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The Religious Factor in Private Education

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Abstract This paper quantifies the religious factor in education demand by calibrating a political economy model of education finance and school choice in which parents who differ in the advantage they attribute to religious education choose from among public, private-nonsectarian and religious schools. The calibrated distribution of religious preferences indicates that the revealed advantage of religious education is strongly contingent on its high levels of subsidization. The results of the calibration are applied to compare the effect of publicly funded vouchers that do not exclude religious schools—to which the Supreme Court recently opened a door in *Zelman v. Simmons-Harris*—with vouchers restricted to nonsectarian schools. It supports the implicit conclusion of the Court, that participation of religious schools in the Cleveland voucher program was essential for achieving its goal of helping low-income parents in a failing school district. Larger vouchers would have reduced the share of religious schools in the program, though they would still have attracted a majority of students.

Keywords: religious education, public education, school finance, school vouchers
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1. INTRODUCTION

The importance of the religious factor for private education in the United States is evident from the large proportion of private school students—five out of six—attending religious schools.[1] Commitment to religious values is clearly an important factor behind parents' decisions to incur the added expense of sending their children to private schools, but other factors are also at work: religious education is often privately subsidized, and may also be perceived as more efficient than public education.[2] In Cleveland, a state-funded pilot voucher program gave low-income a choice between religious and nonsectarian private schools, and almost all chose religious schools: the vouchers were large enough to cover tuition in religious schools but not in private nonsectarian schools, and the participating families could not afford to top them up. In a similar but more generous program in Milwaukee, parents were offered vouchers that exceeded average tuition in private nonsectarian elementary schools and about two thirds chose religious schooling.[3] The Supreme Court has recent ruled that the channeling of state funds to religious schools through the Cleveland program voucher did not violate the Establishment Clause of the First Amendment. This opens a door to further implementation of similarly structured programs that include religious schools,[4] which is likely to further expand religious education.

This paper quantifies the strength of the religious factor in education demand, and applies its findings to compare vouchers that are restricted to nonsectarian schools with vouchers that include religious education. Parents who choose religious schools for their children must view these schools as providing a better education than local public schools, as the tuition they pay for private education does not reduce their school-tax liabilities; and yet average tuition in private religious schools is much lower than spending per pupil in public schools.[5] This implies that parents who choose religious schools must view a dollar of religious school tuition as buying

more education than a tax dollar spent on public education. Of course, this perceived advantage is not shared by all parents, many of whom see religious instruction as a disadvantage. This variety of religious sentiment implies a distribution of preferences for religious schooling, and it is this distribution that we quantify here.

To this purpose we introduce a religious dimension in a political economy model of education finance and school choice: households differ in their preferences for different types of schools and choose between public, private-religious and private-nonsectarian schools based on the added (or diminished) utility they derive from religious schooling, the degree to which religious schools are subsidized, and the quality of public education.[6] Public school spending is determined by majority voting that anticipates households' decisions on school choice. A political-economy equilibrium in which these anticipations are correct is then derived. Calibrating it to observed enrolment shares by school type, public spending on education, and the parameters of the income distribution yields a distribution of the religious factor that underlies observed patterns of school choice. It indicates that at current subsidy levels, three out of four households prefer religious to nonsectarian education, but that few households would prefer religious education if religious and nonsectarian schools were equally subsidized.

The results of the calibration are then applied to compare, through simulations, vouchers restricted to nonsectarian schools to vouchers that include religious schools.[7] These indicate that vouchers must be large enough to cover, or nearly cover, private tuition to have a significant effect on the low-income households that such programs are generally intended to help. Hence vouchers restricted to nonsectarian schools must be considerably larger than the Cleveland vouchers to have a significant effect on private enrolment, and even then our calibration indicates that a majority of households would choose religious education no matter how large the

amount of the voucher. Only if religious schools are included in the program can smaller sized vouchers reach low-income families. This supports the implicit conclusion of the Supreme Court, that participation of religious schools in the Cleveland voucher program was essential for achieving its goal of assisting low-income parents in a failing school district, and suggests that similar findings are likely to apply in other settings. Comparing voucher effects across states, we find substantial variety in the magnitude of local responses similarly structured voucher programs, suggesting that moderately sized vouchers will only be effective in location where substantial existing religious enrolment indicates strong religious sentiment. Finally, we find that if vouchers are restricted to low-income families (that would not otherwise enroll in private schools), and the marginal savings to the public system from the exit of a voucher recipient is greater than the sum of the voucher, then the voucher program should generate modest fiscal benefits in the long run, though transition costs may be substantial.[8]

The structure of the paper is as follows: Section 2 defines the model, derives its basic properties and characterizes its political-economic equilibrium; Section 3 calibrates it to national and state-level data; Section 4 applies the calibrated model to school voucher programs; Section 5 discusses various extensions; and Section 6 concludes.

2. FORMAL ANALYSIS

2.1 Basic definition of the model

Consider an economy with a continuum of households of measure one, indexed by i, each comprising one parent and one child. Each household is characterized by its income y_i and by a religious parameter $z_i \geq 0$ that reflects the intrinsic value it attaches to a religious education.[9] Let $g(y, z)$ denote the joint density function of y and z, let y_m denote median household income, and

let Y denote mean income. Household utility then depends on: consumption of a numeraire good c; the quality of education, measured as spending per pupil in the child's school, x;[10] and the religious orientation of the household's school of choice given the nature of its own religious sentiment, z. To fix ideas, set household utility equal to:

$$U(c_i, x_i, z_i) = \begin{cases} c_i^{\,a}\, x_i^{1-a} & \textit{if household } i \textit{ chooses a secular school} \\ c_i^{\,a}\, (z_i\, x_i)^{1-a} & \textit{if household } i \textit{ chooses a religious school} \end{cases} \qquad (1)$$

where $0 < a < 1$ is a fixed, common parameter. Thus households with $z_i < 1$ view religious schooling as a drawback *per se*, though they may opt for a religious school if it is sufficiently subsidized (and their value of z_i is not too small), while households with $z_i > 1$ view religious schooling as an advantage.

Public education is available free of charge to all households at a uniform quality $\bar{x}$ funded by a proportional income tax rate t levied on all households and determined by majority vote.[11] Denoting by q the proportion of households that send their children to public schools, and choosing quality units so that the price of public school quality equals one, the government's balanced budget constraint implies that the quality of public schooling is

$$\bar{x} = t\, Y / q \qquad (2)$$

Nonsectarian private schooling and religious private schooling are available as alternatives to public schooling, and can be purchased from a competitively priced private sector in any desired quality, though doing so does not reduce one's tax liability. We assume that the cost of a unit of education quality in nonsectarian schools is the same as in public schools, while stipulating that religious school tuition is subsidized at the rate h.[12]

2.2 School choice

The indirect utility anticipated by a household with income y_i sending its child to public school equals:

$$V_p\,(\,y_i,\,t,\,q^e) \;=\; [(1-t)\,y_i\,]^a\,[\,t\,Y\,/\,q^e\,]^{\,1-a} \qquad (3)$$

where q^e is the level of public enrolment that it anticipates. A household with income y_i that sends its children to a nonsectarian private school solves:

$$\max_{c,x}\; c^a\,x^{\,1-a} \qquad \text{subject to} \qquad c \;+\; x = \;(1-t)\,y_i \qquad (4)$$

obtaining indirect utility

$$V_n\,(y_i,\,t) = \;\; a^{\,a}\,(1-a)^{1-a}\,(1-t)\,y_i \qquad (5)$$

And a household with income y_i and religious preference z_i that sends its child to a religious private school solves:

$$\max_{c,x}\; c^a\,(z_i\,x)^{\,1-a} \qquad \text{subject to} \qquad c \;+\; (1-h)\,x \;=\; (1-t)\;\,y_i \qquad (6)$$

and obtains indirect utility

$$V_r\,(\,y_i,\,z_i,\,t) = \;[z_i\,/\,(1-h)]^{1-a}\;a^{\,a}\,(1-a)^{1-a}\;(1-t)\,y_i \qquad (7)$$

As the model does not separate between the effect of the religious preference parameter z_i and the effect of the subsidy for religious schooling h, we simplify the notation by setting $k_i = z_i\,/\,(1-h)$, and denote by $f\,(y,\,k)$ its induced joint density function with y.[13] It follows from direct comparison of (5) and (7) that households prefer private religious schooling to private secular schooling if and only if $k_i > 1$, and to simplify the exposition we assume that when parents are indifferent between secular and religious schooling they choose secular schooling.

As opting out of public education does not reduce one's tax obligations, sending one's

child to private school must be aimed at obtaining a higher quality of education; and as education quality is a normal good, households that favor a given type of private school over public schooling will be those with higher incomes. A household with $k_i \leq 1$ chooses between *public* and *private-nonsectarian* schooling by comparing the utility levels in equations (3) and (5). Given a tax level t and anticipated public enrolment q^e, either all households with $k_i \leq 1$ prefer public education, or there exists a threshold income $y_n(t, q^e)$ implicitly defined by

$$V_p(y_n, t, q^e) = V_n(y_n, t) \tag{8}$$

such that households with $k_i \leq 1$ and income above y_n (and only those households) send their children to nonsectarian private schools (figure 1).[14] Private nonsectarian enrolment is then

$$q_n(t, q^e) = \int_0^1 \int_{y_n(t,q^e)}^{\infty} f(y, k)\, dy\, dk \tag{9}$$

Similarly, a household with $k_i > 1$ chooses between *public* and *religious* schooling by comparing (3) and (7), and for a given tax level t and anticipated public enrolment share q^e sends its child to a religious school if and only if its income exceeds the threshold $y_r(k_i, t, q^e)$ implicitly defined by[15]

$$V_p(y_r, t, q^e) = V_r(y_r, k_i(1-h), t) \tag{10}$$

(See figures 1 and 2). Private religious enrolment then equals

$$q_r(t, q^e) = \int_1^{\infty} \int_{y_r(k,t,q^e)}^{\infty} f(y, k)\, dy\, dk \tag{11}$$

In equilibrium we require that, given the tax rate t, the actual public enrollment rate equals the anticipated rate, i.e., we seek a value of $q = q(t)$ that solves:

$$q(t) = 1 - q_n(t,q) - q_r(t,q) = \int_0^1 \int_0^{y_n(t,q)} f(y,k)\, dy\, dk + \int_1^{\infty} \int_0^{y_r(k,t,q)} f(y,k)\, dy\, dk \tag{12}$$

Differentiation of (8) and (10) with respect to q reveals that both y_n and y_r are decreasing in q, and as the value of the right-hand side of (12) at $q = 1$ is non-negative, and its value at $q = 0$ is no greater that 1, for each t there exists a unique equilibrium value of public enrolment $q(t)$, implicitly defined by (12), that equates anticipated and actual enrolment rates.

2.3 Voting on the tax rate

Under our assumption of a Cobb-Douglas utility function, all households that anticipate sending their children to public school prefer the same tax rate, which is characterized by the first-order condition

$$dV_p/dt = (1-t)^{a-1}(y/\bar{x})^a [-a\,\bar{x} + (1-a)(1-t)\,d\bar{x}/dt] = 0 \qquad (13)$$

where $\bar{x}(t) = t\,Y/q(t)$, and $q(t)$ is defined by the solution to (12). Assuming a majority of households choose public education,[16] equation (13) determines the tax rate.

3. CALIBRATION

3.1 Calibration to national averages

We calibrate the model initially to average United States data.[17] Assume that both the distribution of income in the population and the distribution of the parameter k follow lognormal distributions: $\ln y \sim N(m_y, s_y^2)$ and $\ln k \sim N(m_k, s_k^2)$, and that the two variables are uncorrelated. The joint distribution of $\ln y$ and $\ln k$ is then bivariate normal with zero correlation, and the joint density of y and k is given by

$$f(y,k) = \frac{1}{2p s_k s_y} e^{-0.5\cdot\left[\left(\frac{\ln k - m_k}{s_k}\right)^2 + \left(\frac{\ln y - m_y}{s_y}\right)^2\right]} \qquad (14)$$

The parameters of the income distribution are calibrated directly from the actual distribution of

household income in the United States in 1998. Under the assumption of a lognormal distribution of income, median income is $y_m = \exp(m_y)$ and mean income is $Y = \exp(m_y + s_y^2/2)$. Setting Y equal to mean household income in that year, \$52,513, and y_m equal to median household income,[18] \$38,885, gives $m_y = 10.57$ and $s_y^2 = 0.601$.

The parameters m_k and s_k^2 that determine the distribution of k, along with a the parameter of the utility function, are calibrated from the tax rate, which we set equal to the share of public spending on education in household income, and which must satisfy equation (12); and from enrolment shares in private-secular and private-religious education. To set the tax rate, note that public expenditure per pupil equals tY / qm where m is the ratio of pupils to households. Setting tY / qm = \$6,189, $m = 0.507$, and $q = 0.901$—their actual values in 1997/8—and taking average household income Y as above, yields a tax rate of $t = 5.38\%$.[19]

Incorporating the lognormal specification in equations (9) and (11) we obtain the following expressions for the share of households that opted for private-secular and private-religious education, which are set equal to actual enrolment shares in 1997/1998:[20]

$$q_n = \int_0^1 \int_{y_n(t,q)}^{\infty} f(y,k)\, dy\, dk = 0.0156 \qquad (9a)$$

$$q_r = \int_1^{\infty} \int_{y_r(k,t,q)}^{\infty} f(y,k)\, dy\, dk = 0.0836 \qquad (11a)$$

Substituting equation (8) in (9a) and (10) in (11a), and requiring that equation (12) is satisfied, gives three equations in the three unknowns a, m_k and s_k. The calibrated values of the household preference parameters that we obtain from solving these equations are: $a = 0.933$, $m_k = 0.148$, and $s_k = 0.232$, implying that the mean value of k is 1.190, its median value is 1.158, and its standard deviation is 0.279. It follows that 74% of households have k values over 1, and

hence prefer religious education to private nonsectarian education, if funding is independent of school choice. This is roughly consistent with parents' choices in the Milwaukee voucher program: given vouchers that exceeded average tuition at both religious and nonsectarian private elementary schools, two thirds chose religious schools.

3.2 Measuring the relative efficiency of religious schools

The distribution of the parameter k is not in itself a measure of the relative efficiency of religious schools as it also includes a subsidy term, h, the rate at which tuition in religious schools is privately subsidized. The inherently subjective, multi-dimensional quality of religious education is represented in our model by the distribution of the parameter z. Recalling that $\ln k_i = \ln z_i - \ln (1 - h)$, identifying the distribution of z is equivalent to measuring h. But this is far from straightforward: parish subsidies may be partially offset by tacit requirements that parents donate their own time or money to the school; and lower salaries in religious schools may or may not reflect differences in teacher quality (see note 2). Furthermore, the school choices that underpin our calibrated value of k are a reflection of the subjective quality of *locally available* religious schools, and in this regard reflect not only individual preferences but also conditions of supply. The implications of different values of h for the distribution of z are presented in Table 1, the last column of which is the share of the population with $z \geq 1$, i.e., the share of the population that views the religious schools to which it has access as more desirable, without a subsidy, than local public schools. This share varies widely: 74% if $h = 0$, 37% if $h = 20\%$, 18% if $h = 30\%$, 6% if $h = 40\%$, and 1% if $h = 50\%$. This implies that if religious schools are as heavily subsidized as the raw data suggest—as much as 50% in Catholic schools (see note 2)—then only a very small minority of the population finds these schools subjectively more cost-effective than public

schools.

3.3 Sensitivity analysis

To check the sensitivity of our calibration to specific parameter values, we varied each parameter individually around its national value. The results of are presented in Table 2. Both the mean and median values of k vary in narrow ranges, about ±5% around their calibrated values, while its standard deviation varies more, ranging between 0.194 and 0.546.

3.4 Calibration to state data

Calibrating the model to state data serves both to check the sensitivity of the calibration to national data and as a basis for analyzing the impact of local conditions on voucher outcomes, in the following section. Basic descriptive data for all states are presented in Table 3, and the calibration results are reported in Table 4. Calibration was successful for 37 states. The mean value of k has an average value of 1.196 over these states, very near its calibrated value from national data, 1.190; it ranges from a minimum of 0.988 to a maximum of 1.467; and has a standard deviation of 0.134. It is closely correlated with the share of religious schools in total enrolment in the state. A regression of mean k values on religious enrolment shares q_r across states yielded the equation: $k = 0.86 + 4.08*q_r$ with an R^2 value of 0.916. The median value of k behaves similarly, with a mean value of 1.126, very near the value calibrated from national data, 1.158, a range of 0.807 to 1.328, and a standard deviation of 0.131. The standard deviation of k varies more widely, between 0.052 and 1.396, with a mean value of 0.384 and a standard deviation of 0.272.

There were thirteen states for which we were not able to calibrate the model, presumably

because their parameters were not consistent with our theoretical framework. Six states (Arkansas, Nevada, North Dakota, Texas, West Virginia, Wyoming) are characterized by surprisingly low private enrolment rates given their high income inequality, which may be attributable to low population densities that, together with initially increasing returns to scale, raise the relative cost of private education—a factor that does not enter in our model. A second group of six states (Alabama, Delaware, Maine, Maryland, Mississippi, Vermont) is characterized higher private enrolment rates than might be expected given their levels of income inequality. This too may be a supply-side phenomenon: private schools locating in these states for unique historical or geographical reasons not represented in the model, and attracting large numbers of out-of-state pupils.[21] The thirteenth state, Utah, is characterized by an exceptionally low religious enrolment rate, possible attributable to the unique religious composition of its population.

4. SCHOOL VOUCHERS

In this section we apply the results of the calibration to gauge the effects of differently structured school voucher programs on enrolment shares and public spending per pupil. We assume throughout that the tax rate is fixed at 5.38% of household income; the amount of the voucher is exogenously determined, and not so large as to draw a majority of households out of public education; and the voucher program is financed from the same tax base as public education, so that its cost is deducted from the public school budget.[22] The voucher program is allowed to vary in three dimensions: the size of the voucher; whether its use is restricted to nonsectarian schools or "unrestricted" and available for use in both nonsectarian and religious schools; and whether or not it is means-tested, i.e., available only to households below some given income. We begin

with the simplest case, that of an unrestricted voucher available to all households, which we then compare to vouchers available only for use in nonsectarian schools and to means-tested vouchers.

4.1 Unrestricted vouchers offered to all households for use in all schools

Consider a voucher of exogenous magnitude *s* funded from the same tax base as expenditure on public schools and offered to all households for use in any private school they choose. Assume all households have the same number of children, *m*, and that each treats its children identically. Spending per pupil in public schools is then

$$\bar{x}(t, q, s) = [t\,Y - (1-q)\,s\,m\,] / (q\,m) \tag{15}$$

and the indirect utility of a household that chooses public education equals

$$V_{ps}(y_i) = [(1-t)\,y_i\,]^{a}\ \ \bar{x}^{\,1-a} \tag{16}$$

Households that send their children to nonsectarian private schools have indirect utility:[23]

$$V_{ns}(y_i, k_i) = \begin{cases} s^{1-a}\left[(1-t)y_i\right]^{a} & y_i < a\ \ s\,m/\left[(1-a)(1-t)\right] \\ a^{\,a}(1-a)^{1-a}\left[(1-t)y_i + sm\right]/m^{1-a} & y_i \geq a\ \ s\,m/\left[(1-a)(1-t)\right] \end{cases} \tag{17}$$

And households that send their children to religious private schools have indirect utility:[24]

$$V_{rs}(y_i, k_i) = \begin{cases} (k_i s)^{1-a}\left[(1-t)y_i\right]^{a} & y_i < a\ \ s\,m/\left[(1-a)(1-t)\right] \\ a^{\,a}(1-a)^{1-a}\,k_i^{\,1-a}\left[(1-t)y_i + sm\right]/m^{1-a} & y_i \geq a\ \ s\,m/\left[(1-a)(1-t)\right] \end{cases} \tag{18}$$

Setting (16) equal to (17) determines a threshold income level $y_{ns}(t, q^e, s)$ defined by

$$V_{ps}(y_{ns}) = V_{ns}(y_{ns}) \tag{19}$$

such that all households with $k_i \leq 1$ and income below y_{ns} send their children to public schools

while those with $k_i \leq 1$ and income above y_{ns} send their children to private nonsectarian schools,[25] and the private nonsectarian enrolment share equals

$$q_n(q^e) = \int_0^1 \int_{y_{ns}(t,q^e,s)}^{\infty} f(y,k)\,dy\,dk \tag{20}$$

Next, comparing (16) and (18) for a given value of $k_i > 1$, we distinguish between two cases. If $k_i \leq \bar{x}/s$ then there exists a threshold income $y_{rs}(k_i, t, q^e, s)$ defined implicitly by

$$V_{ps}(y_{rs}) = V_{rs}(y_{rs}, k_i) \tag{21}$$

such that households with $k = k_i$ and income y_i above y_{rs} choose religious schooling (see figure 3a); and if $k_i > \bar{x}/s$ then all households with $k = k_i$ choose religious schooling (figure 3b), and we set $y_{rs}(k_i, t, q^e, s) = 0$. The enrolment share of religious schools then equals

$$q_r(q^e) = \int_1^{\infty} \int_{y_{rs}(k,t,q^e,s)}^{\infty} f(y,k)\,dy\;dk \tag{22}$$

In equilibrium we require that realized public enrollment equal its anticipated value, and seek q that solves:

$$q = 1 - q_n(q) - q_r(q) \tag{23}$$

for the given voucher amount s, the given tax rate $t = 5.38\%$, and the parameter values calibrated in the preceding section.

Table 5 presents the effect on enrolment and spending of unrestricted vouchers in increments of $1,000, from $1,000 to $5,000. The impact on private enrolment is substantial, especially in religious schools, and each has a positive though small impact on public spending per pupil, indicating a Pareto improvement over the no-voucher case.[26] The fall in public enrolment below 50% when a voucher of $5,000 is offered points to the possibility of large unrestricted vouchers ultimately undermining the viability of public education. It suggests that

on purely fiscal grounds, and ignoring the social benefits of public education, a majority of households may prefer to replace the public education system with a pure voucher program. We consider this issue further in section 5.

4.2 Vouchers restricted to non-sectarian schools (without a means test)

Now consider the effect of explicitly incorporating in the model an exogenous restriction that prevents the use of tax dollars to finance vouchers for religious schools, and assume for the moment that such vouchers are available to all households regardless of income. Spending per pupil in public schools is then given by

$$\bar{x} = (t\,\bar{y} - q_n\, s\, m) / (q\, m) \tag{24}$$

and indirect utility from public education is

$$V_{p1}(y) = [(1-t)\,y]^{a}\ \ \bar{x}^{\,1-a} \tag{25}$$

Indirect utility when private nonsectarian schooling is chosen equals

$$V_{n1}(y_i) = \begin{cases} s^{1-a}\left[(1-t)\,y_i\right]^{a} & y_i < a\ s\ m/\left[(1-a)(1-t)\right] \\ a^{\,a}\,(1-a)^{1-a}\left[(1-t)\,y_i + sm\right]/m^{1-a} & y_i \geq a\ s\ m/\left[(1-a)(1-t)\right] \end{cases} \tag{26}$$

and indirect utility when religious schooling is chosen equals

$$V_{r1}(y, k) = a^{a}\,(1-a)^{1-a}\ k^{\,1-a}(1-t)\,y\,/\,m^{1-a} \tag{27}$$

As above, all households with $k_i \leq 1$ prefer private non-sectarian schooling to religious schooling, and hence send their children to nonsectarian private schools if and only if their income exceeds a threshold level $y_{n1}(t, q^e, q_n^e, s)$ defined by $V_{p1}(y_{n1}) = V_{n1}(y_{n1})$. However,

households with $k > 1$ may now prefer private nonsectarian schooling to private religious schooling because only the former allows them to take advantage of the voucher program. Thus a household with $k > 1$ sends its children to private religious school if it meets two conditions: It must prefer religious to public schooling, which holds if its income exceeds the threshold level $y_{rp1}(k, t, q^e, q_n^e, s)$ defined by (the positive root of) $V_{p1}(y_{rp1}) = V_{r1}(y_{rp1}, k)$; and it must prefer religious to private nonsectarian schooling, which holds if its income exceeds the threshold level $y_{rn}(k, t, s)$ defined by $V_{n1}(y_{rn1}) = V_{r1}(y_{rn}, k)$.[27] Denote $y_{r1}(k_i ; t, q^e, q_n^e, s) = \max\{y_{rp1}, y_{rn}\}$; then private religious enrolment equals

$$q_r(q^e, q_n^e) = \int_1^{\infty} \int_{y_{r1}(k,t,q^e,q_n^e,s)}^{\infty} f(y,k)\, dy\, dk \tag{28}$$

A household with income y_i and $k_i > 1$ chooses private-nonsectarian education if it prefers it to both public and religious education (figure 4a), which holds if

$$y_{n1}(t, q^e, q_n^e, s) < y_i < y_{rn}(k_i, t, s) \tag{29}$$

Inspection of (27) reveals that y_{rn} is decreasing in k so that for sufficiently high values of k, we may have $y_{n1} > y_{rn1}$ in which case households with such values of k never choose private-secular schooling (figure 4b). Let $\underline{k}_1(t, q^e, q_n^e, s)$ be the smallest value of k for which $y_{n1} \geq y_{rn}$. The share of private nonsectarian enrolment is then:

$$q_n(q^e, q_n^e) = \int_0^1 \int_{y_{n1}(k,t,q^e,q_n^e,s)}^{\infty} f(y,k)\, dy\, dk + \int_1^{\underline{k}_1(t,q^e,q_n^e,s)} \int_{y_{n1}(t,q^e,q_n^e,s)}^{y_{rn}(k,t,s)} f(y,k)\, dy\, dk \tag{30}$$

The model is then solved by requiring that anticipated enrolment shares in public and private-secular education accord with household decisions, i.e., we seek q^* and q_n^* such that $q^* = 1 - q_r(q^*, q_n^*) - q_n(q^*, q_n^*)$ and $q_n^* = q_n(q^*, q_n^*)$, where $q_r(q^e, q_n^e)$ and $q_n(q^e, q_n^e)$ are defined by equations (28) and (30).

The results of these calculations for vouchers restricted to non-sectarian schools, in increments of $1,000 between $1,000 and $5,000, holding the tax rate fixed at t = 5.38%, are presented in Table 6. The relative effect on private non-sectarian enrolment is substantial—a $2,000 voucher more than doubles the private non-sectarian share—but because of its small absolute size, and because some of the increase is drawn from private religious enrolment, the impact on public enrolment is small. Moreover, the beneficiaries of these programs are exclusively higher income households, many of which would have opted for private education without the voucher. Consequently spending per pupil in public education falls slightly, and the program has a detrimental effect on low-income households.

4.3 Means-tested vouchers

Means-tested vouchers available for use in both nonsectarian and religious schools offered to low-income families in Cleveland under Ohio's Pilot Project Scholarship Program, and in a similar program in Milwaukee, induced extensive enrolment of children from underprivileged homes in private religious schools. As we show here, this result is not surprising and is likely to be replicated in other localities where similarly structured programs are put into place. Furthermore, vouchers targeted exclusively at low-income families should also induce slight increases in public spending per pupil, holding the tax rate fixed, if the exit of students from the public system generates proportional savings (Chen and West, 2000; Bearse et al., 2000).

Let $\underline{y}$ denote the maximal income for participating in the voucher program. Then, as vouchers are unrestricted with regard to type of school, households with $k_i > 1$ that choose private schooling choose religious schooling, while households with $k_i \leq 1$ that choose private schooling choose nonsectarian schooling. Spending per pupil in public education is then a

function of public enrolment q and of the share of households that meet the means test and choose private education, p:

$$\bar{x}\,(q, p) = [\,t\,Y - p\,s\,m\,] / (q\,m) \qquad (31)$$

Comparing indirect utility levels across school types within each of the four types of households ($k_i \leq 1$, $y > \underline{y}$;), ($k_i \leq 1$, $y \leq \underline{y}$;), ($k_i > 1$, $y > \underline{y}$) and ($k_i > 1$, $y \leq \underline{y}$;) yields four threshold income levels: $y_{nh}\,(t, s, q^e, p^e)$, $y_{nl}\,(t, s, q^e, p^e)$, $y_{rh}\,(t, s, q^e, p^e)$ and $y_{rl}\,(k, t, s, q^e, p^e)$ such that each household chooses private education (of the type it prefers) if and only if its income exceeds the relevant threshold.[28] Private nonsectarian enrollment is then:

$$q_n(q^e, p^e) = \int_0^1 \int_{y_{nl}(t,s,q^e,p^e)}^{\bar{y}} f(y,k)\,dy\,dk \quad + \quad \int_0^1 \int_{y_{nh}(t,s,q^e,p^e)}^{\infty} f(y,k)\,dy\,dk \qquad (32)$$

private religious enrollment is

$$q_r(q^e, p^e) = \int_1^{\infty} \int_{y_{rl}(k,t,s,q^e,p^e)}^{\bar{y}} f(y,k)\,dy\,dk \quad + \quad \int_1^{\infty} \int_{y_{rh}(k,t,s,q^e,p^e)}^{\infty} f(y,k)\,dy\,dk \qquad (33)$$

and the share of households that use a voucher is

$$p\,(q^e, p^e) = \int_0^1 \int_{y_{nl}(t,s,q^e,p^e)}^{\bar{y}} f(y,k)\,dy\,dk \quad + \quad \int_1^{\infty} \int_{y_{rl}(k,t,s,q^e,p^e)}^{\bar{y}} f(y,k)\,dy\,dk \qquad (34)$$

The model is then solved by requiring that anticipated public enrolment and voucher use accord with household decisions. Thus we seek q^* and p^* such that $q^* = 1 - q_r\,(q^*, p^*) - q_n\,(q^*, p^*)$ and $p^* = p\,(q^*, p^*)$ where the functions $q_r\,(q^e, p^e)$, $q_n\,(q^e, p^e)$ and $p\,(q^e, p^e)$ are defined by equations (32) – (34).

The results are presented in Table 7 for vouchers of $3,000 and $4,000, and means tests between $20,000 and $80,000. Religious enrolment increases substantially, with the size of the

increase depending strongly on the size of the voucher and the stringency of the means test. For the larger voucher, religious enrolment increases by more than half when the means test is set at $40,000 and more than doubles when it is set at $80,000. Public spending per pupil increases throughout, increasing more the larger the voucher and the higher the threshold (within the given range), though the largest increase is no more than 4%. This increase incidentally causes a slight decline in nonsectarian private enrolment. Clearly, in terms of the model, an unrestricted means-tested voucher of $4,000 is a Pareto improvement over no voucher: households that choose to remain in the public school system benefit from higher spending per pupil without an increase in taxes; households that take advantage of the voucher clearly gain; and those above the means test are no worse off than before.[29]

4.4 Restricting means-tested vouchers to nonsectarian schools

Restricting vouchers to nonsectarian schools virtually precludes their use by lower-income households unless they are offered in very generous amounts. Low-income families will only use a voucher if it is sufficient in itself to obtain a better education than local public schools can offer.[30] If voucher amounts are not very large, only subsidized religious schools will accept it in full payment of tuition; nonsectarian schools that do not have access to similar charitable sources will require additional tuition. In the context of our model, our calculations show that even a $5,000 voucher restricted to non-sectarian schools would not be taken up by households earning less than $40,000 annually.[31] While this result should not be taken literally—costs are lower for elementary schools than for high schools, private nonsectarian schools may be more efficient than public schools in failing school districts, and may offer reduced tuition to disadvantaged children for a variety of reasons (a sense of public service, the value of a diverse student body,

marginal costs that are below average costs)—its essence is clear. It supports the conclusion implicit in the Court's ruling on *Zelman v. Simmons-Harris*, that the primary objective of Ohio's pilot voucher program—to provide greater educational opportunity for underprivileged students in a failing public school system—could not have be achieved if the program had excluded religious schools, unless of course it offered much larger vouchers than those it provided.[32]

4.5 Voucher simulations using the results of calibrations to state data

To test the sensitivity of these results to variation in the parameters of the model across states we computed the impact of an unrestricted means-tested voucher equal to one half of public spending per student in the state and available to households with no more than median state income, for the 37 states for which we were able to calibrate the model. The results are presented in table 8, and show large variation between the states. Thus while the national calibration indicates a decline of one half a percentage point in public enrolment and a similar rise in religious enrolment, seven states show declines in public enrolment (and increases in religious enrolment) of more than 5 percentage points, while in nine others the change is less than 0.05 percentage points. In general, the magnitude of the change varies closely with the mean and standard deviation of the religious factor *k*, which itself is strongly correlated with religious enrolment in the state.[33] Holding the tax rate fixed and assuming that each student opting out of public education generates cost savings equal to average spending per student in the state before implementation of the voucher program, an increase in public spending per student is inevitable, as the sum of the voucher is half this amount and the means test is sufficiently stringent to exclude virtually all families that sent their children to private schools before the program is implemented. However, the relative increase is small—approximately half the size of the

reduction in public enrolment and never more than 4%. These increases, which represent improvements in public education in the context of the model, lead to slight declines in nonsectarian private enrolment of up to 0.2 percentage points.

5. DISCUSSION

In this section we discuss in more general terms various extensions of the model that bear on the preceding analysis.

5.1 Endogenous determination of the sum of the voucher

In the preceding sections we assumed that the tax rate and voucher amounts were exogenously determined, and focused on their effect on enrolment. Now allow endogenous determination of the amount of the voucher by majority vote while holding the tax rate fixed, retaining the assumption that there are no external funding sources, and restricting our attention to vouchers that leave a majority of households attending public schools.[34] Then voters who anticipate sending their children to public schools—the majority—all prefer the voucher amount that maximizes public spending per pupil. Letting t_0 denote the fixed tax, this is the voucher that satisfies $\P\ \bar{x}(t_0, s)/\P\ s = 0$, where $\partial\bar{x}(t_0, s)/\partial s$ is obtained by total differentiation of the relevant equilibrium conditions.[35] Applying this observation to the voucher programs considered in the preceding section, it follows that of the different configurations presented in Tables 5, 6 and 7, a voucher of $4,000 available to households with incomes below $80,000 for use in any type of private school would command a majority over all other voucher programs described in these tables.[36]

5.2 Endogenous determination of the tax rate

Assume now that the tax rate is determined endogenously by popular vote before the voucher amount is similarly chosen. Let $s^*(t)$ denote the voucher amount chosen contingent on the tax rate t, again restricting our attention to vouchers that leave the majority of households in public schools. Our choice of utility function then implies that all these households prefer the same tax rate, which—after applying the envelope theorem—satisfies

$$t / (1 - t) = [(1-\alpha) / \alpha] [\partial \bar{x}(t, s^*(t)) / \partial t] / [\bar{x}(t, s^*(t)) / t] \qquad (35)$$

Numerical simulations indicate that the partial elasticity $[\partial \bar{x}(t, s) / \partial t] / [\bar{x}(t, s^*(t)) / t]$ is small for our calibration, implying little variation in the tax rate—as long as there is a majority in favor of public schooling.[37]

5.3 The viability of public education

The narrow focus of Ohio's Pilot Project Scholarship Program on helping low-income families in a failing school district, and the modest sums of money involved, were key elements in the Supreme Court's landmark ruling on *Zelman v. Simmons-Harris*,[38] which suggests that a program broad enough to allow a majority of families in a school district to opt out of public education, might not have earned the Court's approval. However, if unrestricted voucher funding of religious education should be allowed, our analysis suggests that, holding the tax rate fixed, a majority coalition of religious and high-income households would prefer receiving an unrestricted voucher and having public education discontinued, to a public education system without vouchers.

To see that this is consistent with our calibration, let q_0 denote the fraction of households

attending public education before vouchers are introduced. Households with values of $k > 1/q_0$ prefer that public education be discontinued and all tax revenues used to fund an unrestricted voucher of sum tY, which they could apply towards tuition in religious schools and obtain a preferred education for their children.[39] They would be joined by households with income in excess of some threshold y_s that would supplement the voucher amount to obtain a higher quality education than currently offered by public schools.[40] Noting that $1/q = 1.1$ is less than the median value of k calibrated from national data, 1.15, and less than the median value of k for 25 of the 37 states for which we calibrated the model, such a majority is likely to exist provided religious schools are able to maintain current subsidy levels while substantially expanding their enrolment. This suggests that continued public support for public education rests on other considerations: regard for the constitutional separation of religion and government; subscription to the principle of equal opportunity embodied in public education; an appreciation of the external benefits of a public education system in reducing crime and ethnic strife, and promoting communal values; and so on.

Mixed systems that combine unrestricted means-tested vouchers with public education may be preferred by a majority of households to either a pure public system and a pure voucher system. Our calibration indicates that an unrestricted means-tested voucher of $4,000 offered to households with income under $80,000 as an alternative to public education would be preferred by a majority of households to either pure system.

5.4 The supply of private education and the direct costs of privatization

Empirical evidence suggests that tuition at parochial schools may be subsidized by as much as 50%, through private donations, institutional support from the church and reduced salaries paid

to teachers in religious orders, thought this may be partially offset if parents are expected to supplement tuition with contributions of money or time that raise the cost of schooling. However, current subsidy levels for tuition in parochial schools may be difficult to maintain if parish support or the supply of teachers in religious orders cannot keep pace with increases in enrolment.

We assume in our analysis that the cost of "education quality" in private nonsectarian schools is the same as in public schools, but this is certainly not always the case. Moreover, variation in the cost of quality may also be observed within public education: in poorly managed school districts the imputed cost of quality is much higher than in well-managed districts. While a theoretical extension along these lines is easily done, relating the parameters of the model to observed variables is less straightforward. Non-academic dimensions of quality cloud its measurement; and self-selection introduces further variety in student motivation and parental support that may be difficult to identify.

Supply side factors can also affect schooling costs when voucher programs change enrolment patterns. In small school districts, scale effects can substantially lower average costs when enrolment expands and raise them when it contracts. The availability of voucher support is likely to increase the variety of religious options, especially in smaller school districts, which should further increase the attraction of private religious education. In addition, as the calibration to state data indicated, there are other factors, such as population density, as well as historical and geographical factors, that affect the local supply of private education but do not enter our analysis.

Moreover, the process of school choice itself requires additional resources, from schools and parents (Levin and Driver, 1997). Experience with open enrolment suggests that as schools

become dependent on voucher income they need to devote substantial resources to marketing efforts; and parents facing wider choices need to collect more information, monitor school performance more closely, and generally deal with a school administration that has at least one eye on the bottom line.[41] Finally, cost savings from reducing public enrolment materialize more slowly than the added cost of funding the vouchers, generating a negative fiscal impact in the short term, even if the long-term effect is positive.

5.5 Other extensions of the model

The joint distribution of income, religious preferences and family size. The model can accommodate almost without change alternative assumptions regarding the correlation between religion and income, replacing our assumption of a zero correlation. It is also readily extended to allow for a variable number of children in the family, again with possibly nonzero correlations between family size, income and religious inclination. And the model could also be extended to allow conditions of extreme poverty or affluence to exercise a "non-linear" effect on school choice, by using a more general utility function.

Institutional factors. Our simple analysis ignores important institutional detail, such as state and federal sources of external funding, the precise nature of the tax base, and the electoral process through which education budgets are approved, which vary substantially from one school district to another. We skirt these issues by assuming that the design of the voucher program is exogenously determined (the small net fiscal effects generated by the programs we consider here imply that the source of voucher funding has little impact on individual school choice, on which we focus in this paper). Extending the analysis to incorporate the fiscal relations between local and state jurisdictions would allow us explicitly to consider the political economy of how

voucher programs are shaped.[42]

Other important factors. Other important dimensions of religious education not addressed in this paper could be addressed in extensions of the model that combined a distribution of religious preferences with other aspects of the political economy of education. Hoxby (2002) argues that school choice improves the efficiency of public schools through competitive pressure, specifically documenting the beneficial effect of the Milwaukee voucher program on productivity in local *public* schools.[43] Others warn that the wide use of vouchers for private schools may erode popular support for ailing public schools. Peer-group effects generated by the movement of pupils from public to private schools may promote inequality by increasing stratification, thus benefiting the strong but hobbling the weak; such effects have been incorporated in school choice models by Epple and Romano (1998), among others. Schools that promote different value systems, through vouchers or other means, may undermine the important role of public education in strengthening the fabric of society and increase racial, ethnic or religious divisions.[44] Finally, the localized structure of school finance in the United States implies that school funding and school choice are closely linked to property values, migration and competition between local jurisdictions. These issues have been integrated and quantitatively analyzed by Epple and Sieg (1999) and Nechyba (2000).

6. CONCLUDING REMARKS

The recent ruling of the Supreme Court on the constitutionality of Ohio's pilot voucher program reflects a growing recognition that alternative modes of education finance may be needed to improve the quality of education for underprivileged children. Limited prior experience with pilot programs suggests that if voucher sums are moderate, nonsectarian private schools do not

offer a viable option for low-income families. The Court's ruling that indirect voucher support for religious schools need not violate the constitutional separation of religion and government opens a door to voucher programs that include religious schools.

This paper offers a methodological framework for anticipating the impact of such programs, in lieu of direct empirical evidence, which as yet is limited. It uses current data on enrolment shares and tax rates to calibrate a political economy model of education finance and school choice that incorporates a religious dimension, which reveals the distribution of preferences for religious education. This is then used to gauge the effects of differently designed voucher programs on enrolment shares. The results confirm the hypothesis that moderately sized vouchers restricted to nonsectarian schools can have little affect on low-income families, and demonstrate the stronger impact of voucher programs that include religious schools, while indicating that the advantage of religious schools is contingent on their high levels of subsidization. Comparing calibrations of the model across states highlights large differences among them, indicating that states with low religious enrolment will need to offer more generous vouchers to achieve significant results.

In focusing our analysis on the religious dimension of private education we have ignored other important dimensions of voucher reform with which it should be integrated: interaction between state and local funding of public schools; peer-group effects that result from the changing composition of school populations; the benefits of competition between schools; a closer analysis of cost factors; reciprocal effects between schools, local property values and residential mobility; and the potential impact of a large increase in religious schooling on social discord. Integrating the religious dimension of education with these different elements offers extensive scope for further research.

REFERENCES

Bearse, P., Glomm, G. and Ravikumar, B., 2000. On the political economy of means-tested education vouchers. *European Economic Review* 44, 904-15.

Buddin, R., Cordes, J. and Kirby, S. N., 1998. School choice in California: Who chooses private schools? *Journal of Urban Economics* 44, 110-134.

Card, D. and Krueger, A. 1996. Labor market effects of school quality: Theory and evidence. NBER WP 5708.

Chen, Z. and E. G. West, 2000. Selective versus universal vouchers: Modeling median voter preferences in education. *American Economic Review* 90, 1520-1534.

Clotfelter, C., 1976. School desegregation, "tipping" and private school enrolment. *Journal of Human Resources* 11, 28-50.

Epple, D. and Sieg, H. 1999. Estimating equilibrium models of local jurisdictions. *Journal of Political Economy* 107, 645-682.

Epple, D. and Romano, R. E., 1998. Competition between private and public schools, vouchers and peer-group effects. *American Economic Review* 88, 33-62.

Epple, D. and Romano, R. E., 1996. Ends against the middle: Determining public service provision when there are private alternatives. *Journal of Public Economics* 62, 297-325.

Evans, W. and Robert, S., 1995. Finishing high school and starting college: Do Catholic schools make a difference? *Quarterly Journal of Economics* 110, 947-74.

Fernandez, R. and Rogerson, R., 1999. Education finance reform and investment in human capital: Lessons from California. *Journal of Public Economics*, 74(3), 327-350.

Fiske, E. B. and Ladd, H. F., 2000. *When Schools Compete*. Washington, DC: Brookings.

Friedman, M., 1962, The role of government in education. In *Capitalism and Freedom*, Chapter VI. Chicago: University of Chicago Press.

Friedman, M., 2002. The market can transform our schools. *New York Times* July 2.

Glazer, Nathan, 2001. Seasons Change. *Education Next* (Fall) pp. 34-37.

Glomm, G. and Ravikumar, B., 1998. Opting out of publicly provided services: A majority voting result. *Social Choice and Welfare* 15, 187-199.

Hanushek, E., 1996. School resources and student performance. In G. Bartles, ed., *Does money matter? The effect of school revenues on student achievement and adult success*, pp. 43-73.

Howell, W. G. and Peterson, P. E., 2002. *The Education Gap*. Washington, DC: Brookings.

Hoxby, C. M., 2002. School choice and school productivity (or Could school choice be a tide that lifts all boats?) NBER WP 8873

Hoxby, C. M., 1998. What do America's 'traditional' forms of school choice teach us about school choice reforms? *Federal Reserve Bank of New York Economic Policy Review* 4, 47-59.

Hoyt, W. and Lee, K., 1998. Educational vouchers, welfare effects and voting. *Journal of Public Economics* 69, 211-228.

James, E., 1987. The public-private division of responsibility for education: An international comparison. *Economics of Education Review* 6,1-14.

Krueger, A., 1998. Reassessing the view that American schools are broken. *Federal Reserve Bank of New York Economic Policy Review* 4, 29-43.

Levin, H. M. and Driver, C. E., 1997. Costs of an Educational Voucher System. *Educational Economics* 5(3) 265-283.

Martinello, F., and West, E. G., 1988, The optimal size of the tuition tax credit, *Public Finance Quarterly,* 16, 425-438.

National Center for Education Statistics, 2000. *Digest of Educational Statistics* 2000.

National Catholic Educational Association, 2001. *Balance Sheet for Catholic Elementary Schools*: *2001*.

National Catholic Educational Association, 1990. *United States Catholic Elementary and Secondary Schools 1989-90.*

Nechyba, T. J., 2000. Mobility, targeting and private school vouchers. *American Economic Review* 90, 130-146.

New York Times, 2002. Voucher backers see opening for a wider agenda. June 28.

New York Times, 2001a. Schools are now marketers where choice is taking hold. April 20

New York Times, 2001b. As bid to privatize schools ends, supporters second-guess effort. March 31.

Paine, Thomas, 1792. *Rights of Man*, Part 2. Reissued by Wordsworth Editions, 1996.

Rangazas, P., 1995. Vouchers and voting: An initial estimate based on the median voter model. *Public Choice* 82, 261-79.

Romer, T., Rosenthal, H. and V. Munley, 1992. Economic incentives and political institutions: Spending and voting in school-budget referenda. *Journal of Public Economics* 49, 1-33.

Sander, W., 1997. Catholic high schools and rural academic achievement. *American Journal of Agricultural Economics* 79, 1-12.

Sonstelie, J., 1982. The welfare cost of free public schools. *Journal of Political Economy* 90, 794-808.

Smith, Adam, 1776. *An Inquiry into the Nature and Causes of the Wealth of Nations*. Reissued by Everyman's Library, 1991.

U.S. Census Bureau, *Statistical Abstract of the United States 2000.*

West, E., 1997. Education vouchers in principle and practice: A survey. *World Bank Research Observer* 12, 83-103.

Zelman et al. v. Simmons-Harris et al., U.S. Supreme Court No. 00-1751, decided June 27, 2002, http://laws.findlaw.com/us/000/00-1751.html.

Table 1. Distribution of the religious preference parameter *z* for different values of the subsidy factor *h*

h	E (ln *z*)	SD (ln *z*)	E (*z*)	SD (*z*)	Prob ($z \geq 1$)
0	0.15	0.23	1.19	0.28	74%
10%	0.04	0.23	1.07	0.25	57%
20%	-0.08	0.23	0.95	0.22	37%
30%	-0.21	0.23	0.83	0.20	18%
40%	-0.36	0.23	0.71	0.17	6%
50%	-0.55	0.23	0.60	0.14	1%

Table 2. Sensitivity of the calibration to variation in individual parameter values

Parameter (base value)	Parameter value	Mean *k*	Std dev *k*	Median *k*
Share of public spending in income (5.38%)	4.38%	1.187	0.271	1.157
	6.38%	1.194	0.287	1.161
Median to mean income ratio (0.74)	0.64	1.165	0.208	1.147
	0.84	1.152	0.546	1.041
Private religious enrolment share (8.4%)	7.4%	1.148	0.206	1.130
	9.4%	1.235	0.341	1.191
Private nonsectarian enrolment share (1.55%)	1.0%	1.184	0.194	1.169
	2.0%	1.187	0.362	1.135

Table 3. State data

State	Mean income (household)	Median to mean ratio	Public education share in income	Religious enrolment	Private secular enrolment
Alabama	41,815	0.867	5.22%	6.05%	2.77%
Alaska	54,373	0.932	9.35%	4.29%	0.23%
Arizona	45,673	0.812	4.65%	4.19%	1.04%
Arkansas	39,678	0.697	5.58%	4.78%	0.74%
California	58,454	0.700	4.90%	7.54%	1.97%
Colorado	54,357	0.857	4.58%	5.41%	1.70%
Connecticut	73,608	0.632	5.23%	8.36%	3.10%
Delaware	57,687	0.719	5.07%	14.66%	3.11%
Florida	48,840	0.715	4.43%	8.78%	1.88%
Georgia	50,127	0.771	5.45%	4.94%	2.28%
Hawaii	57,143	0.714	4.85%	13.17%	1.75%
Idaho	43,199	0.849	5.96%	3.45%	0.35%
Illinois	58,286	0.741	4.82%	12.07%	0.93%
Indiana	47,415	0.838	5.89%	9.09%	0.55%
Iowa	45,564	0.812	5.98%	8.93%	0.17%
Kansas	48,526	0.757	5.54%	7.35%	0.62%
Kentucky	41,940	0.864	5.56%	8.63%	0.93%
Louisiana	43,254	0.734	5.83%	13.26%	2.17%
Maine	43,361	0.822	6.75%	3.84%	3.64%
Maryland	59,990	0.834	5.11%	10.99%	2.53%
Massachusetts	62,960	0.673	4.99%	8.51%	3.31%
Michigan	51,213	0.817	6.35%	9.25%	0.68%
Minnesota	54,068	0.886	5.63%	8.89%	0.69%
Mississippi	38,704	0.752	5.61%	5.56%	4.19%
Missouri	47,078	0.854	5.15%	10.50%	1.10%
Montana	37,955	0.832	7.08%	4.56%	0.33%
Nebraska	47,897	0.760	5.72%	12.05%	0.23%
Nevada	52,630	0.755	4.41%	3.43%	0.72%
New Hampshire	56,597	0.794	4.87%	6.53%	2.96%
New Jersey	69,543	0.716	5.86%	12.18%	1.92%
New Mexico	41,004	0.769	6.41%	4.04%	1.44%
New York	63,095	0.593	5.93%	12.15%	1.89%
North Carolina	46,507	0.771	4.85%	4.82%	1.83%
North Dakota	40,948	0.740	5.93%	5.65%	0.18%
Ohio	48,823	0.797	5.47%	11.11%	0.88%
Oklahoma	40,451	0.834	6.02%	3.88%	0.37%
Oregon	47,165	0.828	5.73%	6.35%	1.21%
Pennsylvania	51,840	0.753	5.50%	14.37%	1.53%
Rhode Island	51,646	0.788	6.26%	11.80%	2.51%
South Carolina	41,880	0.794	5.81%	5.45%	2.40%
South Dakota	42,957	0.763	5.59%	6.09%	0.34%
Tennessee	45,226	0.754	4.64%	7.03%	1.63%
Texas	51,521	0.695	5.78%	4.65%	0.77%
Utah	48,996	0.904	5.78%	1.62%	0.93%
Vermont	45,303	0.869	7.17%	4.04%	5.23%
Virginia	53,196	0.815	4.91%	5.95%	2.18%
Washington	53,676	0.883	5.04%	6.05%	1.16%
West Virginia	36,579	0.730	7.28%	4.23%	0.40%
Wisconsin	49,290	0.838	6.46%	13.11%	0.89%
Wyoming	44,826	0.786	7.28%	2.14%	0.46%

Table 4. Calibration to state data (selected states; see text)

State	Religious enrolment	Mean k	Standard dev k	Median k	$\acute{a}$	Mean ln k ($\grave{\imath}_k$)	Std dev ln k ($\acute{o}_k^2$)
Alaska	4.29%	1.095	0.521	0.988	0.890	-0.012	0.452
Arizona	4.19%	1.062	0.090	1.058	0.945	0.056	0.085
California	7.54%	1.144	0.251	1.118	0.940	0.111	0.216
Colorado	5.41%	1.035	0.476	0.941	0.944	-0.061	0.438
Connecticut	8.36%	1.173	0.524	1.071	0.936	0.069	0.427
Florida	8.78%	1.201	0.332	1.157	0.945	0.146	0.271
Georgia	4.94%	1.056	0.230	1.032	0.935	0.032	0.215
Hawaii	13.17%	1.418	0.641	1.293	0.937	0.257	0.431
Idaho	3.45%	1.070	0.061	1.069	0.932	0.067	0.057
Illinois	12.07%	1.347	0.352	1.303	0.937	0.265	0.257
Indiana	9.09%	1.262	0.247	1.239	0.923	0.214	0.194
Iowa	8.93%	1.239	0.143	1.231	0.924	0.208	0.115
Kansas	7.35%	1.140	0.118	1.134	0.933	0.126	0.103
Kentucky	8.63%	1.240	0.378	1.186	0.927	0.171	0.298
Louisiana	13.26%	1.424	0.875	1.213	0.924	0.193	0.566
Massachusetts	8.51%	1.159	0.655	1.010	0.939	0.010	0.526
Michigan	9.25%	1.258	0.255	1.232	0.918	0.209	0.201
Minnesota	8.89%	1.264	0.383	1.210	0.925	0.190	0.296
Missouri	10.50%	1.287	0.472	1.208	0.931	0.189	0.355
Montana	4.56%	1.098	0.077	1.095	0.917	0.091	0.070
Nebraska	12.05%	1.337	0.212	1.320	0.925	0.278	0.157
New Hampshire	6.53%	0.988	0.700	0.807	0.940	-0.215	0.637
New Jersey	12.18%	1.370	0.624	1.247	0.924	0.220	0.435
New Mexico	4.04%	1.029	0.052	1.028	0.926	0.027	0.050
New York	12.15%	1.413	0.596	1.302	0.926	0.264	0.405
North Carolina	4.82%	1.061	0.143	1.051	0.942	0.050	0.134
Ohio	11.11%	1.314	0.337	1.273	0.928	0.242	0.253
Oklahoma	3.88%	1.065	0.054	1.064	0.930	0.062	0.051
Oregon	6.35%	1.152	0.262	1.123	0.929	0.116	0.225
Pennsylvania	14.37%	1.467	0.689	1.328	0.926	0.284	0.446
Rhode Island	11.80%	1.300	1.396	0.886	0.920	-0.121	0.876
South Carolina	5.45%	1.051	0.371	0.991	0.929	-0.009	0.343
South Dakota	6.09%	1.076	0.052	1.075	0.934	0.072	0.048
Tennessee	7.03%	1.137	0.224	1.116	0.943	0.110	0.195
Virginia	5.95%	1.069	0.419	0.996	0.939	-0.005	0.378
Washington	6.05%	1.074	0.534	0.961	0.938	-0.040	0.470
Wisconsin	13.11%	1.388	0.477	1.313	0.910	0.272	0.334
US	8.36%	1.190	0.279	1.159	0.933	0.148	0.232

Table 5. Universal unrestricted vouchers

Voucher amount	*Public spending per pupil*	*Public enrolment*	*Nonsectarian private enrolment*	*Religious enrolment*
no voucher	$6,189	90.1%	1.56%	8.36%
$1,000	$6,195	88.1%	1.84%	10.09%
$2,000	$6,195	85.2%	2.20%	12.57%
$3,000	$6,197	80.6%	2.70%	16.74%
$4,000	$6,249	70.0%	3.37%	26.60%
$5,000	$6,221	47.1%	4.63%	48.26%

Table 6. Universal vouchers restricted to non-sectarian schools

Voucher amount	*Public spending per pupil*	*Public enrolment*	*Nonsectarian private enrolment*	*Religious enrolment*
no voucher	$6,189	90.1%	1.56 %	8.36 %
$1,000	$6,186	89.74%	2.34%	7.91%
$2,000	$6,176	89.10%	3.59%	7.30%
$3,000	$6,152	87.88%	5.63%	6.49%
$4,000	$6,099	85.41%	9.14%	5.45%
$5,000	$5,986	79.49%	16.33%	4.18%

Table 7. Means-tested, unrestricted vouchers

Maximum qualifying income	*Public spending per pupil*	*Public enrolment*	*Nonsectarian private enrolment*	*Religious enrolment*
$3,000 voucher				
$20,000	$6,192	90.0%	1.56 %	8.47 %
$40,000	$6,203	89.6%	1.55 %	8.80 %
$60,000	$6,241	88.5%	1.53%	10.00%
$80,000	$6,306	86.3%	1.48 %	12.20 %
$4,000 voucher				
$20,000	$6,228	88.3%	1.53 %	10.22 %
$40,000	$6,290	85.5%	1.50 %	13.02 %
$60,000	$6,360	82.5%	1.45 %	16.00 %
$80,000	$6,435	79.3%	1.41 %	19.27 %

Table 8. Effect of a voucher equal to 50% of state public spending per student, available to households with up to median state income, for use in all schools, by state

	Pre-voucher religious enrolment share	*Mean k (from table 4)*	*Proportionate change in public spending per pupil*	*Percentage point change in:*		
				Public enrolment	*Nonsectarian private enrolment*	*Enrolment in religious schools*
Alaska	4.3%	1.095	1.8%	-3.8	0.0	3.8
Arizona	4.2%	1.062	0.0%	0.0	0.0	0.0
California	7.5%	1.144	0.1%	-0.2	0.0	0.2
Colorado	5.4%	1.035	1.1%	-2.4	-0.1	2.5
Connecticut	8.4%	1.173	1.6%	-3.1	-0.1	3.2
Florida	8.8%	1.201	0.6%	-1.1	0.0	1.1
Georgia	4.9%	1.056	0.0%	-0.1	0.0	0.1
Hawaii	13.2%	1.418	3.5%	-6.4	-0.2	6.5
Idaho	3.5%	1.070	0.0%	0.0	0.0	0.0
Illinois	12.1%	1.347	1.3%	-2.4	0.0	2.4
Indiana	9.1%	1.262	0.4%	-0.8	0.0	0.8
Iowa	8.9%	1.239	-0.1%	0.0	0.0	0.0
Kansas	7.4%	1.140	0.0%	0.0	0.0	0.0
Kentucky	8.6%	1.240	1.4%	-2.8	-0.1	2.9
Louisiana	13.3%	1.424	4.0%	-7.6	-0.2	7.8
Massachusetts	8.5%	1.159	2.2%	-4.2	-0.2	4.3
Michigan	9.3%	1.258	0.4%	-0.8	0.0	0.8
Minnesota	8.9%	1.264	1.7%	-3.5	0.0	3.5
Missouri	10.5%	1.287	2.2%	-4.4	-0.1	4.5
Montana	4.6%	1.098	0.0%	0.0	0.0	0.0
Nebraska	12.1%	1.337	0.2%	-0.4	0.0	0.4
New Hampshire	6.5%	0.988	1.7%	-3.5	-0.1	3.6
New Jersey	12.2%	1.370	3.1%	-5.7	-0.1	5.9
New Mexico	4.0%	1.029	0.0%	0.0	0.0	0.0
New York	12.2%	1.413	3.2%	-5.8	-0.1	5.9
North Carolina	4.8%	1.061	0.0%	0.0	0.0	0.0
Ohio	11.1%	1.314	1.1%	-2.2	0.0	2.2
Oklahoma	3.9%	1.065	0.0%	0.0	0.0	0.0
Oregon	6.4%	1.152	0.2%	-0.5	0.0	0.5
Pennsylvania	14.4%	1.467	3.9%	-7.3	-0.2	7.5
Rhode Island	11.8%	1.300	3.1%	-6.8	-0.2	7.1
South Carolina	5.5%	1.051	0.6%	-1.2	0.0	1.2
South Dakota	6.1%	1.076	0.0%	0.0	0.0	0.0
Tennessee	7.0%	1.137	0.1%	-0.1	0.0	0.1
Virginia	6.0%	1.069	0.9%	-1.8	-0.1	1.9
Washington	6.1%	1.074	1.6%	-3.4	-0.1	3.5
Wisconsin	13.1%	1.388	2.7%	-5.4	-0.1	5.5
US	8.4%	1.190	0.3%	-0.5	0.0	0.6

Figure .
The distribution of households among school types (schematic representation)

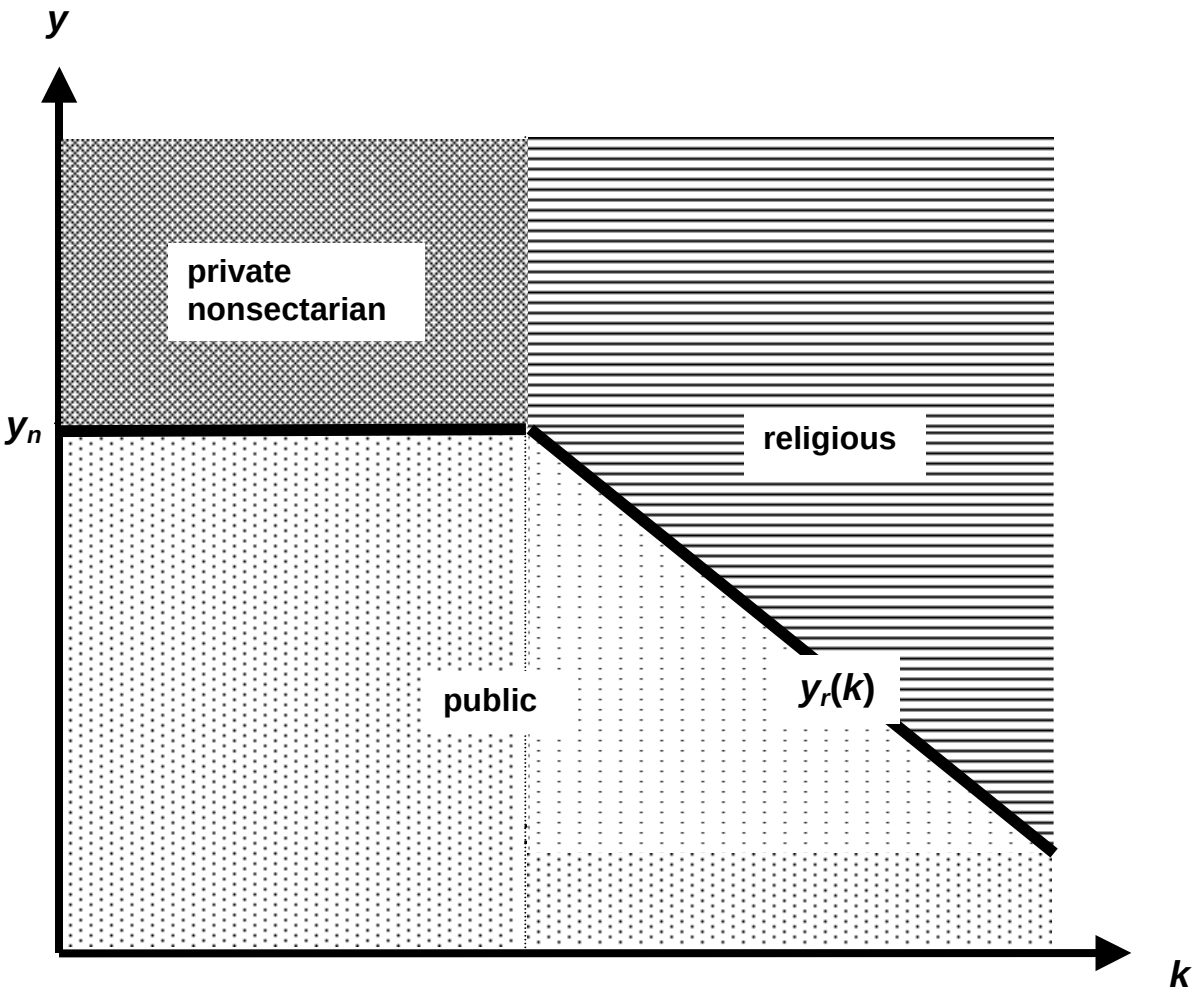


Figure 2. School choice in a household with $k > 1$

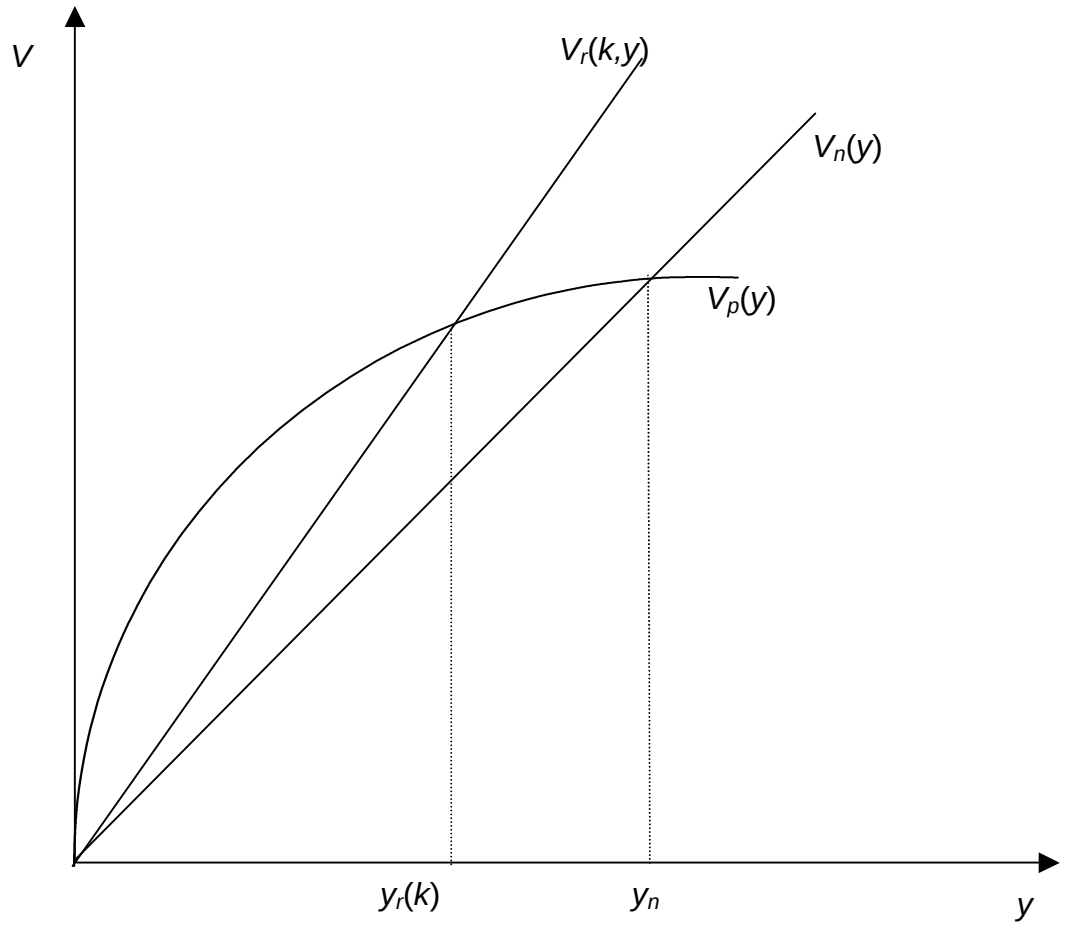
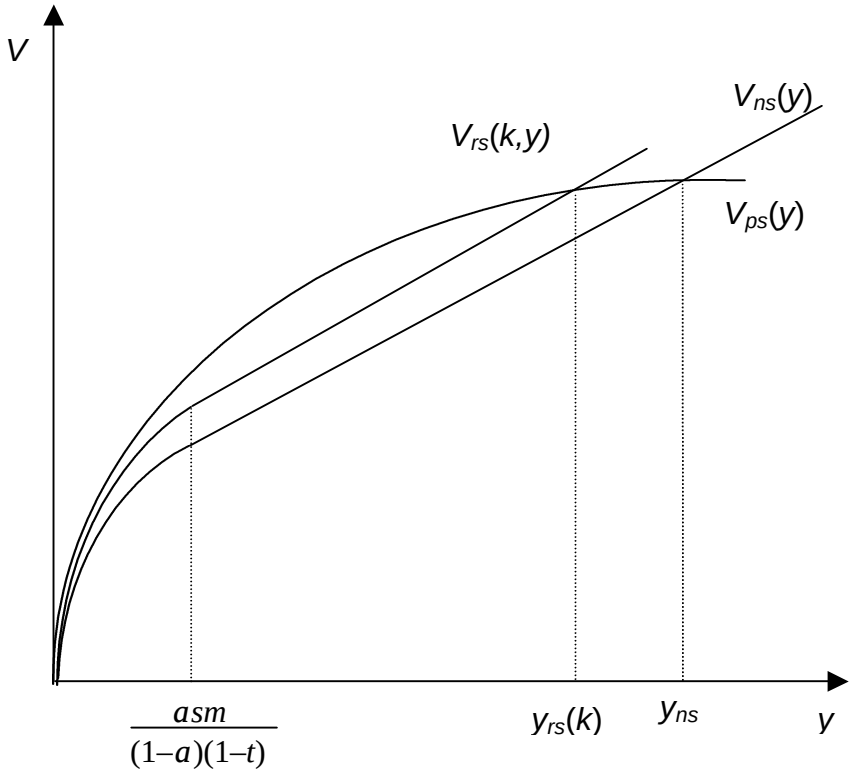


Figure 3. School choice with unrestricted vouchers

(a)



(b)

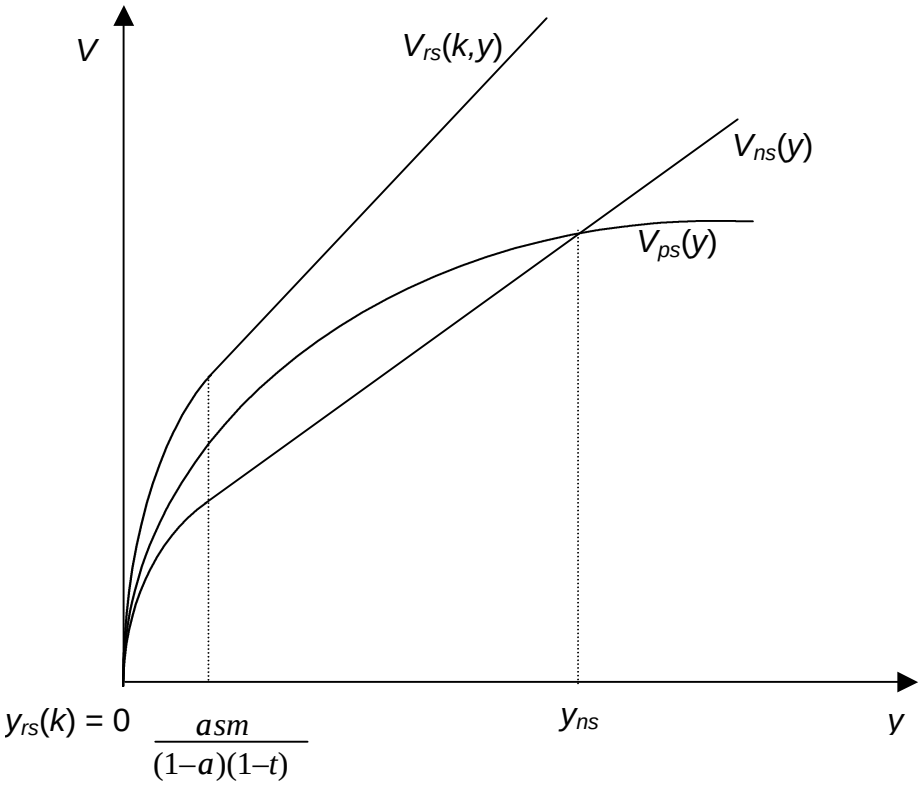
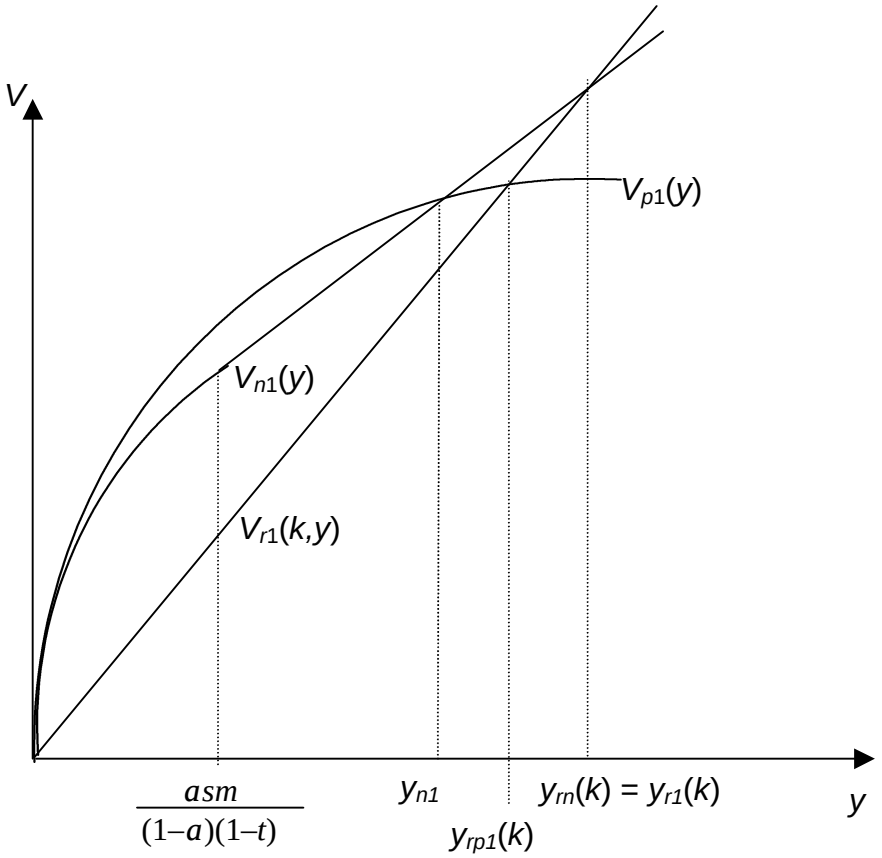
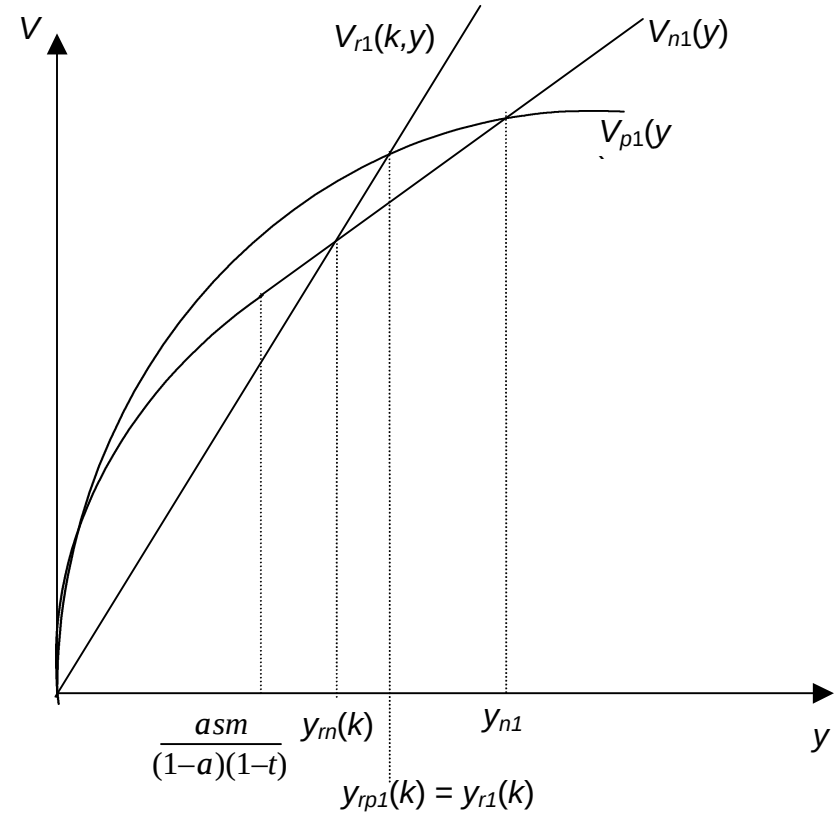


Figure 4: School choice with vouchers restricted to nonsectarian schools

(a)



(b)



Appendix A. Threshold levels for unrestricted means-tested vouchers

The threshold levels are determined by setting the indirect utility values offered by the different school types equal to each other. In the first three cases we solve:

$$[(1-t)\ \ _{nh}]^{a}\,[\,(t\,Y - p^{e}\,s\,m\,)\,/\,(q^{e}\,m)]^{\,1-a} \;=\; a^{a}\,(1-a)^{1-a}\ (1-t)\ \ _{nh}\,/\,m^{1-a}$$

$$[(1-t)\ \ _{nl}]^{a}\,[\,(t\,Y - p^{e}\,s\,m)\,/\,(q^{e}\ m)]^{\,1-a} \;=\; a^{a}\,(1-a)^{1-a}\ [(1-t)\ \ _{nl} + s\,m]\,/\,m^{1-a}$$

$$[(1-t)\ \ _{rh}]^{a}\,[\,(t\,Y - p^{\,e}\,s\,m\,)\,/\,(q^{e}\ m)]^{\,1-a} \;=\; k_i^{1-a}\ a^{a}\,(1-a)^{1-a}\ (1-t)\ \ _{rh}\,/\,m^{1-a}$$

and set $y_{nh} = \max\{\ _{nh}, \underline{y}\}$; $y_{nl} = \min\{\ _{nl}, \underline{y}\}$; and $y_{rh} = \max\{\ _{rh}, \underline{y}\}$. In the fourth case we take into account the possibility that a low-income household with $k > 1$ may take advantage of the voucher without adding to it. This happens if and only if $k_i > \bar{x}/s$, in which case all households with this k and income below the means test use a voucher, and we set $\ _{rl} = 0$. If $1 < k_i \le \bar{x}/s$ then $\ _{rl}$ is the larger root that solves

$$[(1-t)\ \ _{rl}]^{a}\,[(tY - p^{e}sm)\,/\,(q^{e}m)\,]^{1-a} = k_i^{1-a}\ a^{a}(1-a)^{1-a}\,[(1-t)\ \ _{rl} + sm]$$

and we set $y_{rl} = \min\{\ _{rl}, \underline{y}\}$.

Appendix B. Means-tested vouchers restricted to nonsectarian schools

In this case, spending per pupil in public education is a function of public enrolment q and of the share of households meeting the means test that choose private nonsectarian education p:

$$\bar{x}\,(q, p) \;=\; (\,t\,Y - p\,s\,m\,)\,/\,(q\,m)$$

Utility from public education is then

$$V_{p2} = [(1-t)\,y_i\,]^{a}\,[\,(t\,Y - p^{e}\,s\,m\,)\,/\,(q^{e}\,m)]^{\,1-a}$$

As households that opt for religious schooling are now not eligible for the voucher, utility from

religious education is

$$V_{r2} = a^a (1-a)^{1-a} k^{1-a} (1-t)\, y / m^{1-a}$$

All households with $k_i \leq 1$ prefer private nonsectarian schooling to religious schooling, and again, for these households we have two thresholds between public and private nonsectarian schooling: one for lower-income households who meet the means test, $y \leq \underline{y}$, and are eligible for the voucher; and another for higher income households who choose private education though not eligible for a voucher. The threshold income level between public and private nonsectarian schooling for households who are eligible for the voucher, $_{nl}$, is implicitly defined by

$$[(1-t)\ _{nl}]^a [\,(t\,Y - p^e\, s\, m) / (q^e\ m)]^{\,1-a} = a^a (1-a)^{1-a}\ [(1-t)\ _{nl} + s\, m] / m^{1-a}$$

and, as before, let y_{nl} = min { $_{nl}$, $\underline{y}$}. The threshold income, $_{nh}$, between public and private nonsectarian schooling for households not eligible for the voucher, is implicitly defined by

$$[(1-t)\ _{nh}]^a [\,(t\,Y - p^e\, s\, m\,) / (q^e\, m)]^{\,1-a} = a^a (1-a)^{1-a}\ (1-t)\ _{nh} / m^{1-a}$$

and denote y_{nh} = max { $_{nh}$, $\underline{y}$}.

The difference between this case and the case of unrestricted means-tested vouchers is that in this case households with $k > 1$ and $y < \underline{y}$ may prefer private secular to private religious schooling because only the former allows them to take advantage of the voucher program. A household with income $y < \underline{y}$ and $k > 1$ sends its children to a private nonsectarian school if it prefers it to both public and private religious schooling. It prefers private nonsectarian schooling to public schooling if its income exceeds the threshold level $y_{nl}\,(t, q^e, p^e, s)$ defined above; and it prefers private nonsectarian schooling to religious schooling if its income is lower than the threshold level $y_{rn}\,(k, t, s\,)$ defined by

$$a^a (1-a)^{1-a} [(1-t)\, y_{rn} + s\, m] / m^{1-a} = a^a (1-a)^{1-a}\ k^{1-a} (1-t)\, y_{rn} / m^{1-a}\ .$$

Private nonsectarian enrollment is then

$$q_n(q^e, p^e) = \int_1^{\infty} \int_{y_{nl}}^{\min\{y_{rn}, \underline{y}\}} f(y,k)\,dy\,dk + \int_0^1 \int_{y_{nl}}^{\underline{y}} f(y,k)\,dy\,dk + \int_0^1 \int_{y_{nh}}^{\infty} f(y,k)\,dy\,dk \qquad \text{(C1)}$$

A household prefers religious schooling to public schooling if its income exceeds the threshold y_{rp2} defined implicitly by

$$a^a (1-a)^{1-a}\ k^{1-a} (1-t)\, y_{rp2} / m^{1-a} = [(1-t)\, y_{rp2}]^a\ [\ (t\,Y - p^e\, s\, m\ ) / (q^e\, m)]^{\ 1-a}$$

Private religious enrollment is then

$$q_r(q^e, p^e) = \int_1^{\infty} \int_{\max[y_{rp2}, y_{rn}]}^{\underline{y}} f(y,k)\,dy\,dk + \int_1^{\infty} \int_{\max[y_{rp2}, \underline{y}]}^{\infty} f(y,k)\,dy\,dk \qquad \text{(C2)}$$

and the share of households that use a voucher is

$$p\ (q^e, p^e) = \int_0^1 \int_{y_{nl}}^{\underline{y}} f(y,k)\,dy\,dk \quad + \quad \int_1^{\infty} \int_{y_{nl}}^{\min\{y_{rn}, \underline{y}\}} f(y,k)\,dy\,dk \qquad \text{(C3)}$$

The model is then solved by requiring that anticipated public enrolment and voucher use accord with household decisions, i.e., we seek q^* and p_1^* such that $q^* = 1 - q_r\ (q^*, p^*) - q_n\ (q^*, p^*)$ and $p^* = p\ (q^*, p^*)$ where the functions $q_r\ (q^e, p^e)$, $q_n\ (q^e, p^e)$ and $p\ (q^e, p^e)$ are defined by equations (C1) – (C3).

[1] In 1997/8, there were 5,076,119 students enrolled in private schools in the United States, about 10% of total K-12 enrolment. Of these, 2,514,699 attended Catholic schools and 1,764,447 other religious private schools, together accounting for 84.2% of total private enrolment (Digest of Educational Statistics, 2000, Table 60). Econometric estimates of the demand for private schooling consistently attribute a prominent role to religious factors, in the United States as in other countries (Clotfelter, 1976; James, 1987; Buddin et al., 1998; among many others).

[2] The link between religious affiliation and school choice is evident in the large proportion of Catholic school pupils who come from Catholic homes (87.9% in 1989/90; National Catholic Educational Association, 1990). The effect of subsidies on this proportion is evident from the Cleveland voucher program, where a large fraction of participating families have been Baptists who send their children to Catholic schools, as only one Baptist school participated in the program (*Zelman v. Simmons-Harris,* footnote 11). Hoxby (1998) estimated that charitable subsidies from all sources reduce tuition costs in religious schools by as much as 50%; Catholic elementary schools received 24.1% of their revenues from parish subsidies in 2000/2001, and average salaries received by religious sisters serving as principals in these schools were 60% lower than those of public school principals (National Catholic Education Association, 2001, cited in *Zelman v. Simmons-Harris* footnote 15). However, tuition may not fully reflect private costs if parents are expected to supplement it with donations of their own time or money, as is often the case in religious schools. Of course, differences in tuition are not an accurate measure of cost differences unless they control for quality. Studies that measure the relative academic achievement of Catholic schools (Evans and Robert, 1995; Sander, 1997) partly address this issue, but ignore other, necessarily subjective dimensions of quality that are especially important with regard to religious schools. Hence the need to gauge quality and cost-effectiveness from revealed preferences.

[3] Both programs are aimed at low-income families in failing school districts. In Cleveland, vouchers of up to $2,250 were offered, and 96% of voucher recipients opted for religious schools (*Zelman v. Simmons-Harris*). In Milwaukee, where vouchers of more than $5,000 were offered, two thirds chose religious schools (Hoxby, 2002). In 1993/4, average tuition was $1,628 in Catholic elementary schools, $2,606 in other religious schools, and $4,693 in private nonsectarian schools; the corresponding figures for secondary schools were $3,643, $5,261 and $9,525 (Digest of Education Statistics, 2000, Table 62)

[4] The Supreme Court's ruling in *Zelman v. Simmons-Harris* reversed lower-court decisions that enjoined the State of Ohio from offering vouchers for religious private schools to low-income parents in the Cleveland City School District, determining that the program was not in violation of the Establishment Clause of the First Amendment to the Constitution prohibiting the federal government from enacting laws that advance or inhibit religion, extended by the Fourteenth Amendment to state governments. The court reached this decision "(b)ecause the program was enacted for the valid secular purpose of providing educational assistance to poor children in a demonstrably failing public school system … " and "…is neutral with respect to religion and provides assistance directly to a broad class of citizens who, in turn, direct government aid to religious schools wholly as a result of their own genuine and independent private choice."

[5] In 1993/4 spending per pupil in public elementary and secondary schools was $5,767, compared to average tuition of $2,178 in Catholic schools and $2,915 in other religious schools (Digest of Education Statistics, 2000, Tables 170, 62)

[6] This extends work by Sonstelie (1982), Martinello and West (1988), Rangazas (1995), Epple and Romano (1996), Bearse et al. (2000), Nechyba (2000) among others. Sonstelie (1982) applied his analysis to estimate the difference in efficiency between private and public schooling, albeit as a single value rather than a distribution, and—absent a distinction between religious and nonsectarian schools—without recognizing that the choice of school may be influenced by religious sentiment and private subsidization, as well as cost-efficiency.

[7] The use of calibrated theoretical models supplements direct evidence on the effect of school vouchers, from pilot and experimental programs in the United States (e.g., Howell and Peterson, 2002), and international experience, especially in Chile and New Zealand (West, 1997; Fiske and Ladd, 2000)

[8] The costs of the program are immediate; the savings generated by students leaving the public system materialize gradually. Levin and Driver (1997) estimate that "accommodating additional students, record keeping, student transportation, information to parents and dispute adjudication … could raise public education costs by 25% or more."

[9] We abstract from migration and assume that the local population is fixed, as is the local supply of private religious schools, in relation to which the parameter z_i is defined. Thus in a school district in which all religious schools were, say, Catholic, a Baptist parents might have a z value close to one while Jewish and Muslim parents had much lower z values.

[10] There are conflicting opinions regarding the extent to which material resources—such as reduced class size—affect scholastic achievement and classroom behavior (Krueger, 1998; Card and Krueger, 1996; Hanushek, 1996; among others). However, for the purpose of our positive analysis it is parents' perceptions that matter, i.e., it is sufficient that parents believe that their children will benefit from a larger school budget.

[11] Public schooling in the United States is largely financed by a combination of property taxes and state grants, with local taxes determined by referenda on proposals set by a school board (Romer et al., 1992). We ignore these important institutional factors in the analysis, ignore external funding, and implicitly assume that incomes are perfectly correlated with property values.

[12] Thus we abstract from the possibility of purchasing private education as a supplement to public schooling. We also ignore the fixed costs of education, which limit the variety of private schooling options in smaller communities. A uniform efficiency parameter for nonsectarian private schools could be incorporated in the model without difficulty, though its calibration raises some difficulties.

[13] Hence we calibrate the distribution of k_i, from which the distribution of z_i can only be inferred by making an appropriate assumption on the size of h (see below).

[14] From (3) and (5), $y_n(t, q^e) = t\,Y / [q^e (1-t)(1-a)\, a^{a/(1-a)}]$; it is possible of course that there are no households beyond this threshold, i.e., that $f(y,k) = 0$ for $y > y_n$ and $k \leq 1$.

[15] From (3) and (7), $y_r(k_i, t, q^e) = t\,Y / [k_i\, q^e\, (1-t)\,(1-a)\, a^{a/(1-a)}]$, and again there may be no households beyond this threshold for some or all values of $k > 1$.

[16] We discuss popular support for the existence of public education in Section 5.

[17] Ours are indicative rather than operational calibrations for predicting actual policy outcomes. Because of the local nature of school finance in the United States, outcomes are strongly affected by the concrete context of specific school districts. In addition we do not take into account important peer-group, housing and migration effects (see, e.g., Nechyba, 2000). Our analysis offers a methodology for incorporating the religious factor in more detailed analyses, as well as indicating its general strength and variability.

[18] Per capita money income in that year was $20,120 and there were 2.61 persons per household (Statistical Abstract of the United States, 2000, Tables 737, 753, 63).

[19] Spending per pupil is taken from the Digest of Educational Statistics (2000, Table 169). In 1997/8 there were 46,126,897 children in public schools and 5,076,119 in private schools, from which q is derived; $m\,q$ is the ratio of public school students to households, of which there were 101,041,000 in 1998 (Statistical Abstract of the United States, 2000, Table 63).

[20] In 1997/8 the 4,279,146 pupils enrolled in private religious schools were 8.357% of total enrolment; and the 796,973 enrolled in nonsectarian private schools, 1.556% (Digest of Educational Statistics, 2000, Tables 41 and 60).

[21] Data on private enrolment by state are tallied by the location of the school, not the hometown of the pupil.

[22] As the vouchers we consider have little net fiscal effect, the assumption of a balanced budget has little effect on individual school choice (see also Section 5, below).

[23] If vouchers are unrestricted, only households with $k_i \leq 1$ choose private nonsectarian schooling. They maximize $c^a\, x^{1-a}$ subject to $c + x\,m = (1-t)\,y_i + s\,m$ and $x \geq s$. As we have assumed that the subsidy is smaller than spending per pupil in public school and can only be used for private education, the second constraint is never binding: parents prefer nonsectarian private school to public school only if they intend to spend more than public spending per pupil. Hence such parents have $y_i > [a\,s\,m + (t\,Y - s\,m) / q] / [(1-a)\,(1-t)] > a\,s\,m / [(1-a)\,(1-t)]$.

[24] They maximize $c^a\,(k_i\,x)^{1-a}$ subject to $c + x\,m = (1-t)\,y_i + s\,m$ and $x \geq s$, and must have $k_i > 1$. A household with $k_i > \bar{x} / s > 1$ may choose to opt out of public education without adding to the sum of the voucher.

[25] There may be no households with $k_i \leq 1$ and income greater than the threshold y_{ns}.

[26] Public spending per pupil increases holding the tax rate fixed if savings to the public system as a result of the reduced pupil load are greater than the cost of vouchers paid to pupils who would have attended private schools without the vouchers. This holds if public enrolment after the voucher is implemented is no greater than a threshold value q^* given by $t\,Y / q_0 = [t\,Y - (1-q^*)\,s\,m] / q^*$ where q_0 is public enrolment before the voucher program is implemented. Hoyt and Lee (1998, p. 224) calculate a related threshold and conclude that vouchers are likely to reduce taxes

holding public spending per pupil fixed.

[27] This threshold value is $y_{rn} = s\,m / [(k^{1-a} - 1)(1 - t)]$.

[28] See Appendix A for details of the derivation.

[29] The large majority of households prefer means-tested vouchers to universal vouchers, as they generate a greater improvement in public school quality.

[30] In the Cleveland voucher program, low-income families were required to contribute 10% of tuition, but participating schools accepted payment in kind, of parents' time.

[31] See Appendix B for details of the derivation.

[32] In Milwaukee, where vouchers exceeding $5,000 are offered to families with incomes up to 175% of the poverty line, one third of recipients chose nonsectarian schools, almost exclusively in elementary schools.

[33] Regressing the increase in religious enrolment on the mean and standard deviation of k yields the equation $\Delta q_r = -7.6 + 6.2\,E(k) + 6.6\,SD(k)$ with standard deviations 1.31 and 0.64, and an R^2 of 0.86. The correlation coefficient between the increase in religious enrolment and prior religious enrolment in the state equals 0.71.

[34] Again, we ignore important institutional aspects of the democratic process through which education budgets are determined as well as the nexus of state and local funding.

[35] Letting $q(t_0, s)$ denote the share of households receiving a voucher—the definition of $q(t_0, s)$ will vary with the type of voucher program—spending per pupil in public schools is $\bar{x}(t_0, s) = [t_0 Y - q(t_0, s)\,s\,m] / [q(t_0, s)\,m]$, which is maximized when $-(\partial q / \partial s)\,\bar{x}(t_0, s) = q(t_0, s) + s\,(\partial q / \partial s)$, where the derivatives of q and q with respect to s are obtained by total differentiation of the relevant equilibrium conditions.

[36] Alternatively, if voters are constrained to spend a given amount x_0 per pupil in public schooling in voting on the amount of the voucher, the tax rate and voucher amount are linked by the equation $\bar{x}(t_0, s) = x_0$, which implicitly defines t as a function of s, and households anticipating sending their children to public schools seek to minimize the tax rate subject to this constraint, which similarly implies $\partial \bar{x}(t, s) / \partial s = 0$.

[37] Increases in the tax rate are offset by increases in public enrolment, which dampen the effect of the tax rate on spending per pupil. The small size of the effect is also indirectly indicated by the small variations in spending, in Tables 5-7, when the voucher amount is changed: as the voucher has little effect on spending per student when the tax rate is held fixed, allowing the tax rate to vary should not result in much change in the chosen rate. Further details are available from the authors on request.

[38] The emphasis on helping low-income families appears throughout the decision. Justice O'Connor emphasizes the small size of the program, noting that at most $8.2 million of public funds flowed to religious schools through it, which "pales in comparison to the amount of funds that federal, state and local governments already provide religious institutions."

[39] If $k > 1 / q$ then $k\,t\,Y > t\,Y / q$ which implies that household utility from an education voucher funded by all tax revenues is greater than utility from public schooling without vouchers, for a given tax rate.

[40] This value is implicitly defined by $[tY + (1 - t)\,y_s]\;a^a(1 - a)^{1-a} = [(1 - t)\,y_s]^a\;(tY / q)^{1-a}$ which equals \$69,000 for our calibrated values, corresponding to the 77th percentile of the income distribution, i.e., 23% have incomes greater than y_s , though just over half of these are included among the households with $k > 1/q_0$.

[41] This may deter all but the most committed and enterprising parents from opting out of the public system they know. Parents of weaker pupils are especially wary of privately managed schools, as was evident in the electoral defeat of an initiative to transfer five failing schools in New York City to private-sector management (*New York Times*, 2001b).

[42] See, for example, Fernandez and Rogerson (1999) for a formal analysis of state and local funding of education in California.

[43] This continues a long line of argument closely identified with Milton Friedman (1962, 2002), and appearing in Adam Smith (1776, Bk V, Ch 1, Art II) and Thomas Paine (1792).

[44] Concern for damage to the fabric of society is raised in all the dissenting opinions to *Zelman v. Simmons-Harris*. Justice Stevens writes that, "Whenever we remove a brick from the wall that was designed to separate religion and government, we increase the risk of religious strife and weaken the foundation of our democracy." Justice Breyer warns of "the risk that publicly financed voucher programs pose in terms of religiously based social conflict." Conversely, Glazer (2001) has argued that in some cases parochial schools may be more faithful guardians of traditional American values than multi-cultural public schools.