability of voucher participation, although the coefficients are never precisely estimated and imply very small elasticities. These results suggest that municipal voucher participation is not strongly affected by past municipal capacity to raise revenue.[12]

Overall, the results in Table 2 are strongly consistent with a model of municipal cost minimization subject to an obligation to provide secondary schooling opportunities to under-served students. The results suggest that municipalities are most likely to use vouchers to address the needs of these students when private excess capacity exists and when the number of under-served students per secondary teacher is below the existing public secondary class size.

III. School Participation

A school can only participate in the voucher program if the municipality agrees to participate. Conditional on municipal participation, all licensed private schools in the municipality can join the program.[13] There has been a steady increase in the number of private schools that have participated since 1992. By mid-1995, 1,795 private schools were accepting voucher students. In this section, we examine theoretically and empirically the school's choice of whether or not to participate in the voucher program.

A. Model

We assume that private schools compete on both quality and price.[14] Improved quality is costly to the school, but it also raises demand for that school; hence, the quality of the school is positively correlated with the level of fees it can charge.[15] To the extent that public education is free or almost free and private education is not, it is easy to suppose that there is a minimum quality

level (q_m) of private education below which a student will only consider public school attendance, or even non-enrollment if the public school option is closed.

We assume that there is a perfectly competitive market for private schools offering education of quality q_m. As a consequence, the market price for private education of quality q_m is f_0 in Figure 5. Price-taking schools on the minimum-quality fringe select the most efficient means of producing q_m. Consequently, they use the schooling technology represented by $AC(q_m)$, enroll e_0 students, and earn zero economic profits.

These minimum quality schools cannot benefit from the voucher program. To illustrate, let v_M represent the maximum value of the voucher allowed. If $v_M<f_0$, the school cannot recoup its marginal cost of providing education to a student using a voucher. If $v_M=f_0$, the school is indifferent between participation and non-participation. Because it can offer enrollment to as many students as it wants at f_0, it has no need to acquire additional students through the voucher. In fact, schools on the minimum-quality fringe would generally have no capacity to absorb additional students. Voucher students would have to displace non-voucher students to leave the school at e_0 enrollment and economic profits at zero.

Even if $v_M>f_0$, schools in existence at the time the program was initiated could not benefit. Program rules prevented schools from raising fees in the first year of participation. In subsequent years, fee increases were only allowed an officially sanctioned inflation adjustment. Thus, minimum-quality schools could not raise fees above f_0, which meant that they could not profitably raise enrollments beyond e_0.[16]

Schools offering quality above q_m have a differentiated product so that they have power to set price. In Figure 5, a school offering quality $q_1>q_m$ will face a downward sloping demand for its services, given by $D(q_1)$. However, there is free entry into the private school sector so that the

market for schools offering $q>q_m$ will be monopolistically competitive. These schools will have zero economic profit, but will have the potential to expand their services in response to the voucher.

Suppose that the representative school faces an average cost $AC(q_1)$ and marginal cost $MC(q_1)$ to provide quality q_1. Absent a voucher, its optimum strategy is to offer enrollment to e_1 students at a price of f_1. The optimum occurs in the range where the average cost curve is declining, and so the school has capacity to add students if it can do so profitably.

The voucher provides the incentive to add students. If the voucher is equal to f_1, the school will expand enrollment to e_1' and make economic profit above its pre-voucher level. However, even if $v_M<f_1$, the school can profit from the voucher program by lowering its fees to v_M and expanding enrollment according to $v_M=MC(q_1)$. In fact, the firm will profit by expanding enrollment provided v_M is set anywhere above $f_m(q_1)=\min AC(q_1)$. Schools that decide to participate will increase enrollment to at least $e_m(q_1)$.

As quality increases, $f_m(q)$ increases. Therefore, there is some quality level beyond which $v_M<f_m(q)$. These high-quality schools will not gain anything from participation because the fee that they must charge in order to recover their marginal cost of adding a student exceeds the maximum value of the voucher.[17] 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 by using a co-financing scheme that reduces the burden to their own scholarship program.

The simple model illustrated in Figure 5 can be made more realistic. Many private schools do not operate for profit. Their unit costs are partially offset by monetary or in-kind assistance from sponsoring religious or non-sectarian organizations. These transfers lower their average costs by the value of these donations, d, per student. Furthermore, voucher participation requires that the school

attract students, that they elicit applications from families in the lowest income groups, and that they cooperate with the regional program agency to verify the continued attendance of each voucher student throughout the school year. These requirements impose administrative costs on the school, a_S. The donation and administrative costs are observed with error, u_S. Combining these pieces of information, the probability that a school offers a positive number of vouchers is

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

Equation (5) states that the i^{th} private school participates when the maximum value of the voucher plus any per-pupil external support covers the average cost of a voucher student, provided the school is not at the competitive fringe, a minimum-quality school charging f_0. This equation can be operationalized by noting the implied relationship between school participation and charged fees or school quality. Schools offering the least quality, q_m, and charging the lowest fees cannot profit from expanding their services because rules prevent them from raising their fees in response to the voucher. However, as quality and fees rise, schools can profitably expand their enrollments. Eventually as fees and quality continue to increase, the voucher will fail to cover the marginal cost of an additional student. Equation (5) then suggests a probit equation of the form

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

where the expected signs are indicated below the explanatory variables.[18] The theory suggests a quadratic relationship between participation and school fees and/or quality so that schools of intermediate price and quality would be the most likely to participate. Because fees and measured quality are not perfectly correlated, we incorporate both in the analysis. Holding fees and quality 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.

B. Data

Data on schools and students were collected by the National Testing Service for the Ministry of Education as part of its Sistema Nacional de Evaluaci∴n de la Calidad de la Educaci∴n (SABER). The data were collected in late 1992 in some schools and early 1993 in others, the first year in which the voucher system was being expanded nationally. Municipalities could have had the program in place for at most one year, but most had not yet adopted the program. Data on students pertain only to seventh and ninth graders, none of whom qualified to receive the vouchers since the program was restricted to new sixth graders in 1992. In addition, schools were prevented from changing their fees in the first year of the program. Consequently, the data on the schools and the students pre-date the influence of the vouchers on school or household attributes.

The sample consists of 71 participating private schools and 77 non-participating private schools. The ratio of participation is larger in our sample than for the universe of private schools because the SABER sampling design is skewed towards more urban areas.[19] This does not pose a serious problem to the study because the voucher program was designed to meet excess demand for secondary education in overcrowded public schools, which are likely to be located in urban areas. Sample statistics of the variables discussed above are reported in Table 3 for participating and non-participating private schools, and for comparison, means for public schools in participating municipalities are presented as well.

Monthly fees for schools that participated in the voucher program averaged about sixty percent of the fees in non-participating private schools. The non-participating schools were also of higher quality, as indicated by higher average scores on the nation-wide school-leaving exam administrated to eleventh grade students. Test scores for the public schools also averaged above those of participating private schools, albeit by only a small and insignificant margin. In terms of quality, participating private schools were more similar to public schools than to non-participating

private schools. Another indication of this is that participating schools were more likely to offer nonacademic (vocational or technical) tracks and had higher pupil-teacher ratios than did non-participating schools

Promotional costs of administering the voucher are likely to differ more across schools than the monitoring costs once students are enrolled. Schools that cater to poorer families will have an advantage in identifying potential voucher recipients. Using counts of household durable goods as a measure of household wealth, we do find that children from the wealthiest households tend to attend non-participating schools. Public schools had the lowest average for this wealth indicator.

C. Estimation

Table 4 reports three sets of probit estimates of the school participation function. As discussed, only schools in participating municipalities could choose to join the program. Thus, we first investigated whether school participation was related to the municipal participation decision. A correction for possible selection bias was introduced into equation (6), using the inverse Mills ratio derived from the estimated municipal participation equation in Table 2. The results, which are not shown here, indicate that the probability of municipal participation is not correlated with the regressors in the school participation equation.[20] This implies that the results of the school participation equation can be interpreted to hold for private schools generally and not just for those in participating municipalities.

The main variables of interest are tuition fees and average student test scores. Both have the predicted quadratic sign pattern of first rising and then falling probability of participation as the variables increase in value. The patterns hold regardless of whether fees and test scores enter the specification jointly or separately. We take this as strong corroboration for our model that

schools make their participation decisions at least partially along the lines of the profit-maximizing model described above.

The implied pattern of the impact of fees and of test scores on school participation is traced out in Figure 6. The horizontal axis is normalized to range from zero to one, where one corresponds to the largest value of the test scores or fees in the sample and zero corresponds to the smallest value.[21] This allows us to superimpose the two relationships in one graph. Participation is highest in the lower half of the range of values for both fees and test scores. This peak 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 qualities as measured by test scores, with many schools in the upper half of the range of scores also participating.

These results suggest that the participation decision is very much tied to the schools' prior fee structure, so that higher quality schools still participate if they charge relatively low fees. Such schools are likely to depend upon external support to enable them to provide good quality at low cost. Nonprofit schools were more likely to participate, as were schools which served students with lower average measured wealth. Apparently, vouchers did encourage expansion of services offered by higher quality schools which catered to poorer families.

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 having higher pupil-teacher ratios were more likely to admit voucher students. These estimates were not precisely estimated, however.

The results of Table 4 and Figure 6 strongly support our opening hypothesis that the attributes of participating schools will not reflect the average of all private schools. Peak

participation occurs in schools at the 20th percentile of the range of fees and at the 35th percentile in the range of test scores. Therefore, assuming that private school averages will apply to voucher students generally will overstate the potential gains of the voucher program.

IV. Conclusions

Colombia's national voucher program illustrates how a central government can effectively mobilize local government resources and private providers in order to alleviate constraints to public provision. At the end of five years, the program has provided vouchers to more than 100,000 students around the country. Schools that responded to the program are those that atypically served students from poorer households, and voucher recipients come from the poorest socioeconomic strata of the country. Concerns that schools would exploit voucher recipients by offering inferior quality at a publicly subsidized price appear exaggerated. Program designs that prevented schools from raising fees as a consequence of the program caused the worst schools to self-select out of the program, while modest fee and quality schools participated.

Nevertheless, the results also show that national programs do not imply universal adoption. Only 25 percent of the municipalities participated. Adoption was most likely in municipalities with preexisting private school capacity to expand, a large proportion of students already in private school, and a relatively small number of underserved students. Municipalities with large numbers of underserved students or with relatively little preexisting private school capacity opted not to participate, presumably because the costs of the voucher system would exceed the costs of building additional public schools. If these results hold in other country contexts, they suggest that cities will be most likely to adopt vouchers if they already have many private schools and if they anticipate that relatively few students will participate in the program.[22]

Only about half of Colombia's eligible private schools participated in the program. While the lowest fee and quality schools did not participate, no school charging in the upper two quintiles of fees participated either. While some of the highest quality school did participate, they included only those nonprofit schools which received support through charitable gifts. If these results hold in

other country contexts, they suggest that it is incorrect to assume that the universe of participating schools will mimic the universe of preexisting private schools. Participating schools will be disproportionately those that already cater to the poor, that are of lower quality than average, and that are subsidized by charitable contributions.

The Colombia case offers several avenues of future research. First, it would be useful to monitor student performance through standardized tests to assess whether students who enroll in private schools as a consequence of the program do better than poor children who remain in public schools. It will also be important to examine persistence to graduation. Because schools lose the voucher if the student fails or leaves, schools have an incentive to retain voucher students, an incentive which may translate to higher graduation rates for voucher recipients. A lottery was used in some municipalities to randomly choose student awardees when applications exceeded the number of vouchers that municipalities were willing to co-finance. Since participation is voluntary, this randomization device is necessary to address the problem of self selection bias in estimating program impact. Finally, there are schools that have entered the market since vouchers have been introduced. Because these schools will not be constrained by the prohibition against raising fees, it is possible that they enter at the lower quality fringe and make a profit, lowering the average quality of the participating schools. This supply response deserves further inquiry.

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Table 1: Sample Statistics for Participating and Non-Participating Municipalities

Variables	Total (917)	Non-Participants (716)	Participants (201)
Endogenous			
Participate	0.22	0	1
	(0.41)		
Exogenous			
Secondary private	0.0052	0.0025	0.015
teachers/primary students	(0.012)	(0.0097)	(0.015)
Proportion private	0.052	0.028	0.14
primary students	(0.10)	(0.07)	(0.13)
Per-capita taxes paid	0.27	0.22	0.44
	(0.47)	(0.39)	(0.66)
Proportion rural	0.30	0.31	0.29
primary schools	(0.34)	(0.35)	(0.31)
S_u [a]	12.16	11.27	15.31
	(24.84)	(23.60)	(28.65)
$N*S_u$	8.03	7.72	9.14
	(17.93)	(17.64)	(18.93)
Other Information			
N: Needs index	0.60	0.63	0.51
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	3022	792	10,963

Distribution of S_u, $N*S_u$	S_u	$N*S_u$
29th percentile	0	0
50th percentile	5.22	2.6
70th percentile	12.99	7.48
80th percentile	20.76	12.5
90th percentile	35.84	23.53
95th percentile	52.96	36.25

[a] S_u = (primary students -secondary students) /secondary public teachers.

Table 2: Probit estimates for municipal participation in the voucher program

Variables	1	2	3[†]	4[†]
$S_u/100$	2.620***		2.264**	
	(3.700)		(2.382)	
	[0.351]		[0.221]	
$(S_u/100)^2$	-2.802***		-2.627	
	(-2.586)		(-1.505)	
$(S_u/100)^3$	0.802**		0.821	
	(2.079)		(1.073)	
$S_u \geq 0$		0.046		0.173
		(0.277)		(1.067)
		[0.001]		[0.002]
$\geq 50^{th}$ percentile of S_u		0.267		0.157
		(1.552)		(0.943)
		[0.032]		[0.100]
$\geq 70^{th}$ percentile of S_u		0.263		0.125
		(1.339)		(0.635)
		[0.063]		[0.018]
$\geq 80^{th}$ percentile of S_u		0.171		0.027
		(0.811)		(0.123)
		[0.070]		[0.006]
$\geq 90^{th}$ percentile of S_u		-0.208		-0.031 [†]
		(-0.950)		(-0.143)
		[-0.290]		[-0.086]
Secondary private teachers /	0.356***	0.346***	0.341***	0.340***
(primary students/100)	(8.923)	(8.726)	(8.595)	(8.582)
	[0.255]	[0.171]	[0.263]	[0.230]
Proportion private	4.649***	4.597***	4.786***	4.811***
primary students	(8.584)	(8.456)	(8.882)	(8.920)
	[0.332]	[0.335]	[0.368]	[0.346]
Proportion rural	-0.211	-0.183	-0.053	-0.011
primary schools	(-1.053)	(-0.908)	(-0.272)	(-0.059)
	[-0.088]	[-0.089]	[-0.024]	[-0.020]
Per capita taxes paid	0.0573	0.081	0.0631	0.067
	(0.536)	(0.739)	(0.601)	(0.621)
	[0.023]	[0.055]	[0.027]	[0.045]
Constant	-1.50**	-1.593***	-1.470***	-1.621***
	(-15.981)	(-12.495)	(-15.947)	(-12.720)
Sample size	917	917	917	917
Log Likelihood	-352.022	-350.991	-356.331	-355.851
Pseudo R^2	0.2700	0.2722	0.2611	0.2621

*** significant at 1%, ** significant at 5%, * significant at 10%

z statistic in parentheses; elasticity in brackets computed at the median of the range for the dummy variables.

[†] S_u is defined as $N*S_u$ in columns 3 and 4.

Table 3. Means and standard deviation of variables used in school participation functions

Variable	Participating private schools	Non-participating private schools	Public schools
Monthly fee per student	7777.1	13161.5	626.9
	(4643.1)	(11140.29)	(1582.8)
Average school -leaving test score	47.6	52.8	49.2
	(5.1)	(7.4)	(5.1)
Non-profit school	0.51	0.53	--
	(0.50)	(0.50)	--
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

Table 4. Probit estimates of school participation function

Dependent variables	1	2	3
Monthly fee per student (x 10^3)	0.240	0.275	
	(2.39)	(2.71)	
	[0.25]	[0.21]	
Monthly fee-squared (x 10^6)	-0.011	-.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)
Non-profit school	.624	.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
Pseudo R-square	.240	.209	.188
Log-likelihood	-73.2	-79.9	-78.2

Notes: Probit coefficients, (z-statistic for probit) and [elasticities at the mean]. Specification also includes a dummy variable indicating if the school fee is missing (9 percent of the sample).

Figure 1: Average Cost of Vouchers versus Added Public School Capacity When There is No Private School Constraint.

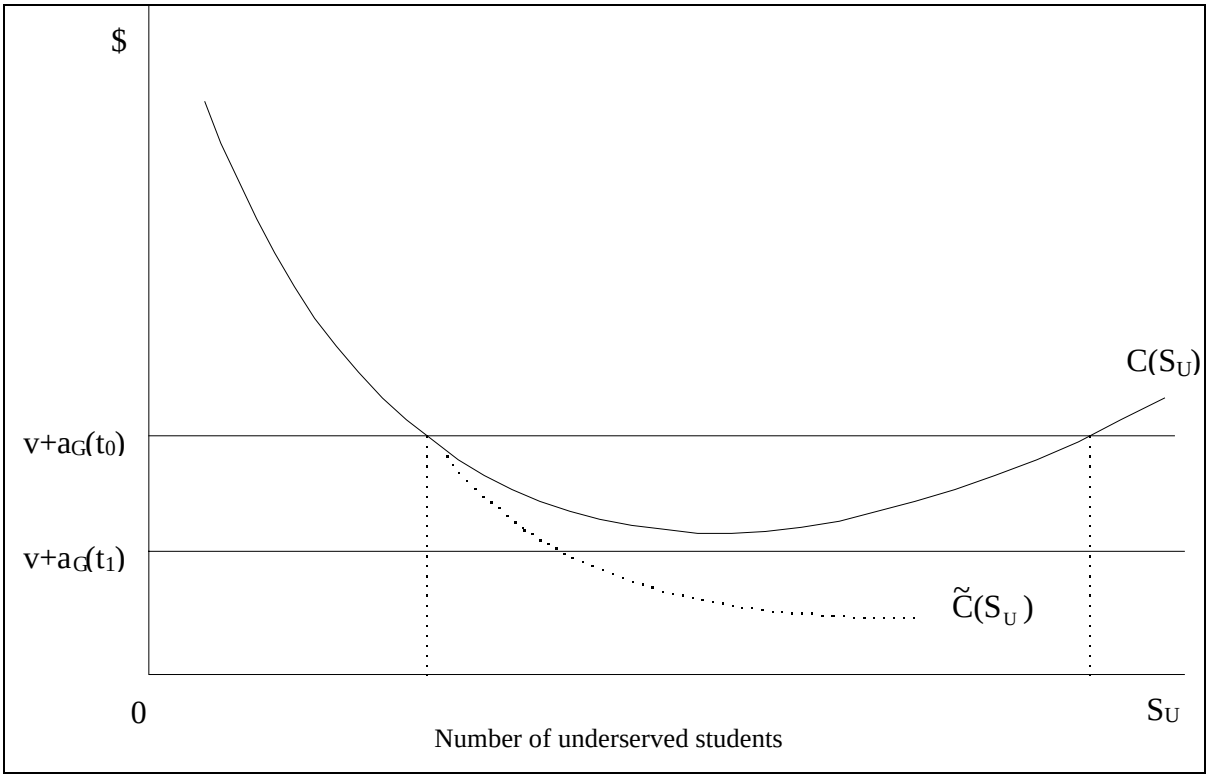


Figure 2: Average Cost of Vouchers versus Added Public School Capacity with Rising Marginal Cost of Private School Capacity

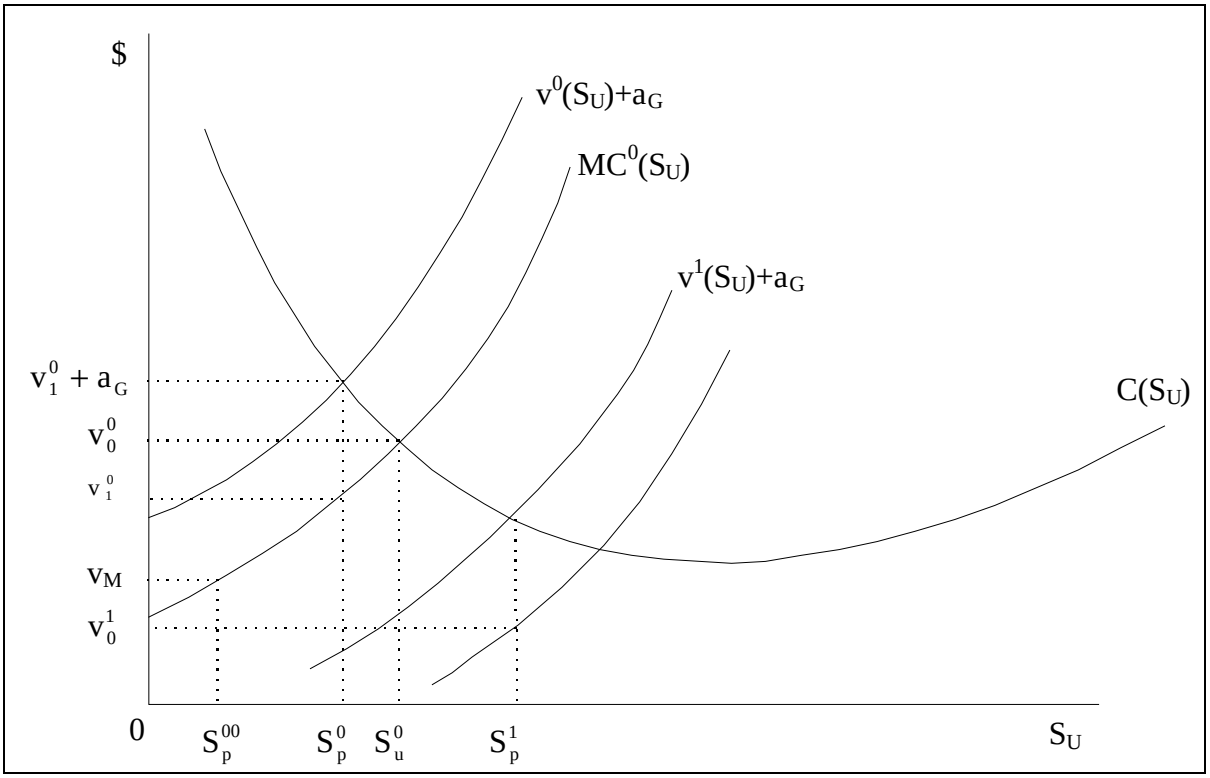


Figure 3: Probability of Municipal Participation in the Secondary Education Voucher Program, cubic specification

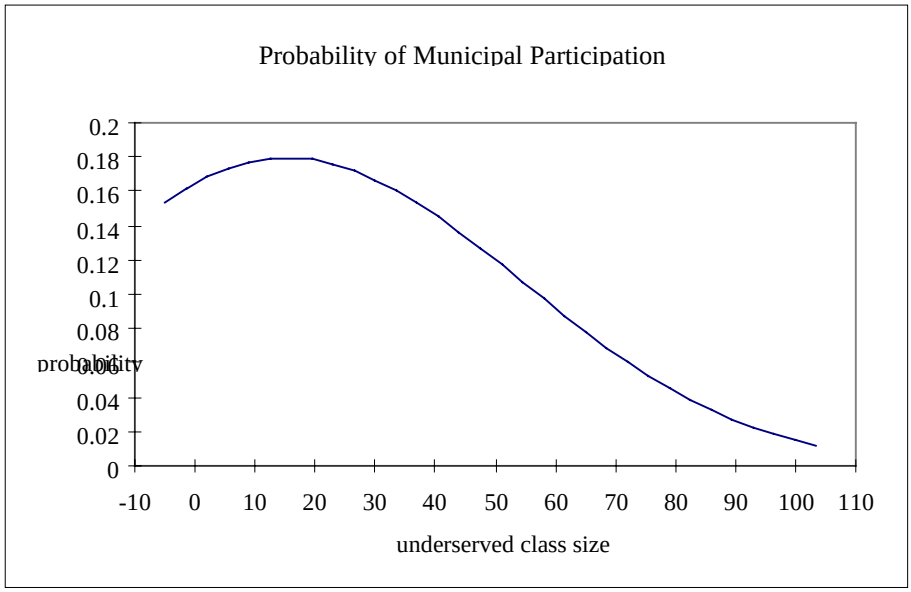


Figure 4: Probability of Municipal Participation in the Secondary Education Voucher Program, spline specification

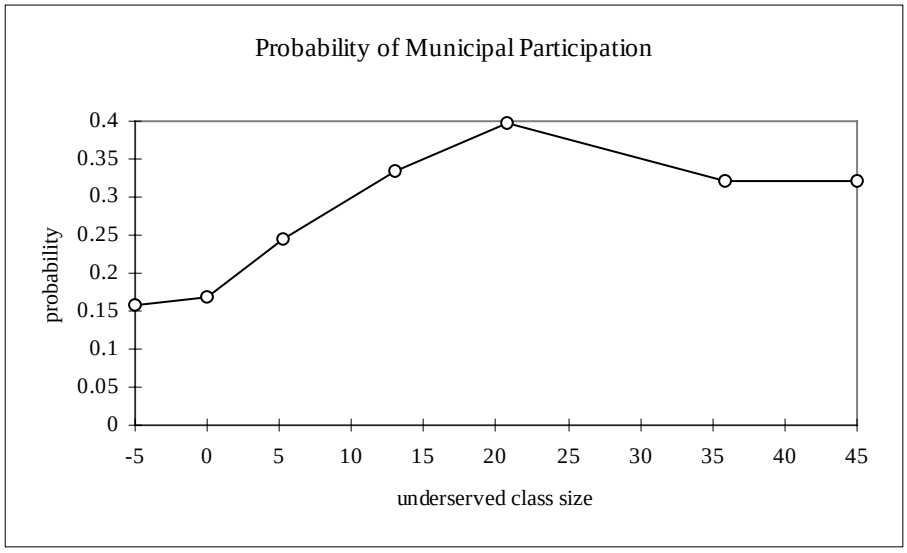
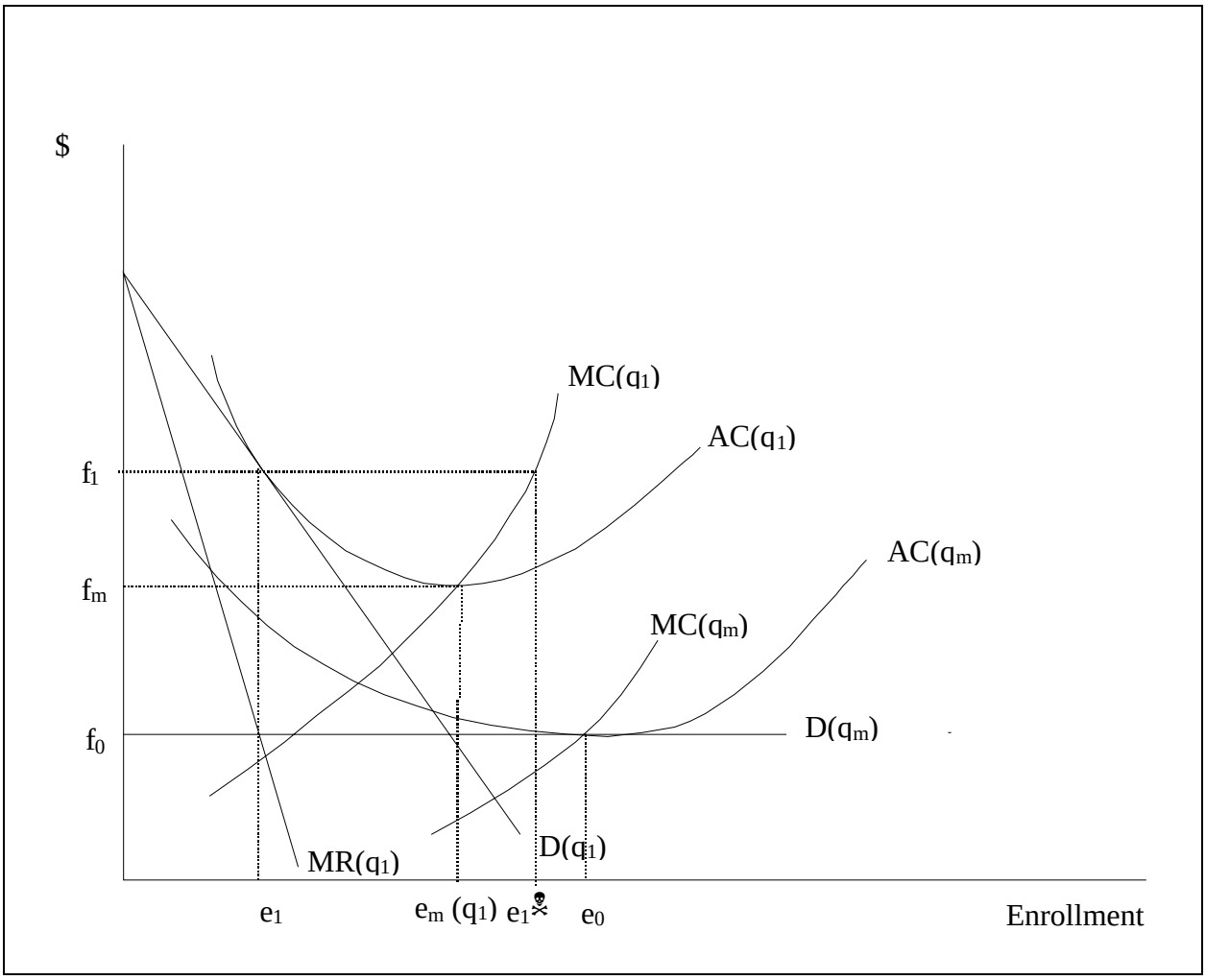
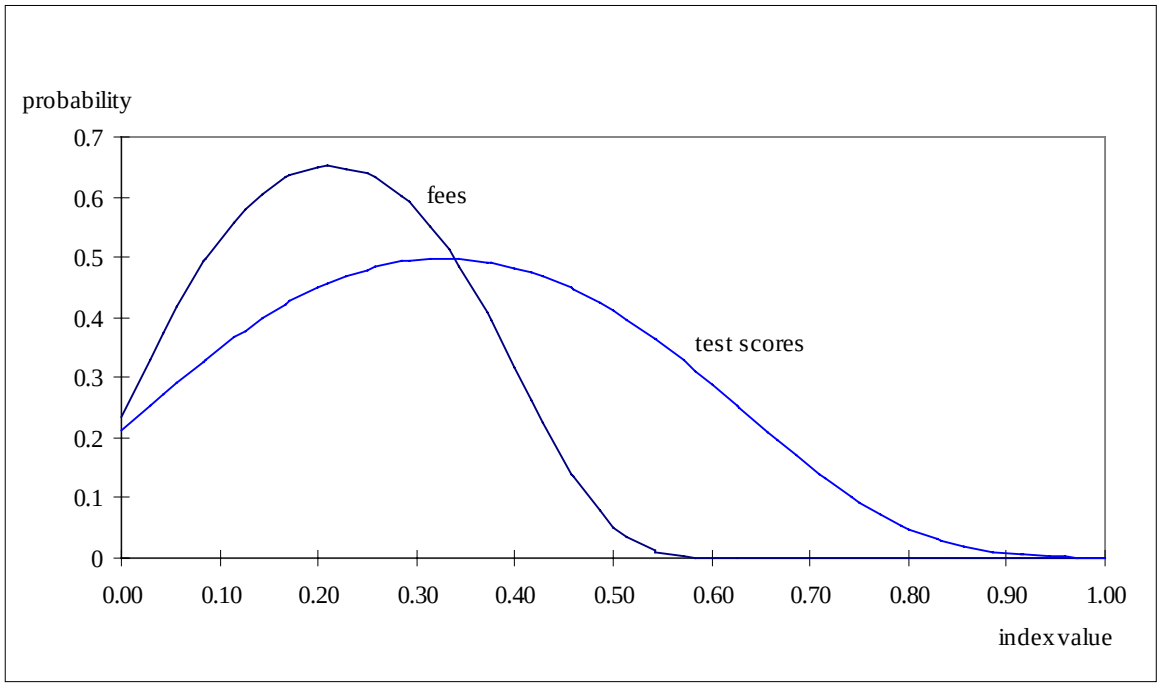


Figure 4: Representative School Demand and Cost Curves For Minimum and Intermediate Quality Private Schools



Note: School offers vouchers if $v_m > f_m(q_1) = \min AC(q_1)$.

Figure 5: Estimated Probability of School Participation Over the Range of School Fees and Test Scores, All Other Variables Fixed at Sample Means



Endnotes

[1] Witte's (1996) review of the literature contends that there is no evidence of increased achievement in private schools, once controls have been made for the nonrandom selection of potentially higher ability students to private schools. In fact, Hoxby's (1996) simulation of the effect of vouchers on student achievement argued that vouchers would cause average test performance across all schools to rise, but that test scores for private school students would fall. All the gains in average scores were attributable to improved public school efficiency necessitated by the increased competition for students. On the other hand, Murnane, Newstead and Olsen (1985) and Sander (1996) did find positive effects of Catholic school attendance on student achievement, even after controlling for selection, particularly for Hispanic students. In addition, Neal (1997), Sander and Krautman (1995) and Witte (1996) report that Catholic schools appear to lower the probability of dropout and increase the probability of attending college. Hoxby's (1996) and Lankford and Wyckoff's (1992) simulations based on school choice models predicted that vouchers would increase private school enrollments, but the proportion of poor children or children with less-educated parents in private schools would not be affected.

[2] Nevertheless, 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) for a review of this literature.

[3] Witte argues that, "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 (p. 170)." To develop reasonable estimates of voucher program effects, 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 (p. 172)". He contends that the crucial information on how schools respond to vouchers will only be available when a large-scale voucher program is implemented, and not until then will researchers be able to establish the validity of simulated voucher effects based on existing schools.

[4] For more details about the program, see King et al. (1997).

[5] For example, in the highest-priced private school in our sample, the voucher would cover only one-fifth of annual fees.

[6] In addition, there is evidence suggesting that private schools provide better learning than do public schools (Jimenez, Lockheed and associates 1996; James, King and Suryadi 1996). Vouchers can also improve the quality in public schools by shifting students from overcrowded public to private schools, thereby easing the pressure on resources in public schools.

[7] 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 were not targeted by the central government could and did enter the program. Therefore, it is reasonable to model municipal choice as a local decision.

[8] The private school's marginal cost of accepting an additional voucher student is assumed to include the added instructional and facility expenses associated with adding students, plus some administrative costs. School incentives to admit voucher students will be discussed in more detail in the next section.

[9] One might think that municipalities would avoid plans to ration public services, because those excluded would form a block of potentially irritated voters. Nevertheless, almost 50 percent of municipalities opted for rationed voucher plans.

[10] The index, which is called the *Necesidades Basicas Insatisfechas* (NBI) index, is a composite of a few characteristics of each municipality derived from household survey data, and includes the following indicators: the proportion of households with inadequate housing as measured by the physical condition or materials used in the dwelling; proportion of households who have no access to clean water and sanitation facilities; proportion of households who live in overcrowded dwellings; proportion of households with a high dependency ratio and in which the household head has less than three years of eduction; and the proportion of households in which a child of primary school age is not enrolled in school (Department of National Planning 1994.

[11] The distributional information on S_U and $N \bullet S_U$ in Table 3 show that S_U and $N \bullet S_U$ turn positive at the 30^{th} percentile, so the first dummy variable represents the upper 70 percent of the distribution of underserved students.

[12] One important point to note is that transfers are made by the central government to local governments in relation to poverty-reduction programs. As these transfers are made on the basis of the level of need, local tax revenues do not accurately reflect the envelope of resources that a municipality has to finance its social services.

[13] In 1996, rules changed with respect to school eligibility in the program. Entry into the program became limited to nonprofit schools.

[14] This is in contrast to Manski's (1992) simulation model which assumed that all private schools charged the same price and offered the same quality. However, Manski (p. 360) pointed out that the assumption was 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.

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

[16] New minimum quality schools might be able to take advantage of the system by charging fees above f_0 because they have no prior record of charged fees. Therefore, the voucher may induce entry of new minimum quality schools, even if old minimum quality schools cannot profit from the voucher.

[17] The model can be complicated somewhat by allowing schools to charge students the difference between the voucher and $f_m(q)$. However, the voucher was only offered to the poorest households which could not afford to pay much of a premium above v_M. In practice, most vouchers paid full school fees.

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

[19] The SABER sample also includes only schools that offer up to grade 11, the terminal year of secondary education. Many schools, primarily in rural areas, offer only up to grade 9.

[20] The corresponding probit coefficients (and z statistics) for the Inverse-Mills Ratio for two specifications similar to those shown in Table 6 are: 0.332 (0.92) and 0.218 (0.60).

[21] If f_{max} is the largest fee in the sample and f_{min} is the smallest, the fee index is defined as $(f_i - f_{min})/(f_{max}-f_{min})$. Similarly, the test score index is $(q_i - q_{min})/(q_{max}-q_{min})$.

[22] In developed countries, underserved students would be those relegated to schools of inferior quality because of capacity constraints in higher quality schools. If our quantity based outcomes apply to quality as well, our results would suggest that locally funded vouchers would not be adopted in cities with the greatest need to improve quality schooling because too many students would want to use the vouchers.