Federal Reserve Bank of Chicago

USING MARKET VALUATION TO ASSESS THE IMPORTANCE AND EFFICIENCY OF PUBLIC SCHOOL SPENDING

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Abstract

In this paper we take a "market-based" approach to examine whether increased school expenditures are valued by potential residents and whether the current level of public school provision is inefficient. We do so by employing an instrumental variables strategy to estimate the effect of state education aid on residential property values. We find evidence that, on average, additional state aid is valued by potential residents and that school districts appear to spend efficiently or, if anything, underspend. We also find that school districts spend less efficiently in areas in which they face little or no competition from other public schools, in large districts, and in areas in which residents are poor or less educated. One interpretation of these results is that increased competition has the potential to increase school efficiency in some areas.

I. Introduction

An enduring question in education policy is whether spending additional resources on schools improves student outcomes. Some researchers point to evidence that schooling inputs, such as lower pupil-teacher ratios, longer school terms, and more qualified teachers, improve test scores and wages (e.g., Card and Krueger (1992), Angrist and Lavy (1999), Achilles and Finn (1990), and Krueger (1999)). Others point to research that suggests that improvements in school inputs, and expenditures in particular, do not result in higher student achievement (e.g., Betts (1995), Hanushek (1986), and Hanushek, Rivkin, and Taylor (1996)). Many of these researchers also argue that teachers unions and bloated bureaucracies inhibit improved schooling inputs from generating better outputs resulting in inefficiency in public school provision (Chubb and Moe, 1990; Hoxby, 1996). Thus, it is the inefficiency in public school provision that interferes with additional spending improving student outcomes. The typical approach in the existing literature is to estimate directly the relationship between schooling expenditures and student outputs, such as test scores or eventual wages. However, the importance of test scores to adult outcomes is unclear, and it is rare to be able to link schooling inputs to later outcomes because of the cost and difficulty in implementing long longitudinal surveys and the unreliability of asking retrospective information on schooling inputs in labor market surveys.

An alternative approach to analyzing whether schools effectively use additional expenditures is to consider whether the market appears to value the spending, such as by examining the relationship between school spending and property values. In the United States, the provision of elementary and secondary education is largely determined at the local level.[1] Therefore, if individuals make residential choices based on their preferences for schooling, then property values should reflect how schooling in a particular area is valued by potential residents.[2] If an additional dollar spent by a district improves school outcomes, then one should find

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[1] In the U.S. only 7 percent of public primary and secondary school revenues are provided by the federal government, while states and local governments contribute approximately 45 percent each (*Digest of Education Statistics*, 1996). The balance is funded by private sources.

[2] For evidence that households with children choose where to live based in part on school quality, see Barrow (1999) and Black (1999).

that additional expenditures lead to higher property values. In contrast, if the additional spending does not result in better schools, then one should not find that additional school spending increases property values.

An advantage of this approach is that it permits an assessment of the value of school spending using a more contemporaneous measure of (at least the perception of) the provision of schooling. In addition, one can assess whether schools receiving the additional revenue are inefficient in their provision of education by testing whether a one dollar increase in state aid generates a (properly discounted) one dollar increase in housing values. On the one hand, as established by Tiebout (1956), if individuals choose their residence based on the provision of public goods, then the optimal level of such public goods should be provided.[3] Therefore, by this argument, the provision of schooling in the United States may well be efficient because schools compete with one another through the residential housing market. This form of competition insures both allocative and productive efficiency as parents who would like a different kind or bundle of schooling can choose a different neighborhood, as can those who do not believe that the quality of schooling merits their tax dollars (i.e., the district is inefficient).

On the other hand, there are several obstacles that may prevent the majority of school districts from achieving the optimal level of schooling. First, because it is costly to move, parents may not be perfectly mobile or have perfect information about localities and the provision of education. In particular, low-income families may not be able to choose to move out of the inner-city in order to reside in a district providing their preferred level of education. In addition, a Tiebout equilibrium requires that parents have a choice of different kinds of communities. Over the past 20 years many states have centralized education finance to improve the equity in the provision of schooling (Kenny and Schmidt, 1994). To the extent that these policies have led to more equal provision of schooling across districts within states, parents may have less ability to choose their preferred provision of schooling today than they did 20 years ago.

[3] Tiebout (1956) relies on several assumptions including full mobility, a large number of communities, unrestricted employment opportunities, and an optimal community size.

In this paper we adopt this "market-based" approach to examine both whether additional spending on schools appears to increase school outputs, as perceived by the housing market, and whether public schools are inefficient. Because most of the debate surrounding school finance in the U.S. is implicitly about whether current spending is too high,[4] we focus on testing whether the current level of public school provision is inefficiently high. We consider efficiency in the situation in which local school spending continues to be (primarily) financed by a property tax as occurs in the majority of school districts in the U.S. In this case, housing choices may be distorted by the property tax. Nevertheless, if families have the option of choosing to send their children to the school of their choice, communities may still achieve the second-best schooling optimum. Therefore, we test for whether the current level of school spending is efficient conditional on the inefficiency induced by the property tax.[5]

In order to evaluate effectively the question of the efficiency of school spending, we have assembled a rich and unique set of data on school districts. Our data sources consist of both original data collected from state tax and education agencies as well as various Census data. We find evidence that, on average, additional school spending leads to increased property values suggesting that additional expenditures may improve student outcomes. In addition, we find that, on average, public school districts likely spend increases in state aid for

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[4] For example, many who argue that the public provision of schooling in the U.S. is likely inefficient note that during the 1963-64 school year the government spent $2,609 per pupil (in 1995 dollars), compared to $6,459 per pupil spent during 1995-96, an increase of over 147 percent (*Digest of Education Statistics*, 1996), without comparable increases in student achievement. Further, many argue that despite the fact that the U.S. ranks fourth and third in spending per pupil for primary and secondary education, respectively, (*Education at a Glance: OECD Indicators, 1998*), it ranks much lower in standardized tests of mathematics and science knowledge, particularly at the secondary level (*Pursuing Excellence: A Study of U.S. Fourth-Grade Mathematics and Science Achievement in International Context, 1998; Pursuing Excellence: A Study of U.S. Twelfth-Grade Mathematics and Science Achievement in International Context, 1998*).

[5] Alternatively one could consider the case where under a full school choice program, either property taxes are not used to finance schooling or the school property tax rates are fully-equalized thereby severing the link between the local property taxes raised and the schooling provided. In this case, if families have the option of choosing to send their children to any school, their housing choices will not be distorted by the financing of that education. See, for example, Epple, Zelenitz, and Visscher (1978).

education efficiently. However, to the extent there is inefficiency, it is likely that school districts underspend on education; that is, a one dollar increase in state aid results in more than a properly discounted one dollar increase in local housing values. We also find that school districts spend less efficiently in areas in which school districts face little or no competition from other public schools (as defined by a Herfindahl-Hirschman index), in large districts, and in areas in which residents are poor or less educated. One interpretation of these results is that increased competition has the potential to increase school efficiency in some areas.

The rest of the paper is organized as follows: section II outlines the theoretical model upon which we base our statistical tests for the efficiency of school spending, section III explains our empirical strategy, section IV describes our data, section V contains our results and section VI concludes.

II. A (Highly) Stylized Model of Public Good Valuation

A. Basic Model

Our market-based approached for examining efficiency in public schooling is based on Brueckner's bid-rent model of property value determination (1979, 1982, 1983).[6] The result derived from this model is that efficient public good provision occurs at the level that maximizes aggregate property value. The model relies on some strong assumptions, and we address potential violations of these assumptions below.

In the bid-rent model of the housing market, consumers are assumed to have identical preferences, and their utility depends on the level of schooling provided, E; other local public goods, G; housing units, H; and the numeraire good, B. All residents in a community consume the same level of the public goods, E and G.[7]

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[6] Other attempts to test for efficiency in the public provision of schooling include Barlow (1970) and Bergstrom et al. (1988).

[7] We assume there are no externalities across communities. Boskin (1972) argues that due to such externalities, mobility may not lead to the optimal provision of public goods if local governments compete through their tax and expenditure policies. In particular, public goods that redistribute among constituents may be under-provided and those that increase the value of property over-provided. Although mobility will lead to allocative inefficiencies, it will continue to induce productive efficiency.

Costless mobility is assumed such that consumers with the same level of income must achieve the same utility level.[8] As a result, house prices (rents) adjust to insure that residents are indifferent between different houses.[9] Formally this means that a resident with income *I* achieves utility *h(I)* and her consumption bundle must satisfy,

$$U(E,G,H,B) = h(I). \tag{1}$$

This equality is guaranteed since if a consumer could achieve a higher utility elsewhere, she would move. As a result, such disparities are arbitraged away. A resident's budget constraint can be written as $B+R=I$, where R represents the rent paid for housing and the price of B is normalized to 1. Then, R must satisfy

$$U(E,G,H,I-R) = h(I). \tag{2}$$

This equation determines the bid-rent function,

$$R = R(E,G,H;I). \tag{3}$$

This function specifies the rent necessary to equalize an individual's utility across differing residences. Differentiating equation (3) with respect to E gives

$$R_E(E,G,H;I) = \frac{U_E(E,G,H,I-R)}{U_B(E,G,H,I-R)} \tag{4}$$

where subscripts denote partial derivatives. Equation (4) shows that the required change in the rent resulting from a change in E is equal to the marginal rate of substitution between education and the numeraire good, B. Similarly, the required change in the rent resulting from a change in G is equal to the marginal rate of substitution between the other public goods and B.

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[8] We could also allow for heterogenous preferences in which case residents with the same preferences and income would have to achieve the same level of utility.

[9] One can think of "rent" as either the price of owning a house or of renting because in equilibrium an individual should be indifferent between owning and renting a property.

Next, assume that local revenues for schooling are financed exclusively by a residential property tax rate, t_E, and the other public goods by a residential property tax, t_G. The property tax rates are applied to both land and improvements to ensure that the choice of housing-factor inputs is not distorted. Letting δ be the discount rate, the value of an individual house *i* is,

$$P_i = \frac{R - (t_E + t_G) \cdot P_i}{\delta} \tag{5}$$

which rearranged gives,

$$P_i = \frac{R(E, G, H_i; I_i)}{\delta + t_E + t_G}. \tag{6}$$

The aggregate value of housing property is defined as the sum of the individual property values within a community,

$$P = \sum_{i=1}^{N} P_i = \sum_{i=1}^{N} \frac{R(E, G, H_i; I_i)}{\delta + t_E + t_G}, \tag{7}$$

where *N* is the number of houses in the community.

Assuming that the state contributes an amount, *S*, to local school districts (the local community fully finances the other public goods, *G*, for simplicity), the community budget constraint is,

$$(t_E + t_G) \cdot P = CE(E, N) - S + CG(G, N), \tag{8}$$

where *CE* and *CG* are the (convex) cost functions for *E* and *G*. The fact that cost is a function of the community size, *N*, reflects potential congestion costs.[10] Combining equations (7) and (8) gives,

[10] Note that for simplicity in notation we have allowed the community size in terms of congestion costs to equal the number of housing units. In fact, one might think total population or number of school-aged children, in the case of education, is a more appropriate measure for potential congestion.

$$P = \frac{1}{\delta}\left[\sum_{i=1}^{N} R\left(E,G,H_i;I_i\right) - CE\left(E,N\right) + S - CG\left(G,N\right)\right]. \tag{9}$$

Aggregate property values are a function of the aggregate rents, state aid, the discount rate, and the production costs of education and the other public goods.[11] Differentiating equation (9) with respect to the state aid and assuming that changes in state money for education have no effect on the provision of other public goods, *i.e.* $\partial G/\partial S = 0$, yields

$$\frac{\partial P}{\partial S} = \frac{1}{\delta}\left[\sum_{i=1}^{N} R_E\left(E,G,H_i;I_i\right) - CE_E\left(E,N\right)\right]\frac{\partial E}{\partial S} + \frac{1}{\delta} \tag{10}$$

where, as shown in equation (4), R_E is equal to the marginal rate of substitution between education and the numeraire good, *B*. As a result, equation (10) establishes that $\partial P/\partial S = 1/\delta$ when the "Samuelson condition" for the optimal provision of education is satisfied, i.e., the sum of the marginal rates of substitution between education and the numeraire equals the marginal cost of providing education. (A similar condition holds for all other public goods as well.) Assuming that *R* is a strictly concave function of *E* and *G* and that *CE* is convex in *E* and *G*, it follows that *P* in equation (9) is strictly concave in *E* and *G*. As a result, aggregate property value reaches a global maximum at values of *E* and *G* where the Samuelson condition holds, ceteris paribus. Thus, one can determine whether education is under-provided or over-provided relative to the property value maximizing level as $\partial P/\partial S \gtreqless 1/\delta$. Because the null hypothesis of the coefficient of interest, that on state school aid, depends on the discount rate, we use 7.33 percent which is the average real 30-year conventional mortgage rate from 1980-1990 in our hypothesis tests regarding school efficiency.[12]

[11] We discuss adding business property to the model below.

[12] The nominal mortgage rate is from the Federal Home Mortgage Corporation (obtained from the Federal Reserve Board of Governors – http://www.bog.frb.fed.us/releases/h15/data/a/cm.txt). We use the personal consumption expenditure price index to calculate the real mortgage rate.

B. Discussion of Assumptions and Omissions

The result above derives from a number of rather strong assumptions and omissions that may not hold in reality. For example, the model assumes that households can move without cost, that changes in state aid are perceived as permanent changes, and that the provision of public goods other than education are unaffected by changes in state funds for public schooling. In addition, the theoretical model omits the role of commercial property. In this section we discuss the reasonableness of these assumptions and their likely effects on interpretation of the results that follow.

1. Costless Mobility

Costless mobility insures that equation (1) holds, that is, households with the same income achieve the same utility level because if a household could achieve a higher utility elsewhere, it would move. We have attempted to incorporate costs to moving into the model in two ways. First, we considered the case of a household facing the following consideration: remain in community 1 or move to community 2. If there is only one period, then the individual on the margin of moving will be indifferent between moving and staying. We represent this by amending equation (2) as,

$$U\left(E_1, G_1, H_1, I-R_1\right)=U\left(E_2, G_2, H_2, I-R_2-k\right)=h(I). \tag{2$'$}$$

where E_j, G_j, H_j, and R_j represent the amenities and rent in community j (where j=1,2) and k represents the fixed cost of moving. In this case, equation (9) still holds (i.e., one would test for efficiency by testing whether $\partial P/\partial S = 1/\delta$) because the moving costs do not change the marginal cost and benefit of education.

More generally, however, one may be concerned that households in poor neighborhoods have fewer options (which could be thought of as extremely high mobility costs). In this case, as in all districts, as long as there are some households moving into and out of the district (i.e., there is some market determining prices), then the market price for those houses should reflect the valuation that potential homeowners put on the amenities in the district. And, in districts in which households have less mobility (such as low-income districts), we might expect that education (and other public goods) is not provided efficiently.

2. Permanent changes in state aid

An implicit assumption of the above model is that changes in state aid for education are permanent. If instead changes in state aid were transitory, we would expect them to have a much smaller impact on property values. However, the formulas that determine the level of state education aid tend to change slowly over time such that changes in state aid are likely to be viewed as permanent by districts. In addition, many districts (67 percent in 1977 and 48 percent in 1990) are covered by “hold harmless” provisions which minimize the amount that districts can lose due to policy changes, property value growth, or decreases in enrollment. On balance it seems reasonable to assume that changes in state aid are viewed as permanent. We note, however, that to the extent that they are viewed as more transitory our coefficient of interest will tend toward zero.

3. $\partial G/\partial S = 0$

A third assumption is that state spending on education does not affect the provision of other public goods. From the standpoint of basic economic theory this assumption seems unrealistic since funding is fungible and if a district receives aid from the state, the equivalent to an increase in income, then the share devoted to education should be equal to the marginal propensity to spend out of income (which would be about 5-10 cents on the dollar) (Hines and Thaler, 1995). In our case, however, the assumption is not so unrealistic because we limit our analysis to independent school districts, about 92 percent of all elementary and secondary school districts in the U.S. (*1992 Census of Governments, Government Finances*). Independent school districts, as defined by the Census of Governments, are fiscally and administratively independent of other government entities, such as townships and counties, and thus are considered governments themselves.

Dependent school districts, on the other hand, are dependent on a "parent" government. Consequently, the parent government of a dependent school district has the ability to shift public expenditure among various public goods, whereas independent districts provide education and are unable to spend revenues on public goods other than education. As a result, any aid received by an independent district from the state either must be spent on the provision of education or rebated back to residents in the form of a tax rate reduction. Thus, it is only indirectly that increased state aid may lead to an increase in the provision of other public goods in the county or township in which the school district is situated (because the reduction in school taxes can be off-set by an increase in taxes to fund other public goods). In the model this relationship between state aid and the other public goods is accommodated through the budget constraint.

4. Business Property

The model specified above omits business property from consideration. To understand the effect of such an omission on our results, consider the case in which we assume that the value of business property only enters the model through the budget constraint and both residential and business property are taxed. Again assuming $\partial G/\partial S = 0$, equation (10) becomes:

$$\frac{\partial P}{\partial S} = \frac{1}{\delta}\left[\sum_{i=1}^{N} R_E\left(E, G, H_i; I_i\right) - \alpha C E_E\left(E, N\right)\right]\frac{\partial E}{\partial S} + \frac{\alpha}{\delta} \qquad (10')$$

where α is the residential share of total property value.[13] Thus, at the efficient level of education provision, the first part of equation (10′) no longer equals zero: in fact, it is now positive (as long as $\alpha \neq 0$). This positive effect on $\partial P/\partial S$ is partially offset by the effect of α on the second term, but the net effect is indeterminate. What we can say is that this problem is minimized in heavily residential areas where α is close to one. In addition, it is still clear that $\partial P/\partial S < 0$ implies that too much is being spent on public education.

[13] In 1986, approximately 61 percent of gross assessed valuation was due to residential (nonfarm) property (*1987 Census of Governments, Taxable Property Values*).

Empirically, we do not include business property in our estimation because data are not available for most states. However, when we include it (along with other types of property, such as personal property) for the (few) states for which we have the data, it has not changed the estimated coefficients substantially. As a result, we conclude that our treatment of commercial property is unlikely to have a large effect on our conclusions about education spending.

III. Empirical Framework

Based on the theoretical framework, we estimate the following reduced-form equation,

$$P_{jcst} = \alpha_0 + X_{jcst}\alpha_1 + H_{jcst}\alpha_2 + W_{cst}\alpha_3 + \beta S_{jcst} + \xi_j + \varepsilon_{jcst} \tag{11}$$

where P_{jcst} is the aggregate house value per pupil in school district j, in county c, in state s, and year t, X_{jcst} are a set of demographic characteristics about the district's population, H_{jcst} are characteristics of the housing stock of the district, W_{cst} are county characteristics, and S_{jcst} is state revenue per pupil for education spending. ξ_j is a district fixed-effect and ε_{jcst} is a normally distributed random error term. The estimate of β represents the efficiency of school district spending on education.

By far the most difficult empirical challenge to overcome is to control for all characteristics that are correlated with state schooling revenue and housing values as omitted factors may bias the results.[14] In the 1970's many states relied on categorical aid to fund education. During this time, state revenue was primarily determined by a flat grant per pupil or by a flat grant in which the pupil count was weighted by the characteristics of the students in each school district (such as grade level, special education needs, and transportation). Between the 1970's and the 1990's many states changed their formulas in order to equalize education funding across rich and poor districts. Many of the formulas now incorporate the wealth of the

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[14] See Rubinfeld (1987) for a discussion of the empirical challenges of testing the Tiebout model.

district (the total assessed valuation per pupil), such that property-rich districts receive less state aid while property-poor districts receive more.[15] As a result, while the relationship between district state funding per pupil and district assessed valuation per pupil was relatively flat in 1980, the relationship has gotten more negatively sloped in 1990 for states that have made "equalizing" changes to their state financing formulas.[16]

Figures 1a and 1b depict predicted total state aid per pupil in 1980 and 1990 versus aggregate house values per pupil in 1980 for Colorado and West Virginia.[17] Each graph also includes regression fitted values from regressing predicted total state aid per pupil in each year on aggregate house values per pupil in 1980. Colorado, in Figure 1a, is a good example of a state in which state school aid was made more equalizing. In 1980, the slope of the regression fitted line is relatively flat while in 1990 the slope of the regression fitted line is more negative indicating that property-poor districts are getting more aid per pupil than wealthier districts. While West Virginia (Figure 1b) adopted a more generous school financing formula in 1990, as evidenced by the upward shift in the regression fitted line in 1990, the state did not adopt a formula that increased the degree of equalization between 1980 and 1990. This is evidenced by the slope of the regression fitted lines remaining relatively similar. West Virginia's school financing formula generates some equalization, however, as can be seen by the negative relationship between predicted state aid per pupil and aggregate house values per pupil. (Also see Card and Payne (1997).)

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[15] This is a very broad generalization. See Card and Payne (1997), Evans, Murray, and Schwab (1997), Hoxby (1998), and Murray, Evans, and Schwab (1998) for more details on state financing plans.

[16] We have attempted to model which states change their financing formulas and which states adopt more or less equalizing formulas. We did so by aggregating our data to the state level and estimating binary and multinominal logit models. While we found some evidence that the average state household income and/or property values (either the levels or distribution) may partially determine state behavior, the evidence was neither overwhelming nor systematic. A more in-depth political economy approach would be quite useful for this literature.

[17] In these figures, both 1980 and 1990 state aid are predicted from the state school financing formulas using the characteristics of the districts in 1980. Figures from all states are available from the authors on request.

Because moving toward greater equalization is likely to result in districts with declining property values receiving greater increases in state aid per pupil, we expect that the coefficient estimate on changes in state aid will be negatively biased. We attempt to address this potential problem in three ways. First, we control for a variety of district and county characteristics that may be correlated with education provision and district property values. For example, we include demographic characteristics of the district as well as the county crime rates. These measures vary over time as well. Second, we focus on estimates that contain school district fixed-effects (which we implement through first-differenced equations). This allows us to parcel out any time-invariant features of districts that may be correlated with state education revenues and house values (such as distance to employment centers, climate, and relatively stable characteristics about the student and local populations).

Third, we instrument for changes in state education revenue with changes in the state school financing formulas. We do so by first calculating the amount of aid that each district should have received based on the state's financing formulas in effect in 1978-79 and 1990-91.[18] We calculate both the "basic" state aid and the "total" state aid which includes other components such as aid for special and vocational education for each year. Because many states have a "variable grant" portion of their state financing formulas in which each district's state aid depends in part on its actual spending,[19] we instrument for state revenue received using predicted state revenue based on 1980 district characteristics so that the change will not depend on district

[18] We predict the amount of state aid that each district receives according to the formulas as described in the *Public School Finance Programs* series from 1978 and 1990. In some states we also supplemented these descriptions of the formulas with additional information from the states or from the state statute when necessary. We used total assessed valuations by district nationwide in 1980 and 1990 (which we collected) to determine the amount of state aid.

[19] According to Card and Payne (1997), approximately 40 percent of states had a variable grant component either in 1975-76 or in 1990-91.

behavior.[20] We refer to this instrument as the "predicted state aid." The disadvantage of the predicted state aid instrumental variables strategy is that it relies on the assumption that the changes in district housing values are not correlated with district characteristics in 1980 (which we use to construct the instrumental variable). To the extent that (residual) changes from 1980 to 1990 housing values are correlated with district characteristics in 1980, the instrumental variables results may be inconsistent.[21]

We also note that our strategy is to include an array of district and county characteristics to proxy for the district's underlying cost function for education, rather than control directly for education costs. We do so for two reasons. First, education costs (as opposed to expenditures) are inherently more difficult to observe, and second, if we use education expenditure as a proxy for local education cost, we do not have a strategy for addressing the endogeneity of local education expenditure in addition to state aid. Many state school financing formulas calculate a total amount of school financing "need" for each district based on pupil counts in the district. One common feature of this portion of the formulas is to assign different weights to different types of pupils in generating a total pupil count. More specifically, the formulas give more weight to pupils that are more costly to educate, such as students with special education needs. As a consequence, this feature of the

[20] See Hoxby (1998) for a discussion of the incentives built into the formulas for districts to change their behavior regarding educational expenditures.

[21] To assess these results, we have also constructed instrumental variables by predicting state aid using "synthetically" constructed districts. For each district, we predict the logarithm of property value per pupil (as used in the school financing formulas) from a regression on a set of household characteristics from our data. We construct distance in predicted log property value per pupil for each district and take a weighted average of the characteristics of the 100 nearest districts (outside of the district's own state) to form a "synthetic" district for each district (the inverse of the distance measures are used as weights). This synthetic 1980 data is then used to predict state aid in both 1980 and 1990. We refer to these instrumental variables as "synthetically predicted state aid" and present results comparing the two instruments in Appendix Table I. In general, the results generated using the synthetically predicted state aid are similar to those using the predicted state aid, suggesting that any potential bias in our preferred instrument may not significantly change the results. We do not highlight the synthetic instrument in the text of the paper because the instrument has some serious limitations that derive from the fact that states rely differently on property taxes relative to other forms of taxes and with non-linear formulas issues of scale can significantly alter the predicted state aid in ways that make it difficult to assess the results.

formulas will induce some positive correlation between local education costs and state aid. Our IV estimates may be downward biased to the extent to which we have not properly proxied for local education costs.

IV. Data

For most of our empirical analysis we use data from the 1980 and 1990 decennial census school district data files, the 1977 and 1987 *Census of Governments*, and the *USA Counties 1996* CD-ROM. In order to generate our instrumental variables, we have also merged these data with data we collected on tax rates and the total assessed valuation (adjusted to market value both by the statutory assessment ratio and assessment-to-sales ratios where possible) by school district from 1980 and 1990.[22] The unit of observation is an independent school district. As a result, we drop all school districts from the following states – Alaska, District of Columbia, Hawaii, Maryland, North Carolina, and Virginia – in which there are no independent districts. We also lose most districts in Connecticut, Massachusetts, Rhode Island, and Tennessee in which the majority of school districts are dependent on a parent government.

We limit the sample to elementary, secondary, and unified school districts that did not change between 1980 and 1990 (that is, they did not merge or split apart). We exclude districts in California because we could not obtain property value data with which to model the school financing formulas. We also exclude school districts with zero enrollment in either 1980 or 1990, and those for whom we are missing data on our instruments and aggregate property values. The final analysis sample includes 11,827 observations, about 86 percent of all independent elementary and secondary level school districts in existence in 1991 (*1992 Census of Governments, Government Finances*).[23]

Means of selected school district characteristics in 1980 and 1990 are presented in Table 1. On

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[22] Note, however, that the dependent variable of aggregate house values per pupil in our regressions is from the 1980 and 1990 decennial censuses.

[23] A more detailed description of the data are available from the authors upon request.

average, aggregate house values per pupil increased by nearly 50 percent between 1980 and 1990.[24] State aid per pupil also increased from 1980 to 1990, by 61 percent, arising from both increases in total state aid as well as declining enrollment over the time period.

V. Empirical Analysis

A. Ordinary Least Squares Estimation (OLS)

In Table 2 we present ordinary least squares (OLS) estimates of the relationship between the change in aggregate house value per pupil and the change in state aid for education per pupil. The results from a simple bivariate regression are presented in column (1); the remaining two columns sequentially add district and then county characteristics. We estimate a negative and statistically significant relationship between housing values and state aid per pupil in column (1) reflecting the redistributive intent of state education aid.

The estimates in column (2) include the first-differences for a quadratic in average household income, the percentage of the population with at least 16 years of education, the percentage of the population that is unemployed, the percentage of housing units that are owner occupied, the percentage of housing units that are vacant, the percentage of occupied housing units that were built more than 10 years ago, the percentage of the population that moved into their house less than 10 years ago, the percentage of the population over 55 years of age, the percentage of children enrolled in private schools, total housing units in the district, and public school district enrollment. In column (3) we also add the FBI's serious crime index, the percentage of voters that voted for the republican candidate in the most recent presidential election, the percentage of voters that voted for the democratic candidate in the most recent presidential election, the percentage of the county employees that are union members, and the percentage of workers employed in manufacturing.[25] We expect

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[24] The aggregate house value for a school district excludes the value of rental housing property.

[25] We also include dummy variables indicating whether there are missing values for the percentage of households that moved into their house less than 10 years ago, the percentage of children enrolled in private

that the coefficient estimates on changes in state aid per pupil will increase when the additional covariates are included.

As expected, the estimate in column (2) increases such that we estimate a one dollar increase in state aid will increase property values by 9.3 dollars, an effect that is statistically significant. The effect increases slightly to 9.5 dollars in column (3) when we add the county variables. Note, however, that these estimates are significantly different from 13.64 (corresponding to a discount rate of 0.0733), the value we would expect if districts were spending efficiently. As a result, based on the OLS results, one would conclude that although the increased expenditures appear to be valued in the housing market, school districts are inefficiently spending state school financing dollars since a one dollar increase in their state education aid does not generate a (properly discounted) one dollar increase in housing values.

B. Instrumental Variables (IV) Estimation

1. Overall Efficiency

Because it is likely that the OLS coefficient estimates on state aid per pupil are negatively biased because most states have moved to "more equalizing" state financing formulas, we instrument for changes in state aid with changes in "predicted state aid," an instrument that holds the school districts' characteristics constant at their 1980 levels. The first-stage estimates of the relationship between observed changes in state aid per pupil and the instrumental variables are presented in Table 3. Column (1) shows the relationship when we predict "basic" state aid; column (2) shows the relationship when we predict "total" state aid. Both instruments are significantly correlated with observed changes in state aid per pupil as reflected in the F-statistics (Bound, Jaeger, and Baker, 1995; Staiger and Stock, 1997). A one dollar increase in predicted aid is associated with approximately a 10 cent increase in actual state aid, controlling for district and county

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schools, the FBI crime index, the percentage of county workers who are organized, and the percentage of employment in manufacturing.

characteristics.

The IV estimates are presented in Table 4; the estimates in column (1) use the change in predicted basic state aid and those in column (2) use the change in predicted total state aid. We continue to control for the district and county characteristics described in the text and shown in column (3) of Table 2. The magnitudes of the IV estimates are remarkably similar across the two calculations of state aid. A one dollar increase in state aid increases aggregate housing values per pupil between $15 and $17. These results suggest that increases in state aid increase property values which reflects that potential residents value the education expenditure.

We also report the p-values for the test of the null hypothesis that districts are spending education money efficiently, i.e., that the coefficient on state aid equals 13.64. While our coefficient estimates are larger than 13.64, suggesting that school districts might be underspending on education, the differences are not significant in a statistical sense. This interpretation, however, depends heavily on the assumed discount rate. Another way to evaluate the precision of the finding is to consider the range of discount rates over which one would reject the null hypothesis that school districts spend inefficiently by overspending. Given point estimates in Table 4 of about 16, if the true discount rate is less than about 6.3 percent, we would conclude that, on average, school districts overspend. Likewise, we would conclude that school districts are underspending if the true discount rate is greater than 6.3 percent. Thus, an interpretation that school districts overspend would hold for only a small range of discount rates (those less than 6.3 percent).

An important question is whether increases in state aid truly translate into increases in education expenditures at the district level for our inferences about the efficiency of school expenditures only hold if $\delta E/\delta S \neq 0$ (see equation (10)). To provide some evidence on how the additional state aid is spent, we study the relationship between state aid and district total expenditures on education, local school property tax rates, and local revenues for education. We estimate instrumental variables models identical to those in Table 4 except for the dependent variable. The results, in Table 5, suggest that changes in state aid for education increase education expenditure, decrease school district tax rates, and have little effect on total local revenue for public schools.[26] The results from estimating the effect of changes in state aid on total education expenditures are presented in column (1).[27] A $1 increase in state aid per pupil increases total expenditures per pupil by approximately 73 cents. These results suggest that education provision responds to changes in state aid, i.e. $\delta E/\delta S \neq 0$, such that our estimate of the effect of changes in state aid per pupil on changes in aggregate house values per pupil leads to inferences about efficiency.

The results presented in columns (2) and (3) suggest that school districts may use some of the increase in state aid per pupil to decrease their own tax burden but that they do not decrease their overall local contribution. In column (2) we show that a one dollar increase in state aid per pupil is associated with a decrease in school district property tax rates by 6-7 cents per $10,000 of aggregate property value. However, the ability to lower tax rates without changing spending on education is boosted also by increasing property values over the decade, and in fact, the results in column (3) suggest that any decrease in district tax rates was not large enough to decrease districts' total local contribution. A $1 increase in state aid per pupil is associated with an effectively zero change in total local revenue per pupil.

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[26] We have also explored the effect of changes in state aid on education inputs and outcomes, namely, district pupil-teacher ratios and high school dropout rates. We find a small, negative, and statistically insignificant effect of state aid on district pupil-teacher ratios and a very small negative and imprecisely estimated effect on dropout rates.

[27] There is some difficulty in consistently defining total education expenditure over time. We define district total expenditure on education as the sum of current expenditure (as defined by Murray, Evans, and Schwab (1998)), intergovernmental expenditure, construction expenditure, expenditure on other capital, and interest on debt. If we limit expenditure to current expenditure only and re-estimate column (1) we find that a $1 increase in state aid per pupil leads to about a 58 cent increase in current expenditure per pupil. The smaller coefficient estimate is not surprising given that current expenditure is less than total expenditure, and the result suggests that our coefficient estimate might be even closer to one if we could accurately account for all expenditures. Note that in Table 5 we use a smaller sample because of missing data in the dependent variable in column (2); the results in columns (1) and (2) are nearly identical when we use the full analysis sample.

2. Differential Efficiency

The previous section tested for whether there is inefficiency in school spending, on average, in the U.S. This aggregate estimate, however, may mask important differences across the country. A natural implication of the theoretical framework is that areas with better performing markets should be more efficient. Therefore, because households with greater income have more schooling options (as they can afford to consider a wider range of school districts in which to reside and can more easily afford private schools), we expect that school spending in wealthier areas should be more efficient. Similarly, characteristics of school districts (e.g., the degree of competition or size) may affect the efficiency of school spending. Therefore, in this last section we consider whether the degree of inefficiency in the public schools is related to household and district characteristics.[28]

We begin by asking whether public schools are more efficient in wealthier districts. To do so we divide districts (using their characteristics in 1980) into quintiles based on the average household income and the proportion of householders who do not have a high school degree. We classify those in the lowest quintile as being "low income" or having "low education" and those in the highest quintile as being "high income" or having "high education."[29] The average income of districts classified as "low income" is $29,114; the average for those classified as "high income" is $57,009. The average proportion of householders with less than a high school education in "less educated" districts is about 50 percent, whereas only 17 percent of householders in "highly educated" districts have less than a high school education. The efficiency of schooling provision may

[28] In Tables 6a and 6b we restrict the effects of the other covariates to be the same across the districts and only interact state education revenues with the demographic or district characteristic in question. We also interact the instruments with these categories.

[29] Because the definitions for many of the categorizations in Tables 6a and 6b are inherently arbitrary, we adopted the rule of defining the categories based on the 20th and 80th percentiles (when weighted). The exceptions are the categorization of districts into "competitive" or "not competitive" using the county Herfindahl-Hirschman Index, and urban and rural, as discussed below. The results are not generally sensitive to small changes these cut-off choices.

differ by the income or education level of the district for two reasons. First, residents in predominantly lower income or less educated communities may have fewer schooling options because of a lack of income; the idea being that education may reflect permanent income better than average household income. Second, the presence of peer effects may make the production of schooling in wealthier or highly educated communities more efficient than that in less educated communities (Bénabou, 1993).

In the upper-panel of Table 6a we estimate whether wealthier school districts are more efficient than poorer school districts. The results in both columns (1) and (2) suggest that the low income districts could increase property values by decreasing spending on public schools since each additional dollar of state aid lowers property values. And, the difference in the effect of state aid on property values between low and high income communities is statistically significant. The estimates reported in the bottom panel allow for variation in efficiency by the education level of the community. Again we find that districts in less educated communities seem to be less efficient than those in high education communities. Using the benchmarks discussed above, it appears that districts with poorer and less educated residents are overspending on schools relative to wealthier and more highly educated districts. These results can be explained by the fact that poorer and less educated households are less mobile and have fewer schooling options and/or have poorer quality peers.

In Table 6b we conduct a similar exercise for district characteristics. In the top panel of Table 6b we test for differential efficiency by the level of public school competition, as measured by the Herfindahl-Hirschman Index (HHI). Researchers argue that an HHI based on the concentration of enrollment in a geographic area reflects the market power of public schools in the area and therefore the degree of "choice" that parents may have (Borland and Howsen, 1992; Hoxby, 1994). Thus, we would expect that districts with less market power would be more efficient than those in less competitive areas. The HHI ranges from 0 to 1.[30]

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[30] The HHI is defined for each market as the sum of the squares of the market shares of all participants. In this case, we define market share as the proportion of county public school enrollment in each district and sum the squares of these proportions for each county, i.e., HHI = $\sum_{j=1}^{J} S_{jc}^2$ where S_{jc} is district j's share of county

Districts in areas with only a few large school districts will have values close to 1 as the districts monopolize student enrollments; districts with lower values face more competitive pressure. We base our HHI on the concentration of public school enrollments in the county. The Federal Trade Commission (FTC) guidelines for horizontal mergers define markets with HHIs below 0.10 as unconcentrated, HHIs from 0.10 to 0.18 as moderately concentrated, and HHIs above 0.18 as highly concentrated. Using these guidelines, 71 percent of school districts are in highly concentrated markets. However, the FTC guidelines were not written for school districts, which must exist in all counties, and will therefore generate markets that are more concentrated than the typical product market. As a result, we use a more moderate definition of concentration and divide the districts into those that are somewhat competitive (HHI<0.15, approximately 22 percent of our sample), those that are monopolistic (HHI>0.46, approximately 32 percent of the sample), and those in between.[31]

The results in the top panel of Table 6b show that the coefficient on change in state aid is negative among districts that face little or no competition from other public schools suggesting that these districts overspend. In addition, the estimates suggest that the spending practices of school districts in not-competitive counties are significantly different from the practices of those that face the most competition. As a result, it appears that increased competition increases district efficiency.[32]

Next we examine the effect of school district size. Undoubtedly there is an optimal size for school districts as small districts may not be able to reach an efficient scale in the production of education and large districts may be beyond the efficient scale. The concern in education policy today is that large districts, such

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c's total enrollment.

[31] That said, if we use the FTC guidelines for defining degree of competition, our results are qualitatively similar.

[32] These results are consistent with Grosskopf, Hayes, Taylor, and Weber (1999) who find that school districts in metropolitan areas in Texas are increasingly allocatively inefficient with increases in market concentration when the HHI exceeds 0.27. If we define high Herfindahl districts as those with HHIs in excess of 0.27, we also find that districts facing little competition are less efficient than all other districts.

as those in New York City and Chicago, are so large that administration and bureaucracy absorb resources that efficiency would dictate should be directed towards instruction. Further, in these areas residents have less choice among public school districts. Thus, in the middle panel of Table 6b we test for differences in efficiency by district size. Using both sets of instruments, we find that there is a significant difference between small and large districts suggesting that large districts are less efficient than small districts. The results are consistent with the idea that small districts perform better than large districts; however, we cannot say exactly what mechanism is driving the efficiency difference.

Finally in the bottom panel of Table 6b we differentiate schools by whether the school district is urban, rural, or suburban. Districts are classified as urban, rural, or suburban based on where the majority of the district population lives in 1970. Urban districts have the majority of the population living within the central city of a Standard Metropolitan Statistical Area (SMSA) (23 percent of the weighted sample); rural areas are those in which the majority of the population lives outside an SMSA (39 percent of the weighted sample); and suburban areas comprise the balance.[33] We suspect that districts in rural areas will be less efficient than those in suburban and urban areas because they are likely to face little competition from other public schools; further rural districts may not reach efficient scale and urban districts may be too large. The results suggest that school district efficiency does, indeed, vary by the urbanicity of the school district as both urban and rural districts do not appear to be efficient, rather both appear to overspend.[34]

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[33] These definitions are based on 1970 Census data because the data we have available from the 1980 Census are more crude and put central city and suburban districts in the same "urban" category. If we use definitions from 1990 Census data, instead, our results are very similar to using the 1970 definitions.

[34] The results by the income and education level and the Herfindahl-Hirshmann Index of the district cannot solely be explained by urban/rural differences. When we estimate the results by income or education levels by the urbanicity of the districts, in most cases the qualitative result that districts in poorer and/or less-educated communities are inefficient remain. In addition, when we estimate the results by the competitive pressure felt by the district separately for rural and suburban school districts, the qualitative results that districts facing little competition are inefficient also remain. There are too few "urban" districts to get precise estimates. Similarly, the results by the Herfindahl-Hirshman Index do not appear to be affected by the size of the county since if we control for the number of square kilometers in the county the results are nearly identical.

The results in Tables 6a and 6b suggest that school districts in areas with poorer and less educated residents spend less efficiently than school districts with wealthier and highly educated residents and that schools districts that face a lot of competition (as measured by a Herfindahl-Hirschman Index and, to some extent, district size) are more efficient than districts that face little or no competition. These results are consistent with Hoxby (1994).[35]

VI. Conclusion

In this paper we take a "market-based" approach to examine whether increased school expenditures are valued by potential residents and whether the current level of public school provision is inefficient. We find that, on average, additional school spending is valued by potential residents and that school districts appear to spend efficiently or, if anything, underspend. We also find that school districts spend less efficiently in areas in which school districts face less competition from other public schools and in areas in which residents are poor or less educated (leading either to less mobility from a lack of resources or to less efficient education production through peer effects). One interpretation of these results is that increased competition has the potential to increase school efficiency in some areas.

Some care must be taken in interpreting these findings. First, the judgements about school efficiency

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[35] We have also tested for differences by the percentage of residents over the age of 55 and found that areas with the lowest concentration of older residents (about 12 percent) were significantly more likely to overspend relative to areas with more than 29 percent older residents. We also find significant differences by percentage of children who attend private schools and percentage of homeowners in the district; districts with low percentages of children enrolled in private school are more likely to overspend, as are districts with high shares of owner-occupied housing. When we test for differences by the type of school district (elementary, unified, or high school), we find that elementary districts overspend relative to high school districts. When we examine the effect of teacher unionization on efficiency we find little evidence that unionized districts spend beyond the optimal level thereby spending education dollars inefficiently; rather, we find that unionized districts may underspend (particularly relative to non-union districts). Surprisingly, when we test for differences by the percent of funding from the state, we find that districts in states with less centralized funding (7 percent of the weighted sample) underspend relative districts in states with more centralized spending (12 percent of the weighted sample).

result from a model with potentially strong assumptions. While we do not believe that violations of these assumptions would have a large impact on our qualitative findings, they must be kept in mind. Second, based on our methodology, it is unclear whether increased efficiency would generate higher or lower levels of education spending. For example, while we find evidence that some districts overspend on education, our analysis cannot reveal the source of the inefficiency and therefore we cannot determine whether increased competition would lead to increases or decreases in education spending. Competition may lead districts to decrease the amount of education provided and thus decrease spending. Alternatively, competition may lead districts to increase their productivity with little effect on the total spending. Finally, we note that the competition we observe that improves efficiency may have the consequence of increasing stratification which may decrease social welfare (Fernández and Rogerson, 1996, 1998; Bénabou, 1993). As such, policymakers interested in increasing competitive pressure on schools should attempt to do so with policy mechanisms that do not also have the consequence of increasing stratification.

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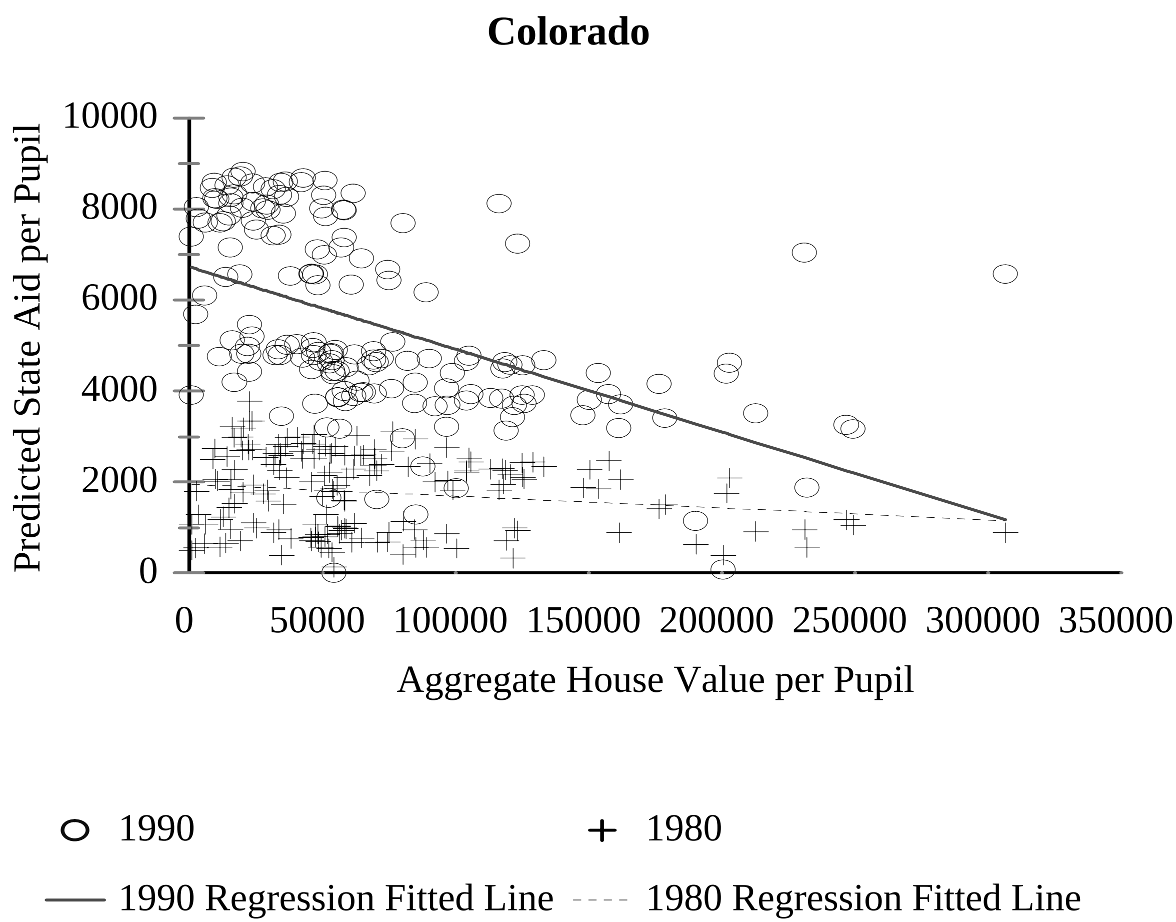
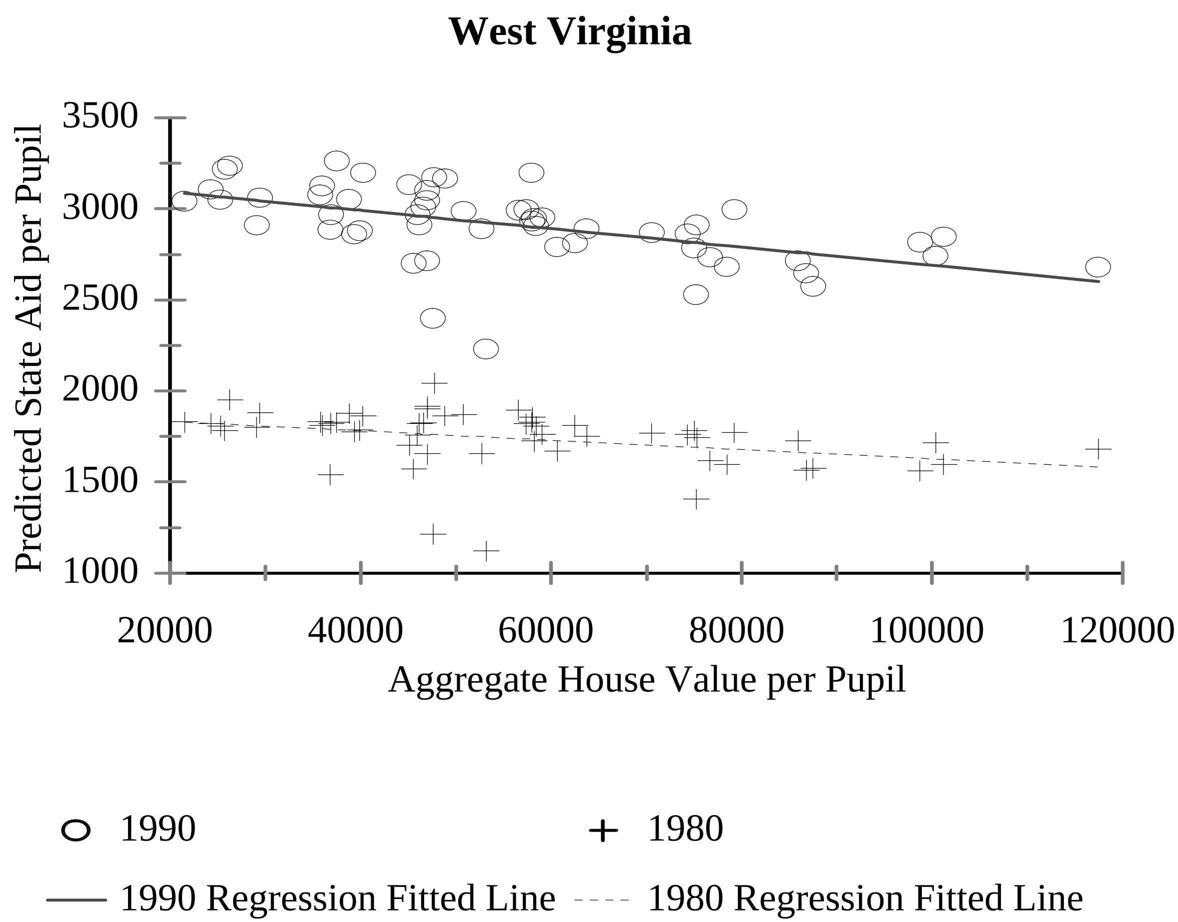
Figure 1a
Predicted State Aid per Pupil in 1980 and 1990 Versus Aggregate House Value per Pupil in 1980



Notes: Regression fitted lines are constructed from regressing predicted state aid per pupil on aggregated house value per pupil in 1980.

Figure 1b
Predicted State Aid per Pupil 1980 and 1990 Versus Aggregate House Value per Pupil in 1980



Notes: See notes for Figure 1a.

Table 1
Means and Standard Deviations

	Mean	Standard Deviation
Change in Aggregate House Value per Pupil ($1000s)	45.031	113.246
Change in Actual State Aid per Pupil	958.267	796.327
Change in Predicted Basic Aid per Pupil	1031.399	1679.395
Change in Predicted Total Aid per Pupil	1057.370	1732.431
Change in Average Household Income ($1000s)	2.521	6.955
Change in % Population With at Least 16 Years of Education	3.918	3.043
Change in % Unemployed	-0.392	2.785
Change in % Housing Units Owner Occupied	-1.275	3.712
Change in % Housing Units Vacant	2.392	4.867
Change in % Occupied Housing Units Built More Than 10 Years Ago	8.869	8.301
Change in % Households Moved into House Less Than 10 Years Ago	-11.198	10.488
% Missing Change in % Households Moved into House Less Than 10 Years Ago	0.0002	0.013
Change in % Population Over 55 Years of Age	1.153	2.711
Change in % Children Enrolled in Private School	2.625	3.355
% Missing Change in % Children Enrolled in Private School	0.0001	0.012
Change in Total Housing Units (1000s)	5.809	23.002
Change in Enrollment (1000s)	-3.919	14.267
Change in % Households in Urban Areas	1.303	7.350
Change in Crime Index	322.867	1339.297
% Missing Change in Crime Index	0.008	0.088
Change in % Voting Republican	-13.579	6.713
Change in % Voting Democratic	1.038	6.608
Change in % County Employees Organized	2.179	22.027
% Missing Change in County Employees Organized	0.032	0.176
Change in % Employed in Manufacturing	-4.349	24.816
% Missing Change in % Employed in Manufacturing	0.0002	0.014

Notes: There are 11,827 observations. All dollar values are in 1994 dollars. All means are weighted by student enrollment in 1980. Change in "predicted" state aid is calculated using only the 1980 characteristics of school districts.

Table 2
OLS Estimates of the Effect of Change in State Aid on Change in Aggregate House Values per Pupil

	(1)	(2)	(3)
Change in State Aid per Pupil	-4.780	9.311	9.463
	(1.307)	(0.970)	(0.951)
Change in Average Household Income		6.279	6.455
		(0.285)	(0.280)
Change in Average Household Income Squared Divided by 10000		0.172	0.144
		(0.013)	(0.013)
Change in % Population With at Least 16 Years of Education		4861.921	3915.373
		(351.672)	(346.708)
Change in % Unemployed		-151.296	821.568
		(279.170)	(286.369)
Change in % Housing Units Owner Occupied		747.905	142.202
		(217.636)	(218.801)
Change in % Housing Units Vacant		46.206	162.877
		(154.361)	(152.355)
Change in % Occupied Housing Units Built More Than 10 Years Ago		-1558.751	-1944.072
		(101.131)	(101.057)
Change in % Households Moved into House Less Than 10 Years Ago		397.875	137.305
		(85.304)	(85.616)
Change in % Population Over 55 Years of Age		7046.933	7152.647
		(301.181)	(295.162)
Change in % Children Enrolled in Private School		1963.501	1709.267
		(250.449)	(246.192)
Change in Total Housing Units		-0.033	-0.058
		(0.038)	(0.037)
Change in Enrollment		0.225	0.463
		(0.061)	(0.065)
Change in % Urban		64.694	107.425
		(100.975)	(98.628)
Change in Crime Index			-3.732
			(0.606)
Change in % Voting Republican			1527.865
			(149.488)
Change in % Voting Democratic			3383.966
			(153.577)
Change in % County Employees Organized			31.070
			(33.571)

Change in % Employed in Manufacturing			-38.377 (28.588)
p-value: State Aid = 13.64 (δ = 0.0733)[a]	0.000	0.000	0.000
R^2	0.001	0.515	0.539

Notes: The dependent variable is the change (from 1980-1990) in the aggregate house value per pupil. Standard errors are in parentheses. There are 11,827 observations. All equations include a constant. Columns (2) and (3) also include dummy variables indicating whether the percent of the population that moved in 10 years ago and the percent of children enrolled in private school are missing. In addition, column (3) includes dummy variables indicating if the crime index, the percent of county employees that are unionized, and the percent employed in manufacturing are missing. The equations are weighted by student enrollment in 1980. All dollar values are in 1994 dollars.

[a] δ is the discount rate; see text.

Table 3

First-stage Estimates:
The Effect of Change in Predicted State Aid per Pupil on Change in Actual State Aid per Pupil

	(1)	(2)
Change in Predicted Basic State Aid per Pupil	0.096 (0.004)	
Change in Predicted Total State Aid per Pupil		0.097 (0.004)
F(1,11802)	522.52	553.77
R^2	0.165	0.167

Notes: The dependent variable is the change (from 1980-1990) in actual state aid per pupil. Standard errors are in parentheses. See text or column (3) of Table 2 for other covariates. There are 11,827 observations. The equations are weighted by district student enrollment in 1980. Change in "predicted" state aid is calculated using only the 1980 characteristics of school districts.

Table 4

IV Estimates of the Effect of Change in State Aid per Pupil on Change in Aggregate House Values per Pupil

	Instrumental Variable	
	Change in Predicted Basic State Aid	Change in Predicted Total State Aid
	(1)	(2)
Change in Actual State Aid per Pupil	14.820 (4.627)	16.781 (4.506)
p-value: State Aid = 13.64 (δ = 0.0733)[a]	0.799	0.486

Notes: The dependent variable is the change (from 1980-1990) in aggregate house values per pupil. The endogenous variable is the change in actual state aid per pupil. Standard errors are in parentheses. See text or column (3) of Table 2 for other covariates. There are 11,827 observations. The equations are weighted by district student enrollment in 1980. Change in "predicted" state aid is calculated using only the 1980 characteristics of school districts.

[a] δ is the discount rate; see text.

Table 5
IV First-Differenced Estimates of the Effect of Change in State Aid per Pupil on School Expenditures, Property Tax Rates, and Property Tax Revenue

	Dependent Variable		
	Change in Total Expenditures per Pupil	Change in School District Property Tax Rates	Change in Local Revenue
	(1)	(2)	(3)
	Instrumental Variable = Change in Predicted Basic State Aid per Pupil		
Change in Actual State Aid per Pupil	0.731 (0.069)	-0.068 (0.006)	0.031 (0.051)
	Instrumental Variable = Change in Predicted Total State Aid per Pupil		
Change in Actual State Aid per Pupil	0.739 (0.067)	-0.060 (0.005)	0.036 (0.049)
Number of Observations	10746	10746	10746

Notes: For each equation estimated, the endogenous variable is the change in actual state aid per pupil. Standard errors are in parentheses. See text or column (3) of Table 2 for other covariates. The equations are weighted by district student enrollment in 1980. The mean of the dependent variable for column (1) estimates is 1420.82; the mean for column (2) is -1.956; the mean for column (3) is 625.21. The school district property tax rate units are dollars raised per 10,000 dollars of property value. Change in "predicted" state aid is calculated using only the 1980 characteristics of school districts.

Table 6a

IV First-Differenced Estimates of the Effect of Change in State Aid per Pupil on Aggregate House Values per Pupil by Selected Characteristics of the School District Residents

	Type of State Aid Used as Instrument	
	Change in Predicted Basic State Aid per Pupil	Change in Predicted Total State Aid per Pupil
Average Household Income		
Low (Bottom 20th percentile)	-9.738 (11.378)	-10.466 (10.467)
Average (20 to 80th percentile)	6.533 (5.712)	7.973 (5.616)
High (Top 20th percentile)	52.641 (9.913)	57.489 (9.653)
p-value: Low = High	0.000	0.000
Education		
Low (Top 20th percentile in share of persons without a high school diploma)	-11.069 (9.610)	-12.880 (9.027)
Average (20 to 80th percentile in share of persons without a high school diploma)	22.644 (6.392)	25.209 (6.287)
High (Bottom 20th percentile in share of persons without a high school diploma)	19.591 (10.246)	24.826 (10.040)
p-value: Low = High	0.025	0.004

Notes: The dependent variable is the change in aggregate house values per pupil. The endogenous variable is the change in actual state aid per pupil. Standard errors are in parentheses. The effects of the other covariates are restricted to be the same across the districts and only the state education revenues are interacted with the demographic characteristic in question. See text or column (3) of Table 2 for other covariates. There are 11,827 observations. The equations are weighted by district student enrollment in 1980. Change in "predicted" state aid is calculated using only the 1980 characteristics of school districts. The demographic groups are based on their values in 1980.

Table 6b
IV First-Differenced Estimates of the Effect of Change in Predicted State Aid per Pupil on Aggregate House Values per Pupil by Selected Characteristics of the School District

	Type of State Aid Used as Instrument	
	Predicted Basic State Aid per Pupil	Predicted Total State Aid per Pupil
County Herfindahl Index (HHI)		
Low (HHI < 0.15/Competitive)	49.860 (6.245)	52.949 (6.188)
Average ($0.15 \leq$ HHI ≤ 0.46)	-18.202 (8.360)	-17.632 (7.846)
High (HHI > 0.46/Not Competitive)	-1.227 (11.397)	-1.704 (12.001)
p-value: Low = High	0.000	0.000
District Size in 1980		
Small (Bottom 20th percentile)	32.969 (12.929)	41.876 (12.995)
Average (20 to 80th percentile)	6.511 (5.492)	7.161 (5.385)
Large (Top 20th percentile)	-3.535 (9.489)	-5.155 (8.914)
p-value: Small = Large	0.023	0.003
Urbanicity of District*		
Rural	3.118 (1.827)	3.209 (1.839)
Suburban	36.353 (9.341)	40.247 (8.901)
Urban	-12.639 (13.114)	-14.336 (11.975)
p-value: Rural = Urban	0.228	0.142

Notes: See notes to Table 6a. The school district characteristic groups are based on their values in 1980.

* A district is considered rural if its population is located primarily outside of a Standard Metropolitan Statistical Area (SMSA); it is considered urban if its population is located primarily within the central city of an SMSA; and it is considered suburban if its population is located primarily within the suburban area of an SMSA.

Appendix Table I

IV First-Differenced Estimates of the Effect of Change in State Aid on Change in Aggregate House Values per Pupil Using an Alternative Instrumental Variable

	Instrumental Variable	
	Change in Predicted Basic State Aid per Pupil	Change in Predicted Total State Aid per Pupil
	(1)	(2)
Change in State Aid per Pupil	14.820 (4.627)	16.781 (4.506)
p-value: State Aid = 13.64 (δ = 0.0733)[a]	0.799	0.486
Number of Observations	11827	11827
	Change in Predicted Basic State Aid per Pupil	Change in Predicted Total State Aid per Pupil
	(3)	(4)
Change in State Aid per Pupil	14.798 (4.631)	16.760 (4.509)
p-value: State Aid = 13.64 (δ = 0.0733)[a]	0.803	0.489
Number of Observations	11808	11808
	Change in Synthetically Predicted Basic State Aid per Pupil	Change in Synthetically Predicted Total State Aid per Pupil
	(5)	(6)
Change in State Aid per Pupil	9.230 (4.885)	16.324 (4.694)
p-value: State Aid = 13.64 (δ=0.0733)[a]	0.367	0.567
Number of Observations	11808	11808

Notes: The dependent variable is the change in aggregate house values per pupil; the endogenous variable is the change in actual state aid per pupil. See text or column (3) of Table 2 for other covariates. The equations are weighted by district student enrollment in 1980. "Predicted" state aid is per pupil is calculated using only the 1980 characteristics of school districts. "Synthetically Predicted" state aid is state aid calculated for each school district using the mean characteristics in 1980 of the 100 districts outside the district's state that are "nearest" to the particular district in terms of regression predicted 1980 log property value per pupil.

[a] δ is the discount rate; see text.