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# State aid programs for equalizing spending across local school districts: does the structure of the program matter, or only it's size?

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**Abstract** This paper provides interesting insights into an important causal mechanism underlying Murray, Evans and Schwab's (Am. Econ. Rev. 88(4):789–812, 1998) finding that court mandated reforms result in less inequality in spending per pupil levels across rich and poor school districts within a state. Treating the choice of an education program's structure as endogenous, following the analysis of Leyden (Public Finance/Finances Publiques 47:229–247, 1992; Public Choice 115(1–2):83–107, 2003), yields empirical results suggesting that court mandated reforms increase the likelihood that a program's structure will include a price effect and that the inclusion of a price effect in turn results in a decrease in spending inequality.

**Keywords** Education finance · School district spending equalization · Court mandated reform

## 1 Introduction

When state governments determine to implement policies designed to promote greater equality in the resources available to local schools, either because of legislative initiative or in response to judicial mandates,[1] they must confront directly a number of challenging questions: How equal must the pattern of spending levels in a state be to satisfy equity concerns? How should geographic cost differentials be taken into account? What policy instruments are available to the state officials who bear the burden of responsibility for achieving a desired result? And, increasingly, concerns about adequacy and accountability in the provision of education services have assumed at least equal footing with equity concerns both within

[1] For an excellent analysis of the effect of court-mandated school finance reform see Evans et al. (1999).

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the education policy arena and among the education research community in the evaluation of state aid programs that support K-12 education.

Under a foundation program, a state establishes a foundation level of spending per student—typically an amount deemed sufficient to provide a basic level of educational services. Under a power equalization program, a state first establishes a guaranteed tax yield or a guaranteed tax base. An interesting development accompanying the shift in emphasis from equity to adequacy and accountability has been the emergence of a tacit consensus that the ability of foundation programs, provided that the local effort to provide the foundation level is mandated in all districts, to achieve an adequate level of education across all school districts in a state makes this type of state aid program preferable to the power equalization alternative.[2] A corollary to this judgment is the conclusion that district power equalization programs put in place during the 1970s and 1980s had not achieved as much spending equalization across school districts as proponents had expected.[3] Conspicuously absent from the evidence serving as the basis for this conclusion is an explicit examination of the observable difference in the extent to which state aid programs of these two general variants have reduced inequality in spending levels across school districts within states.

In their most thorough and highly influential analysis of the impact of education finance reform policies on the distribution of resources across local school districts, Murray et al. (1998) focus on court ordered reform mandates. Their basic model uses state specific fixed effects to control for other factors that affect the distribution of spending across districts in 46 of the 50 states over a 25-year time period. They expand this basic model to include a variety of specific demographic and socioeconomic characteristics, but do not examine explicitly the impact of the structure of the state aid program that governs the distribution of state aid to local districts.[4] In the analysis that follows we attempt to fill in this missing piece of the puzzle. Importantly, in doing so we will take explicit account of the endogeneity of the choice of state aid program structure in examining how this choice affects the equalizing of resources across school districts within a state. The results provide an interesting insight into what may comprise an important causality mechanism underlying Murray, Evans and Schwab's principal finding.[5]

[2] For example, in concluding his comprehensive review of 'State Aid and the Pursuit of Educational Equity' Yinger (2004) notes: "State supreme courts, policymakers, and scholars appear to have reached a consensus that a foundation plan with a foundation level based on a generous notion of educational adequacy, a required minimum tax rate, and some kind of educational cost adjustment that provides extra funds for high-need districts forms the core of an acceptable reform of state education finance."

[3] In their 1994 evaluation of the earlier round of state level school finance reforms Reschovsky and Wiseman conclude: "it is now evident that while equalizing prices may work to equalize expenditures to some extent, price effects are not sufficient alone to eliminate the most egregious disparities in per-pupil expenditures."

[4] Murray et al. (1998) control for demographic and socioeconomic characteristics by including state fixed effects in their empirical model. They augment their basic model with additional characteristics drawn for the decennial Census of the Population. An obvious strength of their results is the comprehensive data upon which they are based, school districts from forty-six states over a twenty-five year time period. The comprehensiveness of this data base is no doubt the reason that they did not focus explicitly on institutional measures such as the structure of the school finance aid program in each state at each five year interval, especially as this information is not readily accessible for at least the initial fifteen years of the twenty five year time period they examined.

[5] Evans et al. (1997) seek to shed light on the underlying mechanism responsible for their 1998 findings by examining how court mandated reforms impacted the relative funding from state and local sources for districts in different positions in a state's spending distribution. On the basis of these results they conclude that "we believe to be the mechanism by which inequality has been reduced: a greater role for states in education finance" (p. 20). In this analysis they do not consider explicitly the potential effect of the structure of a state's aid program, the principal focus of the analysis presented here.

## 2 The structure of state aid programs

The specific details characterizing the way that state governments provide aid to local school districts vary considerably from state to state. The education finance literature has, however, established two broad categories into which most programs can be grouped. They are: (1) a foundation program, and (2) a power equalization program. This distinction provides a useful classification scheme for understanding how state aid impacts the choices confronting individual residents of local districts within a standard microeconomic framework.

### 2.1 Local spending only

Consider the simple, but representative, case where local spending on elementary and secondary education is financed solely by an ad valorem tax on property. In this situation the budget constraint facing a household is:

$$I = P_G \cdot G + t \cdot H \tag{1}$$

where $I$ is pre-tax income, $P_G$ the unit price of a numeraire private good, $G$ the quantity of the private good, $t$ the school district tax rate, and $H$ the taxable property (for most individuals, their house).

The budget constraint facing the local school district, absent any intergovernmental aid, is:

$$n \cdot E = t \cdot V \tag{2}$$

where $n$ is the number of students, $E$ the expenditure per student, and $V$ the total value of taxable property within the district.

Solving (2) for t yields:

$$t = \frac{E}{(V/n)} \tag{3}$$

and substituting this into (1):

$$I = P_G \cdot G + \left(\frac{H}{(V/n)}\right) \cdot E \tag{4}$$

From (4) it is clear that in a consumer-voter's budget constraint $P_G$ is the price of the numeraire private good and $H/(V/n)$, the ratio of the consumer-voter's taxable property to the per pupil value of the total taxable property in the district, is the tax price of an additional dollar of educational spending per pupil.

### 2.2 Foundation program

Under a foundation program, a state establishes a foundation level of spending per student—typically an amount deemed sufficient to provide a basic level of educational services. Each local district then receives a grant from the state equal to the difference between this foundation level of spending per student and the amount that the district would raise locally under a uniform tax rate on property throughout the state. The total grant received by the district is:

$$n \cdot S = n \cdot F - r \cdot V \tag{5}$$

where $S$ is state aid per student, $F$ the foundation level of spending per student, $r$ the foundation program tax levy, and the other terms are defined as above.

Most foundation programs allow local districts to spend in excess of the established foundation level through additional locally raised revenues. The budget constraint facing a local district then is that total spending equals locally raised revenues plus the foundation program state aid grant, or:

$$n \cdot E = t \cdot V + n \cdot [F - r \cdot (V/n)] \tag{6}$$

Solving (6) for t and substituting this into the resident household's budget constraint yields:

$$I + \left\{ \left[ \frac{H}{V/n} \right] \cdot [F - r \cdot (V/n)] \right\} = P_G \cdot G + \left[ \frac{H}{(V/n)} \right] \cdot E \tag{7}$$

Notice that the effect of this type of state aid program is to increase the purchasing power of the resident household by the second term on the left hand side of (7)—a pure income effect. The magnitude of this income effect depends upon both the size of the state grant $\{F - r \cdot (V/n)\}$ and the household's local tax price $\{H/(V/n)\}$ for school spending.

### 2.3 Power equalization program

Under a power equalization program a state first establishes a guaranteed tax rate or a guaranteed tax base.[6] Each local district then receives a grant from the state equal to the difference between the amount of revenue raised locally at any tax rate and the amount that would be raised under the state guaranteed program.[7] The size of this grant to a local school district is:

$$n \cdot S = t \cdot V^* - t \cdot V \tag{8}$$

where $n$ is the number of students, $S$ the state aid per student, $(V/n)$ the per student taxable property, $(V^*/n)$ the guaranteed tax base, or $t \cdot (V^*/n)$ guaranteed tax yield.

The budget constraint facing a local district again is that total spending equals locally raised revenues plus the power equalization state aid grant:

$$n \cdot E = t \cdot V + n \cdot [t \cdot (V^*/n) - t \cdot (V/n)] \tag{9}$$

or, simplifying:

$$n \cdot E = t \cdot V^* \tag{10}$$

Solving (10) for $t$ and substituting this into the resident household's budget constraint yields:

$$I = P_G \cdot G + \left[ \frac{H}{(V^*/n)} \right] \cdot E \tag{11}$$

Notice that the only difference between this and (4) is the value of taxable property, $V^*$ versus $V$. The effect of this type of state aid program is to change the price of school

[6] Because Tax Yield = Effective Tax Rate ∗ Tax Base, guaranteeing either the yield or the base at any locally determined tax rate in effect also guarantees the other.

[7] It is possible, of course, for a local district's tax base to exceed that guaranteed under the state program, making this grant negative. The school finance literature refers to the required give-back in this situation as a recapture provision. For very obvious political reasons, in practice power equalization programs typically do not include recapture.

spending relative to other goods and services. For "in formula" districts—those districts where the local value of taxable property, $V$, is less than the power equalization program guaranteed tax base, $V^*$—educational services can now be bought at a reduced, or state subsidized, price. Thus, a power equalization program is simply an example of a matching grant that lowers the price of educational spending per pupil by the difference between the guaranteed tax base and the actual total value of taxable property per pupil in the consumer-voter's home district.

A critical feature of a power equalization program is that the aggregate magnitude of the state aid program is determined by local school districts as they select the level of expenditure per student and hence the size of their individual grant. The total commitment of state funds is therefore not under the direct control of its legislature. Because aid to local districts comprises a major component of annual appropriations in most states, this feature has often caused concern about the total exposure of the state treasury to the decisions of local school districts. As a result, an important variant of the power equalization program is one where the program operates only up to a state-specified level of spending per pupil. This corresponds to a closed-end matching grant program.

For our purposes, the important distinction between a foundation program and a power equalization program involves how each affects the budget constraints of resident households. In particular, is there a price effect or is there only a pure income effect? We do not consider explicitly how individual preferences for the actual level of spending per student in any district are aggregated through the political process into an actual spending level.[8] Rather, we take a retrospective look at whether or not the basis for the apparent conclusion that the additional incentive provided to low spending districts by a price effect had not proven sufficient in achieving equalization in spending throughout a state is in fact borne out by the available evidence. We pose the simple query: "Does the structure of the program that a state selects have a significant impact on the extent to which it equalizes spending levels across local districts, or is the magnitude of the state's contribution all that really matters?"

## 3 The dispersion in local spending levels

We follow Murray et al. (1998) by measuring the dispersion in spending levels across school districts within a state using four distinct metrics. The first metric is the Gini coefficient, calculated as:

$$\text{GINI} = \frac{\sum_{i=1}^{N}\sum_{j=1}^{N} P_i P_j |E_i - E_j|}{2(\sum_{i=1}^{N} P_i)^2 \bar{E}} \tag{12}$$

where $N$ is the number of school districts, $E_k$ the expenditure per student in the $k$th district, $P_k$ the number of students in the $k$th district, and $\bar{E}$ the average expenditure per student in the state.

The second metric is the Theil index, calculated as:

$$\text{Theil} = \frac{\sum_{i=1}^{N} P_i E_i \ln(E_i/\bar{E})}{\sum_{i=1}^{N} P_i E_i} \tag{13}$$

[8] That is, it is not necessary for our purposes to distinguish between how the outcome might vary under a median voter model versus an alternative such as a Romer and Rosenthal (1978, 1979) agenda control model.

The third metric is the coefficient of variation, CV, the ratio of the standard deviation in per pupil spending across all districts in a state divided by the mean expenditure, where both the mean and standard deviation are calculated by weighting the per pupil expenditure level in each district by the number of pupils in that district. This metric is then multiplied by 100 rather than expressed as a decimal.

The final metric is the natural logarithm of the ratio of the 95th to the 5th percentile of per pupil expenditures within the state.[9]

When executing these calculations, it is necessary to address a few definitional and institutional issues. We employ data for the 1989–1990 and the 1998–1999 school years. By using data for these two academic years, almost a decade apart, we are able to investigate the impact of a discrete change that occurs in some states in the most fundamental policy instrument—the basic structure of the state aid program—over a period that legal scholars have categorized as the third of three 'waves' of school finance reform.[10] We define educational expenditures to include only funds spent for instructional purposes. This definition excludes, for example, capital expenditures, debt service and inter-fund transfers. It also excludes adult education, community services and student enterprise activities.[11]

The most important institutional issue involves which districts to include in the analysis. The organizational structure through which local educational services are provided varies substantially across the 50 US states. Some states organize all elementary and secondary schools into unified K-12 districts. Other states allow for a combination of unified school districts together with some districts that provide elementary education only and other districts that provide secondary education only. For the purpose of measuring the dispersion in spending levels across districts this situation is problematic. The cost of providing secondary education is more costly than for elementary education. Thus, states with a hybrid organizational structure will exhibit more disparity in spending across districts for this reason alone. We therefore calculate the dispersion metrics for each state based only for those expenditure per student data for unified, kindergarten through 12th grade, school districts.[12]

A second institutional consideration involves small, mostly rural school districts. A high level of expenditure per pupil may arise in such districts because individual classes are simply not large enough to realize the scale economies that exist in the production of educational services. To compensate for this we compute each of the four dispersion metrics twice: once for all unified school districts within each state and a second time for only those unified districts with a total enrollment of 200 or more students.[13] Even for states with a relatively large number of small enrollment districts,[14] none of the calculated dispersion metrics dif-

[9] See Murray et al. (1998) for a discussion of the relative characteristics of these four metrics.

[10] See, for example, Lukemeyer (2004). An additional advantage of the 1989–1990 and 1998–1999 academic years is that information about the structure (foundation versus power equalization) of all state aid programs is readily available (Munley 1990, and AEFA 2001).

[11] The data used to calculate these measures were compiled from the National Center for Educational Statistics (NCES) (1980), Common Core of Data.

[12] A link that identified which 'elementary only' and which 'secondary only' school districts serve the same population constituencies would make it possible to artificially construct hypothetical unified districts from these data and include these in the analysis. Unfortunately the NCES Common Core of Data does not provide an identifying code that might enable this type of linking mechanism.

[13] Any enrollment cut-off must be based on an arbitrary number. We chose 200 because with enrollments smaller than this individual classes would have fewer than 15 students—a reasonable point for serious concern about whether economies of scale have been exhausted.

[14] North Dakota and Nebraska had the largest proportion of school districts with enrollment less than 200 students, at 42 percent and 25 percent respectively.

fers substantially between these two cases. We therefore base the empirical analysis below on the dispersion metrics calculated for all unified school districts within a state.[15]

We eliminate four states from the empirical analysis due to the nature of their organizational structure for K-12 school systems.[16] For the academic years considered Montana had only one unified school district with more than 200 students. In Vermont less than 50% of all students attended a unified school district with more than 200 students enrolled. Hawaii provides elementary and secondary education through a single state-wide school district. Finally, 23 of Alaska's 55 school districts cover large regions and are operated directly by the state government.

## 4 Empirical model

Our principal focus is on whether the structure of a state's education finance program makes a difference in the extent to which it equalizes spending across school districts or whether the resources provided by state government relative to revenues raised locally is all that matters. In particular, does including a price effect in the program design mechanism matter? In answering this question we must take into account that the design of a state's aid program is accomplished in the same policy arena wherein the size of the state aid program is determined. Leyden (1992, 2003) provides particularly relevant insights about the legislative choice of the structure of a school finance state aid program. His analysis demonstrates how the structure of a state aid program chosen depends upon both the preferences of state legislatures, which through the annual budget process determine the state's share of K-12 school spending, and the legal standard used by courts in issuing a mandate for education finance reform. Following this reasoning we employ the following treatment model (as described in Greene 2008: 889–890).

We specify that the dispersion metric assessing the distribution of spending across school districts is a function of control variables, $x_i$, together with the treatment, which is whether or not the design of the state aid program includes a price effect:[17]

$$\text{EXP Dispersion}_i = x_i'\beta + \delta\, \mathit{PriceEffect}_i + e_i \tag{14}$$

While our primary focus is on how the design of a state aid program affects the pattern of spending levels across school districts, other factors clearly also play a role. These factors comprise the control variables, $x_i$, in (14).

[15] We re-estimated the empirical model below using the dispersion metrics calculated by omitting districts with enrollment less than 200 students. The estimated coefficients and their significance levels presented in Tables 2 and 3A–3D change only slightly and all qualitative conclusions remain the same. These results are available from the authors upon request.

[16] Murray et al. (1998) use the same 46 states in their comprehensive analysis of the effect of court mandated reforms on the distribution of education resources over the period 1972 through 1992.

[17] The states that have a value of one for *PriceEffect* for the 1989–1990 school year are: (1) those with a power equalization program (Connecticut, Kansas, Michigan and Rhode Island) and (2) those with a closed-end matching program (Colorado, Illinois, New Jersey, Oregon and Wisconsin). Some states changed the nature of their aid program between the 1989–1990 and 1998–1999 school years. Connecticut, Michigan, New Jersey, Oregon and Rhode Island changed from a power equalization or a closed-end matching program to a foundation program. Indiana and Texas did the reverse. See Munley (1990, Appendix B) for a description of the state aid programs in place for the 1989–1990 school year and AEFA (2001) for the 1998–1999 school year.

The most obvious potential determinant of variations in spending levels across local school districts to include as a control variable is the organizational structure of school districts in a state. In a state where all school districts cover large geographic areas, variations in tastes and preferences for education, as well as variations in the ability to pay for school services, by individual households will not easily manifest themselves in spending differentials.[18] In this instance the Tiebout (1956) sorting mechanism will be suppressed for this publicly provided service. On the other hand, a preponderance of small local districts will provide a venue for such sorting. We thus include in the analysis measures of the size characteristics of the distribution of school districts in each state. These variables are the median enrollment and the coefficient of variation in enrollment across districts. We expect that the dispersion of spending levels will be lower in states with high median enrollments. Greater variation in enrollment may lead to greater variation in spending per pupil, though prior judgment about this is less clear than for the median value. While median enrollment provides a measure of the size of school districts within a state, it does not do so unambiguously. It is possible for two states, one large in area and the other much less so, to have similar median enrollment values but substantially different geographically sized districts. This would result in quite differential opportunities for Tiebout sorting.[19] We therefore also include as an explanatory variable the average geographic size, measured in square miles, of school districts within each state.

Another factor that may affect the dispersion of spending levels across districts is income. Mullen (1980) argues that fiscal decentralization is itself a normal economic good and presents evidence that states with higher levels of income supply a larger share of publicly provided services at the local than at the state level. If higher income leads to greater decentralization, it follows that it may also lead to greater variation in local spending levels. To allow for this we include as an explanatory variable the median household income in each state.

It is also possible, of course, that the degree of variation in income across school districts within a state will affect variation in spending levels. Since education is certainly a normal good, we expect school districts with higher levels of income to spend more on local schools. We therefore include among the control variables a measure of the geographic variation in median household income across all districts within a state. We calculate each dispersion measure by weighting the median household income in each district by the number of students in that district.[20] In estimating the model we include the same dispersion metric for the geographic variation in income across districts among the control variables as that for the dependent variable measuring the dispersion of expenditure per pupil across districts. Thus, in the specification where the dependent variable is the Gini coefficient of expenditure per pupil, the right hand side measure of income dispersion used is the Gini coefficient for the geographic variation in income across districts. For the Theil measure, the coefficient of variation, and the natural logarithm of the ratio of spending in the 95th percentile district to the 5th percentile district, we likewise use the same respective dispersion metric for the geographic variation in income across districts as the right hand side variable.

[18] Variations in intra-district, as opposed to inter-district, spending levels are also a potential equity concern in school finance. In spite of speculation about this issue, data limitations have thus far restricted widespread systematic inquiry. See Burke (1999) and Burke and White (2001).

[19] We are grateful to an anonymous reviewer for making this point.

[20] We are grateful to Jon Sonstelie for suggesting the inclusion of this control variable. Murray et al. (1998) include a similar measure of the variation in income across school districts in a state among the alternative specifications in their test of the sensitivity for the estimated parameters in their base model.

State aid programs seek as one of their objectives to stimulate spending in districts where it would otherwise be low. We therefore expect a greater degree of equality in spending patterns across school districts when state aid constitutes a larger share of total school revenues. To capture this effect we include as an explanatory variable of principal interest the share of total state and local revenues for K-12 education that is provided by the state.

The final control variable candidate relates to whether a state's supreme court has overturned its school finance system. This measure is the primary focus of Murray et al. (1998). They specify this measure alternatively as either a binary variable indicating that a court mandated reform occurred or a continuous variable for the number of years since this happened. They find that the effect of either measure on the dispersion of school district spending within a state is consistently negative and statistically significant in both their basic model and the several alternative specifications that include a variety of demographic and socioeconomic characteristics as controls. We therefore specify the model alternatively with the discrete and the continuous variants of this feature.

To complete the treatment model we specify the selection equation for whether or not the structure of the state aid program includes a price effect as discussed above:

$$PriceEffect_i^* = w_t'\gamma + u_i \tag{15}$$

and

$$PriceEffect_i = \begin{cases} 1 & PriceEffect_i^* > 0 \\ 0 & \text{otherwise} \end{cases} \tag{16}$$

The variables in $w$ that explain the latent measure, $PriceEffect^*$ include all of the variables in $x_i$ as well as identifying variables. The identifying variables should be measures that impact the decision whether or not to include a price effect in the structure of the state aid program but do not necessarily influence variation in spending per pupil levels across school districts in a state. Our initial identifying variable is the percentage of the state's population that resides in a Metropolitan Statistical Area.[21,22]

Appendix A presents the sources for these data, while Appendix A1 presents summary statistics for all variables included in the model.

If the error terms from the two equations are normal and are correlated, then

$$E[\text{EXP Dispersion}_i|PriceEffect_i = 1, x_i, w_i] = x_i'\beta + \delta + \rho\sigma_e\lambda(-w_i\gamma) \tag{17}$$

[21] The decision about what type of aid program to adopt must be determined politically by a state's legislature. We employ the percentage of the state's population that resides in a Metropolitan Statistical Area as the treatment model's initial identifying variable on the basis that differences across states in the relative size of urban/suburban versus rural populations may serve as a first order proxy for differences in political ideology. To check the reasonableness of the assumption that this measure does not affect the dispersion of expenditures across school districts in the second stage of the model, we included it as a right hand side variable in the OLS equations reported in Table 2. Its estimated coefficient never approached a commonly invoked level of statistical significance. As the results in Tables 3A–3D indicate, this measure performs quite well as an identifying variable in the first stage selection equation.

[22] To account for the policy decision by some states to alter the fundamental nature of the aid program between the two school years considered, we tried including in the model another binary variable, SWITCH, equal to one in the 1998–1999 period for these states. This variable never approached statistical significance in either the selection equation or the second stage equation for any of the specifications of the dispersion metrics.

and

$$E[\text{EXP Dispersion}_i|PriceEffect_i = 0, x_i, w_i] = x_i'\beta + \rho\sigma_e \frac{-\phi(w_i\gamma)}{1-\Phi(w_i\gamma)} \quad (18)$$

$\lambda$ in (17) is the inverse Mills ratio, while the normal distribution and cumulative normal are referenced in the ratio at the end of (18). The treatment model can be estimated in one step using the maximum likelihood procedure or in two steps with probit estimation of the selection equation followed by OLS estimation of (17) and (18), calculating their final terms from the probit results. We present the results of both estimation procedures as the results differ slightly in terms of the statistical significance of key variables.

## 5 Results

Table 1 presents the mean and standard deviation values for all four expenditure per pupil dispersion metrics for the 1989–1990 and 1998–1999 school years separately and also for the two years combined. It also presents the comparable values for the dispersion metrics for median household income, weighted by the number of pupils in each district, across school districts in each state. Inspection of the table reveals that the dispersion in spending levels across school districts decreased through the 1990s according to all four metrics. It also reveals that dispersion in income across school districts remained about the same, or increased just slightly, over the period. The dispersion in income levels across school districts clearly exceeds the dispersion in spending per pupil. This finding is consistent with the common goal of state aid programs to equalize spending across rich and poor school districts as well as the fact the income elasticity of demand for local public education is less than unity (see Leyden 2005: 103).

**Table 1** Summary statistics for expenditure and income dispersion measures

| | | 1989–1990 | 1998–1999 | Combined |
|---|---|---|---|---|
| Gini Exp | Mean | 0.077 | 0.066 | 0.071 |
| | Std. Dev. | 0.023 | 0.019 | 0.022 |
| Gini Inc | Mean | 0.134 | 0.135 | 0.135 |
| | Std. Dev. | 0.036 | 0.040 | 0.038 |
| Theil Exp | Mean | 0.011 | 0.008 | 0.010 |
| | Std. Dev. | 0.006 | 0.004 | 0.005 |
| Theil Inc | Mean | 0.032 | 0.033 | 0.032 |
| | Std. Dev. | 0.015 | 0.017 | 0.016 |
| CV Exp | Mean | 12.538 | 10.944 | 11.741 |
| | Std. Dev. | 6.327 | 4.890 | 5.680 |
| CV Inc | Mean | 20.589 | 21.512 | 21.050 |
| | Std. Dev. | 8.890 | 9.784 | 9.308 |
| 95/5 Exp | Mean | 1.553 | 1.460 | 1.507 |
| | Std. Dev. | 0.215 | 0.162 | 0.195 |
| 95/5 Inc | Mean | 2.229 | 2.260 | 2.245 |
| | Std. Dev. | 0.425 | 0.493 | 0.458 |

Table 2 presents OLS estimates of (14), absent the selection treatment, for comparison purposes. The dispersion in median household income across school districts is positive and highly significant under all four dispersion metric specifications. The estimated magnitude of its effect, between 0.17 and 0.39, suggests that variation in income levels across school districts within a state increases the variation in spending per pupil but on less than a proportionate basis. This is likely due to a combination of the income inelasticity of demand for this public service and the equalizing impact of state aid programs on spending levels between rich and poor districts. Corroborating this interpretation is the negative, and for the most part statistically significant, impact of the state share of revenues devoted to public school spending in a state. Consistent with the summary statistics presented in Table 1, the dispersion in spending per pupil across school districts diminished between the 1989–1990 and 1997–1998 school years.

Most of the other explanatory variables, including the presence of a price effect in the structure of the state aid program, fail to exhibit statistical significance under OLS estimation of (14) regardless of the specification of the dispersion metric. The important exception is either specification of a court mandated reform of the state's education finance program, entered either as a binary variable that indicates this has occurred or as the number of years that have elapsed since it happened. Consistent with the findings of Murray, Evans and Schwab, this measure has a negative and, under all except for the 95th–5th percentile ratio metric, statistically significant effect on the dispersion of spending levels across school districts in a state. It is worthwhile to note that this result holds for the two years considered here that are at the tail end, and subsequent to, the 25 year period that served as the basis for Murray, Evans and Schwab's findings.

Tables 3A through 3D present the estimation results of the selection treatment model for the four dispersion metrics using both the two step and maximum likelihood procedures. The first three columns in each case report the two step results and the final three columns the maximum likelihood results. Within each set of three columns the first includes the binary specification for court mandated reform, the second the continuous variable measuring the number of years since it occurred, and the third column excludes this measure from the expenditure equation but includes the number of years since the reform as an identifying variable in the selection equation.

Note first the estimate of the implied probability level for the test of independence of the two equations in the treatment model presented in the last row of each table.[23] This estimate is statistically significant in almost all cases, generally at the 1% or the 5% level. On this basis we clearly reject the null hypothesis that the error terms of (14) and (15) are uncorrelated and conclude that joint estimation of the treatment model is the appropriate method to utilize.

The conditioning explanatory variables, with the exception of the average geographic area of school districts when the coefficient of variation serves as the dispersion metric (Table 3C), included for ceteris paribus purposes have the anticipated sign when statistically significant. The variables of primary interest in the expenditure dispersion equation (14) are the state share of school district revenues, the respective measures for court mandated reform of a state's school finance program, and the binary variable indicating that the structure of the state aid program includes a price effect.

[23] We present the implied probability level for the test of independent equations because the statistic upon which this test is based depends on the estimation technique used, a t test of the correction selection parameter for the two step method and a chi square test, with one degree of freedom, for the maximum likelihood method.

**Table 2** Model estimates—single equation OLS

| Expenditure dispersion | Gini coefficient | | Theil index | | Coefficient of variation | | ln(95/5 expenditure ratio) | |
|---|---|---|---|---|---|---|---|---|
| Constant | 0.050 | 0.048 | 0.0089 | 0.0080 | 3.70 | 5.02 | 0.28 | 0.28 |
| | (3.36) | (3.12) | (2.44) | (2.13) | (1.36) | (1.09) | (3.01) | (2.71) |
| School area | −2.91E−06 | −3.07 | −3.75E−07 | −4.04E−07 | 0.0021 | 0.0020 | −2.56E−05 | 2.68E−05 |
| | (1.51) | (1.60) | (0.81) | (0.88) | (6.98) | (6.95) | (2.22) | (2.34) |
| Median enrollment | −8.23E−07 | −8.10E−07 | −2.10E−07 | −2.05E−07 | 9.12E−05 | 1.05E−04 | −8.54E−06 | −8.47E−06 |
| | (1.22) | (1.20) | (1.19) | (1.16) | (0.66) | (0.76) | (2.14) | (2.11) |
| Coefficient of variation in enrollment | 1.14E−05 | 1.27E−05 | 1.88E−06 | 2.26E−06 | −0.0032 | −0.0031 | 8.73E−05 | 9.52E−05 |
| | (0.96) | (1.07) | (0.58) | (0.70) | (1.35) | (1.33) | (1.21) | (1.33) |
| State-wide median household income | 2.94E−07 | 3.84E−07 | 2.83E−08 | 5.52E−08 | 8.04E−05 | 1.01E−04 | 2.83E−06 | 3.18E−06 |
| | (0.83) | (1.08) | (0.30) | (0.59) | (1.21) | (1.49) | (1.39) | (1.54) |
| Dispersion of income across school districts | 0.261 | 0.254 | 0.170 | 0.166 | 0.391 | 0.384 | 0.203 | 0.192 |
| | (4.22) | (4.13) | (4.58) | (4.50) | (9.23) | (9.04) | (3.16) | (3.06) |
| State share of school district revenues | −0.028 | −0.027 | −0.0067 | −0.0065 | −3.63 | −3.39 | −0.131 | −0.134 |
| | (2.09) | (2.02) | (1.90) | (1.82) | (1.42) | (1.31) | (1.63) | (1.65) |
| 1998–1999 school year | −0.013 | −0.014 | −0.0029 | −0.0032 | −2.82 | −3.05 | −0.084 | −0.089 |
| | (2.32) | (2.53) | (1.95) | (2.18) | (2.64) | (2.86) | (2.52) | (2.68) |
| Court mandated reform (binary) | −0.0078 | | −0.0024 | | −1.68 | | −0.033 | |
| | (1.87) | | (2.12) | | (2.14) | | (1.29) | |
| Years since court mandated reform | | −0.00048 | | −0.00015 | | −0.111 | | −0.0018 |
| | | (1.75) | | (2.02) | | (2.13) | | (1.07) |
| Price effect | −0.0022 | −0.0023 | −0.00093 | −0.00096 | −1.07 | −1.07 | −0.016 | −0.0019 |
| | (0.42) | (0.45) | (0.69) | (0.71) | (1.08) | (1.07) | (0.51) | (0.59) |
| *R*-squared | 0.54 | 0.54 | 0.50 | 0.50 | 0.75 | 0.75 | 0.50 | 0.50 |

$N = 92$. Numbers in parentheses are the $t$ values for the null hypothesis of no association

**Table 3A** Model estimates—treatment selection model, Gini coefficient

| Expenditure dispersion | Two stage estimation | | | Maximum likelihood estimation | | |
|---|---|---|---|---|---|---|
| Constant | 0.057 | 0.057 | 0.059 | 0.053 | 0.051 | 0.057 |
| | (3.68) | (3.52) | (3.84) | (4.06) | (3.89) | (4.12) |
| School area | −4.13E−06 | −4.21E−06 | −4.38E−06 | −3.50E−06 | −3.55E−06 | −3.86E06 |
| | (2.03) | (2.08) | (2.16) | (2.44) | (2.42) | (2.63) |
| Median enrollment | −1.20E−06 | −1.20E−06 | −1.22E−06 | −1.01E−06 | −9.75E−07 | −9.74E−07 |
| | (1.70) | (1.69) | (1.69) | (2.11) | (2.08) | (1.99) |
| Coefficient of variation in enrollment | 2.00E−05 | 2.07E−05 | 2.19E−05 | 1.56E−05 | 1.60E−05 | 1.86E−05 |
| | (1.58) | (1.64) | (1.76) | (1.44) | (1.51) | (1.65) |
| State-wide median household income | 4.781E−07 | 5.06E−07 | 4.98E−07 | 3.83E−07 | 4.35E−07 | 3.95E−07 |
| | (1.30) | (1.37) | (1.33) | (1.23) | (1.37) | (1.24) |
| Respective metric for the dispersion of income across school districts | 0.234 | 0.230 | 0.224 | 0.248 | 0.244 | 0.228 |
| | (3.64) | (3.62) | (3.56) | (3.56) | (3.48) | (3.22) |
| State share of school district revenues | −0.0390 | −0.039 | −0.042 | −0.033 | −0.032 | −0.038 |
| | (2.74) | (2.70) | (3.09) | (2.83) | (2.86) | (3.09) |
| 1998–1999 school year | −0.017 | −0.017 | −0.018 | −0.015 | −0.016 | −0.016 |
| | (2.90) | (3.01) | (3.03) | (3.77) | (3.87) | (3.96) |
| Court mandated reform (binary) | 0.0026 | | | 0.0053 | | |
| | (0.55) | | | (1.35) | | |
| Years since count mandated reform | | −0.00013 | | | −0.00033 | |
| | | (0.43) | | | (1.20) | |
| Price effect | −0.0220 | −0.0224 | −0.0245 | −0.0117 | −0.011 | −0.014 |
| | (2.41) | (2.41) | (3.03) | (2.03) | (1.90) | (2.65) |

**Table 3A** (*Continued*)

| Price effect | Two stage estimation | | Maximum likelihood estimation | | |
|---|---|---|---|---|---|
| Constant | 3.73 | 4.18 | 3.05 | 3.46 | 1.55 |
| | (1.28) | (1.36) | (1.30) | (1.48) | (1.51) |
| School area | −0.0014 | −0.0013 | −0.00064 | −0.00067 | −0.00065 |
| | (1.09) | (0.83) | (1.76) | (2.15) | (2.33) |
| Median enrollment | −0.0016 | −0.0015 | −0.0017 | −0.0017 | −0.0017 |
| | (2.27) | (1.90) | (3.78) | (3.21) | (3.14) |
| Coefficient of variation in | −0.0013 | −0.0012 | −0.0012 | −0.0012 | −0.0012 |
| enrollment | (0.77) | (0.68) | (0.95) | (1.51) | (0.89) |
| State-wide median household | −0.00011 | −0.000012 | −0.000084 | −0.00010 | −0.00010 |
| income | (1.26) | (1.39) | (1.22) | (1.26) | (1.20) |
| Respective metric for the | −26.5 | −27.0 | −33.8 | −32.9 | −34.1 |
| dispersion of income across | (2.28) | (2.21) | (2.76) | (2.88) | (3.13) |
| school districts | | | | | |
| State share of school district | −6.05 | −5.82 | −6.49 | −6.39 | −6.64 |
| revenues | (2.23) | (2.24) | (2.51) | (2.58) | (2.72) |
| 1998–1999 school year | 1.30 | 1.19 | 0.86 | 0.90 | 0.85 |
| | (1.02) | (1.00) | (1.02) | (0.78) | (0.73) |
| Court mandated reform | 2.04 | | 2.36 | | |
| (binary) | (2.90) | | (3.7) | | |
| Years since count mandated | | 0.126 | | 0.146 | 0.160 |
| reform | | (2.97) | | (3.22) | (4.20) |
| Percent population in MSAs | 0.112 | 0.110 | 0.126 | 0.127 | 0.128 |
| | (2.77) | (2.69) | (3.63) | (3.46) | (3.54) |
| Test of independent equations | 0.003 | 0.003 0.001 | 0.005 | 0.001 | 0.001 |
| ($p$ value) | | | | | |

$N = 92$. Numbers in parentheses are the $t$ values for the null hypothesis of no association

**Table 3B** Model estimates—treatment selection model, Theil index

| Expenditure dispersion | Two stage estimation | | | Maximum likelihood estimation | | |
|---|---|---|---|---|---|---|
| Constant | 0.010 | 0.0097 | 0.011 | 0.0095 | 0.0088 | 0.0103 |
| | (2.7) | (2.51) | (2.81) | (3.13) | (2.95) | (3.06) |
| School area | −6.09E−07 | −6.31E−07 | −7.03E−07 | −4.71E−07 | −4.83E−07 | −5.75E−07 |
| | (1.28) | (1.32) | (1.45) | (1.72) | (1.74) | (1.99) |
| Median enrollment | −2.92E−07 | −2.91E−07 | −3.01E−07 | −2.44E−07 | −2.35E−07 | −2.34E−07 |
| | (1.61) | (1.59) | (1.60) | (2.18) | (2.16) | (2.04) |
| Coefficient of variation in enrollment | 3.92E−06 | 4.17E−06 | 4.94E−06 | 2.71E−06 | 2.93E−06 | 4.02E−06 |
| | (1.15) | (1.23) | (1.47) | (1.01) | (1.13) | (1.37) |
| State-wide median household income | 6.84E−08 | 8.16E−08 | 7.88E−08 | 4.47E−08 | 6.44E−08 | 5.18E−08 |
| | (0.72) | (0.86) | (0.80) | (0.50) | (0.73) | (0.58) |
| Respective metric for the dispersion of income across school districts | 0.158 | 0.155 | 0.147 | 0.165 | 0.162 | 0.148 |
| | (4.18) | (4.14) | (3.93) | (3.51) | (3.52) | (3.05) |
| State share of school district revenues | −0.0093 | −0.0093 | −0.0107 | −0.0078 | −0.0075 | −0.0096 |
| | (2.49) | (2.44) | (2.99) | (2.76) | (2.77) | (3.09) |
| 1998–1999 school year | −0.0038 | −0.0040 | −0.0042 | −0.0033 | −0.0035 | −0.0036 |
| | (2.48) | (2.63) | (2.67) | (2.88) | (3.11) | (3.29) |
| Court mandated reform (binary) | −0.0012 | | | −0.0019 | | |
| | (0.84) | | | (1.82) | | |
| Years since count mandated reform | | −0.000068 | | | −0.00012 | |
| | | (0.82) | | | (1.71) | |
| Price effect | −0.0054 | −0.0056 | −0.0067 | −0.0028 | −0.0026 | −0.0037 |
| | (2.19) | (2.22) | (3.05) | (1.66) | (1.77) | (2.79) |

**Table 3B** (*Continued*)

| Price effect | Two stage estimation | | Maximum likelihood estimation | | |
|---|---|---|---|---|---|
| Constant | 1.71 | 2.15 | 1.04 | 1.50 | 1.47 |
| | (0.68) | (0.83) | (0.52) | (0.74) | (0.72) |
| School area | −0.0012 | −0.00097 | −0.00061 | −0.00041 | 0.00035 |
| | (1.06) | (0.73) | (0.82) | (1.29) | (1.53) |
| Median enrollment | −0.0014 | −0.0012 | −0.0014 | −0.0013 | −0.0013 |
| | (2.21) | (1.84) | (3.11) | (2.76) | (2.64) |
| Coefficient of variation in enrollment | −6.41E−04 | −4.19E−04 | −3.83E−04 | −2.74E−04 | −1.30E−04 |
| | (0.40) | (0.26) | (0.30) | (0.21) | (0.10) |
| State-wide median household income | −0.00010 | −0.00011 | −8.46E−05 | −0.00010 | −9.85E−05 |
| | (1.20) | (1.35) | (1.27) | (1.39) | (1.27) |
| Respective metric for the dispersion of income across school districts | −44.6 | −46.2 | −54.8 | −52.8 | −55.8 |
| | (1.96) | (1.98) | (2.04) | (2.19) | (2.39) |
| State share of school district revenues | −5.82 | −5.69 | −6.12 | −6.10 | −6.35 |
| | (2.19) | (2.23) | (2.35) | (2.51) | (2.63) |
| 1998–1999 school year | 1.19 | 1.14 | 0.99 | 1.01 | 0.96 |
| | (0.96) | (0.97) | (1.13) | (0.94) | (0.86) |
| Court mandated reform (binary) | 1.9 | | 2.14 | | |
| | (2.86) | | (3.16) | | |
| Years since count mandated reform | | 0.124 | | 0.137 | 0.151 |
| | | (2.96) | | (3.00) | (3.73) |
| Percent population in MSAs | 0.098 | 0.095 | 0.104 | 0.101 | 0.101 |
| | (2.61) | (2.61) | (3.04) | (3.05) | (3.00) |
| Test of independent equations ($p$ value) | 0.019 | 0.017 0.001 | 0.045 | 0.005 | 0.001 |

$N = 92$. Numbers in parentheses are the $t$ values for the null hypothesis of no association

**Table 3C** Model estimates—treatment selection model coefficient of variation

| Expenditure dispersion | Two stage estimation | | | Maximum likelihood estimation |
|---|---|---|---|---|
| Constant | 4.77 | 4.57 | 4.77 | *Did not converge* |
| | (1.65) | (1.53) | (1.65) | |
| School area | 0.0019 | 0.0019 | 0.0019 | |
| | (6.00) | (5.96) | (6.00) | |
| Median enrollment | 2.71E−05 | 3.09E−05 | 2.71E−05 | |
| | (0.18) | (0.21) | (0.18) | |
| Coefficient of variation in enrollment | −0.0017 | −0.0016 | −0.0017 | |
| | (0.65) | (0.63) | (0.65) | |
| State-wide median household income | 0.00011 | 0.00012 | 0.00011 | |
| | (1.57) | (1.65) | (1.57) | |
| Respective metric for the dispersion of income across school districts | 0.384 | 0.382 | 0.384 | |
| | (8.63) | (8.52) | (8.63) | |
| State share of school district revenues | −6.04 | −6.03 | −6.03 | |
| | (2.11) | (2.05) | (2.11) | |
| 1998–1999 school year | −3.64 | −3.74 | −3.64 | |
| | (3.11) | (3.22) | (3.11) | |
| Court mandated reform (binary) | −0.062 | | | |
| | (0.66) | | | |
| Years since count mandated reform | | −0.038 | | |
| | | (0.60) | | |
| Price effect | −5.45 | −5.56 | −5.45 | |
| | (2.60) | (2.59) | (2.60) | |

The estimated coefficient for the state share of school district revenues is negative and statistically significant under all four specifications of the dispersion metric. This result is consistent with the supposition that, inasmuch as a principle aim of state aid is to promote equity, a larger relative contribution from the state government leads to greater equality in spending across school districts, ceteris paribus.[24] On this basis we conclude that the size of the state aid program definitely matters. It is worth noting, moreover, that the magnitude of its estimate within the treatment selection model is generally about 25 percent to 50 percent greater than for the OLS estimates presented in Table 2.

The estimated coefficient for the binary variable indicating the presence of a price effect in the structure of the state aid program, when the endogeneity of its choice is explicitly accounted for in the estimation procedure, is now negative and statistically significant in all cases other than maximum likelihood estimation for the logarithm of the 95th–5th percentile ratio dispersion metric.[25] And the estimated coefficient for either specification of court man-

[24] See footnote 5 above.

[25] It is also interesting to note that maximum likelihood estimation for the logarithm of the 95th–5th percentile ratio dispersion metric is the only instance where the coefficient of variation in enrollment uniformly exhibits statistical significance. Of the four metrics considered this one is least efficient in the sense that it measures dispersion solely by the distance between two single observations in the distribution, the one at the 95th percentile and the one at the 5th percentile, ignoring the information contained in all the other observations.

**Table 3C** (*Continued*)

| Price effect | Two stage estimation | | Maximum likelihood estimation |
|---|---|---|---|
| Constant | 0.270 | 0.54 | *Did not converge* |
| | (0.12) | (0.23) | |
| School area | −0.00075 | −4.73E−04 | |
| | (0.86) | (0.52) | |
| Median enrollment | −0.0013 | −0.0011 | |
| | (2.09) | (1.81) | |
| Coefficient of variation in enrollment | −0.00076<br>(0.51) | −0.00059<br>(0.40) | |
| State-wide median household income | −0.000076<br>(0.97) | −0.000082<br>(1.06) | |
| Respective metric for the dispersion of income across school districts | 0.026<br>(0.70) | 0.020<br>(0.54) | |
| State share of school district revenues | −3.95<br>(1.72) | −3.77<br>(1.69) | |
| 1998–1999 school year | 0.659 | 0.603 | |
| | (0.57) | (0.55) | |
| Court mandated reform (binary) | 1.46<br>(2.55) | | |
| Years since count mandated reform | | 0.0904<br>(2.59) | |
| Percent population in MSAs | 0.064 | 0.060 | |
| | (2.18) | (2.16) | |
| Test of independent equations ($p$ value) | 0.009 | 0.009 | 0.001 |

$N = 92$. Numbers in parentheses are the $t$ values for the null hypothesis of no association

dated reform in the state aid program now fails to exhibit a statistically significant effect on the dispersion of spending levels across school districts within a state in all cases other than maximum likelihood estimation for the Theil index dispersion metric. To understand the reversal of these results from the OLS estimation of (14) presented in Table 2 it is helpful to turn to the estimates of the first stage of the selection model.

Inspection of Tables 3A–3D reveals that the estimated coefficient for either measure of court mandated reform in a state's education finance program is positive and significant at the 1% level in the price effect selection equation given all specifications of the dispersion metric. Both the existence of a court mandated reform and the number of years since it occurred make it more likely that a state has adopted a school finance program that includes a price effect in its design mechanism. This result is clearly in accordance with the history of school finance reforms. As noted in the introduction above, many of the reforms enacted during the 1970s and 1980s adopted a district power equalization scheme that included a price effect in the form of a matching grant.

In the Table 2 OLS estimation of (14), consistent with the results of Murray et al. (1998), the binary indicator variable and the continuous variable measuring the number of years since court mandated reform both are significant determinants in the dispersion of spending

**Table 3D** Model estimates—treatment selection model, ln(95/5 expenditure ratio)

| Expenditure dispersion | Two stage estimation | | | Maximum likelihood estimation | | |
|---|---|---|---|---|---|---|
| Constant | 0.313 | 0.307 | 0.324 | 0.309 | 0.293 | 0.318 |
| | (3.40) | (3.27) | (3.68) | (2.90) | (3.21) | (3.81) |
| School area | −3.07E−05 | −3.05E−05 | −3.17E−05 | −3.01E−05 | −2.87E−05 | −3.02E−05 |
| | (2.68) | (2.70) | (2.85) | (2.61) | (3.13) | (3.47) |
| Median enrollment | −9.73E−06 | −9.43E−06 | −9.49E−06 | −9.58E−06 | −8.96E−06 | −8.96E−06 |
| | (2.48) | (2.42) | (2.41) | (2.93) | (3.25) | (3.11) |
| Coefficient of variation in enrollment | 0.00012 | 0.00012 | 0.00013 | 0.00011 | 0.00011 | 0.00012 |
| | (1.64) | (1.66) | (1.82) | (1.80) | (2.37) | (2.86) |
| State-wide median household income | 3.46E−06 | 3.50E−06 | 3.43E−06 | 3.38E−06 | 3.34E−06 | 3.19E−06 |
| | (1.73) | (1.39) | (1.71) | (1.72) | (1.54) | (1.49) |
| Respective metric for the dispersion of income across school districts | 0.175 | 0.174 | 0.164 | 0.179 | 0.183 | 0.169 |
| | (2.75) | (2.82) | (2.78) | (2.18) | (2.50) | (2.47) |
| State share of school district revenues | −0.171 | −0.166 | −0.183 | −0.166 | −0.151 | −0.174 |
| | (2.12) | (2.05) | (2.44) | (1.81) | (2.31) | (2.56) |
| 1998–1999 school year | −0.098 | −0.098 | −0.099 | −0.096 | −0.093 | −0.095 |
| | (2.97) | (3.03) | (3.06) | (3.58) | (3.34) | (3.34) |
| Court mandated reform (binary) | 0.0145 | | | 0.017 | | |
| | (0.56) | | | (0.46) | | |
| Years since count mandated reform | | 0.00087 | | | 0.0013 | |
| | | (0.51) | | | (0.74) | |
| Price effect | −0.0784 | −0.0681 | −0.0797 | −0.0708 | −0.0440 | −0.057 |
| | (1.73) | (1.47) | (1.97) | (0.74) | (1.10) | (1.49) |

**Table 3D** (*Continued*)

| Price effect | Two stage estimation | | Maximum likelihood estimation | | |
|---|---|---|---|---|---|
| Constant | 5.51 | 5.56 | 2.47 | 4.07 | 3.74 |
| | (1.72) | (1.74) | (0.48) | (1.51) | (1.37) |
| School area | −0.0025 | −0.0026 | −0.0010 | −0.0020 | −0.0018 |
| | (1.23) | (1.28) | (0.45) | (1.69) | (1.51) |
| Median enrollment | −0.0021 | −0.0021 | −0.0019 | −0.0021 | −0.0021 |
| | (2.11) | (2.15) | (1.28) | (2.70) | (2.57) |
| Coefficient of variation in | −0.0016 | −0.0017 | −0.0007 | −0.0018 | −0.0017 |
| enrollment | (0.76) | (0.86) | (0.26) | (1.24) | (116) |
| State-wide median household | −0.00012 | −0.00012 | −4.59E−05 | −8.94E−05 | −8.17E−05 |
| income | (1.33) | (1.39) | (0.31) | (1.18) | (1.06) |
| Respective metric for the | −7.55 | −7.39 | −8.36 | −7.34 | −7.33 |
| dispersion of income across | (2.87) | (2.76) | (2.95) | (3.64) | (3.65) |
| school districts | | | | | |
| State share of school district | −7.58 | −7.00 | −7.37 | −6.69 | −6.65 |
| revenues | (2.55) | (2.54) | (2.92) | (2.43) | (2.44) |
| 1998–1999 school year | 1.51 | 1.25 | 0.58 | 0.89 | 0.79 |
| | (1.15) | (1.06) | (0.33) | (0.73) | (0.64) |
| Court mandated reform | 2.40 | | 2.68 | | |
| (binary) | (3.03) | | (2.57) | | |
| Years since count mandated | | 0.138 | | 0.136 | 0.140 |
| reform | | (3.04) | | (2.80) | (3.17) |
| Percent population in MSAs | 0.149 | 0.147 | 0.149 | 0.151 | 0.150 |
| | (2.87) | (2.89) | (3.14) | (3.30) | (3.22) |
| Test of independent equations | 0.047 | 0.143 0.069 | 0.50 | 0.11 | 0.047 |
| ($p$ value) | | | | | |

$N = 92$. Numbers in parentheses are the $t$ values for the null hypothesis of no association

levels across school districts within a state. The results presented here, taking account of the endogeneity of the legislative choice of the structure of a state's aid program, provide insights into the mechanism underlying the Murray, Evans and Schwab findings. States that were subject to court mandates, and especially early ones, were more likely to adopt an aid program that contained a price effect, and this program structure, holding constant the size of the state aid program share of total school revenues, reduces the dispersion in local spending levels to a greater degree than a foundation program that produces an income effect only.

Given this interpretation it is interesting to note the estimated coefficient of the state share of total school district revenues in the price effect selection equation. This estimate is consistently negative and statistically significant. This suggests that states contributing smaller shares of local district revenues are more likely to have adopted a state aid program that contains a price effect.[26] The identifying variable, percentage of the population residing within metropolitan statistical areas, is always positive and statistically significant, generally at the 1% level, in the price effect selection equation while median enrollment is consistently negative and statistically significant. It is interesting to note that there is no statistical difference between the 1989–1990 and 1998–1999 school years in the number of states whose aid program contains a price effect.[27]

A particularly relevant question to ask given the public policy importance of the effectiveness of state aid programs in achieving an equitable distribution of resources to students in property rich and property poor school districts is: While the results presented here suggest that the presence of a price effect in the structure of a state aid program equalizes spending levels in a statistically significant way, is the magnitude of this effect quantitatively of consequence? The fact that it enters (14) as a binary variable makes answering this question more straightforward as the estimated coefficient indicates the impact on any of the dispersion metrics of including a price effect in the structure of a state's education finance program.

In Tables 3A, 3B and 3D the maximum likelihood estimate of the price effect is about one-half the magnitude of the estimate obtained from the two step procedure.[28] Comparing this more conservative measure to the summary statistics in Table 1 reveals that the estimated effect of including a price effect is about one-half the magnitude of the standard deviation in the observed variation across states in the dispersion of spending levels across school districts for the Gini coefficient, Theil index and the logarithm of the 95th–5th percentile ratio.[29] Including a price effect based on the two step estimation procedure thus is predicted to reduce the observed variation across states by approximately one standard deviation. Comparing the estimated coefficient for the price effect to the estimated coefficient for the state share of school district revenues in Tables 3A–3D, however, provides a better intuitive measure of the magnitude of its impact. Note that the ratio of the estimated co-

[26] This is consistent with the theoretical argument and empirical evidence presented by Leyden (2003, Chap. 4).

[27] As noted in footnote 14 above, while five states changed their school finance programs from district power equalization to foundation regimes over this period, two other states did the reverse.

[28] The maximum likelihood estimation procedure did not converge for the coefficient of variation metric for spending per pupil presented in Table 3C.

[29] The values presented in Table 1 are for the 95th–5th percentile ratio itself, rather than its logarithm, to allow intuitive interpretation. The standard deviation for the logarithm of these values for the sample is 0.11.

efficients of price effect to the state share of school district revenues is at least one-third for all equation specifications given all four dispersion metrics. This suggests that including a price effect in the state aid program yields the same impact in equalizing spending levels across school districts as does increasing the state share of total school district revenues from 33% to 67%. On this basis it appears that the quantitative magnitude of this effect is indeed at least as much a matter of economic consequence as is its statistical significance.

## 6 Concluding remarks

The results presented here provide an interesting insight into an underlying mechanism that is at least partly responsible for Murray, Evans and Schwab's finding that "Court-mandated education-finance reform can decrease within-state inequality significantly" (1998: 806). By taking into account within our empirical model the endogeneity of the choice of a state's education finance program structure we find that a court mandated reform increases the likelihood that a state will adopt an aid program that includes a price effect in its design. The presence of a price effect in the program's design in turn leads to a decrease in within-state spending inequality that is both statistically significant and quantitatively consequent.

The estimate obtained here of the economic magnitude of the presence of a price effect in a state education finance program's ability to equalize spending levels across school districts clearly calls into question the legitimacy of the tacit conclusion that foundation programs are preferable to power equalization programs. The perceived advantage of a foundation program in achieving an *adequate* level of spending in all districts rests on the premise that the program include a mandated minimum local effort. The same result can be achieved by a power equalization program that either likewise mandates a minimum required local tax rate or perhaps includes in its design a two-tier matching rate where the initial rate is sufficiently high to induce all districts to reach its cut-off level. And Duncombe and Yinger (1998) have demonstrated how both *cost* and *quality* criteria can be incorporated into either a foundation or a power equalization program's structure.

At the very least it seems, based on the results presented here, that to the extent to which equalizing the resources available to poor as well as to rich school districts continues as an important objective of state education finance programs, the potential advantage of adopting a power-equalization price effect deserves further consideration. Likewise further inquiry appears warranted to extend Leyden's (1992, 2003) analysis to examine explicitly the role that other policy arena participants—education advocates, 'educrats' and teachers' unions—play in determining the design of a state aid program. The size of the state aid program clearly matters in the pursuit of equity objectives, but so too apparently does the program's structure.

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## Appendix A: Data sources

| Variable | Source | Description |
|---|---|---|
| SCHOOL AREA | CCD[a] | # of square miles per school district |
| MD ENRL | CCD[a] | Median Enrollment |
| CV ENRL | Calculated (CCD[a]) | Coefficient of Variation in Enrollment across districts |
| INCOME | US Census | Median Household income per State |
| STATE SHR | CCD[a] | Percentage of state revenues Compared to state and local revenues |
| PRICE | Munley 1990[b] AEFA 2001[c] | State Aid Program has Price Effect |
| DISPERSION METRICS | (CCD[a]) | Calculated from CCD school district expenditure and income data (see Table 1) |
| COURT REFORM | AEFA 2001[c] | Years since judicial mandate |
| MSA | US Census | Percentage share of state population |

[a]National Center for Education Statistics (1980), Common Core of Data

[b]Programs with Price Effect in 1989–1990

[c]Programs with Price Effect in 1998–1999

## Appendix A1: Summary statistics for right hand side variables

| Variable | 1989–1990 | 1998–1999 | Combined |
|---|---|---|---|
| SCHOOL AREA | | | |
| Mean | 599 | 609 | 604 |
| Std. Dev. | 1,082 | 1,095 | 1,075 |
| MD ENRL | | | |
| Mean | 2,518 | 2,856 | 2,687 |
| Std. Dev. | 2,410 | 2,876 | 2,644 |
| CV ENRL | | | |
| Mean | 205 | 204 | 205 |
| Std. Dev. | 149 | 148 | 148 |
| INCOME | | | |
| Mean | $28,742 | $41,460 | $35,101 |
| Std. Dev. | $5,218 | $6,222 | $8,572 |

(*Continued*)

| Variable | 1989–1990 | 1998–1999 | Combined |
|---|---|---|---|
| STATE SHARE | | | |
| Mean | 51.1% | 53.4% | 52.2% |
| Std. Dev. | 15.5% | 13.8% | 14.7% |
| PRICE (binary variable) | | | |
| Mean | .196 | .109 | .152 |
| Std. Dev. | .401 | .315 | .361 |
| COURT REFORM YEARS | | | |
| Mean | 2.348 | 4.587 | 3.467 |
| Std. Dev. | 5.047 | 8.057 | 6.780 |
| MSA POPULATION (%) | | | |
| Mean | 66.1 | 69.9 | 65.1 |
| Std. Dev. | 20.7 | 19.5 | 21.4 |

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