Legal constraints and the choice of educational grant structures

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"Legal Constraints and the Choice of Educational Grant Structures." *Public Choice*, 2003, 115(1-2): 83-105.

Abstract:
Recent empirical work suggests that legal constraints are significant in choosing state educational grant structures. Unfortunately, the literature has not taken such constraints into account, thus calling into question particular grant structure recommendations. This paper studies the conditions under which a legislature, under order to reform its educational grant structure, prefers foundation grants over district power equalization grants. A theoretical model is presented in which the choice is shown to depend on the legal basis of the court's decision, and the empirical validity of this conclusion is demonstrated using Connecticut data and a separate model of school district expenditure choice.

Article:
1. Introduction
This paper studies the conditions under which a legislature, confronted with a court order to reform its educational grant structure, prefers a district power equalization (DPE) grant structure over a foundation grant structure. DPE grants, which became popular as a result of the *Serrano* case[1] and the controversy over funding equity in public education, provide local school districts with more equal per-pupil tax bases. Foundation grants, which were in use long before the equity controversy arose, provide local school districts with a lump-sum per-pupil grant.

The literature on this issue has generally focused on assessing the effect of alternative grant structures on local school-district spending behavior but not on the choice of grant structures themselves. Early work concluded that DPE grant structures were neither neutral in their effects (Feldstein, 1975) nor successful in reducing disparities in per-pupil expenditures across school districts (Carroll and Park, 1983; Murname, 1985). As a result, later work investigated alternative, and what were sometimes argued superior, grant structures. Feldstein (1975, 1984), for example, offered (and defended against Perkins' 1984 criticism) a grant structure that he argued was fiscally neutral.

However, the more common argument was that some version of a foundation grant structure would be more effective, less expensive, and therefore more desirable (Ladd and Yinger, 1994; Reschovsky, 1994; and Fisher, 1996).[2]

More recent empirical work (Evans, Murray, and Schwab, 1997; Murray, Evans, and Schwab, 1998) has found that what success there has been in reforming educational grant structures is tied to court-mandated changes[3] and not to educational grant structure changes in general. This suggests that legal constraints are a critical factor in the choice, and hence the outcome, of educational grant structure reform.[4] Unfortunately, the literature has generally failed to take such constraints into account, thus calling into question the argument that foundation grants are more desirable than DPE grants.[5]

To address this failure, this paper presents a theoretical model of grant structure choice based on Leyden's (1992a) work on legislative response to court mandates.[6] Then, using data from Connecticut's 1980 experience with educational grant structure reform, the empirical validity of the model is tested by estimating a separate model of local school district expenditures based on Turnbull (1992) and Moffitt (1984, 1986) and using the results of that estimation to simulate expenditures under alternative grant structure regimes. The empirical results confirm the theoretical analysis — a legislature's choice of grant structure depends on the legal standard used by the court in evaluating the constitutionality of a state's educational grant structure. If the court bases its ruling on a state equal-protection clause, then the legislature will choose a DPE grant structure; if the court bases its ruling on a state thorough-and-efficient clause, then the legislature will prefer a foundation grant structure. Interestingly, a DPE grant structure is more cost effective than a foundation grant structure when satisfying a court's order, regardless of the legal standard used. When an equal protection standard is used, this advantage of the DPE structure is consistent with the legislature's preference for a DPE structure. However, when a thorough-and-efficient standard is used, the cost savings associated with the DPE grant structure is more than offset by other virtues of a foundation structure. Hence, the foundation structure is preferred.

These conclusions, because they contradict the view that a foundation grant structure would be less expensive and more effective than a DPE grant structure,[7] point to the value of incorporating state legislative behavior and legal constraints into the analysis of educational grant structures. Such incorporations allow the analyst to more accurately assess the effect of alternative grant structures. In addition, such incorporation gives the analyst a greater chance of making a contribution to policy formulation because it affords the analyst the ability to separate politically feasible from politically infeasible policy recommendations.

2. Legally constrained grant structure choice

2.1. A *spatial-voting representation of public education expenditure levels*

Let public education expenditures be determined in a two-tiered federal governmental structure in which a state legislature chooses a particular grant structure and provides per-pupil grants A^i to each of its M local school districts, and in which the M local school districts choose the level of per-pupil educational expenditures γ^i for their districts. Using Enelow and Hinich (1984), Leyden (1992a) shows that this decision problem can be modeled as a spatial voting problem in which the state legislature chooses the per-pupil expenditures γ^i of its M local school districts so as to minimize a political loss function P that is a positive function of deviations in actual district per-pupil expenditure levels γ^i from the legislature's ideal expenditure levels, γ^{i*}. Letting the political loss function take the form of a weighted Euclidean distance function, P can then be written as:

$$P = \left[\sum_{i=1}^{M} w^i (\gamma^i - \gamma^{i*})^2 \right]^{\frac{1}{2}} \qquad (1)$$

where $w^i > 0$ represents the political importance (or salience) of district spending in generating political support for the ruling coalition. Because it is reasonable that there are spillover effects across districts so that coalition members get political support for providing grants to both member and non-member districts, let $w^i > 0$ for all i. In general, w^i will be higher for districts that are in the dominant coalition.[8]

Graphically, this problem can be illustrated by a set of indifference curves representing the legislature's loss function P. These indifference curves will take the form of M-dimensional ellipses with their direction and shape determined by the w^i, and with the level of the political loss P associated with deviating from the legislature's ideal γ^{i*} decreasing in the direction of those ideal levels. In addition, per-pupil spending statewide, $\bar{\gamma}$, can (assuming N^i is the number of students in school district i) be noted by iso-spending planes composed of all the γ^i that satisfy the equation:

$$\bar{\gamma} = \frac{\sum_{i=1}^{M} N^i \gamma^i}{\sum_{i=1}^{M} N^i} \qquad (2)$$

for a given value of $\bar{\gamma}$. Figure 1 provides an illustration of the legislature's problem for the two-district case with ideal spending levels noted by γ^{1*}

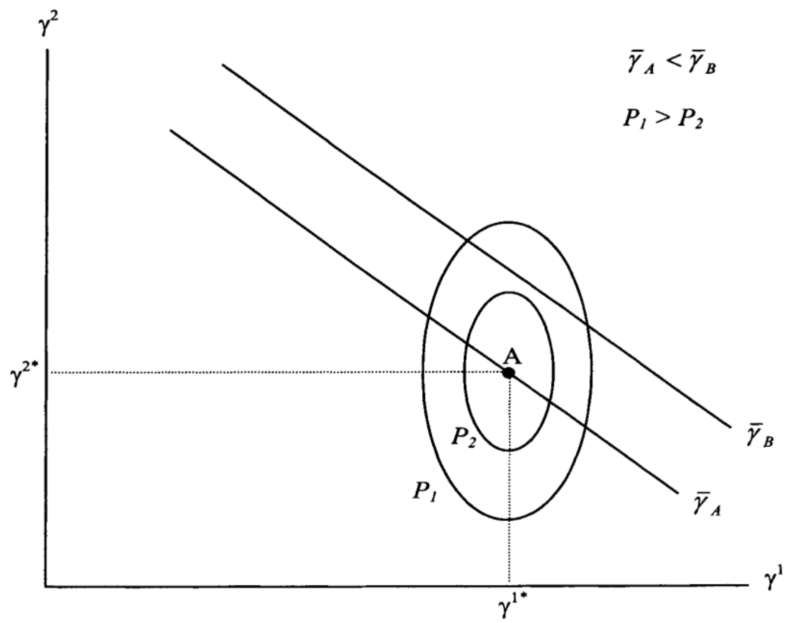

Figure 1.

and γ^{2*}, per-pupil spending statewide noted by the iso-spending lines $\bar{\gamma}_A$ and $\bar{\gamma}_B$ (where $\bar{\gamma}_A < \bar{\gamma}_B$), and the political loss associated with different combinations of $\bar{\gamma}^1$ and $\bar{\gamma}^2$ noted by the indifference curves P_1 and P_2 (where $P_1 > P_2$).

2.2. *The effect of the courts*

While public education is mandated by a state's constitution, the standard used to judge whether the state is in compliance with that mandate varies. In some states, the standard is based on an equal-protection clause in the state constitution. In other states, the standard is based on a state constitutional requirement that the state provide a "thorough and efficient" system of free public schools.

Suppose that a state's existing educational grant structure is declared to be unconstitutional under one of those two standards, and suppose that the legislature has been ordered to bring that structure into compliance with the state's constitution. For simplicity, let the legislature's choice be restricted to two possible grant structures — an archetypal foundation grant structure and an archetypal DPE grant structure. The intended purpose of an archetypal foundation grant structure is to assure that all districts will be able to spend at least some minimum per-pupil amount, γ^{min}, if they set their local tax rate at some minimum level t^{min}. As a result, the archetypal foundation grant structure will take the form:

$$A^i = \begin{cases} \gamma^{min} - t^{min}V^i & \text{if } \gamma^{min} - t^{min}V^i > 0 \\ 0 & \text{if } \gamma^{min} - t^{min}V^i \leq 0 \end{cases} \qquad (3)$$

where A^i is the per-pupil value of the state's grant to school district i and where V^i is the per-pupil tax base of that same school district. Note that districts with a sufficiently large tax base (that is, $V^i > \gamma^{min}/t^{min}$) will receive no grant from the state. Note also that the parameters γ^{min} and t^{min} are policy variables chosen by the legislature. By contrast, the intended purpose of the archetypal DPE grant structure is to assure more equal per-pupil revenue for equal local tax effort. To accomplish this, the legislature defines an ideal per-pupil district tax base V^* and provides a per-pupil grant A^i equal to some fraction of the difference between the amount of revenue per pupil that the district could raise were it to have a per-pupil tax base equal to V^* and the actual amount of revenue it raises:

$$A^i = \rho t^i (V^* - V^i) \qquad (4)$$

where ρ is a positive, calibration parameter that is set by the legislature and that allows the legislature to choose the degree to which effective tax bases are equalized across school districts. If the legislature chooses to completely equalize the effective tax base across school districts, then ρ would equal one. Note also that for districts with $V^i > V^*$, the grant would be negative.

2.2.1. Choice under an equal-protection standard

Though defensible from a macroeconomic growth perspective (Hoxby, 1998b), the use of a state constitutional equal protection clause to attack existing educational grant structures is based on distributive justice arguments (Hoxby, 1998b; Zajac, 1995). As a result, courts that find an existing structure unconstitutional under an equal-protection clause focus on a reduction in per-pupil spending disparities across school districts. Assume that disparity can be measured by the standard deviation in per-pupil spending across districts:

$$\sigma = \left[\frac{1}{N} \sum_{i=1}^{M} N^i (\gamma^i - \bar{\gamma})^2 \right]^{\frac{1}{2}} \qquad (5)$$

and that the court insists that the legislature reduce the level of disparity to some level σ^{max}. Because the standard deviation measures the minimum (pupil-weighted) Euclidean distance between the actual γ^i and the hyper-plane defined by $\gamma^i = \gamma^i$ for all i and j, this constraint can be represented graphically (see Figure 2) for the 2-district case by the requirement that the pair (γ^1, γ^2) be within the space defined by two lines that are σ^{max} away from, and parallel to, the line where $\gamma^1 = \gamma^2$.

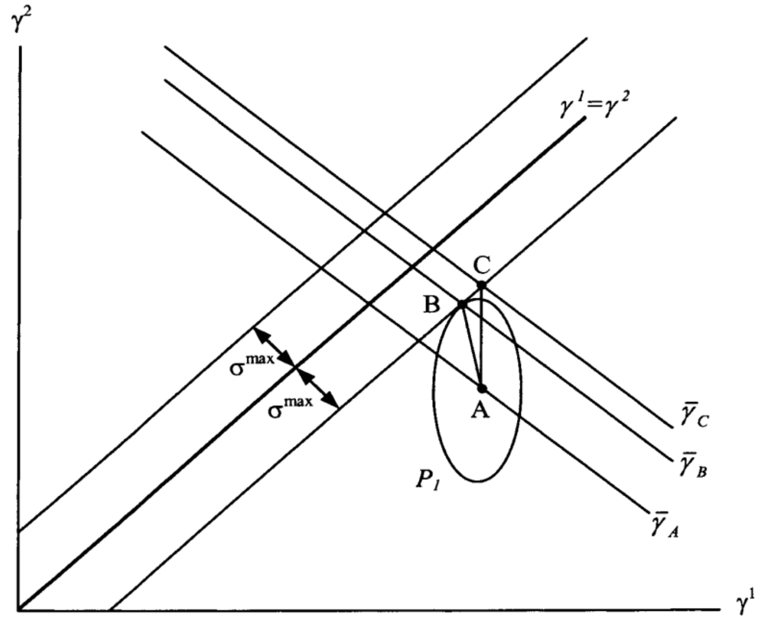

Figure 2.

If the legislature employs the archetypal DPE grant structure, it can re-duce per-pupil spending in the wealthier, more politically salient districts and increase per-pupil spending in the poorer, less politically salient districts through the choice of V* and ρ. As a result, by choosing V* and ρ appropriately, it can generate an outcome such as noted in Figure 2 by the point B where the political cost to complying with the court's order is minimized. On the other hand, if it uses the archetypal foundation grant structure, it can increase spending in those districts that fall below the foundation level, but it cannot lower spending in other districts. Hence, it must move to some point C in order to satisfy the court's order.[9]

As Figure 2 reveals, use of the foundation grant structure is less preferred by the legislature to the DPE grant structure because, while it allows the wealthier, more politically salient districts to maintain their level of per-pupil spending, it does so at too high a political cost. Per-pupil spending statewide using the foundation structure, as indicated by the iso-spending line $\bar{\gamma}_C$, is higher than can be achieved with the DPE grant structure.[10] In addition, because the foundation grant structure relies on income effects to raise the spending in lower-spending districts while the DPE grant structure uses both income and substitution effects (by effectively lowering the price of education) for lower-spending districts, the legislature's budget will be larger with a foundation grant structure than with a DPE grant structure.

2.2.2. *Choice under a* thorough-and-efficient *standard*

The use of a state constitutional thorough-and-efficient clause to attack existing educational grant structures is typically based on a right-to-necessities argument (Zajac, 1995) or a Rawlsian perspective (Rawls, 1971; Ladd and Yinger, 1994). Hence, courts that find a structure unconstitutional under this standard will focus on increasing per-pupil spending in the lowest spending, and typically poorest, districts. Thus, court orders based on this standard can be thought of as imposing a constraint that per-pupil spending in all districts be no less that some $\hat{\gamma}$:

$$\gamma^i \geq \hat{\gamma} \forall i \qquad (6)$$

which graphically can be represented for the 2-district case by an L-shaped constraint such as show by the line FF in Figure 3.

If the legislature employs the archetypal foundation grant structure, it can increase spending in those districts whose per-pupil spending is below the court-imposed $\hat{\gamma}$ while leaving the spending in all other districts unchanged. Graphically, this can be illustrated for the 2-district case by the point C in Figure 3. Alternatively, the legislature can use the archetypal DPE grant structure. While it is theoretically possible that a DPE grant structure could achieve the same result, it is unlikely because of the less than perfect correlation between V^i and γ^i. As a result, the outcome will depend on the level of V*.

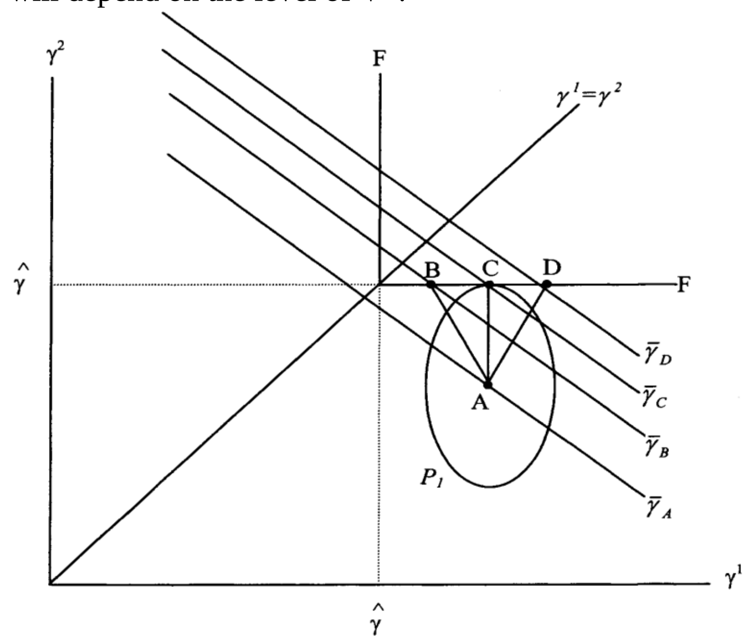

Figure 3.

If V* is set below the V^i of some of the districts, the result (as illustrated by point B in Figure 3 shows) will be a reduction in spending by the wealthier, politically more salient districts. In addition, while it is true that per-pupil spending statewide (as well as the legislature's budget) will be lower with the DPE structure (compare the iso-spending lines $\bar{\gamma}_B$ and $\bar{\gamma}_C$, it is not sufficient to compensate for the lower political support associated with the reduction in spending among the wealthier, politically salient districts. As a result, the foundation grant structure will be preferred.

Likewise, if V* is set above V^i for all districts, per-pupil spending in all districts (see point D in Figure 3) will rise, thus making per-pupil spending statewide higher under the DPE grant structure than under the foundation grant structure (compare the iso-spending lines $\bar{\gamma}_C$ and $\bar{\gamma}_D$). Given that the foundation grant structure allows the legislature to satisfy the court's order with a level of per-pupil spending statewide that is closer to its ideal, $\bar{\gamma}_A$, the result once again is that the foundation grant structure will be preferred.

3. Empirical analysis

Empirical evidence in support of the above arguments can be found in Connecticut's 1980 experience with educational grant reform. Connecticut's educational grant structure in 1974 (as it was through most of the 1970s) took the form for the most part of a flat $250 per-pupil grant with district spending ranging from $1000 to $3000 per-pupil (1980 dollars) (Table 1). In 1977, the Connecticut Supreme Court in *Horton v. Meskill* (172 Conn. 615) ruled that the educational finance system violated the Connecticut constitution's equal protection clause. While the Court left the ultimate solution up to the legislature, it was clear that the Court envisaged a grant structure that provided "a substantial degree of equality of educational opportunity" while preserving local control and the use of the local property tax as an important source of funding *(Horton v. Meskill, 172* Conn. 650-651).

Table 1. Connecticut before and after *Horton* (1980 dollars)

	1974–5	1980–1	Change
Number of districts	169	169	0
Number of pupils	649,608	533,836	–115,772
Expenditures statewide			
• Aggregate	$1,392,964,280	$1,385,373,312	–$7,590,970
• Per-pupil	$2144	$2595	+$451
District per-pupil expenditures			
• Mean	$2003	$2480	+$477
• Minimum	$1302	$1753	+$451
• Maximum	$3066	$3550	+$484
• Range	$1763	$1797	+$34
• Standard deviation	$349	$388	+$39
State aid			
• Aggregate	$343,210,508	$360,967,786	+$17,757,278
• Per-pupil	$528	$676	+$148
• As % of total expenditures	0.25	0.26	+0.01

Sources. Data derived from Connecticut Public Expenditure Council (1976), Connecticut State Board of Education (1981), U.S. Council of Economic Advisors (1993), and photocopies provided by the Connecticut State Department of Education.

This emphasis on equal protection suggests that the Connecticut legislature would put in place a form of DPE grant structure, and, in fact, that is what happened. However, while the program apparently satisfied the Court, it appears to have been a failure. As Table 1 reports, by 1980 disparities in district per-pupil spending (as measured by standard deviation and by range) had risen. What makes this less than clear, however, is the fact that enrollments fell by nearly 1/5 over this same period while per-pupil spending statewide rose by roughly 1/5. As a result, the question remains as to whether the Connecticut legislature acted rationally in its choice of a DPE structure.

That is, was the structure preferable to a foundation grant structure that would have also satisfied the court? To answer that question, an empirical model of local school district expenditures was estimated using 1980 Connecticut data, and the results of that estimation exercise were used to simulate local school district expenditures under three alternative grant structure regimes.

3.1. *Empirical model*

Because school district expenditure decisions in Connecticut are, more often than not, the result of some form of town-meeting political structure,[11] I used Turnbull's (1992) pivotal voter model of local expenditure as the foundation for the empirical model. Turnbull's model has the additional virtue of incorporating the empirically ubiquitous flypaper effect into the formal structure of the model through the assumption of a risk averse pivotal voter.[12] In addition, because Connecticut's educational grant structure generates piecewise-linear budget constraints for its local school districts, the model is also based on Moffitt's (1984, 1986) work on piecewise linear demand.[13]

Following Turnbull, then, assume that the provision of education in each school district is determined by a risk-averse pivotal voter who chooses a local tax rate t and receives utility U(γ, C) from district per-pupil education expenditures γ and other consumption C.[14] In choosing t, the pivotal voter is constrained by the personal budget constraint:

$$I(1 - s) = C + tH \qquad (7)$$

and the school district budget constraint:

$$\gamma = t(V + \theta) + A \qquad (8)$$

where i represents the pivotal voter's income, H represents the value of the pivotal voter's assessed property, $V + \theta^V$ represents the local per-pupil tax base, A represents state aid per-pupil, and s represents the state income tax rate needed to fund the state's educational grant program. Because the pivotal voter does not know the size of the district's tax base when choosing t, the local per-pupil tax base is modeled as the pivotal voter's expectation concerning that tax base, V, plus a stochastic element θ^V (assumed to have zero mean and finite variance σ_V^2) reflecting the pivotal voter's uncertainty over that tax base.

In 1980, Connecticut state aid per pupil A was provided through a DPE program that took the form of a per-pupil block grant B and a matching grant with rate m tied to local tax effort t:[15]

$$A = B + tm. \qquad (9)$$

The pivotal voter's problem is to choose t so as to maximize the expected value of utility U(γ , C) subject to the Equations (7), (8), and (9). The optimal tax rate t is thus characterized by the first order condition:

$$\frac{\left(\frac{\partial U}{\partial \gamma}\right)^e}{\left(\frac{\partial U}{\partial C}\right)^e} = \frac{H}{V+m} - \frac{\left(\frac{\partial U}{\partial \gamma}\right)^e \theta^V}{(V+m)\left(\frac{\partial U}{\partial C}\right)^e}. \qquad (10)$$

with the superscript e being the expectations operator. The pivotal voter's optimal tax rate defines the voter's desired level of expenditures yd. This desired level of expenditures yd is assumed to be a function of the pivotal voter's tax price P, effective income M, and a set of personal characteristics Z:

$$\gamma^d = D(P, M, Z). \qquad (11)$$

As Equation (10) reveals, the form of the pivotal voter's effective tax price P is more complex than the classic form of tax price because of the presence of uncertainty and risk aversion:

$$P = \frac{H}{V+m} - \frac{\left(\frac{\partial U}{\partial \gamma}\right)^e \theta^V}{(V+m)\left(\frac{\partial U}{\partial C}\right)^e}. \qquad (12)$$

This effective tax price differs from the standard tax price for two reasons. First, an increase in t results in an increase in expenditures both through increased local revenue and through increased state aid. Hence, V + m in-stead V in the denominator of the first term. Second, voter risk aversion and uncertainty over the local tax base result in a tax price that is augmented in the mind of the voter by the 'risk premium' II:

$$\Pi = -\frac{\left(\frac{\partial U}{\partial \gamma}\right)^e \theta^V}{(V+m)\left(\frac{\partial U}{\partial C}\right)^e} > 0. \qquad (13)$$

Effective income M is the amount of resources that the pivotal voter would expect to have were γ set to zero.[16] An examination of Equations (7), (8), and (9) after setting γ equal to zero reveals:

$$I(1 - s) + \frac{BH}{V + m + \theta^V} = C. \qquad (14)$$

Hence, the pivotal voter's expected income M is the sum of the voter's personal income net of state taxes and the voter's expected share of the district's grant income:

$$M = I(1 - s) + \left(\frac{BH}{V + m + \theta^{V}}\right)^{e}. \qquad (15)$$

The particular P and M that each pivotal voter saw depended on the matching rate m and block grant B that the pivotal voter's school district used to calculate their state aid. Most districts in 1980 used the "standard" formulae M_1 and B_1 to calculate the matching rate and the block grant,[17] thus resulting in an effective tax price P_1 and effective income M_1. However, for particularly wealthy districts and for a few other districts with sufficiently high local tax rates, the use of these standard formulae would have resulted in a per-pupil grant less than $250 (the size of the flat per-pupil grant provided in 1974). Originally, the legislature had hoped to provide additional "hold-harmless" aid to ensure that no district would receive less than $250 per pupil. How-ever, fiscal pressures eventually led to each district's hold-harmless aid being reduced by 25%. The net effect was that districts receiving hold-harmless aid had a block grant B_2 that was greater than that which they would have received under the standard formula and a matching rate m_2 that was 75% lower than the standard matching rate formula.[18] Thus, the effective tax price and effective income for these districts was $P_2 > P_1$ and $M_2 > M_1$. For all districts, there was also a district-specific minimum expenditure requirement (MER).

This grant structure resulted in three types of school district. The first type were those districts with sufficiently low property wealth to assure that state aid was at least $250 per pupil regardless of the value of t chosen. Hence, formulae B_1 and m_1 were used, and desired demand took the form:

$$\gamma_1^{d} = f(M_1, P_1, Z). \qquad (16)$$

Actual expenditures for these districts depended on whether $\gamma_1^{d}$was greater or less that the minimum possible level of expenditure γ_1^{min}. Because $B_1 > 0$, γ_1^{min} was equal to the greater of B_1 and the district's MER. If $\gamma_1^{d} > \gamma_1^{min}$, actual expenditures were simply the sum of desired expenditures γ_1^{d} and unanticipated local revenues $t\theta^{V}$. On the other hand, if $\gamma_1^{d} \leq \gamma_1^{min}$, actual expenditures were set equal to the sum of γ_1^{min} and $t\theta^{V}$. Thus, following Moffitt (1984, 1986) and Rothstein (1992), actual expenditures can be defined as:

$$\gamma_1 = (1 - D_1)\gamma_1^{min} + D_1\gamma_1^{d} + \varepsilon_r \qquad (17)$$

with ε_r being the unanticipated random error $t\theta^{V}$ and:

$$D_1 = \begin{cases} 1 & \text{if } \gamma_1^{d} > \gamma_1^{min} \\ 0 & \text{if } \gamma_1^{d} \leq \gamma_1^{min} \end{cases} \qquad (18)$$

The second type of district were those districts with sufficiently high property wealth that state aid with the standard formulae would be less than $250 per pupil regardless of the value of t chosen. Hence hold-harmless aid was always provided, and desired demand took the form:

$$\gamma_2^{d} = f(M_2, P_2, Z). \qquad (19)$$

Because $B_2 > 0$, minimum expenditures γ_2^{min} was equal to the greater of B_2 and the minimum expenditure requirement MER. Actual expenditures were therefore:

$$\gamma_2 = (1 - D_2)\gamma_2^{min} + D_2\gamma_2^{d} + \varepsilon_r \qquad (20)$$

with γ_2^{min} equal to the greater of B_2 and the district's MER, ε_r being defined as before, and:

$$D_2 = \begin{cases} 1 & \text{if } \gamma_2^{d} > \gamma_2^{min} \\ 0 & \text{if } \gamma_2^{d} \leq \gamma_2^{min} \end{cases} \qquad (21)$$

Finally, the third type of district were those with property wealth between the two extremes examined above. For these districts, the receipt of hold-harmless aid depended on the value of t chosen. Let t_0 represent the value of t such that expected aid based on m_1 and B_1 equals expected aid based on m_2 and B_2. Then:

$$t_0 = \frac{BV2 - BV1}{mV1 - mV2} \qquad (22)$$

If the actual tax rate chosen was less than t_0, hold-harmless aid was provided, so that aid was defined by m_2 and B_2 and effective income and tax price were defined by M_2 and P_2. However, if the actual local tax rate chosen was greater than or equal to t_0, no hold-harmless aid was required, and so aid was defined by m_1 and B_1 and effective income and tax price were defined by M_1 and P_1. Because $P_1 < P_2$, the implied budget constraint for these third type of districts was convex to the origin with a kink at $t = t_0$. Moreover, because $B_1 < B_2$, MER = γ_2^{min}. Thus, if MER was greater than or equal to the expenditure level associated with $t = t_0$, the budget constraint was the same as that associated with Case 1 districts. Hence, demand was defined by γ_1 (Equation (17)). On the other hand, if MER was less than the expenditure level associated with $t = t_0$, the budget constraint remained convex to the origin. The resulting form of desired demand equation under this latter situation therefore depended on which segment of the budget constraint provided the higher utility. If the indirect utility function is indicated by the function W(P, M), then the first budget-constraint segment (where tax price and effective income are P_2 and M_2) was preferred if $W(P_1, M_1) < W(P_2, M_2)$. On the other hand, if $W(P_1, M_1) \geq W(P_2, M_2)$, the second segment was preferred. Actual demand therefore took the form:

$$\gamma_3 = (1 - D_2)\gamma_2^{min} + D_2(1 - D_3)\gamma_2^{d} + D_3\gamma_1^{d} + \varepsilon_r \qquad (23)$$

with γ_1^d, γ_2^d, and D_2 defined by Equations (16), (20), and (21), ε_r being defined as before, and:

$$D_3 = \begin{cases} 1 & \text{if } W(P_1, M_1) > W(P_2, M_2) \\ 0 & \text{if } W(P_1, M_1) \leq W(P_2, M_2) \end{cases} \qquad (24)$$

3.2. *Estimation*

The theoretical model was estimated using 1980 data from all 169 Connecticut school districts.[19] Population mean and median values were used for the pivotal voter's housing, income, and other personal characteristics.[20] To ac-count for the pivotal voter's expectations, I used the lagged value of the local tax base to proxy for V,[21] assumed that the risk premium Π can be modeled by the function $\varphi p/(V + m)$ with φp being a parameter to be estimated, and assumed that the voter's expected share of the district's grant income which enters into the determination of expected effective income (see Equation (15)), can be modeled by the function $BH/(V + m + \varphi m)$ with φm being the parameter to be estimated. Finally, I assumed that desired demand took a log-linear form with, following Moffitt (1984, 1986) and Rothstein (1992), an additive error term ε_h (with finite variance σ_h^2) that reflects heterogeneity error.[22] This error, like the random error ε_r, is not known to the analyst. However, unlike the random error, this error is known to the pivotal voter. Thus, desired demand took the form:

$$\ln\gamma^d = \pi P + \mu M + \zeta Z + E_h. \qquad (25)$$

As Moffitt (1986) notes, two-error models generally require maximum likelihood methods. However, a complication arises here because the expenditure data cluster away from the minimum expenditure requirement MER. Hence, it is not possible to separately identify ε_h and ε_r. The model must therefore be specified as a single-error model. While such models can be estimated with either non-linear least squares or maximum likelihood, I chose maximum likelihood using EZClimb (Leyden, 1991), a hill-climbing program based on Goldfeld, Quandt, and Trotter's (1966, 1968) modified quadratic hill-climbing algorithm.

The results of estimating the model are presented in Table 2. Overall performance, with a squared correlation coefficient of 0.65, was good. The coefficients on the core variables (φ_p, φ_M, π, μ, ζ_0) were of expected sign and generally significant. The size of the grant-income share parameter φ_M suggests that the 1980 Connecticut pivotal voter effectively discounted the local per-pupil tax base by more than half as a result of risk aversion and the presence of uncertainty. Calculation of the tax price reveals reasonable mean values with the classic tax price H/ (V + m) being 0.35 and the effective tax price H/ (V + m) + Π being 0.52. The mean price elasticity with respect to actual tax price was —0.18. This value is consistent with other studies and, as expected, smaller than the mean price elasticity with respect to effective tax price (-0.27).[23] Mean income elasticity with respect to personal income with a value of 0.44 was somewhat lower than other studies, but within the range expected.[24] The demographic variables as a group had a statistically significant effect as measured by a likelihood ratio test.

Districts with a greater median level of education had, ceteris paribus, greater per-pupil spending, as did districts with a greater proportion of the population that was black, that were renters, or that lived in urban areas. Districts with an older median age or greater median household size tended, ceteris paribus, to choose lower levels of spending.[25] Finally, note that the mean derivative of per-pupil district expenditures with respect to an increase in the pivotal voter's share of grant income $(BH/ (V + m + \theta^{V})^{e}$ was 0.14 which was more than twice the value of the same derivative with respect to an equal increase in personal income (0.05). This flypaper effect, which is ubiquitous in empirical studies of local spending behavior, is consistent with Turnbull's (1992) argument that the flypaper effect is the result of voter risk aversion in the face of uncertainty concerning the size of the local tax base. Further evidence of the consistency of these results with Turnbull's argument can be seen by calculating the risk-income effect elasticity which measures the degree to which an increase in the standard error in the tax base affects the level of expenditures. The mean risk-income effect elasticity was —0.61, thus indicating that a relatively small amount of uncertainty over the local tax base is sufficient to explain a significant portion of the flypaper effect. Turnbull's benchmark value for the risk-income effect elasticity is —0.12.

Table 2. Estimation results (p-values in parentheses)

Parameter	Description	Demographic model
φ_P	Risk premium parameter	31,597
		(0.28)
φ_M	Grant-income share parameter	–104,393
		(0.00)
π	Tax price coefficient	–0.51
		(0.01)
μ	Income coefficient	2.0E-5
		(0.00)
ζ_0	Constant term	7.92
		(0.00)
ζ_{MA}	Age coefficient	–4.0E-5
		(0.66)
ζ_{MS}	Household size coefficient	–0.15
		(0.00)
ζ_{ME}	Education coefficient	0.02
		(0.41)
ζ_{PB}	Proportion black coefficient	0.89
		(0.00)
ζ_{PR}	Proportion renting coefficient	0.03
		(0.65)
ζ_{PU}	Proportion urban coefficient	0.01
		(0.40)
σ^2	Likelihood function variance parameter	0.8E-2
		(0.00)
	Function value	–1154.38
	Squared corr. coefficient for actual and predicted exp's	0.65
	Likelihood ratio test (demographic variables; df = 6)	58.84
		(0.00)

3.3. *Simulation*

Using the above results, local school district expenditures were simulated under three alternative grant structure regimes — the actual DPE program employed by Connecticut in 1980, the archetypal foundation grant program, and a "complete" foundation program that requires school districts to levy the minimum tax rate associated with the archetypal foundation grant structure (Ladd and Yinger, 1994; Reschovsky, 1994). To eliminate the possible effect of different state tax rates, I assumed for all simulations that total aid from the state, and hence the state tax rate, was fixed at actual 1980 levels. For the two foundation grant structures, V* was set at 45% of the maximum school district tax base, or $288,276. Given the total amount of aid from the state, this implied a t* = 0.0060 (compared to the 1980 district mean of 0.0092).[26]

Table 3. Predicted effects of alternative grant structures on Connecticut public school district expenditures

	DPE	Archetypal foundation	Complete foundation
Spending by wealthiest districts	Fall	No change	No change
Spending by poorest districts	Rise the most	Rise the least	Rise a middle amount
Standard deviation	Fall the most	Fall the least	Fall a middle amount
State-wide per-pupil spending		Less than the level associated with the complete foundation program	Less than the level needed to achieve the same reduction in disparity associated with the DPE program

Table 3 summarizes the anticipated results based on the theoretical analysis in Section 2. In brief, the DPE program was predicted to reduce spending disparities the greatest by raising spending in the poorest districts and reducing spending in the richest districts. Both foundation grant structures were predicted to increase spending in the poorest districts (more so with the complete foundation grant structure) but leave spending in the richest districts unchanged. Predictions about the level of per-pupil spending statewide was less straightforward. Based on the analysis in Section 2, it is anticipated that any foundation grant structure that reduces spending disparities to the same degree as the DPE grant structure will result in higher per-pupil spending statewide and a bigger legislative budget. Because total state aid was kept constant in the simulations, it was therefore anticipated that per-pupil spending statewide under the two foundation grant structures would be less than the amount needed to reduce spending disparities to levels associated with the DPE structure. Moreover, because the complete foundation grant structure requires a minimum school district tax rate, it was anticipated that per-pupil spending statewide would be lower with an archetypal foundation grant structure than with a complete foundation grant.

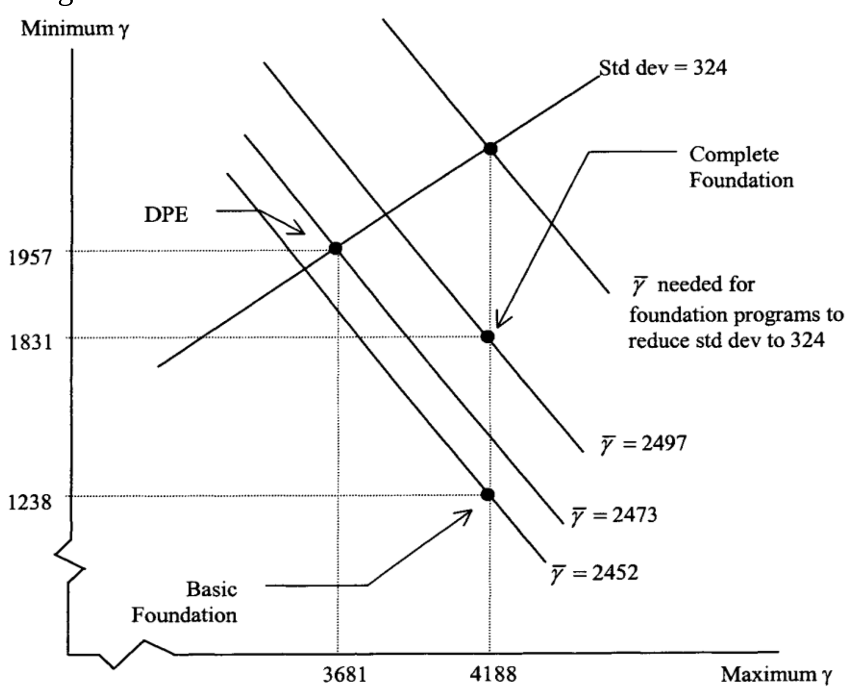

Figure 4.

Actual results are summarized in Table 4. As predicted, under the DPE structure, minimum spending is greater, maximum spending is lower, and spending disparity is lower than under either form of foundation grant structure. Moreover, and again as predicted, increasing the rigor of the foundation grant structure (as witnessed by the change from the archetypal foundation grant structure to the complete foundation grant structure) does not change maximum spending levels. Finally, and again as predicted, per-pupil spending statewide is less under the archetypal foundation grant structure than under the complete foundation structure and per-pupil spending statewide under the two foundation grant structures is less than the amount needed to reduce spending disparities to the levels associated with the DPE structure. This last result, in particular, provides indirect evidence that had the legislature employed some form of foundation grant structure to satisfy the court, its budget would have been larger than it was using the DPE structure. Figure 4 presents these results graphically, and a comparison of Figure 4 and Figure 2 reveals the consistency of the simulation results with the theory.

Table 4. Simulated 1980 Connecticut per-pupil expenditures

	Simulated expenditures				Effect of switching from DPE to:	
	DPE	Archetypal foundation	Complete foundation	Actual exp's	Archetypal foundation	Complete foundation
Mean	2473	2452	2497	2480	–21	25
Median	2424	2432	2432	2424	–19	–19
SD	324	425	395	389	255	220
Minimum	1957	1238	1831	1753	–914	–316
Maximum	3681	4188	4188	3550	2918	2004

4. Conclusion

Using a spatial model of legislative choice, this paper has shown that when a court finds a state's educational grant structure illegal under equal-protection arguments, the legislature will prefer an archetypal DPE grant structure to an archetypal foundation grant structure. Likewise, when a court finds a state's educational grant structure illegal under thorough-and-efficient standards, the legislature will prefer an archetypal foundation structure to an archetypal DPE structure (despite the added cost associated with the foundation structure). Finally, an examination of Connecticut's 1980 experience with educational grant structure reform using a separate model of school district expenditure choice confirms these arguments empirically.

For the policy analyst, these results suggest that any recommendations must take account of existing legislative preferences and the particular legal arguments used to evaluate the legality of a state's educational grant structure. For states which emphasize equal protection, policy recommendations are likely to be ignored if they do not work within the class of DPE structures. Likewise, for states that emphasize the thorough-and-efficient standard, policy recommendations are likely to be ignored if they do not work within the class of foundation structures.

Notes

1**.** *Serrano v. Priest* (1971, 1977). See Mandelker, Netsch, Salsich, and Wegner (1990) for the original decision and Williams (1990) for the second. The original *Serrano* decision rested, in part, on federal equal protection claims that were thrown out as a result *of San Antonio Independent School District v. Rodriquez* (1973). The case was then reheard and affirmed based solely on state constitutional claims.

2. The debate over the appropriate grant structure takes place within the larger and more general context of school reform. See Downes (1992), Oakland (1994), and Downes, Dye, and McGuire (1998). For an overview of this literature and the contributions of economic research, see Hoxby (1998a).

3. Even with court intervention, success is by no means guaranteed. See for example Silva and Sonstelie (1995), Underwood (1995), and Fischel (1996).

4. Hoxby (1998b) suggests that the push for greater inter-district spending equality may be due to a change in the demand for public education, not a failure of existing public finance systems. If true, it raises an intriguing question beyond the scope of this paper as to why such a change has not manifest itself in the decisions of legislatures not under court order to change their educational grant structure.

5. Buchanan and Tullock (1975) provides general support for including the political dimensions of economic policy issues into economic analysis. For rather different examples of analyses that emphasize the political dimensions in intergovernmental grants and public education funding, see Brennan and Picus (1990), Hoyt and Toma (1993), and Poterba (1998).

6. Leyden's model is useful because it allows the choice of grant structure to affect a legislature's willingness to fund public education and thereby affect both the level of state taxes as well as the distribution of spending across local school districts. For general evidence of the connection between a donor government's tax and spending decisions and recipient governments' tax and spending decisions see Hettich and Winer (1988), Leyden (1992b), and Nechyba (1996). For more direct evidence of the link between changes in a grant structure and the level of taxes, see Addonizio (1991), Manwaring and Sheffrin (1997), Evans, Murray, and Schwab (1997), and Murray, Evans, and Schwab (1998). Finally, for evidence of the influence of these connections on the economic effect of alternative grant structures (and hence their political desirability), see Brennan and Picus (1990) and Munley (1995).
7. Interestingly, preliminary theoretical work by Fernández and Rogerson (1999) finds that a DPE system dominates other grant structures in statewide plebiscite.
8. It is possible, however, for there to be exceptions. In general, w^i will depend both on whether the school district is in the dominant coalition and on the number of students Ni in the district. As a result, while members of the dominant coalition are, ceteris paribus, more salient, it is possible for a particularly large, non-member district to be more salient. See Leyden (1992a) for a more formal treatment.
9. Strictly speaking, implementation of either grant structure would require additional state funds. If these funds were raised via an increase in state taxes, spending in all districts would fall somewhat. However, empirically this effect is quite small because of the small income elasticity of the demand for school district expenditures and because of the small tax rate used to fund public education. Using data from Connecticut, for example, the result is a fall in per-pupil expenditures of less than a dollar. As a result, I have for expository reasons omitted this effect from the formal analysis.
10. In general, as Leyden (1992a) shows, for any given reduction in disparity in spending across districts, the change in the average level of spending across all districts will depend on whether the state legislature is dominated by higher spending districts (in which case state average spending will rise) or lower spending districts (in which case state average spending will fall). Because typically higher spending districts tend to dominate state legislatures, only that case is illustrated here.
11. See Connecticut Secretary of State (1980). Connecticut is divided into 169 school districts that are coterminous with the state's 169 towns. Funding for school districts comes from the town's property tax and from state aid. Although school districts do not levy a separate tax, the share of the town's property tax revenues dedicated to public education is known (Connecticut State Board of Education, 1979, 1981). There are also some "regional" districts. However, these districts are essentially cooperative arrangements among two or more of the 169 town-based districts. Sometimes the purpose of such districts is to run a joint school system. Other times, it is simply to run a combined high school.
12. It should be noted that the issue of the appropriate treatment of the flypaper effect is an unsettled question. Because exploring alternative treatments of the flypaper effect would distract from the purpose of characterizing legislative preferences for grant structure, but because some treatment of the flypaper effect is necessary given the ubiquity of the effect, I have chosen to use Turnbull's model as a reasonable solution. For alternative behavioral and econometric explanations of the flypaper effect, see Filimon, Romer, and Rosenthal (1982), Fisher (1982), Hamilton (1983), Zampelli (1986), Megdal (1987), Marshall (1991), and Turnbull (1992).
13. Rothstein (1992) uses such techniques in examining local school expenditure decisions.
14. For ease of exposition, the i superscripts have been dropped.
15. Because the level of state aid was widely publicized before t was chosen, I assume that this aid was known with certainty.
16. Craig and Inman (1986) refer to this effective income as "full fiscal income".
17. The standard block grant was equal to a district-specific block grant for various smaller, special programs plus 68% of the previous year's DPE grant. The standard matching rate was set equal to 32% of (V* — $\bar{H}$)(N+ 1/2)/N with V* equal to a district-specific guaran-teed tax base, $\bar{H}$ equal to the district's population-mean tax base, N the district's number of students, and W the district's number of children receiving AFDC aid. Defining $\bar{I}$ to be a district's population-mean income, V* for each district was equal to the ninth largest $\bar{H} \bullet \bar{I}$ divided by the district's own $\bar{I}$.
18. The block grant formula with the receipt of hold harmless aid was equal to a district-specific block grant for various smaller, special programs plus the sum of $187.50 and 17% of the previous year's DPE grant.

19. Data were taken from U.S. Bureau of the Census (1982a), from printouts based on U.S. Bureau of the Census (1982b, 1983), from Connecticut Office of Policy and Management (1980), from photocopies provided by the Connecticut State Department of Education, and from Connecticut State Board of Education (1979, 1981). All data are available upon request.
20. The set of demographic variables available and included in the empirical analysis were median age, median household size, median education, proportion of population that was black, proportion of the population that rented, and proportion of the population that reside in US Census defined urban areas.
21. The use of lagged property values precludes introducing an error-in-variables problem.
22. I also estimated the model using a linear functional form. Results were much the same.
23. Inman (1979) and Bergstrom, Rubinfeld, and Shapiro (1982), found price elasticities in the —1/4 to —1/2 range. Rubinfeld and Shapiro (1989) argue, however, that these estimates may be biased and too elastic.
24. Inman (1979) and Bergstrom, Rubinfeld, and Shapiro (1982), for example, found income
found to affect expenditures positively by Bergstrom, Rubinfeld, and Shapiro (1982); Rubinfeld and Shapiro (1989) found no significant effect, though they cited additional microdata that black voters tend to demand more education than their white counter-parts. Rothstein (1992) found an insignificant negative effect. Concerning household size, Bergstrom, Rubinfeld, and Shapiro (1982), Rothstein (1992), and Rubinfeld and Shapiro (1989) found, unlike this study, that it had a positive effect on education expenditures; Lovell (1978), Romer and Rosenthal (1982), and Filimon, Romer, and Rosenthal (1982) found that the number of children affected expenditures negatively. Concerning age, Bergstrom, Rubinfeld, and Shapiro (1982) and Rubinfeld and Shapiro (1989) found that the proportion of the population over 65 was a positive factor in educational expenditures, while Rothstein (1992) found like this study that age was a negative factor. Finally, Roth-stein (1992) is the only study of which I am aware in which a measure of owner/renter status is used; he finds that the fraction of owner-occupied housing in a district affects expenditures negatively. See Martinez-Vazquez and Sjoquist (1988) for an analysis of the importance of distinguishing renters from homeowners in models of local public choice.
25. I also ran the simulations assuming V* was 40% of the maximum school district tax base, or $256,246. Given the fixed set of state funds, this implies t* = 0.0080, but found the conclusions of this paper did not change. As the percentage that defines V* falls, the foundation grant program (archetypal or complete) results in a higher mean expenditure and higher mean tax rate.

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