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USING MARKET VALUATION TO ASSESS PUBLIC SCHOOL SPENDING

Lisa Barrow
Cecilia Elena Rouse

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ABSTRACT

In this paper we use 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 net, additional state aid is valued by potential residents and that school districts do not appear to overspend on education. We also find that school districts may overspend in areas in which residents are poor or less educated, in large districts, and in districts with higher shares of rental property. One interpretation of these results is that increased competition has the potential to reduce overspending on public schools in some areas.

Lisa Barrow
Economic Research Department
Federal Reserve Bank of Chicago
230 South LaSalle Street
Chicago, IL 60604
lbarrow@frbchi.org

Cecilia Elena Rouse
Woodrow Wilson School
Robertson Hall
Princeton University
Princeton, NJ 08544-1013
and NBER
rouse@princeton.edu

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

[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.

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] Consider the situation in which a district receives an additional dollar from an outside source (to be elaborated below). If this additional dollar spent by the district improves school outcomes, then it should result in an increase in property values. In contrast, if this additional dollar does not result in better schools, then it should not result in an increase in 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 outside funding 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.

On the other hand, there are several obstacles that may prevent the majority of school districts

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

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

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), housing discrimination limits the choices of some individuals (e.g., Yinger, 1998), and choices are more limited in communities with only a few school districts. Each of these factors would limit the ability of parents to choose their preferred provision of schooling.

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

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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*).

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 net, additional school spending leads to increased property values suggesting that additional expenditures may improve student outcomes. In addition, we find that, on net, the current level of funding of public school districts is not inefficiently high. That said, we find evidence of differences in the valuation of spending across school districts. Particularly, we find that school districts may overspend in large school districts, in primarily rental property 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 reduce overspending on public schools 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

[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).

A. Basic Model

Our market-based approach for assessing public school spending 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] 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,

$$U(E, G, H, B) = h(I). \quad (1)$$

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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.

[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.

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,

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

The bid-rent function specifies the rent necessary to equalize an individual's utility across differing

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

residences. Differentiating equation (3) with respect to E gives

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.

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

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

is not distorted. Letting δ be the discount rate, the value of an individual house *i* is,

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,

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

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

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, Aggregate property values are a function of the aggregate rents, state aid, the discount rate, and the

[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.

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

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

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 $\partial P/\partial S \gtreqless 1/\delta$. Note that under- or over-provision of education may result either from productive or allocative inefficiencies. One might conclude that education is being over-provided in a district in which the "right" level of education is being provided but the district is not cost minimizing. Alternatively the district may be productively efficient but not provide the property value-maximizing level of education.

Because the null hypothesis of the coefficient of interest, that on state school aid, depends

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

on the discount rate, we use two rates in constructing our hypothesis tests regarding school efficiency: 7.33 percent which is the average real 30-year conventional mortgage rate from 1980-1990 and the lower risk return of 5.24 percent which is the average real 30-year Treasure bond yield from 1980-1990.[12] In addition, we adjust these discount rates for the average marginal U.S. (income) tax rates between 1979 and 1989.[13]

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

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[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). The nominal 30-year Treasury bond yield (constant maturity) is from the U.S. Treasure Department (obtained from the Federal Reserve Board of Governors – http://www.bog.frb.fed.us/releases/H15/data/a/tcm30y.txt) We use the personal consumption expenditure price index to calculate the real rates.

[13] We calculate the marginal tax rate for 1979 to 1989 using the average income in the our sample for 1980 and inflating to current dollars for the subsequent years. The marginal tax rate we use is the average of these tax rates over the 11 years. This average marginal tax rate is 26.7%.

achieve the same utility level because if a household could achieve a higher utility elsewhere, it would move. We have attempted to incorporate costs of 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 household on the margin of moving will be indifferent between moving and staying. We represent this by amending equation (2) as,

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

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). If we modify equation (10) to relax the assumption that $\partial G/\partial S = 0$, we have,

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

where R_G is equal to the marginal rate of substitution between other public goods and the numeraire good, *B*. In this case, the conclusions we may draw from the test that $\partial P/\partial S=1/\delta$ are somewhat ambiguous.

First, we may conclude that districts appear to be spending efficiently, but in reality they are not. This occurs if the first term (representing the marginal rate of substitution between education and *B* net of marginal cost) is completely offset by the second term (representing the marginal rate of substitution between the other public good and *B* net of marginal cost). As a theoretical possibility, this could only occur if, on average, districts over-provide education and under-provide other public goods (or vice versa). While we have been unable to find any empirical evidence on this issue, it seems more likely that if districts over-provide one public good they likely over-provide the others as well.[14] In this case, our estimated coefficients will be upward or downward biased such that we will reject efficiency although the size of the inefficiency will be exaggerated. A second possibility is that education is provided efficiently (such that the first term does equal zero), but that other public goods are not provided efficiently.[15] In this case, even if $\partial G/\partial S$ is small, a large inefficiency in the provision of other public goods may cause us to find evidence of inefficiency in education where there is none.

We believe the assumption that $\partial G/\partial S = 0$ is not unrealistic in our case 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

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[14] That said, our review of the literature suggests that there is little evidence of systematic over-provision of any public goods (See Brueckner, 1979; Deller, 1990; and Taylor, 1995).

[15] Of course, if one is willing to assume that other public goods are provided efficiently, then equation (10′) becomes equation (10) again because the Samuelson condition is met for the other public goods so that the second piece of equation (10′) equals zero even when $\partial G/\partial S \neq 0$.

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).

To assess the extent of this indirect effect of state school aid on public goods other than education, we examined the relationship between county-level expenditures and state aid for education. Aggregating the school-level data for independent school districts to the county level, we found that the relationship between county expenditures per pupil and state aid per pupil was negative, but not statistically significant. In contrast, when we aggregated to the county level using only districts dependent on a parent government, we found a positive and statistically significant relationship between county expenditures per pupil and state aid per pupil.[16] Thus, $\partial G/\partial S = 0$ seems to hold empirically for the independent school districts examined in this paper while $\partial G/\partial S > 0$ seems to apply to dependent districts that can more easily shift expenditures between budget categories.

[16] We examined the county expenditure per pupil and state school aid per pupil relationship in a regression parallel to the school expenditure regression in column (1) of Table 5. These results are not presented here but are available from the authors on request.

4. Business Property

Finally, 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.[17] 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.

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.

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

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.[18] β is a coefficient that 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.[19] 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

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[18] Note that we do not control for school tax rates in this equation. We do not do so for three reasons. First, in controlling for the tax rate, we would not allow the district to reoptimize school financing in response to the change in state aid. Second, tax rates are not explicitly in the theoretical model. And third, when we do so it does not make a difference to results.

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

formulas now incorporate the wealth of the district (the total assessed valuation per pupil), such that property-rich districts receive less state aid while property-poor districts receive more.[20] 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.[21]

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.[22] 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

[20] 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.

[21] 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.

[22] 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.

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).)

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. To construct our instrument, we first programmed each state's financing formulas in effect in 1978-79 and 1990-91. We then calculate the amount of both the "basic" state aid and the "total" state aid that each district should have received according to our computer programs in 1980 and 1990.[23] "Total" state aid includes "basic" state aid (usually the foundation

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[23] 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. The correlation between our prediction of total state aid

amount) plus some additional components such as aid for special and vocational education. In order to minimize the effect of changing district characteristics on our calculations of the 1990 state aid, we estimate the amount of state aid in 1990 using the formulas from 1990 and the district characteristics in 1980. (The estimated amount of state aid in 1980 is constructed using the 1980 formulas and the district characteristics in 1980.) We refer to this instrument as the "predicted state aid."[24] 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.[25]

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and the actual level of state aid is 0.39 in 1980 and 0.54 in 1990 if the 1990 district characteristics are used and 0.33 if 1980 district characteristics are used.

[24] Unlike instrumental variables used in many recent works (see Card (1995) for some examples), we do not have *a priori* reason to think that our instrument will affect certain districts more than others. Our instrumental variable is designed to recover changes in state school finance formulas which affect all districts. However, to examine more carefully which districts are affected by the instrument, we generated densities of actual and predicted state aid by the various district and household characteristics examined in Section V. B of the paper. We found that for the various by-groups (that represent district characteristics) the actual and predicted state aid densities lie on top of one another and that there was little or no difference in the graphs by the level of the district characteristic in question. Therefore, we believe that the identification is coming from the entire distribution.

[25] 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. (This approach is similar to the simulated instruments in Currie and Gruber (1996).) 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

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 to 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 formulas will induce some positive correlation between local education costs and state aid. Given that state aid is negatively correlated with property values, 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

instrument has some serious limitations that derive from the fact that states rely differently on property taxes relative to other forms of taxes and from the fact that with non-linear formulas issues of scale can significantly alter the predicted state aid in ways that make it difficult to assess the results.

1980 and 1990.[26] 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 also limit the sample to unified school districts that did not change between 1980 and 1990 (that is, they did not merge or split apart).[27] 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 9,079 observations, about 92 percent of all independent, unified school districts and 61 percent of all elementary and/or secondary districts in existence in 1991 based on the 1992 datafile from the Census of Government Finances.[28]

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[26] Note, however, that the dependent variable in our regressions–aggregate residential property values per pupil–is from the 1980 and 1990 decennial censuses. This measure of aggregate property value for a school district equals the sum of aggregate owner-occupied house values and an estimate of the asset value of the rental property derived from aggregate gross rent.

[27] We limit the sample to unified school districts to avoid double counting students for the same property valuation. Specifically, consider two areas one of which has an elementary district with a high school district and the other of which has a unified district. Assume the total property valuation and total number of pupils (aged 5-18) is the same in both. The per pupil valuation will be larger in each of the two districts in the first area relative to the second. Further, the local school tax rates will differ since each area is raising revenues for different numbers and types of schools. That said, we have conducted the analysis using elementary and secondary as well as unified school districts with little difference. Because the unified district analysis is conceptually cleaner, we only present those results. Limiting the sample to unified school districts means losing all school districts in Montana and more than one-half of the school districts in Arizona, Illinois, Nebraska, New Hampshire, New Jersey, and Vermont. The results using the larger sample are available from the authors on request.

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

Means of selected school district characteristics in 1980 and 1990 are presented in Table 1. On average, aggregate house values per pupil increased by 46 percent between 1980 and 1990. State aid per pupil also increased from 1980 to 1990 (63 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 residential property 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 and Census division indicators. We estimate a negative and statistically significant relationship between property 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 and 1980 levels 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 indicators for the district's Census division and the 1980-1990 change and the 1980 levels of 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.[29] We expect 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 10.5 dollars, an effect that is statistically significant. The effect decreases slightly to 8.7 dollars in column (3) when we add the county and Census division variables. Note, however, that these estimates are significantly different from 18.61 (corresponding to a discount rate of 0.0733 adjusted by the marginal tax rate) and 26.03 (corresponding to a discount rate of 0.0524 adjusted by the marginal tax rate), the range of estimates 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 not generating the increase in property values consistent with property value maximization since a one dollar increase in their state education aid does not generate a (properly discounted) one dollar increase in property values.

B. Instrumental Variables (IV) Estimation

1. Overall

Because it is likely that the OLS coefficient estimates on state aid per pupil are negatively

[29] 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 FBI crime index, and the percentage of county workers who are organized.

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 9 cent increase in actual state aid, controlling for district and county 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 as well as Census divisions as 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 $19 and $20. 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 18.61 or 26.03. In only one case (column (2) with the lower discount rate) might we conclude that the districts were overspending (the p-value is 0.054), thus, we conclude that there is no strong evidence of massive overspending by school districts on net.

An important question is whether increases in state aid truly translate into increases in education provision 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 decrease total local revenue for public schools.[30] The results from estimating the effect of changes in state aid on total education expenditures are presented in column (1).[31] A $1 increase in state aid per pupil increases total expenditures per pupil by approximately 60 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. In column (2) we show that a

[30] 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 small positive and statistically insignificant effect on dropout rates.

[31] 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 54 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 (3) are nearly identical when we use the full analysis sample.

one dollar increase in state aid per pupil is associated with a decrease in school district property tax rates by 8-9 cents per $10,000 of aggregate property value. Increasing property values over the decade may explain some of the decline in tax rates. However, the results in column (3) suggest that districts reduced their tax rates by enough to decrease their local contribution to public schools; a $1 increase in state aid per pupil is associated with a 15-17 cent decline in total local revenue per pupil.

2. Differences by School District Characteristics

The previous section tested for whether state aid translates into property value increases, on net. This aggregate estimate, however, may mask important differences. A natural implication of the theoretical framework is that areas with better performing markets should be more efficient. For example, 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 relationship between state aid and property values varies by household and district characteristics.[32]

We begin by asking whether property values in wealthier and more educated public school districts are more responsive (positively) to changes in state aid. To do so we divide districts (using their characteristics in 1980) into quintiles based on the average household income and the

[32] 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.

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."[33] The average income of districts classified as "low income" is $28,973; the average for those classified as "high income" is $55,526. 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.

In the upper-panel of Table 6a, we estimate the results by income. The results in both columns (1) and (2) suggest that low income districts could increase aggregate property values by decreasing spending on public schools since each additional dollar of state aid raises property values by less than the properly discounted value of the additional spending. We also find that 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 middle panel allow for variation by the education level of the community. Again we find that districts in less-educated communities more likely overspend on public schooling than those in high education communities.

Finally in the bottom panel of Table 6a we differentiate schools by whether housing in the school district is primarily owner or renter occupied. Eighty-four percent of housing units in "owner-occupied" districts are occupied by owners. "Renter-occupied" districts have only 52 percent of housing units owner occupied. Assuming that owner-occupation of housing provides another proxy

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[33] 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 exception is the categorization of districts into "competitive" or "not competitive" using the county Herfindahl-Hirschman Index. The results are not generally sensitive to small changes in these cut-off choices.

for resources, we expect that districts with a low percentage of owner-occupied housing may be less efficient than those in owner-occupied districts. The results suggest that school district efficiency does, indeed, vary by the percent of housing in a district that is owner occupied. Compared to largely owner-occupied districts, districts with high rental rates appear to overspend on public schooling.

Overall, it appears that districts with poorer and less educated residents overspend on schools relative to wealthier and more highly educated districts. Note that the difference in coefficient estimates between the wealthier and poorer districts reflects differences in the relative values of the marginal rates of substitution between education and other goods and the marginal costs of providing education. One potential factor driving these differences may be lack of mobility. The restricted mobility may arise because of a lack of income, restricted access to credit markets, or discrimination. Alternatively, if one believes that districts with poorer and wealthier (or more and less educated) residents have similar marginal rates of substitution between education and other goods, then the difference may reflect an inherently higher marginal cost of providing education in the poorer districts. For example, the presence of peer effects may lower the cost of schooling production in wealthier or highly educated communities relative to less advantaged communities (Bénabou, 1993).

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.[34] 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, 74 percent of our 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 20 percent of our sample), those that are monopolistic (HHI>0.46, approximately 34 percent of the sample), and those in between.[35]

The results in the top panel of Table 6b suggest that property values in areas that face little or no competition increase less in response to a change in state aid than districts facing a relatively competitive market. At the same time, however, we cannot reject that districts facing little competition are efficient.[36] Note, as well, that the property value response to changes in the spending

[34] 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 *c*'s total enrollment.

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

[36] The results by the Herfindahl-Hirshman Index of the district cannot solely be explained by urban/rural differences. 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

practices of school districts in not-competitive areas is significantly different from the response to practices of those that face the most competition. These results partly contrast to the those in the previous table in that we would not conclude that those districts facing the least competition as measured by the Herfindahl-Hirshmann Index are overspending, although the gap between districts remains.[37]

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 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 fewer choices among public school districts. Thus, in the lower panel of Table 6b we test for differences in efficiency by district size. Using both sets of instruments, we find there is a significant difference between small and large districts suggesting that large districts are more likely to overspend than small districts. The results are consistent with the idea that smaller districts perform better than large districts; however, we cannot exactly identify the mechanism driving the efficiency difference.

The results in Tables 6a and 6b suggest that school districts in areas with poorer and less

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are inefficient also remain. 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.

[37] These results are partially 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, particularly when judged with a lower discount rate.

educated residents spend less efficiently than school districts with wealthier and highly educated residents and that large and largely renter-occupied districts are less efficient than smaller and more heavily owner-occupied districts. We do not find strong evidence that schools districts that face a lot of competition (as measured by a Herfindahl-Hirschman Index) are more efficient than districts that face little or no competition. While the results that address efficiency by level of competition are not directly consistent with Hoxby (1994), we believe that some of the other results may be interpreted as consistent with her finding that competition improves public school performance.[38]

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 (as perceived by potential residents). We find that, on average, additional school spending is valued by potential residents. In addition, we find that, on net, public school districts do not appear to spend increases in state aid for education inefficiently. That said, we also find that large school districts, and those in areas with fewer homeowners and in areas in which residents are poor or less educated, are more likely to overspend. One interpretation of these results is that increased competition has the potential to reduce overspending on public schools in some

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[38] 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 over 55 years of age) were significantly more likely to overspend relative to areas with a larger concentration of older residents (on average 29 percent over 55 years). We also find significant differences by the percentage of children who attend private schools; districts with high percentages of children enrolled in private school are more likely to underspend. When we examine the effect of teacher unionization on efficiency we find no evidence that unionized districts spend beyond the optimal level thereby spending education dollars inefficiently. Surprisingly, when we test for differences by the percent of funding from the state, we find that districts in states with less centralized funding (6 percent of the weighted sample) overspend relative districts in states with more centralized spending (13 percent of the weighted sample).

areas.

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

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Table 1
Means and Standard Deviations

	Mean	Standard Deviation
Change in Aggregate Residential Property Value per Pupil ($1000s)	56.753	99.431
Change in Actual State Aid per Pupil	1053.339	826.681
Change in Predicted Basic Aid per Pupil	1120.703	1660.762
Change in Predicted Total Aid per Pupil	1147.003	1719.029
Change in Average Household Income ($1000s)	2.377	6.410
Change in % Population With at Least 16 Years of Education	3.835	2.975
Change in % Unemployed	-0.315	2.794
Change in % Housing Units Owner Occupied	-1.309	3.822
Change in % Housing Units Vacant	2.398	4.791
Change in % Occupied Housing Units Built More Than 10 Years Ago	8.958	8.256
Change in % Households Moved into House Less Than 10 Years Ago	-11.402	10.369
% Missing Change in % Households Moved into House Less Than 10 Years Ago	0.003	0.558
Change in % Population Over 55 Years of Age	1.110	2.658
Change in % Children Enrolled in Private School	2.604	3.176
Change in Total Housing Units (1000s)	6.423	24.276
Change in Enrollment (1000s)	-3.767	16.209
Change in % Households in Urban Areas	1.295	7.513
1980 Average Household Income (1000s)	39.875	10.268
1980 % Population With at Least 16 Years of Education	13.037	7.154
1980 % Unemployed	6.937	3.300
1980 % Housing Units Owner Occupied	69.971	12.011
1980 % Housing Units Vacant	7.394	4.443
1980 % Occupied Housing Units Built More Than 10 Years Ago	72.151	15.090
1980 % Households Moved into House Less Than 10 Years Ago	71.978	9.461
% Missing 1980 % Households Moved into House Less Than 10 Years Ago	0.003	0.558
1980 % Population Over 55 Years of Age	20.533	6.224
1980 % Children Enrolled in Private School	7.433	5.876
1980 Total Housing Units (1000s)	77.599	191.558

1980 Enrollment (1000s)	32.041	75.848
1980 % Households in Urban Areas	67.134	36.720
Change in Crime Index	349.160	1352.504
% Missing Change in Crime Index	0.766	8.717
Change in % Voting Republican	-13.431	6.854
Change in % Voting Democratic	0.637	6.742
Change in % County Employees Organized	1.558	20.902
% Missing Change in County Employees Organized	3.122	17.392
Change in % Employed in Manufacturing	-4.329	24.727
1980 Crime Index	4809.895	2254.493
% Missing 1980 Crime Index	0.235	0.048
1980 % Voting Republican	52.201	9.381
1980 % Voting Democratic	40.760	9.888
1980 % County Employees Organized	18.804	25.199
% Missing 1980 County Employees Organized	3.057	17.217
1980 % Employed in Manufacturing	22.923	30.252

Notes: There are 9079 observations. All dollar values are in 1994 dollars. All means are weighted by student enrollment in 1980. Changes in "predicted" state aid are calculated using the state school financing formulas and 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	-5.098 (1.261)	10.496 (0.759)	8.716 (0.754)
Change in Average Household Income		9.599 (0.278)	8.168 (0.286)
Change in Average Household Income Squared Divided by 10000		-0.014 (0.018)	0.005 (0.017)
Change in % Population With at Least 16 Years of Education		720.836 (304.360)	428.598 (289.642)
Change in % Unemployed		3219.059 (289.046)	2967.850 (323.393)
Change in % Housing Units Owner Occupied		-2742.107 (186.294)	-2546.410 (180.957)
Change in % Housing Units Vacant		854.714 (125.767)	610.122 (123.042)
Change in % Occupied Housing Units Built More Than 10 Years Ago		-752.553 (123.121)	-1051.584 (129.143)
Change in % Households Moved into House Less Than 10 Years Ago		-994.991 (167.308)	-781.772 (175.217)
Change in % Population Over 55 Years of Age		3688.244 (291.554)	3826.998 (278.134)
Change in % Children Enrolled in Private School		4274.268 (219.586)	3940.764 (209.009)
Change in Total Housing Units		0.448 (0.049)	0.515 (0.051)
Change in Enrollment		-1.639 (0.118)	-1.892 (0.117)
Change in % Urban		73.794 (79.412)	19.006 (74.879)
1980 Average Household Income		6.728 (0.310)	6.759 (0.320)
1980 Average Household Income Squared Divided by 10000		-0.392 (0.030)	-0.355 (0.029)
1980 % Population With at Least 16 Years of Education		-6.207 (159.215)	-750.505 (157.300)
1980 % Unemployed		2788.169 (264.511)	2235.171 (302.214)

1980 % Housing Units Owner Occupied		-958.395 (109.999)	-869.055 (107.704)
1980 % Housing Units Vacant		138.042 (165.180)	710.592 (161.961)
1980 % Occupied Housing Units Built More Than 10 Years Ago		-812.125 (109.217)	-709.791 (123.767)
1980 % Households Moved into House Less Than 10 Years Ago		-3263.147 (162.987)	-2526.472 (181.785)
1980 % Population Over 55 Years of Age		2566.018 (145.470)	2351.546 (145.355)
1980 % Children Enrolled in Private School		945.191 (131.618)	900.088 (128.814)
1980 Total Housing Units		0.034 (0.027)	0.040 (0.027)
1980 Enrollment		-0.487 (0.069)	-0.503 (0.071)
1980 % Households in Urban Areas		178.259 (27.406)	-77.198 (27.212)
Change in Crime Index			-1.248 (0.501)
Change in % Voting Republican			1303.062 (155.792)
Change in % Voting Democratic			1996.773 (139.270)
Change in % County Employees Organized			-167.900 (28.061)
Change in % Employed in Manufacturing			22.160 (25.502)
1980 Crime Index			-1.874 (0.367)
1980 % Voting Republican			-160.182 (276.422)
1980 % Voting Democratic			-351.994 (284.375)
1980 % County Employees Organized			153.961 (32.452)
1980 % Employed in Manufacturing			-11.280 (21.451)
p-value: State Aid = 18.61 (δ = 0.0733*(1-mtr))	0.000	0.000	0.000

p-value: State Aid = 26.03 (δ = 0.0524*(1-mtr))	0.000	0.000	0.000
R^2	0.002	0.729	0.762

Notes: The dependent variable is the change (from 1980-1990) in the aggregate residential property value per pupil. Standard errors are in parentheses. There are 9079 observations. All equations include a constant. Columns (2) and (3) also include a dummy variable indicating whether the 1980 percent of the population that moved in 10 years ago is missing. In addition, column (3) includes indicators for the Census division of the school district and dummy variables indicating if the change in the crime index or the percent of county employees that are unionized are missing. The equations are weighted by student enrollment in 1980. All dollar values are in 1994 dollars.

[a] δ is the discount rate; mtr is the marginal tax 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	0.093 (0.005)	
Change in Predicted Total State Aid per Pupil		0.092 (0.005)
F(1,11802)	392.02	406.95
R^2	0.357	0.358

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 9079 observations. Changes in predicted state aid are calculated using the state school financing formulas and 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	18.825 (3.732)	20.114 (3.675)
p-value: State Aid = 18.61 (δ = 0.0733*(1-mtr))[a]	0.954	0.683
p-value: State Aid = 26.03 (δ = 0.0524*(1-mtr))[a]	0.054	0.108

Notes: The dependent variable is the change (from 1980-1990) in aggregate residential property 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 9079 observations. The equations are weighted by district student enrollment in 1980. Changes in "predicted" state aid are calculated using the state school financing formulas and the 1980 characteristics of school districts.

[a] δ is the discount rate; mtr is the marginal tax 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	0.609 (0.077)	-0.089 (0.008)	-0.168 (0.058)
	Instrumental Variable = Change in Predicted Total State Aid per Pupil		
Change in Actual State Aid per Pupil	0.634 (0.075)	-0.080 (0.007)	-0.145 (0.056)
Number of Observations	8463	8463	8463

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 1472.37; the mean for column (2) is -2.572; the mean for column (3) is 624.69. The school district property tax rate units are dollars raised per 10,000 dollars of property value. Changes in “predicted” state aid are calculated using the state school financing formulas and 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)	0.552	-1.347
	(7.739)	(7.210)
Average (20 to 80th percentile)	5.137	7.041
	(4.378)	(4.314)
High (Top 20th percentile)	63.132	65.058
	(9.142)	(8.880)
p-value: Low = High	0.000	0.000
Education		
Low (Top 20th percentile in share of persons without a HS diploma)	0.050	-2.960
	(6.420)	(6.187)
Average (20 to 80th percentile in share of persons without a HS diploma)	26.409	28.924
	(4.554)	(4.473)
High (Bottom 20th percentile in share of persons without a HS diploma)	12.349	16.162
	(9.887)	(9.645)
p-value: Low = High	0.294	0.093
Percent Owner Occupied		
Renter-occupied districts (Bottom 20th percentile)	6.885	7.646
	(5.183)	(5.084)
Mixed (20 to 80th percentile)	19.320	21.068
	(8.808)	(5.809)
Owner-occupied districts (Top 20th percentile)	39.304	40.604
	(7.661)	(7.636)
p-value: High Renter = High Owner	0.001	0.000

Notes: The dependent variable is the change in aggregate residential property 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 9079 observations. The equations are weighted by district student enrollment in 1980. Changes in "predicted" state aid are calculated using the state school financing formulas and the 1980 characteristics of school districts. The demographic groups are based on their values in 1980 weighted by pupils 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	39.483	40.911
(HHI < 0.15/Competitive)	(5.706)	(5.619)
Average	9.180	9.011
(0.15 ≤ HHI ≤ 0.46)	(5.576)	(5.239)
High	16.345	20.806
(HHI > 0.46/Not Competitive)	(7.386)	(7.940)
p-value: Low = High	0.015	0.043
District Size in 1980		
Small	42.268	42.846
(Bottom 20th percentile)	(8.659)	(8.628)
Average	20.563	21.057
(20 to 80th percentile)	(4.857)	(4.745)
Large	-18.885	-15.372
(Top 20th percentile)	(7.696)	(7.056)
p-value: Small = Large	0.000	0.000

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

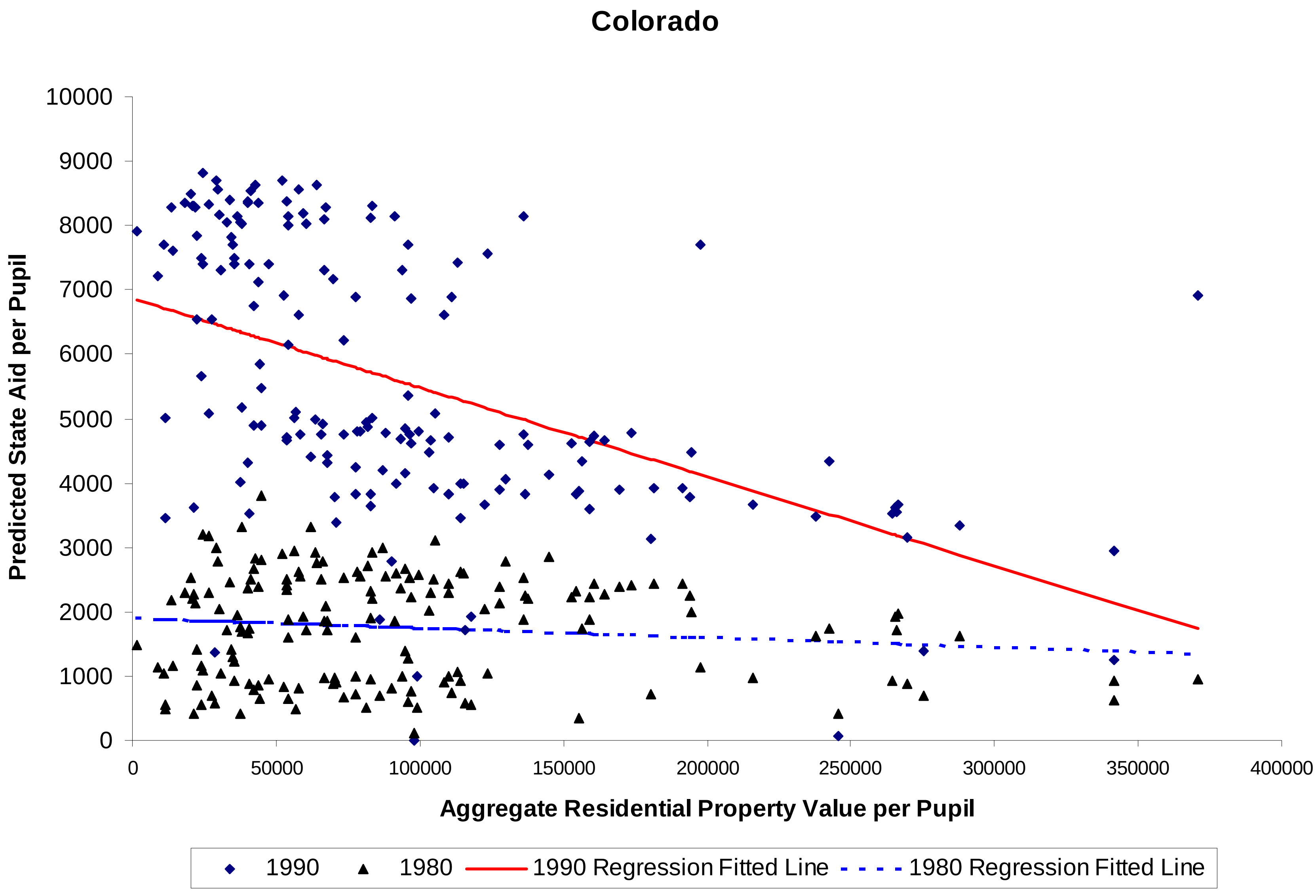
Appendix Table I

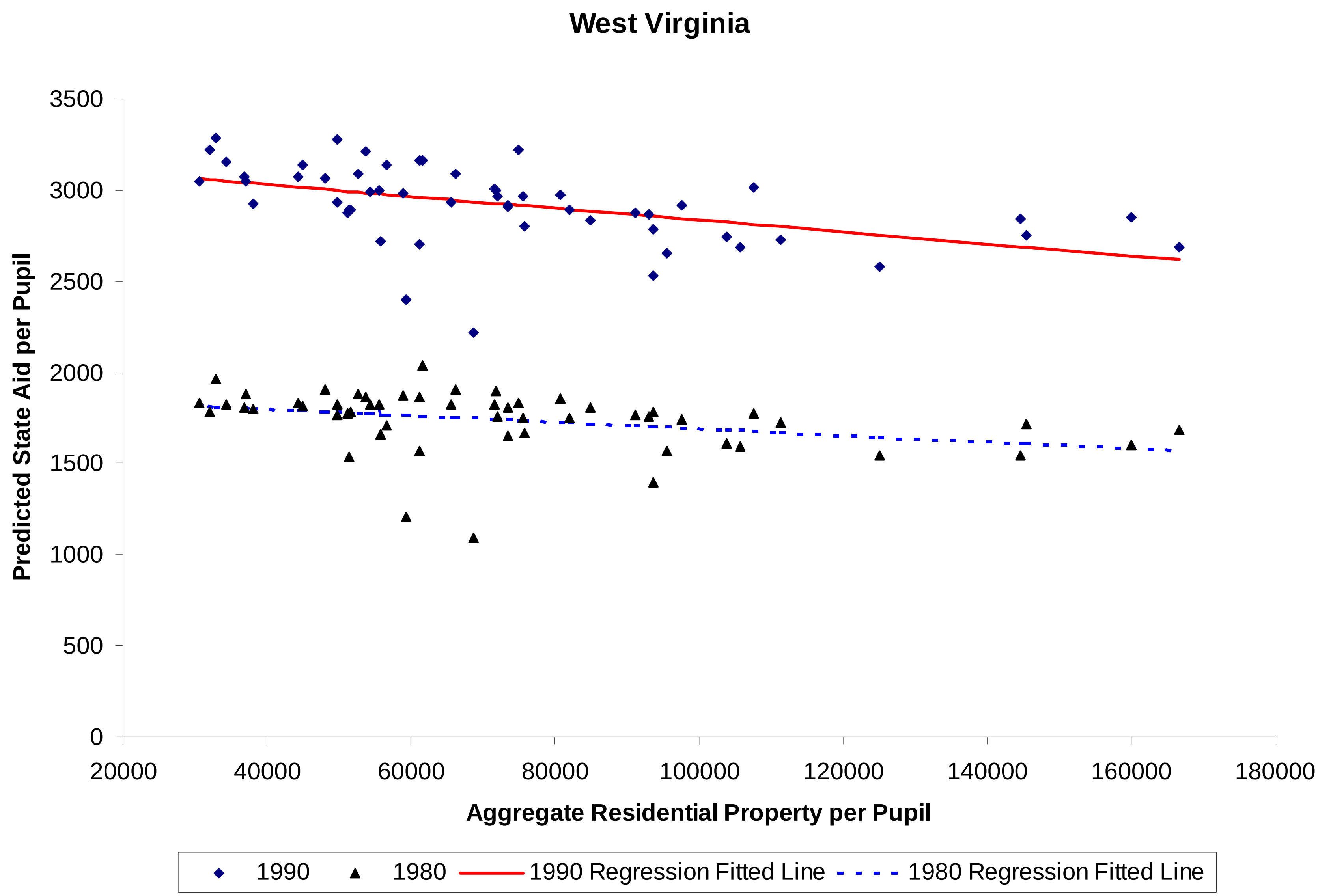
IV First-Differenced Estimates of the Effect of Change in State Aid on Change in Aggregate House Values per Pupil Using an Alternative Instrumental Variable

	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	18.825 (3.732)	20.114 (3.675)
p-value: State Aid = 18.61 (δ = 0.0733*(1-mtr))[a]	0.954	0.683
p-value: State Aid = 26.03 (δ = 0.0524*(1-mtr))[a]	0.054	0.108
Number of Observations	9079	9079
	Change in Predicted Basic State Aid per Pupil	Change in Predicted Total State Aid per Pupil
	(3)	(4)
Change in State Aid per Pupil	18.835 (3.737)	20.120 (3.679)
p-value: State Aid = 18.61 (δ = 0.0733*(1-mtr))[a]	0.952	0.681
p-value: State Aid = 26.03 (δ = 0.0524*(1-mtr))[a]	0.054	0.108
Number of Observations	9076	9076
	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	18.448 (3.258)	21.005 (3.268)
p-value: State Aid = 18.61 (δ = 0.0733*(1-mtr))[a]	0.960	0.464
p-value: State Aid = 26.03 (δ = 0.0524*(1-mtr))[a]	0.020	0.124
Number of Observations	9076	9076

Notes: The dependent variable is the change in aggregate residential property 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 per pupil is calculated using the state school financing formulas and the 1980 characteristics of school districts. "Synthetically Predicted" state aid is state aid calculated for each school district using the state school financing formulas and 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; mtr is the marginal tax rate. See text.


Colorado
Predicted State Aid per Pupil
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
Aggregate Residential Property Value per Pupil
0
50000
100000
150000
200000
250000
300000
350000
400000
1990
1980
1990 Regression Fitted Line
1980 Regression Fitted Line


West Virginia
Predicted State Aid per Pupil
0
500
1000
1500
2000
2500
3000
3500
20000
40000
60000
80000
100000
120000
140000
160000
180000
Aggregate Residential Property per Pupil
1990
1980
1990 Regression Fitted Line
1980 Regression Fitted Line