WORKING PAPERS
RESEARCH DEPARTMENT

WORKING PAPER NO. 02-10

WHY DO HOUSEHOLDS WITHOUT CHILDREN SUPPORT LOCAL PUBLIC SCHOOLS? LINKING HOUSE PRICE CAPITALIZATION TO SCHOOL SPENDING

Christian A. L. Hilber
Fannie Mae

Christopher J. Mayer
The Wharton School, University of Pennsylvania
Visiting Scholar, Federal Reserve Bank of Philadelphia

June 2002

FEDERAL RESERVE BANK OF PHILADELPHIA
Ten Independence Mall, Philadelphia, PA 19106-1574• (215) 574-6428• www.phil.frb.org

Why Do Households Without Children Support Local Public Schools?

Linking House Price Capitalization to School Spending

Christian A. L. Hilber*

and

Christopher J. Mayer**

This Version: June 27, 2002

JEL classification: H53, H7, R14

Keywords: Capitalization, land supply, school spending, elderly households

We thank Harold Elder, Joe Gyourko, Caroline Hoxby, Bob Inman, Loretta Mester, Wallace Oates, Todd Sinai and seminar participants at the ASSA meetings, the Wharton School and Federal Reserve Bank of Philadelphia for helpful comments. Any errors, of course, are our own. Financial assistance from the Swiss National Science Foundation, the Max Geldner Foundation, and the Zell/Lurie Real Estate Center at Wharton is gratefully acknowledged.

* Fannie Mae, Christian_Hilber@fanniemae.com3900 Wisconin Avenue, NW, Room 3218, 3rd floor, Mail stop: 2H-3N/01, Washington, DC 20016

** The Wharton School, University of Pennsylvania, 314 Lauder-Fischer Hall, 256 South 37th Street, Philadelphia, PA 19104-6330, mayerc@wharton.upenn.edu and Visiting Scholar, Federal Reserve Bank of Philadelphia.

Why Do Households Without Children Support Local Public Schools?

Linking House Price Capitalization to School Spending

Abstract

While residents receive similar benefits from many local public expenditures, only about one-third of all households have children in the public schools. In this paper we argue that capitalization of school spending into house prices can encourage residents to support spending on schools, even if the residents themselves will never have children in the schools. To examine this hypothesis, we take advantage of differences across communities in the extent of house price capitalization based on the availability of land or population density. We show that fiscal variables and amenities are capitalized to a much greater extent in Massachusetts cities and towns with little available land and that these localities also spend more on schools. Next, we use data from school districts in 49 states to show that per pupil spending is positively related to population density, a proxy for the availability of land. Consistent with a model tying house price capitalization to school spending, we show that the positive correlation between density and spending persists only in locations with high homeownership rates. Communities with a higher percentage of residents above 65 years old have increased school expenditures only in places with high population densities, and this correlation grows for the percentage of elderly above 75 or 85 years old who have a shorter expected duration in their house. The positive relationship between percentage elderly and school spending is confined to central cities and suburbs of large metropolitan areas and does not exist in places where land for new construction may be easier to obtain. These results support models in which house price capitalization encourages more efficient provision of public services and provide an explanation for why some elderly residents might support local spending on schools.

1 Introduction and Background

The choice of expenditures on public schools is among the most contentious debates in local government. While many residents benefit relatively equally from expenditures on police and fire services or plowing the streets, only about one-third of all households have children in the public schools.[1] Although altruism may drive some voters to support local education even if they will not directly benefit from such expenditures, one might expect that many communities will "underprovide" education from the perspective of an individual that considers demand for education over its entire lifecycle. A countervailing argument is that good schools are an amenity that is capitalized into house prices. Thus, even if a property owner does not use the schools, a future buyer of the property may care about the quality of local schools, so local residents may support education to maintain or increase their house price. Past research has strongly supported the proposition that good schools are capitalized into house prices. (See, for example, Black 1999, Bogart and Cromwell 1997 and 2000, Dee 2000, or Weimer and Wolkoff 2001).

Below, we argue that the level of local spending on education should depend on the extent to which spending is capitalized into property values. In particular, we posit that house prices respond much more strongly in places where land is inelastically supplied, such as many suburbs of large cities, and thus residents in such locations are more willing to vote to support educational services. This proposition is supported by previous theoretical work. Wildasin (1979) and Sonstelie and Portney (1980) point out that in a frictionless world homeowners have an incentive to vote for the local public good level that maximizes the values of their houses. Brueckner and Joo (1991) demonstrate that in a world with imperfectly mobile voters and in the presence of house value capitalization, the voter's ideal spending level for durable local public goods reflects a blend of his or her own preferences and those of the eventual buyer of the house. Authors' computations from the American Housing Survey show that the median successful homebuyer outside of center cities has school-age children, even if the median resident does not. This link may explain, for example, why some voters, such as the elderly, might support additional school spending even though they have no children at school.

[1] According to the 1990 U.S. Census, 36 percent of all households have children below 18 years. Furthermore, the National Household Education Survey (NHES) of the U. S. Department of Education documents that for 1993, 91.2 percent of students in grades 3-12 are enrolled in public schools, while 8.8 percent of the students are enrolled in private schools.

To examine the hypothesis that the extent of house price capitalization drives expenditures on schools, we examine communities that differ in their relative availability of residential land. This link is quite intuitive. As long as land supply is not perfectly inelastic (or perfectly elastic) and communities are not perfect substitutes, both price and quantity will adjust in response to demand shocks. However, price adjustment should be larger (and quantity adjustment smaller) in places with less available land. This argument is at odds with the assumption in other research that long-run house values fully reflect cross-sectional differences in the present discounted value of future tax burdens and benefits, after controlling for housing characteristics. Such an approach depends on demand factors alone and assumes that the supply of land is inelastic and similar across locations. Only a few recent studies examine the possibility of variations in the supply elasticity among different locations (Malpezzi 1996 and Dreiman and Follain 2001) or the effect of differential land supply elasticity on the extent of capitalization (Bruce and Holtz-Eakin 1999).[2]

In the prototypical Tiebout world, residents would perfectly sort into the community with their exact preferences. For example, elderly households would move to communities that focus exclusively on services for the elderly. However, with a relatively small number of communities, multi-dimensional preferences, and moving costs, residents live in a second best world. In heterogeneous communities, residents often have to vote on public services that don't match their preferences. Thus an elderly household may live in a community that happens to have good quality schools because the household has lived in the community for a long time or because the elderly residents take advantage of other amenities in that community besides the schools.

The implication that house price capitalization might lead elderly households to support school spending in communities with a high extent of capitalization differs from the findings of some previous research showing that per pupil educational spending is negatively correlated with the percentage of elderly residents. Evidence comes from data over the last 40 years at the state level (Poterba 1997), at the municipal level in Long Island (Inman 1978), or using historical school district data in three states (Hoxby 1998). In contrast, Goldin and Katz (1997) show that school spending at the beginning of the century grew faster in states with a greater percentage of elderly residents. Other papers show that at least part of the negative relationship between elderly residents and school spending is driven by racial heterogeneity, that is, elderly residents

[2] McMillan and Carlson (1977) examine a sample of small Wisconsin towns and show that amenities are not capitalized in a hedonic regression, a result that is consistent with the spirit of our paper, as well.

are particularly unlikely to support spending on children of a different race. (See Poterba 1997, Cutler et al. 1993, Goldin and Katz 1999, and Alesina et al. 1999.)

Our empirical findings, which confirm the effect of land availability on the extent of capitalization and on school spending, have implications for theoretical and empirical studies in a variety of areas. For example, some authors argue that the capitalization of benefits of durable local public goods into property values can induce local governments to behave efficiently (e.g., Edelson 1976 and Sonstelie and Portney 1978, and Fischel 2001) or that land value capitalization provides a mechanism to induce present generations to internalize the well-being of future generations (e.g., Oates and Schwab 1988 and 1996, Glaeser 1996, and Conley and Rangel 2001). Fischel (2001) describes homeowners as "homevoters" whose voting and local political activities are guided by their concerns about home values. Fischel's homevoter model implies "…that local property taxes are benefit taxes, (and) that locally funded schools are more efficient than state-funded systems…" Our results support such normative implications in locations with limited opportunities for new construction, but not for places where land for development is freely available.

Finally, numerous studies make the implicit assumption of uniform capitalization across jurisdictions. Such conclusions may be inaccurate if the extent of capitalization varies across jurisdictions. For example, Mayer and Somerville (2000) demonstrate that land supply elasticities vary across MSAs based on differences in the extent of land-use regulation. Research in many areas assumes uniform capitalization, including urban quality-of-life comparisons[3] and capitalization studies of environmental amenities,[4] school spending (or school quality),[5] government subsidies,[6] and taxes.[7] Our findings suggest that house price capitalization estimates

[3] Urban quality-of-life comparisons use implicitly generated prices of local amenities by assuming uniform capitalization of interurban amenity differences into local land rents and wage rates in order to report quality of life rankings (see e.g., Blomquist et al. 1988, Gyourko and Tracy 1991, or Gyourko, Kahn, and Tracy 1999 for a survey of the literature).

[4] See, for example, the meta-analysis by Smith and Huang 1995 or recent work by Bui and Mayer (2002).

[5] A strict link between school expenditures—or more precisely school quality improvements—and house prices exists only if land supply is equally inelastic in all observed locations. While Black (1999) looks only at houses very close to attendance district boundaries where land supply might indeed be equally and completely inelastic, Haurin and Brasington (1996) and Dee (2000) present estimates based on much less disaggregated data, which might be biased without controlling for land supply.

[6] Several authors have argued that location-based aid (as opposed to grants to poor individuals) can have adverse consequences, since poor residents are typically renters who will be forced to pay higher rents if the transfers are capitalized into higher house prices (e.g., Hamilton 1976 and Wyckoff 1995).

[7] For example, variation in the extent of capitalization may lead to differences in homeowner benefits from the mortgage interest deduction and have implications of other types of fundamental tax reform in the US. See Capozza, Green, and Hendershott (1996) and Sinai (1998). For other tax studies, see Stull and Stull (1991), Man and Bell (1996), Palmon and Smith (1998a and 1998b), and Hilber (1998).

cannot be easily interpreted as a household's willingness to pay for amenities when land for new development is readily available.

To begin, Section 2 explores the conditions under which land supply elasticity will influence the extent of capitalization and thus school spending. We examine these theoretical predictions in Section 3 using data for the Commonwealth of Massachusetts and building on the empirical framework first used in Bradbury, Mayer, and Case (2001). This procedure uses variation from a property tax limit—Proposition 2½—to generate instruments for otherwise endogenous spending changes across communities. Consistent with theory, our results show that locations with less available undeveloped land have a lower land supply elasticity and that fiscal differentials and amenities are capitalized into house values to a much greater extent in these communities. In addition, localities with little available land vote to increase school spending at a faster rate than other communities when constrained by Proposition 2½.

Next, Section 4 examines national data on school agencies in 49 states and shows that per pupil spending is strongly and positively related to population density, a proxy for supply elasticity. Evidence from Massachusetts shows that the extent of capitalization is positively related to density. The coefficients suggest that a high population density location (1500 persons/sq. km.) is associated with 3.3 percent higher per pupil school spending than a low density location (150 persons per sq. km.). Next we examine a number of interactions that are driven by theory linking house price capitalization to school spending. For example, we show that the positive correlation between school spending and density is even larger in communities with higher homeownership rates. In addition, the percent of elderly residents is positively related to per pupil school spending in densely populated locations and in large MSAs and their suburbs, but percent of elderly residents is negatively related to school spending in smaller MSAs and non-MSA places where land for construction is likely to be more easily obtained. Furthermore, the size of the positive coefficient on the interaction between percent elderly and density rises when looking at older elderly residents who should have a shorter expected duration in their property. Finally, we find that there are strong linkages between school spending and density or density interacted with homeownership or percent elderly in states that mandate few restrictions or financial incentives on spending levels by local governments, while we find no such linkages in states with mandated spending levels. All of these results support the proposition that spending on schools is positively related to the extent of house price capitalization. Section 5 concludes with a brief discussion of policy implications.

2 Theoretical Framework

In the following analysis we argue that the extent of capitalization of fiscal variables and amenities should be particularly high in places where residential land supply is relatively inelastic because (almost) all land is already zoned for residential purposes—typically large urban and suburban communities.[8] In rural areas and locations at the edge of cities, where residential land supply is typically quite elastic, exogenous improvements in local attractiveness lead to relatively minor effects on local residential land values, as open farmland is converted into residential land. In part, this argument assumes that land can be freely converted into residential use. Here we follow the findings of the "endogenous zoning literature."[9] For example, empirical estimates in Pogodzinski and Sass (1994) indicate that land-use regulations appear to "follow the market," after controlling for selection bias.

A second important assumption is that some aspects of current spending affect the utility level of future residents. This assumption would apply if some portion of current spending is on durable goods that benefit future residents, or if current spending decisions represent a signal or commitment to future spending. A few studies recognize that the extent of capitalization of future benefits of durable local public goods affects the spending level (e.g., Sprunger and Wilson 1998, Hoyt 1999). In the case of Massachusetts under Proposition 2½, most increases in the levy (spending) limit are permanent; so if voters choose to increase the spending limit in one year, they are choosing to increase that limit in all future years as well.

2.1 Land Supply Elasticity and House Price Capitalization

In a simple partial equilibrium model, it is quite intuitive that both price and quantity will adjust in response to demand shocks and that the price adjustment is larger (and quantity adjustment smaller) if land supply is inelastic. This argument is illustrated in Figure 1. The figure depicts a residential land market, where—above a certain reservation price p_F (the present value of future land rents from farming)—the amount of developed residential land H increases monotonically with the price for residential land until all land in the community $\bar{H}$ is developed.

8 For example Yinger (1982) suggests that the finite size of urban areas makes land a scarce resource. Fischel (1990) points to a number of political factors that explain why communities pass restrictive zoning measures that move beyond just solving demand externalities and effectively limit supply.

9 The literature on "economics of zoning" is founded on Mills and Oates (1975). For a general review of the literature see Fischel (1990) and Pogodzinski and Sass (1991 and 1994).

Suppose that all communities in a specific region have an identical land supply curve. However, a community A with plenty of available land is at the very elastic part of the residential land supply curve, while a community B with little available land is at the inelastic part of the supply curve.

Figure 1: Exogenous Demand Shocks in a Community with Plenty and Little Available Land

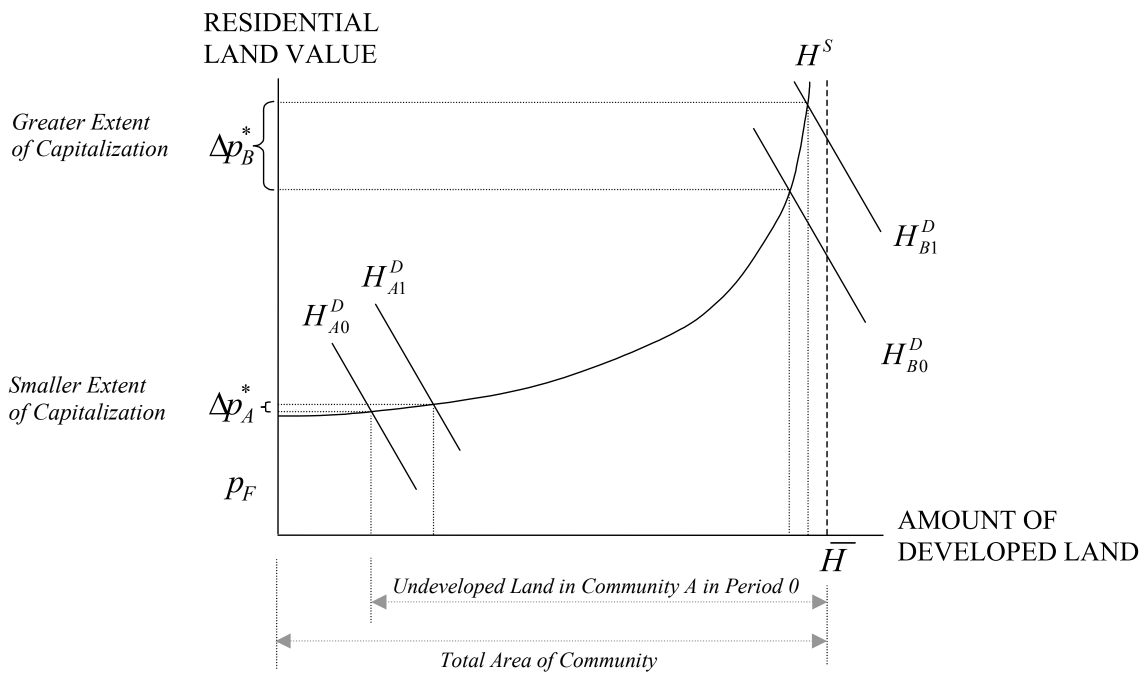


Figure 1 implicitly assumes that the marginal cost of building an additional housing unit increases exponentially in communities with little available land, in small part because of increasing marginal production cost but mostly due to increasing marginal opportunity cost. Hence, the amount of available land in a community can serve as a proxy for the residential land supply elasticity.[10] The figure illustrates that an exogenous demand shock will have a stronger price effect in places with more inelastic land supply or a higher percentage of developed land respectively. The same prediction can also be derived from a framework that assumes mobile households that can relocate between jurisdictions.[11]

---

10 One can also derive mathematically that for every residential land supply function with a strictly positive relationship between price and quantity and a positive intercept on the price axes, the land supply elasticity decreases with the amount of developed land. See Appendix A for a mathematical proof.

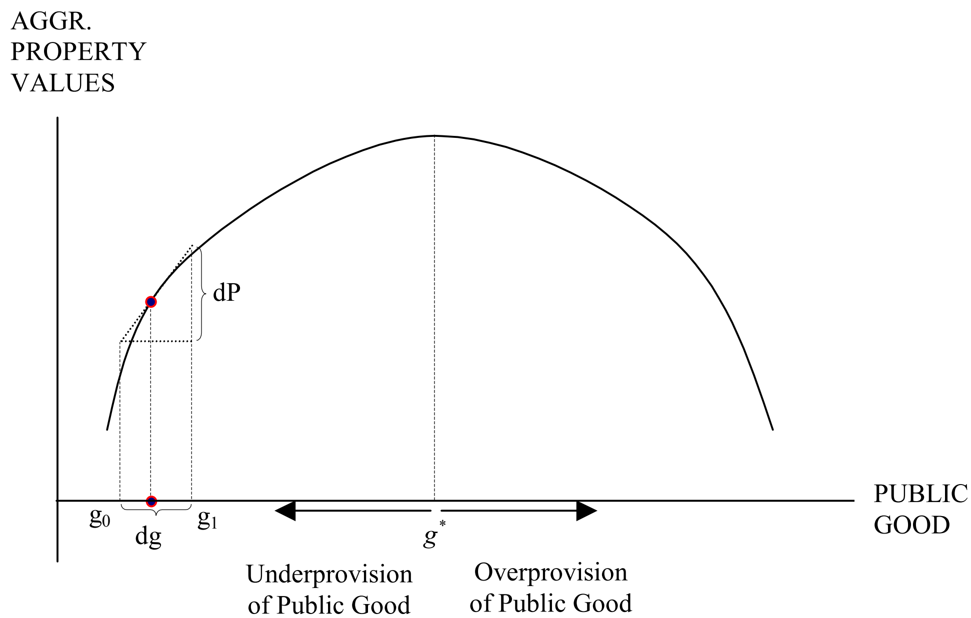
11 In an earlier version of this paper we developed a model of two communities that differ in their land supply elasticity and of households that have identical incomes and tastes. The model builds upon the seminal work of Epple and Zelenitz (1981) and confirms the main prediction of the partial equilibrium model that the extent of capitalization is decreasing in the land supply elasticity.

2.2 A Property Tax Limit as an (Exogenous) Fiscal Shock

A. General Considerations

Brueckner (1982) notes that if local governments provide local public goods in a property-value-maximizing fashion, they will choose a spending level such that the marginal benefit of an extra dollar of spending will be exactly offset by the marginal cost of the property taxes needed to finance that spending. Brueckner's (1982) argument is illustrated in Figure 2 for the simplified case where aggregate property values are a single-peaked function of a local public good g. A public good level left of the peak signifies underprovision, while a level right of the peak signifies overprovision.

Figure 2: Public Goods and Aggregated Property Values



We subsequently use these considerations to analyze the effect of a tax reform that limits property taxes, as was approved in states such as California, Michigan, and Massachusetts in the 1970s and 1980s. These property tax limits were passed based on the perception that local officials had a tendency to spend more on public services than the residents wanted. According to this logic, the existence of a property tax limit will increase the utility of homeowners if a community, *k*, were indeed overproviding the public good ($\partial P / \partial g_k < 0$). However, if the limit restricts the local government from increasing spending to the optimal level, that is, $\partial P / \partial g_k > 0$, the utility of homeowners is decreased in restricted communities. In this case, restricted communities may realize gains in property values to the degree that they are able to overcome the limits.

Brueckner's (1982) efficiency statement has been criticized for a number of reasons. First, Yinger (1985) argues from a theoretical point of view that property taxes apply to both capital (the value of the housing structure) and land. Thereby the existence of property taxes drives a wedge between the first order conditions that govern the spending choice of communities and housing consumption of individuals. As a result, local spending choices are only second best. The second critique derives from the fact that in a world with heterogeneity, the median voter's preferences, which determine spending, differ from the marginal homebuyer's.[12] Finally, voters may not have full control over spending decisions.

B. The Case of Proposition 2½ in Massachusetts

Below, we consider the tax reform "Proposition 2½" in Massachusetts as a good setting to examine whether variations in land supply impact the extent of capitalization. Proposition 2½ was passed in November 1980. It placed important limits on local municipal spending: 1) effective property tax rates were capped at 2.5 percent and 2) nominal annual growth in property tax revenues was limited to 2.5 percent, unless residents passed a referendum (called an "override") allowing a greater increase. Spending limits under Proposition 2½ applied equally to all cities and towns, yet variations in local conditions after its passage have led the measure to have very different impact on individual communities.

Bradbury, Mayer, and Case (2001) use this setting to explore the impact of spending changes on housing values, taking advantage of the tax reform to provide instruments that are correlated with local changes in spending, but are unrelated to property values. Between 1990 and 1994—the time period of our analysis—Massachusetts municipalities faced significant fiscal stress because of a 30 percent cut in real state aid and a demographically driven increase in school enrollments. In 1990, 224 out of 351 communities were at their levy limit, so that the only way to increase spending by more than 2.5 percent per year was for residents to pass an override in a general election. An override raises the levy limit for a specific year, and that increase becomes a permanent part of the levy limit, although a small number of communities

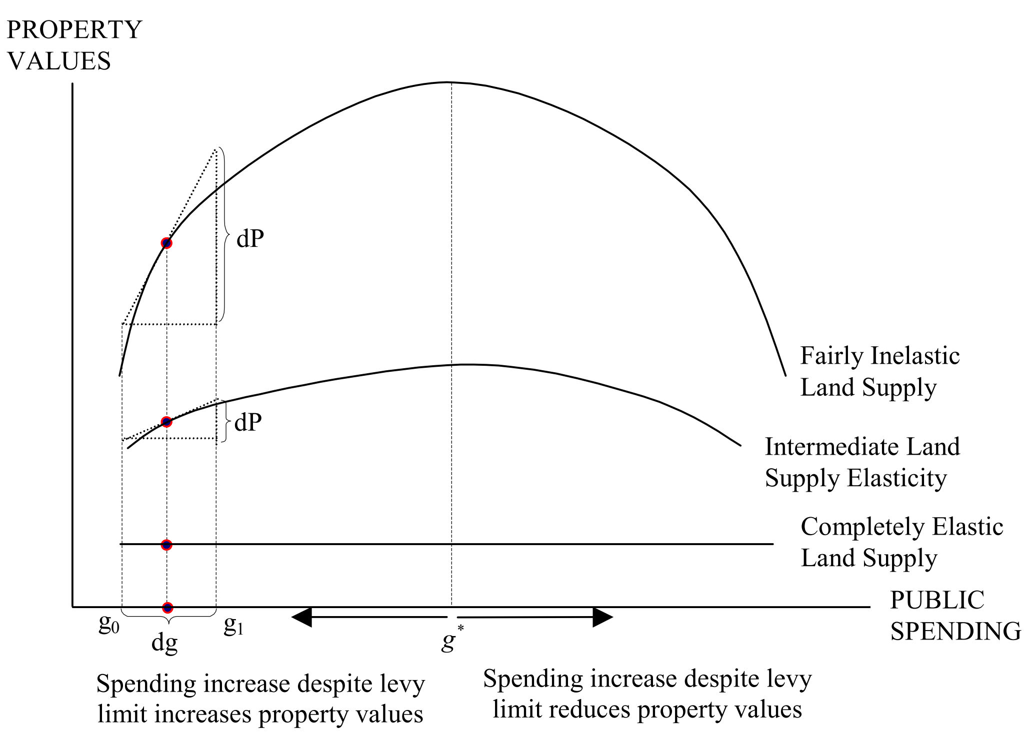
[12] See Ross and Yinger (2000) for a summary of the literature that considers both a housing market and the market for local public services in a setting with heterogeneous households.

passed temporary exclusions to pay for certain capital expenditures. Bradbury, Mayer, and Case (2001) have three principal findings: 1) Proposition 2½ significantly constrained local spending in some communities, with most of its impact on school spending, 2) constrained communities realized gains in property values to the degree that they were able to increase school spending despite the limitation, and 3) changes in non-school spending had little impact on property values.

One possible explanation for these findings is that the marginal homebuyer may place a higher value on school spending than the median voter, possibly because homebuyers were more likely to have children in public schools. That communities were able to realize gains in property values to the extent that they were able to increase spending in spite of the limitation suggests that Proposition 2½ caused many communities to spend "too little" on local public education from the perspective of the marginal homebuyer (i.e., local spending levels in Massachusetts over this time period lie to the left of the peak of the curve in Figure 2).

This econometric framework can also be used to test our main hypothesis that the capitalization of fiscal variables and amenities varies across communities. Communities that increase spending despite Proposition 2½ should realize stronger gains in property values if their land supply curve is inelastic rather than elastic. This effect is illustrated in Figure 3, below.

Figure 3: Land Supply Elasticity and Capitalization



The figure shows the effect of a fiscal shock such as a property tax limit on property values for various degrees of land supply elasticity (completely elastic, intermediate elasticity, fairly inelastic). Consider a specific community that is constrained by Proposition 2½ and can only provide $g_0 < g^*$. The fiscal distortion induced by the property tax limit results in lower property values. If the community increases the public spending level despite the limitation to g_1 it realizes gains in property values. However, the change in property values for a given change in public services depends on the land supply elasticity, as is indicated by the steepness of the three curves.[13] A community with inelastic land supply will have a greater increase in property values than a location with more elastic land supply. We examine this hypothesis in Section 3.

2.3 Capitalization and School Spending

Previous theoretical research points out that in a frictionless world and in the presence of house value capitalization, voters take into account preferences of eventual buyers of their house (e.g., Wildasin 1979 and Sonstelie and Portney 1980). To the extent that public goods are not fully capitalized,[14] communities may underinvest (left of the peak of the curves in Figure 2 and 3) because current homeowners have not enough incentives to take into account preferences of future residents (or future generations). Correspondingly, we predict that land availability should affect the extent of house value capitalization and thereby public spending, so long as the median voter is a homeowner. In Massachusetts, constrained communities with little available land, everything else equal, should spend more on schools and be more likely to pass an override in order to increase (school) spending than communities with more available land.

The intuition behind this prediction is quite straightforward. If additional spending on schools is fully capitalized into higher house values, certain (not completely immobile) households might be willing to vote in favor of the spending even though they have no children. This is because these households might sell their houses in the future (possibly to families with children), pocket the proceeds, and move to a community where the public spending is ideal from a pure consumption point of view. Now consider the other extreme case with perfectly elastic

---

13 The price level of the three curves is arbitrary. However, rural communities that have elastic land supply consist of inexpensive farmland while suburban and urban communities with inelastic supply of land typically have scarce amenities and more expensive residential land.

14 Several studies describe the factors that may lead to less than full capitalization or even "overcapitalization." See Hilber (1998) for an overview and a discussion of the impact of these determinants on the extent of capitalization.

land supply and thereby no capitalization. Investments in durable school facilities will attract other households to the community. Yet if land supply is perfectly elastic, house values will not rise, but instead, previously undeveloped land will be converted to residential use. In this case, households without school-aged children will pay additional taxes without receiving any benefits. Hence, households that have no children—unless they have interdependent utility functions or are altruistic—will vote against additional spending.

We can derive some further predictions by analyzing the voting decision in a more formal partial analytic framework. Consider a voter $i \in \{1,...,I\}$ in a local jurisdiction that has the option to vote in favor of or against an investment that aims to provide better local public school services (or any other durable local public service). If the majority of voters opt for the investment, property owners have to pay additional τ_t in each time period $t \in \{1,...,T\}$.[15] Denote voter *i* as an owner-occupant if $\pi_i = 1$; otherwise $\pi_i = 0$.[16] Assume that not all voters have children in school who would directly benefit from the investment. Define voters with children in school as having $\lambda_i = 1$; otherwise $\lambda_i = 0$. The gross benefit for households that have children in school is assumed to be B_t, otherwise the gross benefit is zero. The discount rate is *r*.

Let us now consider the determination of house prices. The net benefit for the marginal homebuyer *j* may be partially or fully capitalized into house values. If the marginal homebuyer *j* does not have children in school, the net benefit is $b_{jt} = -\tau_t$ and house values will decrease; otherwise, the net benefit is $b_{jt} = B_t - \tau_t$ and house values may increase. The degree of house price capitalization $\theta_n \in [0,1]$ in jurisdiction *n* depends on the land supply elasticity ε_n^S. Places with more inelastic land supply are expected to have a greater extent of capitalization θ_n. The determination of housing rents is very similar. If the marginal new tenant *k* has children in school then $\lambda_k = 1$; otherwise $\lambda_k = 0$. The landlords may increase rents R_t in period *t* by up to the amount of the gross benefit B_t depending on the degree of capitalization θ_n.

Hoyt (1999) correctly points out that—in the case of overprovision—lack of capitalization may also reduce incentives of homeowners to limit government inefficiency.

15 The model assumes that property taxes are exogenous. That is, the house value that is used to calculate the amount of property taxation is fixed for a longer period of time. Alternatively, one could assume that the house value adjusts each year to the new fiscal environment without substantially changing the analysis.

16 Hence we assume that the homeownership status of the voter is exogenously given.

Given that the likelihood of relocation $\overline{t_i}$ of the median voter $i=m$ is determined exogenously (e.g., based on demographics or conditions on the labor market), the median voter's payoff P_{mo} can be expressed as:

$$P_{m0}=\left[\pi_m\left(\sum_{t=1}^{\overline{t}_m}\frac{\lambda_m B_{mt}-\tau_t}{(1+r)^t}+\theta_n\sum_{t=\overline{t}_m}^{T}\frac{\lambda_j B_{jt}-\tau_t}{(1+r)^t}+\right)+\left(1-\pi_m\right)\left(\lambda_m\sum_{t=1}^{\overline{t}_m}\frac{B_{mt}}{(1+r)^t}-\theta_n\lambda_k\sum_{t=1}^{\overline{t}_m}\frac{B_{kt}}{(1+r)^t}\right)\right] \quad (1)$$

If $P_{mo}>0$ the local government will invest in better school services; otherwise school services and property tax rates remain unchanged.

The median voter's payoff is composed of a direct effect (net benefit of investment) and an indirect effect (capitalization effect). Whether it is advantageous for the median voter to invest depends on several factors: (a) the homeownership-status of the median voter, (b) the net benefit of the investment for the median voter, (c) the net benefit of the investment for the marginal homebuyer (or renter), (d) the extent of capitalization, and (e) the likelihood of relocation of the median voter.

This simple analytical framework generates several theoretical predictions. If the median voter is a renter with no children in school, the probability that he or she opts for the investment is zero because the payoff is always negative. This is likely to be true in most renter-dominated communities in the US, as the majority of renters do not have school-aged children. In this case the extent of capitalization should not affect the probability that the median voter opts for the investment.[17]

Now consider a community where the median voter is an owner-occupant. The payoff of the median voter who is an owner-occupant can be expressed as:

$$P_{m0}=\left(\sum_{t=1}^{\overline{t}_m(\text{expected duration in house})}\frac{-\tau_t}{(1+r)^t}+\theta_n\sum_{t=\overline{t}_m(\text{expected duration in house})}^{T}\frac{\lambda_j B_{jt}-\tau_t}{(1+r)^t}\right) \quad (2)$$

In such a community, households with children in school typically will vote in favor of better school services. However, households with children very often do not have a majority. In this case, the payoff of elderly households may be decisive. One particular characteristic of

[17] If the median voter is a renter with children in school, there are conditions under which it is beneficial to invest in better schools. In this case, the likelihood that the median voter opts in favor of the school improvement decreases with the extent of capitalization into rents.

elderly households is that they are likely to have a relatively short expected duration in their property. Thus, they are likely to relocate and sell their homes sooner rather than later. Equation (2) implies that elderly households are more likely to support better schools if they live in a place with a greater degree of house price capitalization. In addition, the link between the extent of capitalization and school spending increases with the likelihood of relocation, so that the older the head of the elderly household, the more likely that household should be willing to support the investment as long as the marginal homebuyer has children who will attend public schools. We examine these predictions in the empirical work below.

3 Empirical Analysis for Massachusetts

The theoretical considerations in the preceding section predict that house prices should change more strongly in response to an increase in public spending in areas with little available land than in areas with plenty of undeveloped land. Recognizing that increases in spending result in higher house prices, communities with little available land should spend more on schools and be more likely to pass an override in order to increase school spending. To test these hypotheses, we turn to data from Massachusetts and look at the impact of Proposition 2½ on property values. In doing so, we use the basic framework in Bradbury, Mayer, and Case (2001) to explore empirically how the extent of capitalization varies with the amount of available land in a community.

The 1990-1994 sample period in Massachusetts has two particular advantages. First, we are able to estimate the impact of government policy on house values using a well-identified methodology. Community characteristics from the date of original passage of Proposition 2½ in 1980 serve as instruments for spending changes 10 years later. Second, we have very detailed data on land availability in Massachusetts that allows us to directly measure the amount of available land in each community. We can then compare capitalization results using land availability with a more easily obtained proxy, population density, that we will use when moving to national data. While the theoretical predictions depend on potential new construction to mitigate changes in house prices in some communities, density can be driven by other factors such as the amount of commercial development or local zoning restrictions that might obscure our ability to link capitalization with land availability.

3.1 Empirical Specification

Our basic estimating equation for the change in house prices is as follows:

$$\Delta P = \beta_0 + \beta_1(\text{local characteristics}) + \beta_2(\Delta \text{ spending}) + \beta_3(\Delta \text{ housing stock}) + \varepsilon \,. \tag{3}$$

This equation is derived by differencing a standard hedonic equation. We examine changes in spending and house prices, rather than levels of those variables, to control for the possibility of omitted fixed effects that might be correlated with included independent variables and thus bias cross-sectional regressions. Recognizing the difficulty in measuring the quality of local services and schools, we include only spending changes on the right-hand side of the equation. Following Brueckner (1982), we interpret the coefficient on (change in) school spending as the net impact on house prices of spending another dollar on schools, taking into account the taxes necessary to pay for the additional spending.

Regressions for house price changes between 1990 and 1994 are estimated using two-stage least squares and assume that changes in spending and new single-family home permits (Δhousing stock) are endogenous. Instruments include variables from the time immediately surrounding the passage of the tax limit to help control for spending changes and lagged permits from 1989 as an instrument for change in quantity. Our results are robust to the inclusion of a third group of instruments that include more contemporaneous resource and cost factors that affect spending changes, but that may be considered less plausibly exogenous.

The estimating equation also contains a number of levels variables to account for possible changes over time in the capitalized value of selected town characteristics as a result of aggregate shocks. For example, the aging of the baby boom and the associated echo baby boom has led to an increase in public school enrollments in Massachusetts since 1990. The resulting increase in the number of households with children in public schools has raised the demand for houses in towns with good quality schools. Bradbury, Mayer, and Case (2001) show that the increase in demand for good schools led to higher house prices in communities with good test scores over the 1990-94 time period. Case and Mayer (1996) find the opposite result in an earlier time period when public school enrollments were falling.

In examining differential capitalization, we divide the sample into two equally sized groups based on an indicator of land supply elasticity. Our most direct measure is the percentage of open and public (undeveloped) land in each community. This variable comes from a University of Massachusetts aerial survey of the entire Commonwealth of Massachusetts in 1984. All land is classified into 21 uses. We divide communities based on the percentage of open or undeveloped land, which includes farmland. In places with little available land, we expect that the restrictions imposed by Proposition 2½ will generate higher price changes, but smaller quantity changes relative to places with more available land. In other words, the coefficients on changes in spending (β_2) or on the other characteristics in the capitalization equation should be larger in the group of communities with little available land.

A second set of regressions present similar findings when we use population density instead of undeveloped land. While population density is reported in 1990, more contemporaneous to the beginning of our sample period, cross-sectional differences in commercial development and regulation could weaken the relationship between available supply and population density.

One might be concerned that land availability or density, our proxies for land supply elasticity, are endogenously determined, so that communities with stricter zoning rules also have more developable land. In this case, one should find empirical evidence that communities with more developable land have a greater extent of house price capitalization. However, as will be demonstrated in the empirical section, exactly the opposite is the case. If land availability is tied to tighter anti-development regulation, it would bias against finding our predicted results.

To examine this hypothesis that locations with little available land should have a lower supply elasticity, we specify a supply equation consistent with the demand equation (3):

$$(\Delta \text{ housing stock}) = \gamma_0 + \gamma_1(\Delta P) + \gamma_2(\text{lagged permits}) + \mu \,. \tag{4}$$

Equation (3) provides a large number of exogenous demand instruments to identify the supply elasticity. Locations with less available land should have a smaller land supply elasticity (γ_1) and, possibly, lower levels of new construction (γ_2). This second test provides important reinforcing evidence that the differences in capitalization identified in the price equation are due to differences in the land supply elasticity as opposed to differences in "unobserved" community attributes that may be correlated with available land.

In assessing the results, notice that our empirical specification looks at changes in house prices over a 4-year period. To the extent that longer-run supply is more elastic than short-run supply, our empirical work might over-estimate the price effects and underestimate the quantity effects of a given fiscal change in towns with more available land. This will bias us against finding any effect of land availability on capitalization and supply elasticities.

Next, we test the proposition that land supply—and thereby the extent of capitalization—affects local spending. First, we directly examine the impact of land availability on school and non-school spending, whether or not communities are constrained by their levy limit, controlling for local characteristics that might also affect spending. The estimating equation is as follows:

$$\Delta \text{spending} = \delta_0 + \delta_1 (\text{\% developed land}) + \delta_2 (\text{local characteristics}) + \nu . \tag{5}$$

Second, we limit our sample to communities that are constrained by Proposition 2½ to confirm that communities with little available land are more likely to pass overrides that increase spending. The estimating equation can be expressed as follows:

$$\left(\text{Amount overrides} \middle| \text{at levy limit} \right) = \pi_0 + \pi_1 (\text{\% developed land}) + \pi_2 (\text{local charact.}) + \varpi . \tag{6}$$

This test may be the most directly applicable to the theory because constrained communities must go directly to the voters in order to pass an override.

3.2 The Data

The analysis below includes a large number of community characteristics, school indicators, and fiscal variables. These variables are summarized in Table 1. During the 1990-94 period, communities show substantial variation in many of these variables. For example, although the average community increases school spending by 15 percent, individual towns had much larger positive and sometimes even negative changes in spending.

The house price indexes presented in this paper are obtained from Case, Shiller, and Weiss, Inc. and are estimated using a variation on the weighted repeat sales methodology first presented in Case and Shiller (1987).[18] Given that the indexes involve repeat sales of the same property, they are not affected by the mix of properties sold in a given time period or differences in average housing quality across communities. The sample includes 208 of the 351 cities and towns. Communities were dropped from the sample because they had too few sales to generate reliable indexes. As such, this data limitation might lead us to underestimate the impact of supply elasticity on capitalization. Communities with the fewest transactions that are dropped from the

[18] The method uses arithmetic weighting described by Shiller (1991) and is based on recorded sales prices of all properties that pass through the market more than once during the period. The Massachusetts file contains over 135,000 pairs of sales drawn between 1982 and 1995.

sample are also small, often rural, communities that may have the most available land and thus should exhibit the smallest degree of residential land value capitalization.

3.3 Results

A. Land Supply and Extent of Capitalization

To begin, we estimate equation (3), but split the sample into two equally sized parts based on the percentage of available developable land. The results—reported in Table 2—are consistent with the prediction that communities with more available land have a greater extent of capitalization. In all cases, coefficients in the house price equation in column (1a)—communities with little available developable land—are larger in absolute value than coefficients in the house price equation in column (1b)—locations with more available land. Of particular interest, the coefficient on changes in school spending is almost three times larger (0.32 versus 0.12) in towns with little available land than in communities with more undeveloped land. In fact, the coefficient for change in school spending is not statistically different from zero in column (1b), but is highly statistically significant in column (1a). As with Bradbury, Mayer, and Case (2001), the coefficient on changes in non-school spending is not statistically significant in either regression, though it is much larger in the first column than the second one. We find smaller, but qualitatively similar results for the average test score. Good commuting locations—communities in the Boston MSA and in the suburban ring—also became relatively more valuable in communities with little available land. Finally, as expected, price changes with respect to new supply are much larger in developed communities, where much less construction takes place. A test of equality for all of the coefficients in columns (1a) and (1b) rejects the hypothesis with a p-value of 0.06.

Columns (2a) and (2b) report the same regressions, except that we split the sample based on population density instead of available land. Overall, the results are somewhat weaker than in the first two columns, but are consistent with the maintained hypothesis that communities with less available land, using higher population density as a proxy, have a greater extent of capitalization. The primary variables of most direct interest, change in school spending and average test scores, are larger in absolute value in dense versus less dense locations, as are the commuting variables.

Table 3 examines the quantity test described above. Here we report evidence in favor of the hypothesis that locations with more available land have a higher elasticity of land supply.

This finding is consistent with our theoretical considerations, as it suggests that shocks to demand lead to greater new construction in locations with more available land in addition to the lower extent of capitalization that we found above.

The number of single-family home permits is the dependent variable in all supply equations. Columns (1a) and (1b) report direct estimates of land supply elasticities. The coefficient on change in house prices is relatively large and marginally significant in locations with more developable land, while it is quite small and not statistically significant in the more developed locations. The test of equality between the coefficients in columns (1a) and (1b) rejects with a p-value of 0.11. Columns (2a) and (2b) include lagged permits to control for other factors that might lead to new construction. The coefficient on change in house prices is about one third larger in locations with more available land, and the test of equality between the coefficients in columns (2a) and (2b) rejects with a p-value of 0.13. In addition, the constants suggest that steady-state construction is one-half as large in relatively developed regions. We would also note, however, that the estimated elasticities are much lower in this paper than other work that looks at longer time periods. (See Gyourko and Voith 2000, for example.)

B. Spending and Override Regression Results

Next, we examine how the extent of capitalization, proxied by the percentage of developed land, is related to spending changes during the 1990-1994 period.[19] Our predictions are that communities with little available land, and thus a high extent of capitalization, spend more on public services than communities with plenty of developable land. At a first glance, the data seem to support our predictions. For example, consider communities whose spending is within 0.1 percent of their levy limit in 1990 and who must pass an override in a general election in order to grow spending by more than 2.5 percent. Over one-half of constrained towns with little available land pass an override (57 percent), while only 35 percent of towns with more potentially developable land pass an override.

[19] One might suppose that the amount of available land is related to changes in spending for other reasons besides capitalization. Effectively, local governments have only two ways to increase revenues: either pass an override or allow more construction. Hence, communities with plenty of available land could relax Proposition 2½ by allowing new units to generate additional revenue. Yet, the results in Table 4 point in the opposite direction. Communities with plenty of available land have less additional spending. Hence, either local governments with more available land do not raise new construction or the behavior of local governments would bias us against finding a relationship between land availability and changes in school spending. Furthermore, land availability is measured in 1984, so land supply had little time to respond to the 1981 passage of Proposition 2½.

To examine overall spending changes regardless of whether or not a community was constrained by Proposition 2½, Table 4 reports estimates from the equations for percentage change in school spending and non-school spending between 1990 and 1994. The school spending regressions include the percent change in number of students as an endogenous variable, while the non-school spending regressions include the percent change in population between 1990-1994. Columns (1) and (2) report the equations with all of the variables described in the data section, a broad set of constraint variables from Proposition 2½, and the percentage of developed land. Columns (3) and (4) drop the more recent Proposition 2½ and state regulatory variables as potentially endogenous, but the results are virtually unchanged.

As predicted, in the school spending equation (columns 1 and 3) land scarcity has a positive effect on school spending that is statistically significant at the 5 percent level and is quite similar across specifications. The coefficient in column (1) suggests that a community with 10 percent more developed land in 1984 has a 2.4 percent larger increase in education spending. Hence, the estimate confirms our theoretical prediction.

Other variables perform as expected. Indeed the limitations passed under Proposition 2½ led to lower spending increases in Massachusetts cities and towns more than 10 years after its original passage. Cities and towns that were required to cut revenues for the first two or three years of Proposition 2½ (the communities that faced the largest initial constraints) increased their education spending 9 and 16 percentage points less, respectively, than communities with zero or one year of initial revenue cuts. All of the Proposition 2½ coefficients but one (at levy limit, no overrides) have the anticipated sign, and many variables are statistically different from zero.

The results for non-school spending are quite different compared to the ones for school spending. The coefficient of the land supply elasticity measure is positive but is not statistically different from zero. Only two other constraint variables are individually statistically significant. Communities that had ever passed an override increased spending by 14 percentage points more than other communities. Also, for every 1 percent that a community was required to increase school spending in 1994, non-school spending fell 0.33 percent between 1990 and 1994.

We have several potential explanations why the coefficient of the land supply elasticity measure may not be statistically different from zero in the non-school estimates. Non-school spending, dominated in most communities by fire and police services and public works such as trash removal, street repair, and snow plowing, may have fewer discretionary items than the school budget. We also conjecture that there are fewer differences between the preferences of the marginal homebuyer and the median voter with regard to these types of services, which are used relatively equally by most groups of residents.

Finally, we examine the relationship between land availability and the cumulative amount of overrides (per capita) passed in a community that is at its levy limit between 1990 and 1994. Rather than looking at spending in all communities, here we only examine communities that are constrained by Proposition 2½ and have bumped up against their state-mandated spending (levy) limits. Thus voters must approve increases in spending above 2½ percent per year in the form of an override. Similar to the spending regressions, we predict that land scarcity (and thereby the extent to which additional spending on schools is capitalized into house values) affects the incentives to vote for an override.

Table 5 presents four different specifications of the amount of overrides approved by voters in communities that were at their levy limit in 1990. Column (1) reports results for the base equation that does not include Proposition 2½ variables. The regression only includes the percentage of developed land in 1984—our proxy for land supply elasticity—plus other local characteristics for 1990 that may affect demand for education. Notice that communities that are at their levy limit are already constrained by Proposition 2½ and there is no necessary reason that these variables should affect incremental spending above the Proposition 2½ limits. Nonetheless, Column (2) includes early 1980s Proposition 2½ variables. Column (3) then adds late 1980s Proposition 2½ variables. Finally, column (4) includes endogenous population changes in addition to the 1990 explanatory variables of the base regression.

The coefficient of the measure for land supply is positive and statistically significant at the 5 percent level (column 1) or at the 10 percent level (columns 2 to 4) in all four regressions. The size of the land supply coefficients is quite stable among all equations. In addition to land supply, only a few other variables have a statistically significant effect on the cumulative amount of overrides. Communities with a higher percentage of college-educated adults are also more likely to approve higher overrides as are localities with a high ratio of school enrollment to total population. Also of interest is that communities with a higher percentage of residents over age 65 are more likely to support overrides, which is in contrast to the common perception that elderly voters do not support many spending increases. Since the use of the proceeds from the overrides are not identified, it is possible that older residents in Massachusetts have strong preferences for certain types of durable local public goods such as parks or services to the elderly, which might have benefited from additional spending. We examine this issue in more detail, below.

We also estimated the effects of several interaction terms on local public spending. Theory predicts that the homeownership status of the median voter and the percentage of elderly residents interacted with population density should affect local public spending. However, with the exception of the homeownership-density interaction—which is confirmed by the data—we do not find statistically significant interactions. We conjecture that this may be due to the relatively small sample size of 208 Massachusetts cities and towns. Thus, we turn to a much larger, national data set on school spending.

4 Empirical Analysis for National Sample

Section 3 demonstrates a relationship between the land market and school spending decisions. Below we suggest that this linkage is not limited to Massachusetts' communities that are constrained by Proposition 2½. To consider the applicability of these results in a broader setting, we turn to school district level data that covers most areas of the United States. Because our preferred proxy for land supply elasticity—the percentage of undeveloped land— is not broadly available across the United States, we use population density as the next best proxy for the inelasticity of land supply.[20] While we lose the precision and the nicely identified setting of the Massachusetts data from 1990-1994, we gain a much broader sample that allows us to examine the relationship between density and school spending in much more detail.

4.1 Empirical Specification

Our basic estimating equation for school expenditures per pupil is as follows:

$$\begin{aligned}\text{spending per pupil} = \; & \beta_0 + \beta_1(\text{population density}) + \beta_2(\text{local characteristics}) \\ & + \beta_3(\text{school characteristics}) + \beta_4(\text{state and federal revenue}) \\ & + \beta_5(\text{state}) + \varepsilon.\end{aligned} \tag{7}$$

Dollar denominated variables such as total school spending per pupil and household income are measured in logs. In addition to population density we add other local and school characteristics to control for additional factors that may explain school spending, including cost variables, household income, the educational and demographic background of residents, and state-specific effects. Also, we include several measures of racial differences and income inequality in a community that have been shown by other authors to help explain variability in school spending across communities. The first variable measures differences in racial composition between the elderly and school-aged children and is quite similar to a variable used in Poterba (1997). The variable is defined as percentage of non-whites among children aged 5-19 minus the percentage of non-white elderly among total elderly. Its value increases when there are relatively more white elderly than non-white children, which Poterba demonstrates is negatively related to school spending at the state level. Second, ethnic fractionalization, measures the probability that two persons drawn randomly from the population belong to different self-identified ethnic groups (white, black, American Indian, Asian, Hispanic, and other) and is shown by Alesina et al. (1999) to be negatively related to the school share of total municipal spending and positively related to overall municipal spending levels. We also include the Gini coefficient as a measure of income inequality within each community. Finally, we also control for revenue received from state and federal sources.

While the Massachusetts spending regressions have a quasi-experimental design (i.e., conditional on being constrained, which communities increased spending levels), the national regressions examine overall per pupil spending levels and presume that most communities in the sample are at or near their desired spending. The model in Section 2.3 suggests that desired spending (by the median voter) may itself be a function of the extent of capitalization. In this case, we examine whether higher density, a proxy for the extent of capitalization, is correlated with increased school spending.

Given the possibility that density might also be related to other community factors that are unrelated to land supply, we use theoretical predictions from Section 2 that should be specifically driven by a land supply effect, including:

Prediction A: School spending should be positively related to population density.

Prediction B: The density effect should be increasing in the homeownership rate of a community, as renters do not benefit from capitalization of school spending into house prices.

---

[20] As the regression results from Table 3 suggest, population density may be a reasonable proxy for land supply inelasticity. These two variables are positively and significantly correlated. Other results from Section 3 also hold when we include density instead of land availability, but with reduced significance levels.

Prediction C: Owners without children in the schools, such as the elderly, should be willing to support educational services if they have a relatively short time horizon in their property and the extent of capitalization is high.

Prediction C1: The interaction of population density and percentage elderly residents should be positive.

Prediction C2: The positive relationship between percent elderly and density should grow larger for older elderly residents who have a shorter expected duration in their property.

Prediction C3: The percentage elderly should be associated with higher spending levels only in large cities and suburbs where land for new supply is particularly scarce.

Prediction D: The theoretical model depends on local voters choosing spending levels to maximize house prices in their community. Locations where states mandate school spending should have no linkage between density and school spending.

4.2 The Data

The data used in the analysis below are drawn from the School District Data Book (SDDB) collected by the U.S. Department of Education for the school year 1989/90. The SDDB provides data on a large number of school districts that includes total expenditures per pupil, cost variables (such as the percentage of children below the poverty line, the percentage of children that "speak English not well," or the percentage of children "at risk"[21]), the school district type, and the number of schools within a district. The SDDB also includes data from the 1990 U.S. Census that is geographically matched to the school district level. In particular, this data set includes the population density, the percentage of households with children, homeownership rate, median household income, college educated adults, age, race, and racial composition of various age categories.

We exclude extremely small school districts as well as school districts with implausibly low or high total expenditures per pupil.[22] Furthermore, not all school districts report total school expenditures or certain school specific characteristics. After dropping data from districts with

[21] A child, 6 to 19 years of age, is defined "at risk" if the child is not a high school graduate and lives with a mother who is not a high school graduate, or who is divorced or separated, and whose income is below the 1989 poverty level.

[22] We exclude school districts that report total expenditures per pupil below $1,000 and above $20,000. Furthermore, we exclude the 10 percent smallest school districts, that is, school districts that have less than 95 students, as the cost of providing education for such a small number of students is likely to differ substantially from the costs faced by the vast majority of districts in the country.

missing values, we have a sample of 13,141 school agencies that are located in 49 states. Table 6 reports summary statistics for the variables that are included in the analysis below.

4.3 Results

To begin, we examine Prediction A; everything else equal, densely populated school districts will have greater total expenditures per pupil. Table 7 reports estimates for total per pupil school spending as in equation (7). Column (1) reports the results for the base equation that includes the population density as proxy for land supply inelasticity. Population density is strongly and positively related to school spending, even when controlling for household income, the educational and demographic background of residents, cost variables, school agency specific characteristics, and ethnic factors. The coefficient on density is both statistically and economically significant. Table 8 presents estimated quantitative effects for two hypothetical communities: a suburban community of a small MSA (population density 150 persons/square kilometer, equivalent to approximately 400 persons per square mile) and a more densely populated suburb or center city for a large MSA (population density of 1,500 persons per square kilometer, or about 4,000 persons per square mile.) The coefficients suggest that the more densely populated place will spend about 3.3 percent more on schools than the less-densely populated community. This is equivalent to about $170 per pupil at the sample mean per pupil spending of $5,169.

Overall, most of the other control variables have the expected effect on school spending and are reported in column (1) of Appendix Table B. In particular, cost variables such as the percentage of children below the poverty line or who speak English “not well” are positively related to school expenditures, while increases in the number of schools within a school district are associated with lower spending (at a decreasing rate), presumably due to beneficial economies of scale. School spending increases with median household income and percentage of residents with a college education. Overall ethnic polarization is associated with more school spending.[23] Also, local districts increase total spending by only about 4 percent of the revenue received from state and federal sources. While the typical community within our sample receives approximately 48 percent of revenue from state and local sources, in many cases this revenue is

[23] The coefficient on ethnic polarization is not inconsistent with Alesina et al. (1999), who find that ethnic polarization is negatively related to the school share of total spending at the city level, but positively related to overall spending. Their model has an ambiguous prediction about the impact of ethnic polarization on the overall level of school spending.

lump sum, so that marginal expenditures are still financed from local sources. We examine this issue further in Table 10, below, by dividing the sample based on state variation in school funding policies.

The results in column (2) of Table 7 support Proposition B, that the relationship between density and school spending is tied to homeownership. When we interact the homeownership rate of the community with density, the coefficient on the interaction is positive and highly significant, while the coefficient on density changes sign and becomes negative, but still statistically significant. We use the overall homeownership rate in the interaction since it is not possible to observe the attributes of the median voter in each community.[24] These results support proposition B and suggest that the positive relationship between density and spending only exists in communities where residents are more likely to be homeowners. Note that the coefficient on homeownership is also positive, but that several other theories predict that high homeownership communities might spend more on schools. For example, owners can deduct property taxes from their federal tax returns. However, such theories are not tied to density. According to Table 8 (Row 2), a 10 percentage-point increase in the homeownership rate is associated with a much larger increase in spending in the densely populated community (3.1 percent increase) than in the less densely populated place (1.1 percent), which is in line with the predictions of our model in Section 2.3.

Next, we confirm that the capitalization effect applies to elderly residents who do not use school services, but have a shorter expected duration in their house, in columns (3)-(5).[25] Again, we interact percent elderly with population density for elderly residents aged 65 and above, 75 and above , and 85 and above. The propositions predict that the interactions will be positive and increase in size for the older elderly residents who have an even shorter expected duration in their property. In all three columns, the interaction between percent elderly and density is positive and the interaction term is statistically significant at the 95 percent level for the definitions using 75 and above and 85 and above. The coefficient is significant with 94 percent confidence using a definition of elderly of 65 and above. Furthermore, the size of the coefficient on this interaction

[24] Alternatively, if we include a dummy variable for communities in which the homeownership exceeds fifty percent, our conclusions remain unchanged. That is, the coefficient on the interaction between communities with a homeownership rate greater than fifty percent and density is strongly positive and statistically significant, while the coefficients on density and the dummy variable for homeowner communities are both insignificant (results are available from the authors, upon request).

[25] Sinaii and Souleles (2001) use a similar strategy to show that rent volatility reduces the likelihood of homeownership, demonstrating that elderly residents who are likely to be especially sensitive to rent risk are more likely to be homeowners in places with a higher volatility of rents.

rises with the age we use for the definition of percent elderly. Interestingly, the direct effect of percent elderly is either insignificant (column 1) or negative and significant (columns 2 and 3). Once again in Table 8, we can see that increases in the percent elderly are associated with more school spending in a high density place, but decreases in spending in a low density community. Table 9 takes this prediction one step further. All of the equations in this section have used population density to proxy for land availability or the elasticity of supply. As an alternative, we use information about the types of locations, dividing communities into seven types, including central city of large MSA (population over 1 million in MSA), suburb of central city in larger MSA, central city of medium-sized MSA (MSA population between 250,000 and 1 million), suburb in medium-sized MSA, central city of small MSA (MSA population below 250,000), suburbs of small MSA, and non-MSA locations. According to the summary statistics in Table 6, over one-half of the districts in our sample are in the last category; that is they do not serve an MSA. Proposition D3 predicts that percent elderly should only matter in places where new land is relatively difficult to obtain, which we would generally expect to occur in the largest MSAs, but not in smaller places. Table 9 includes location type dummy variables as well as interactions between percent elderly and each of the location types. Notice that all other community types have higher spending on a per pupil basis than non-MSA locations, the excluded location type, and that these location dummies are statistically significant for all but central cities of medium sized and small MSAs. Not surprisingly, non MSA-places with a few economies of scale have the highest per pupil spending, even after controlling for all other covariates included in the regressions in Table 7.

Consistent with our earlier results, and Prediction C3, the interaction between percent elderly and community type is positive and statistically significant in the large MSAs, both the central cities and suburbs, but negative in all other locations, including medium and small MSAs, as well as non-MSA locations. The coefficients on the age 65 variables are statistically different from zero in all locations except central city locations in a medium-sized MSA. These results hold whether we drop density (column 1) or include this variable (column 2), or even include the interaction between homeownership and density in column (3). Interestingly, the coefficients on population density, homeownership, and their interaction are nearly unchanged from those in Table 7, column (2), which excludes all of the elderly interactions. Thus, even within these different types of communities, we still find a strong positive correlation between school spending and the interaction of homeownership and density.

Even with all of the earlier results, one could still be concerned that density is picking up some unobserved cost or demand factor. Thus we examine Prediction D; that all of the density results with regard to school spending should only hold in locations where local voters can choose their optimal level of spending on schools. In this regard, we take advantage of state level variation in funding public schools, relying on recent results in Hoxby (2001). Hoxby shows that states take a variety of approaches to funding schools, running the gamut from states that leave most funding decisions to local voters, to other states that "level up" low-spending districts by mandating a high level of local "effort" to fund schools (effectively setting a minimum local property tax rate to be used for school funding), and states that "level down" the efforts of high-spending school districts by requiring that communities raising more than a certain amount of funding must rebate a portion of their money to low-spending districts. Some states provide funding that depends negatively on local property values, effectively penalizing locations that want to maximize local house prices by spending more money on schools. Hoxby shows that state educational policies that impose redistribution can sometimes have unintended general equilibrium effects. For example, policies that "level down" spending in rich school districts, can make even poor districts worse off.

Using state classifications in Table I from Hoxby, we divide our sample into three groups of states: states with policies that place relatively few restrictions on local school spending, states that place significant restrictions on local school spending, and states that essentially mandate a fixed level of funding based on state formulas.[26] Our theory applies most closely to states that mandate few restrictions or financial incentives on spending levels by local governments, while we would expect that there should be no linkages between school spending and density or density interacted with homeownership or percent elderly in states with mandated spending levels. The middle group of states is hard to categorize given the variety of possible general equilibrium effects caused by state policies, so we do not include them in the regressions that follow.

Table 10 reproduces all the regressions in Table 7 for states with mandated expenditures and states with few restrictions on spending, groups one and three. The results support Proposition D. In column (1), the coefficient on density is small and statistically insignificant in the states with mandated expenditures, but positive and statistically significant in states with few

[26] Thirty-four states meet two conditions in order to be classified as having few restrictions: 1) a relatively low foundation (minimum) tax rate below 28 mills (0.28 percent); and 2) no state-imposed "tax" or "subsidy" policies designed to equalize local school spending or tax rates. California, Hawaii, and New Mexico essentially have

restrictions. In fact the density coefficient in the states with minor restrictions is nearly twice as big as in Table 7 for all states. When we include the homeownership and elderly interactions, we get the same pattern. Coefficients on the density interactions are positive and highly statistically significant for states with minor restrictions, but small and insignificant in the other states. Interestingly the direct effect of percent elderly is always quite negative in states with mandated spending, likely because these states have formulas that depend positively on the percentage of children in a district.

Finally, we examine the possibility that our results might be driven by the exclusion of crime data. In particular, some have suggested that elderly households or homeowners might be willing to spend more money on schools if it reduced the crime rate in their community and the crime rate might well be correlated with density. To examine this hypothesis, we obtain crime rates at the zip code level in as many jurisdictions as possible from the FBI.[27] Crime data is considerably more problematic than other variables because not all jurisdictions report crime data and jurisdictions vary in scope both for school districts and police forces. For example, some communities have local schools, but their crime rates are only reported at the county level. Given the difficulties of using disaggregated crime statistics that are unlikely to be accurate for particular locations, we only consider school districts where the crime data are reported at the city level or below. These exclusions decrease our sample by one-third, leaving us with 8,686 remaining school agencies. Empirically, the greatest loss of observations is for rural places without their own police forces.[28]

The regressions show that the inclusion of crime rates or crime rates interacted with the homeownership rate or percent elderly has virtually no effect on the coefficients on density or on the density interactions. For example, when we include murder rate and the murder rate interacted with the homeownership rate or the percent elderly, the coefficients on density and the interaction terms between density and homeownership or the elderly are either unchanged, or are slightly larger in magnitude. The coefficient on the murder rate itself is positive and statistically

---

state-mandated funding levels that local voters cannot change. The remaining states are classified as having significant restrictions on local school spending.

27 The crime data come from U.S. Dept. of Justice, Federal Bureau of Investigation. Uniform Crime Reporting Program Data: United States—Offenses Known and Clearances by Arrest, 1990. Compiled by the U.S. Dept. of Justice, Federal Bureau of Investigation. ICPSR ed. Ann Arbor, MI: Inter-university Consortium for Political and Social Research [producer and distributor], 1997. We also used zip code information from ESRI Inc. and Geographic Data Technology, Inc. to help match the crime data with the school agency information.

28 All of the results with crime rates are similar if we apply county-level crime rates to individual agencies, although we believe this approach to be less accurate.

significant, suggesting that locations with higher crime rates spend more on schools, but the coefficient on the interaction between elderly and murder rate or homeownership and the murder rate is negative and significant. In these regressions we use the murder rate because it is the crime rate that is least likely to be mis-measured and is the highest profile statistic for most citizens. Alternatively, we have run these regressions using rates for all crimes and crimes committed by juveniles, and our findings with regard to density and its interactions are unchanged. Finally, in all the crime regressions, the density coefficient is slightly smaller than in our total sample, possibly because we have to remove many smaller places that help identify the overall density effect.

5 Conclusion

In this paper we present theoretical propositions and supporting empirical work showing that school spending depends on the extent of house price capitalization within a community, and that the extent of capitalization itself is tied to the supply of available land. In particular, we argue that capitalization of fiscal variables and amenities should be especially high in densely populated areas where there is little available land and capitalization should be quite low in rural locations where land is more readily available. Hence, localities with little available land should spend more on local public goods such as schools if this spending is capitalized into house values.

We examine these theoretical predictions using two alternative data sources. First, we analyze unique data from Massachusetts that includes a measure of available land for a large number of communities. Consistent with the theory, we find that fiscal variables and amenities are capitalized to a much greater extent in towns with little available land, and confirm that these locations have a lower elasticity of land supply. We then show that these communities also spend more on schools and voters in these cities and towns are more likely to pass spending overrides in order to undertake costly spending programs.

Next we examine school spending data for the school year 1989-1990 from 49 states and show that per pupil spending is higher in communities with a greater population density. The estimates are quite large. For example, a community with a density of 1,500 people per square kilometer spends $170 (3.3 percent) per pupil more than a town with a density of 150 people per square kilometer. The estimated positive relationship between density and spending becomes larger in places with especially high homeownership rates. Finally, we demonstrate that elderly voters are not necessarily averse to public school spending. A higher percentage of elderly voters in dense locations is correlated with increased spending on schools, but more elderly residents in rural areas is associated with unchanged or even lower school spending levels. The correlation between spending and the interaction of percent elderly and density becomes larger when one examines older elderly citizens who should have a shorter expected duration in their house.

These findings raise questions about the future of educational spending in the U.S. A number of authors (see Poterba 1998, for example) have speculated that the coming increase in percentage of elderly voters might prove problematic for programs such as education that depend on the support of an increasing percentage of households who do not use this service.[29] Our results suggest that an increasing percentage of elderly voters does not necessarily portend lower school spending in all locations, especially places with greater population density. However, projecting these results into the future relies heavily on the assumption that the marginal homebuyer will continue to value public schools in most communities. It is quite possible that an increasing number of elderly voters will sell houses that they purchased when they raised a family and move to communities that focus on elderly services. If the increased number of elderly voters leads to greater Tiebout sorting, then the prognosis of future school spending reductions, at least at the municipal level, might not be a problem. However, even if the elderly sort at the local level, support for state-level spending on schools might still be stymied.

More generally, these results support models in which house prices can encourage the efficient provision of public services. In this regard, the fact that voters care about the preferences of future generations of (marginal) home buyers provides positive incentives to provide a variety of services that may be consumed by only a minority of current residents and discourages communities from financing their services by imposing burdens on future generations of residents or home buyers.

[29] Poterba notes that house price capitalization might serve as a counterweight to his projection that an increasing percentage of elderly voters would be associated with strong reductions in real school spending.

References

Alesina, Alberto, Reza Baqir, and William Easterly. 1999. Public Goods and Ethnic Divisions. *Quarterly Journal of Economics* 114(4): 1243-84.

Black, S. E. 1999. Do Better Schools Matter? Parental Valuation of Elementary Education. *Quarterly Journal of Economics* 114:577-600.

Blomquist, G., M. C. Berger, and J. P. Hoehn. 1988. New Estimates of Quality of Life in Urban Areas. *American Economic Review* 78:89-107.

Bogart, W. T. and B. A. Cromwell. 1997. How Much More Is a Good School District Worth? *National Tax Journal* 50:215-232.

Bogart, W. T. and B. A. Cromwell. 2000. How Much Is a Neighborhood School Worth? *Journal of Urban Economics* 47:280-305.

Bradbury, K. L., C. J. Mayer, and K. E. Case. 2001. Property Tax Limits and Local Fiscal Behavior: Did Massachusetts Cities and Towns Spend Too Little on Town Services Under Proposition 2½. *Journal of Public Economics* 80:287-312.

Bruce, D. and D. Holtz-Eakin. 1999. Fundamental Tax Reform and Residential Housing. *Journal of Housing Economics* 8:249-271.

Brueckner, J. K. 1982. A Test for Allocative Efficiency in the Local Public Sector. *Journal of Public Economics* 19:311-31.

Brueckner, J. K. and M.-S. Joo. 1991. Voting with Capitalization. *Regional Science and Urban Economics* 21:453-467.

Bui, L. and C. J. Mayer. 2002. Regulation and Capitalization of Environmental Amenities: Evidence from the Toxics Release Inventory in Massachusetts. The Wharton School Working Paper, April.

Capozza, D. R., R. K. Green, and P. H. Hendershott. 1996. Taxes, Mortgage Borrowing, and Residential Land Prices. In *Economic Effects of Fundamental Tax Reform*, edited by H. J. Aaron and W. G. Gale. Washington, D.C.: Brookings Institution Press.

Case, K. E. and C. J. Mayer. 1996. Housing Price Dynamics within a Metropolitan Area. *Regional Science and Urban Economics* 26:387-407.

Case, K. E. and R. J. Shiller. 1987. Prices of Single-Family Homes since 1970: New Indexes for Four Cities. *New England Economic Review* September/October:45-56.

Conley, J. P. and A. Rangel. 2001. Intergenerational Fiscal Constitutions: How to Protect Future Generations Using Land Taxes and Federalism. NBER Working Paper No. W8394, July 2001.

Cutler, D. M., D. W. Elmendorf, and R. J. Zeckhauser 1993. Demographic Characteristics and the Public Bundle. *Public Finance* 48: 178-98.

Dee, T. S. 2000. The Capitalization of Education Finance Reforms. *Journal of Law and Economics* 43:185-214.

Dreiman, M. and J. R. Follain. 2001. Drawing Inferences about Housing Supply Elasticity from House Price Responses to Income Shocks. Working Paper, March 2001.

Edelson, N. M. 1976. Voting Equilibria with Market-based Assessments. *Journal of Public Economics* 5:269-284.

Epple, D. and A. Zelenitz. 1991. The Implications of Competition Among Jurisdictions: Does Tiebout Need Politics. *Journal of Political Economy* 89:1197-1217.

Fischel, W. A. 1990. Do Growth Controls Matter? A Review of Empirical Evidence on the Effectiveness and Efficiency of Local Government Land Use Regulation. Lincoln Institute of Land Policy Working Paper, May.

____. 2001. Homevoters, Municipal Corporate Governance, and the Benefit View of the Property Tax. *National Tax Journal* 54:157-173.

Glaeser, E. 1996. The Incentive Effects of Property Taxes on Local Governments. *Public Choice* 89:93-111.

Glaeser, E. L. and J. Gyourko. 2001. Urban Decline and Durable Housing. NBER Working Paper No. 8598.

Goldin, C. and L. Katz. 1997. Why the United States Led in Education: Lessons From Secondary School Expansion, 1910 to 1940. NBER Working Paper No. 6144.

_____. 1999. Human Capital and Social Capital: The Rise of Secondary Schooling in America, 1910 to 1940. *Journal of Interdisciplinary History* 29: 683-723.

Gyourko, J., M. Kahn, and J. Tracy. 1999. Quality of Life and Environmental Comparisons. In *Handbook of Regional and Urban Economics*, edited by P. Cheshire and E. S. Mills. New York: North-Holland.

Gyourko, J. and J. Tracy. 1991. The Structure of Local Public Finance and the Quality of Life. *Journal of Political Economy* 99:774-806.

Gyourko, J. and R. Voith. 2000. The Price Elasticity of the Demand for Residential Land. The Wharton School Working Paper, February.

Hamilton, B. W. 1976. Capitalization of Intrajurisdictional Differences in Local Tax Prices. *American Economic Review* 66:743-753.

Haurin, D. R. and D. Brasington. 1996. The Impact of School Quality on Real House Prices: Interjurisdictional Effects. *Journal of Housing Economics* 5:351-368.

Hilber, C. 1998. *Auswirkungen Staatlicher Massnahmen auf die Bodenpreise. Eine theoretische und empirische Analyse der Kapitalisierung.* PhD Dissertation. Zurich: Rüegger.

Hoxby, C. M. 1998. How Much Does School Spending Depend on Family Income? The Historical Origins of the Current School Finance Dilemma. *American Economic Review* 88(2): 309-14.

Hoxby, C. M. 2001. All School Finance Equalizations Are Not Created Equal. *Quarterly Journal of Economics* 116(4):1189-1231.

Hoyt, W. H. 1999. Leviathan, Local Government Expenditures, and Capitalization. *Regional Science and Urban Economics* 29:155-171.

Inman, R. P. 1978. Testing Political Economy's 'As If' Proposition: Is the Median Voter Really Decisive? *Public Choice* 33(4): 45-65.

Malpezzi, S. 1996. Housing Prices, Externalities, and Regulation in U.S. Metropolitan Areas, Journal of Housing Research 7:209-241.

Man, J. Y., and M. E. Bell. 1996. The Impact of Local Sales Tax on the Value of Owner-Occupied Housing. *Journal of Urban Economics* 39:114-131.

Mayer, C. J., and C. T. Somerville. 2000. Land Use Regulation and New Construction. *Regional Science and Urban Economics* 30:639-62.

McMillan, M., and R. Carlson. 1977. The Effects of Property Taxes and Local Public Services Upon Residential Property Values in Small Wisconsin Cities. *American Journal of Agricultural Economics* 59:81-87.

Mills, E. S. and W. E. Oates. 1975. *Fiscal Zoning and Land Use Control. The Economic Issues.* London: Heath-Lexington Books.

Oates, W. E. and R. Schwab. 1988. Economic Competition Among Jurisdictions: Efficiency Enhancing or Distortion Inducing? *Journal of Public Economics* 35:333-354.

____. 1996. The Theory of Regulatory Federalism: The Case of Environmental Management. In *The Economics of Environmental Regulation,* edited by W. E. Oates. Aldershot, UK: Edward Elgar. Publishing Limited.

Palmon, O. and B. A. Smith. 1998a. New Evidence on Property Tax Capitalization. *Journal of Political Economy* 106:1099-1111.

____. 1998b. A New Approach for Identifying the Parameters of a Tax Capitalization Model. *Journal of Urban Economics* 44: 299-316.

Pogodzinski, J. M. and T. R. Sass. 1991. Measuring the Effects of Municipal Zoning Regulations: A Survey. *Urban Studies* 28: 597-621.

____. 1994. The Theory and Estimation of Endogenous Zoning. *Regional Science and Urban Economics* 24: 601-630.

Poterba, J. 1997. Demographic Structure and the Political Economy of Public Education. *Journal of Public Policy and Management* 16(1): 48-66.

____. 1998. Demographic Change, Intergenerational Linkages, and Public Education. *American Economic Review* 88(2): 315-320.

Ross, S. and Yinger J. 2000. Sorting and Voting: A Review of the Literature on Urban Public Finance. In *The Handbook of Regional and Urban Economics, Vol. 3: Applied Urban Economics,* edited by P. Cheshire and E. S. Mills. New York: North-Holland.

Sinai, T. 1998. Are Tax Reforms Capitalized into House Prices? The Wharton School Working Paper, December.

Sinai, T. and N. Souleles. 2001. Owner Occupied Housing as Insurance Against Rent Risk. The Wharton School Working Paper, May.

Shiller, R. J. 1991. Arithmetic Repeat Sales Price Estimators. *Journal of Housing Economics* 1: 110-126.

Smith, V. K. and J.-C. Huang. 1995. Can Markets Value Air Quality? A Meta-Analysis of Hedonic Property Value Models. *Journal of Political Economy* 103:209-227.

Sonstelie, J. C. and P. R. Portney. 1978. Profit Maximizing Communities and the Theory of Local Public Expenditures. *Journal of Urban Economics* 5:263-277.

____. 1980. Take the Money and Run: A Theory of Voting in Local Referenda. *Journal of Urban Economics* 8:187-195.

Sprunger, P. and J. D. Wilson. 1998. Imperfectly Mobile Households and Durable Local Public Goods: Does the Capitalization Mechanism Work? *Journal of Urban Economics* 44:468-492.

Stull, W. J., and J. C. Stull. 1991. Capitalization of Local Income Taxes. *Journal of Urban Economics* 29:182-190.

Weimer, D. L. and M. J. Wolkoff. 2001. School Performance and Housing Values: Using Non-contiguous District and Incorporation Boundaries to Identify School Effects. *National Tax Journal* 54:231-53.

Wildasin, D. E. 1979. Local Public Goods, Property Values, and Local Public Choice. *Journal of Urban Economics* 6, 521-534.

Wyckoff, P. G. 1995. Capitalization, Equalization, and Intergovernmental Aid. *Public Finance Quarterly* 23:484-508.

Yinger, J. 1982. Capitalization and the theory of local public finance. *Journal of Political Economy* 90:917-943.

____. 1985. Inefficiency and the Median Voter: The Property Tax, Capitalization, Heterogeneity, and the Theory of the Second Best. In *Perspectives on Local Public Finance and Public Policy, Vol. 2*, edited by J. M. Quigley. Greenwich CT: JAI Press.

Summary Statistics and Regression Tables

Table 1
Variable List and Means
N=208

Variable	Mean	Standard Deviation	Minimum	Maximum
Endogenous Variables:				
Percent change in house prices, FY1990-94	-.077	.057	-.208	.071
Percent change in school spending, FY1990-94	.15	.09	-.15	.54
Percent change in non-school spending, FY1990-94	.083	.158	-.323	.680
Single family permits, 1990-94, per 1990 housing unit	.046	.038	.001	.230
Fiscal Variables:				
Effective property tax rate, FY1980	.031	.009	.012	.086
Dummy, one year of initial levy reductions, FY1982	.46	.50	0	1
Dummy, two years of initial levy reductions, FY1982-83	.12	.32	0	1
Dummy, three years of initial levy reductions, FY1982-84	.034	.181	0	1
Excess capacity as percentage of levy limit, FY1989	.018	.036	1.1e-7	.20
Dummy variable, at levy limit and no overrides, FY1989*	.44	.50	0	1
Dummy variable, passed override(s) prior to FY1990	.11	.31	0	1
Dummy variable, "unconstrained" in FY1989*	.46	.50	0	1
Equalized property value per capita, 1980 (000)	16.4	6.2	6.3	44.1
Nonresidential share of property value, FY1980	.19	.09	.04	.60
Percentage of revenue from state aid, FY1984	.26	.10	.05	.52
Percentage of revenue from state aid, FY1981	.19	.08	.05	.43
Percentage increase in state aid, FY1981-84	.43	.31	-.44	3.38
Community Characteristics:				
School test scores, 1990*	2690	168	2160	3080
Fraction of 1980 population under age 5	.062	.013	.032	.11
Fraction of 1990 population over age 65	.13	.034	.027	.22
Dummy variable, in Boston metro area (PMSA)	.45	.50	0	1
Dummy variable, in Boston suburban ring*	.19	.40	0	1
Fraction developed land in community, 1984*	.88	.054	.74	.97
Single family permits per 1990 housing unit, 1989	.008	.007	.000	.038
Enrollment/population ratio, 1981	.20	.04	.08	.42
Median family income, 1980 (000)	21.0	5.6	11.5	47.6
Dummy variable, member of regional district	.26	.44	0	1
Dummy variable, member of regional high school	.19	.39	0	1
Percent of adult residents with college education, 1980	.20	.12	.05	.60

Notes, marked with asterisks:
"At levy limit" is defined as levy within 0.1 percent of levy limit.
"Unconstrained" communities are not at levy limit in FY1989 and have passed no overrides prior to FY1990.
School test scores is combined math and reading MEAP test score for 8th graders in 1990.
Boston suburban ring is defined as within MSA but outside PMSA.
Developable land is defined as open land (including farmland) or public land.
Sources: Massachusetts Department of Education; Massachusetts Department of Revenue, Division of Local Services, Municipal Data Bank; U.S. Department of Commerce, Bureau of the Census.

Table 2
House Price Regression Results Using Land Scarcity and Density as Proxies for Land Supply Elasticity
Dependent Variable: Percent Change in House Prices, Fiscal Years 1990-1994

Specification	Sample divided by percentage of open and public (developable) land		Sample divided based on population density	
Explanatory Variable	Less Developable Land (1a)	More Developable Land (1b)	More Densely Populated (2a)	Less Densely Populated (2b)
Single family permits, 1990-1994, per 1990 housing units	-.64 ** (.20)	-.14 (.17)	.027 (.25)	-.27 (.18)
Percent change in school spending, FY 1990-94	.32 ** (.12)	.12 (.11)	.26 * (.15)	.14 * (.083)
Percent change in non-school spending, FY 1990-94	.064 (.089)	.038 (.061)	-.076 (.085)	.042 (.054)
Combined math and reading MEAP test score, 8th grade students, 1990 (x 10^3)	.14 ** (.028)	.11 ** (.032)	. 18 ** (.028)	.069 ** (.030)
Dummy variable, in Boston metro area	.097 ** (.013)	.075 ** (.011)	.10 ** (.014)	.072 ** (.0092)
Dummy variable, in Boston suburban ring	.11 ** (.022)	.036 ** (.0094)	.059 ** (.012)	.058 ** (.013)
Constant	-.55 ** (.078)	-.42 ** (.081)	-.64 ** (.078)	-.32 ** (.082)
Number of observations	104	104	104	104

Numbers in parentheses are robust standard errors.
* Significantly different from zero with 90 percent confidence.
** Significantly different from zero with 95 percent confidence.
Notes: **Bold** variables are endogenous. Instruments in column (1a) and (1b) include lagged permits from 1989, effective tax rate in 1980, dummy variables for the number of years required to reduce spending due to Proposition 2½, 1980 levels of resource variables from Table 1 (equalized property value per capita, non residential share of property value, median family income, and percentage of adults with a college degree), percentage increase in state aid 1981-84, percentage of revenue from state aid in 1984, and dummies for regional school district or high school.

Table 3
Land Supply Elasticity Regression Results
Dependent Variable: Single family permits, 1990-1994, per 1990 housing units
Sample divided by percentage of open and public (undeveloped) land in each community

Specification	Base set of instruments (without lagged supply as exogenous variable)		Base set of instruments (with lagged supply as exogenous variable)	
Explanatory Variable	Less Developable Land (1a)	More Developable Land (1b)	Less Developable Land (2a)	More Developable Land (2b)
Percentage change in house prices, 1990-1994	.0070 (.056)	.15 * (.080)	.13 ** (.038)	.18 ** (.047)
Single family permits, 1989, per 1989 housing units			4.9 ** (.44)	3.6 ** (.43)
Constant	.043 ** (.0055)	.064 ** (.0086)	.016 ** (.0049)	.032 ** (.0062)
Number of observations	104	104	104	104

Numbers in parentheses are robust standard errors.
* Significantly different from zero with 90 percent confidence.
** Significantly different from zero with 95 percent confidence.
Notes: **Bold** variable is endogenous. The instruments are all of the exogenous variables in the demand equation in Table 2 plus the exogenous instruments from the demand equation of columns (1a) and (1b) in Table 2.

Table 4
Spending Regression Results for Massachusetts
Dependent Variable: Percent Change in School or Non-School Spending, Fiscal Years 1990-94

Explanatory Variable	School Spending (1)	Non-school Spending (2)	School Spending (3)	Non-school Spending (4)
Percentage of developed land in 1984	.24 **	.24	.25 **	.29
	(.12)	(.19)	(.13)	(.21)
Percent change in number of students, 1990-94	.77 **		.84 **	
	(.17)		(.16)	
Percent change in population, 1990-94		1.61 **		1.60 **
		(.73)		(.78)
Equalized property value per capita, FY1990 ($x10^7$)	6.35	1.24	6.90	6.56
	(5.05)	(7.40)	(5.64)	(7.81)
Ratio, enrollment to population, FY1990	.69 **	-.24	.88 **	-.038
	(.32)	(.44)	(.32)	(.47)
Median family income (in '000), 1990	-.0024 *	-.00089	-.0027 *	-.00099
	(.0013)	(.0019)	(.0014)	(.0021)
Percentage of revenue from state aid, FY1984	.29 **	.011	.30 **	-.038
	(.11)	(.24)	(.10)	(.23)
Nonresidential share of property value, FY1990	.029	.051	-.0030	.013
	(.076)	(.12)	(.082)	(.13)
Dummy variable, member of regional school district	.059 **	-.012	.060 **	-.044
	(.028)	(.076)	(.026)	(.068)
Dummy variable, member of regional high school	-.021	-.022	-.024	.018
	(.026)	(.070)	(.025)	(.064)
Percentage increase in state aid, FY1981-84	-.0033	.052	.0081	.075 **
	(.017)	(.035)	(.015)	(.033)
Percent of adult residents with college education, 1990	.18 *	-.095	.18 *	-.12
	(.098)	(.17)	(.10)	(.20)
Percent of residents with age over 65	.25	.76	.35	.81
	(.25)	(.57)	.25	.62
Effective property tax rate, FY1980	1.93 *	-.59	2.7 **	-.62
	(1.10)	(2.3)	(1.1)	(2.2)
Dummy variable, required one year of initial levy reductions, FY1982	-.014	.019	-.023	.0083
	(.015)	(.031)	(.015)	(.032)
Dummy variable, required two years of initial levy reductions, FY1982-83	-.092 **	-.022	-.10 **	-.020
	(.029)	(.048)	(.03)	(.047)
Dummy variable, required three years of initial levy reductions, FY1982-84	-.17 **	.031	-.18 **	.021
	(.051)	(.078)	(.049)	(.080)
Excess spending per pupil (required>actual spending), FY1994	.0054	-.34 **		
	(.087)	(.17)		
Excess capacity as a percentage of levy limit, FY1989	.40	-.14		
	(.31)	(.33)		
Dummy variable, at levy limit and no overrides, FY1989	.045 **	.046 *		
	(.017)	(.027)		
Dummy variable, passed override(s) prior to FY1990	.058 **	.15 **		
	(.020)	(.034)		
Constant	-.40 **	-.28	-.44 **	-.44
	(.14)	(.25)	(.15)	(.29)
Adjusted R-squared	.14	.21	.043	.10
Number of observations	208	208	208	208

Numbers in parentheses are standard errors. *Significantly different from zero with 90 percent confidence. **Significantly different from zero with 95 percent confidence.
Notes: **Bold** variables are endogenous. Spending equations (1) and (2) include fiscal variables from the early 1980s, Proposition 2½ variables from 1989, and the excess spending per pupil in 1994 (required>actual spending). Spending equations (3) and (4) include fiscal variables from 1990 and early Proposition 2½ variables. Instruments include the single family permits in 1989 per 1990 housing units, the fraction of a community's population under age 5, developable land in 1984, housing permits in 1989, dummy variables for inside the Boston PMSA and suburban ring, fraction of residents in manufacturing in 1990, fraction of the population aged 35-60 in 1990, and average eighth grade reading and math test score in 1990.

Table 5
Override Regression Results Including Percentage of Developed Land As Independent Variable
Dependent Variable: Cumulative Amount of Overrides Passed in a Community per Capita, FY 1990-1994

Explanatory Variable	OLS Base Equation (1)	OLS Base Equation Plus Early 80s Prop. 2½ Var. (2)	OLS Base Equation Plus Late 80s Prop. 2½ Var. (3)	2SLS Endogenous Population Change (4)
Percent change in population, 1990-94				-296.3 **
				(144.0)
Percentage of developed land in 1984	92.7 **	96.0 *	93.1 *	76.8 *
	(46.0)	(51.7)	(52.9)	(46.0)
Equalized property value per capita, FY1990 ($x10^6$)	.10	.089	.049	.29
	(.28)	(.29)	(.28)	(.27)
Ratio, enrollment to population, FY1990	305.9 **	283.8 **	244.1 **	288.6 **
	(111.5)	(114.4)	(105.2)	(112.6)
Median family income (in '000), 1990	.14	.16	.30	.43
	(.78)	(.80)	(.79)	(.79)
Nonresidential share of property value, FY1990	-76.0 **	-66.5 *	-51.8	-105.9 **
	(38.2)	(40.2)	(41.2)	(38.5)
Dummy variable, member of regional school district	2.9	.91	-.66	10.5
	(17.8)	(18.6)	(15.9)	(18.4)
Dummy variable, member of regional high school	14.6	15.9	16.2	11.0
	(18.1)	(18.6)	(17.1)	(18.1)
Percent of adult residents with college education, 1990	149.6 **	149.1 **	141.7 **	101.1
	(69.5)	(69.0)	(70.9)	(72.2)
Percent of residents with age over 65	294.2 **	270.1 **	296.3 **	114.0
	(128.1)	(131.7)	(136.3)	(142.1)
Effective property tax rate, FY1980		-136.6	-36.2	
		(570.2)	(570.4)	
Dummy variable, required one year of initial levy reductions, FY1982		-6.2	-5.0	
		(7.9)	(8.6)	
Dummy variable, required two years of initial levy reductions, FY1982-83		4.2	-.61	
		(14.2)	(14.7)	
Dummy variable, required three years of initial levy reductions, FY1982-84		-1.8	-6.1	
		(18.6)	(19.1)	
Excess spending per pupil (required>actual spending), FY1994			24.1	
			(32.4)	
Excess capacity as a percentage of levy limit, FY1989			-62.3	
			(259.6)	
Dummy variable, at levy limit and no overrides, FY1989			1.5	
			(7.9)	
Dummy variable, passed override(s) prior to FY1990			27.3 **	
			(13.1)	
Constant	-179.4**	-170.6**	-178.2 **	-142.2 **
	(54.3)	(59.3)	(58.4)	(54.6)
Adjusted R-squared	.44	.44	.47	.45
Number of observations	155	155	155	155

Numbers in parentheses are standard errors.
*Significantly different from zero with 90 percent confidence.
**Significantly different from zero with 95 percent confidence.
Note: **Bold** variable is endogenous. Regressions include only communities that are at their levy limit. Equation (1) is base equation. Equation (2) additionally includes early 1980s Proposition 2½ variables. Equation (3) additionally includes late 1980s Proposition 2½ variables. Equation (4) includes endogenous population changes. Instruments include the single family permits in 1989 per 1990 housing units, the fraction of a community's population under age 5, developable land in 1984, housing permits in 1989, dummy variables for inside the Boston PMSA and suburban ring, fraction of residents in manufacturing in 1990, fraction of the population aged 35-59 in 1990, and average eighth grade reading and math test score in 1990.

Table 6
Variable List and Means of National School District-Level Sample
N=13,141

Variable	Mean	Std. Dev.	Min.	Max.
Spending and Revenue Variables of School Districts:				
Total expenditures per pupil, SY 89/90	5,169	1,995	1,176	19,682
State and federal revenue per pupil, SY 89/90	2,461	1,270	15.8	20,079
Characteristics of School District, School Year 89/90				
Number of schools in school agency	6.0	16.2	1	998
Agency is independent local school district	.90	.29	0	1
Agency is union component local school district	.092	.29	0	1
Agency is supervisory union administrative center	.0035	.059	0	1
Agency is regional education service agency	.00061	.025	0	1
Percentage students enrolled in special education school	.0010	.013	0	1
Percentage students enrolled in vocational schools	.00060	.0096	0	.35
Percentage students enrolled in other/alternative school	.0010	.011	0	.60
Percentage children speak English not well	.010	.023	0	.36
Percentage children below poverty line	.17	.12	0	.95
Percentage children at risk (e.g., divorced parents)	.033	.046	0	.68
District primarily serves central city of large MSA*	.0025	.050	0	1
District primarily serves suburbs of large MSA*	.042	.20	0	1
District primarily serves central city of medium sized MSA *	.013	.11	0	1
District primarily serves suburbs of medium sized MSA *	.11	.31	0	1
District primarily serves central city of small MSA *	.013	.12	0	1
District primarily serves suburbs of small MSA *	.067	.25	0	1
District primarily serves Non-MSA location *	.57	.50	0	1
Demographics of Residents of School District:				
Population density, 1990 (in 1'000 persons/sq kilometer)	.25	.65	.000012	19.3
Homeownership rate, 1990	.74	.11	0	1
Median household income, 1990	28,529	11,579	5,599	142,211
Percentage households with children (<18), 1990	.39	.074	.028	.90
Percentage households with age >65, 1990	.14	.052	.00043	.71
Percentage households with age >75, 1990	.061	.029	0	.30
Percentage households with age >85, 1990	.014	.0097	0	.096
Percentage college educated residents over 25, 1990	.15	.099	0	.81
Difference % non-whites among children in school age (5-19) - % non-whites among elderly residents over 65	.060	.090	-.75	.69
Ethnic fractionalization, 1990	.16	.17	0	.73
Percentage Black population, 1990	.047	.11	0	.99
Percentage Asian population, 1990	.0090	.023	0	.50
Percentage Hispanic population, 1990	.049	.12	0	1
Gini coefficient, 1990	.39	.045	.19	.62

Notes, marked with asterisks: MSA is defined as large if the population size is > 1 Mio., as medium sized if the population size is between 250,000 and 1,000,000, and as small if the population size is smaller than 250,000 residents. Data source: School District Data Book (SDDB), School Year 1989/90. National Center for Education Statistics, Office of Educational Research and Improvement, U.S. Department of Education.

Table 7
School Spending Regression Results with Interactions, Total Expenditures, National Sample

Dependent Variables: Log of Total School Expenditures per Pupil, SY 1989/90

Explanatory Variable	(1)	(2)	(3)	(4)	(5)
Population density, 1990 (in 1'000 persons/square kilometer)	.024 ** (.0057)	-.046 ** (.0066)	-.060 ** (.010)	-.061 ** (.0094)	-.068 ** (.0090)
Homeownership rate, 1990	.15 ** (.032)	.10 ** (.032)	.10 ** (.032)	.11 ** (.031)	.11 ** (.030)
Population density x Homeownership rate		.14 ** (.014)	.13 ** (.015)	.14 ** (.014)	.13 ** (.015)
Percentage age 65 or older, 1990	.059 (.086)	-.0092 (.086)	-.035 (.086)		
Population density x Percentage age 65 or older			.14 (.075)		
Percentage age 75 or older, 1990				-.40 ** (.13)	
Population density x Percentage age 75 or older				.31 * (.14)	
Percentage age 85 or older, 1990					-1.9 ** (.28)
Population density x Percentage age 85 or older					2.0 ** (.51)
Adjusted R-squared	.57	.57	.57	.57	.57
Number of observations	13,141	13,141	13,141	13,141	13,141

Notes: Numbers in parentheses are standard errors. Significantly different from zero with 95 percent confidence. Significantly different from zero with 99 percent confidence. All regressions control for demographic characteristics of the residents of the school district, school district specific characteristics, and state fixed effects.

Table 8
Quantitative Effects

Change	Specific.	Low-Population Density Place (Density=150)	High-Population Density Place (Density=1500)	Δ Low-Dense versus High-Dense Place
		Percentage Change in Spending per Pupil	*Percentage Change in Spending per Pupil*	*Additional Spending per Pupil in High Dense Place Due to Change (in%)*
Effect of population density on school expenditures per pupil (low-dense versus high-dense place)	T 7 (1)	Baseline	3.3%	3.3%
Homeownership rate increases by 1 standard deviation	T 7 (2)	1.2%	3.4%	+2.2%
Elderly population (over 65) increases by 1 standard deviation	T 7 (3)	-0.068%	0.93%	+1.0%
Elderly population (over 75) increases by 1 standard deviation	T 7 (4)	-1.0%	.17%	+1.2%
Elderly population (over 85) increases by 1 standard deviation	T 7 (5)	-1.5%	1.1%	+2.6%

Notes: Total mean school spending per pupil is $5,169. Density is defined as 1,000 residents per square kilometer. 150 and 1,500 residents per square kilometer approximately corresponds to 400 and 4,000 residents per square mile, which are the population densities of the suburbs of a medium sized metropolitan area versus inner suburbs or a central city of a large metropolitan area. All quantitative effects are measured at the average national homeownership rate (67 percent) and at the average percentage of elderly households of all school districts in the sample.

Table 9
School Spending Regression Results with Location-Age Interactions, National Sample

Dependent Variable: Log of Total School Expenditures per Pupil, School Year 1989/90

Explanatory Variable	(1)	(2)	(3)
Population density, 1990 (in 1'000 persons/square kilometer)		.012 * (.0050)	-.046 ** (.0069)
Homeownership rate, 1990	.15 ** (.029)	.17 ** (.031)	.12 ** (.031)
Population density x Homeownership rate			.12 ** (.014)
School district primarily serves central city of large MSA, 1990	.12 ** (.046)	.12 ** (.046)	.13 ** (.046)
Percentage age 65 or older x School district primarily serves central city of large MSA	1.4 ** (.57)	1.4 * (.61)	1.5 ** (.57)
School district primarily serves suburbs of large MSA, 1990	-.048 ** (.016)	-.047 ** (.016)	-.042 ** (.016)
Percentage age 65 or older x School district primarily serves suburbs of large MSA	1.6 ** (.51)	1.6 ** (.51)	1.6 ** (.51)
School district primarily serves central city of medium sized MSA, 1990	-.0039 (.037)	.0021 (.037)	.0039 (.037)
Percentage age 65 or older x School district primarily serves central city of medium sized MSA	-.15 (.30)	-.17 (.30)	-.14 (.30)
School district primarily serves suburbs of medium sized MSA, 1990	-.042 ** (.014)	-.038 ** (.014)	-.032 * (.014)
Percentage age 65 or older x School district primarily serves suburbs of medium sized MSA	-.27 ** (.11)	-.25 * (.11)	-.25 * (.11)
School district primarily serves central city of small MSA, 1990	-.047 (.040)	-.040 (.040)	-.037 (.040)
Percentage age 65 or older x School district primarily serves central city of small MSA	-.57 * (.27)	-.58 * (.27)	-.57 * (.27)
School district primarily serves suburbs of small MSA, 1990	-.052 ** (.016)	-.049 ** (.016)	-.040 ** (.016)
Percentage age 65 or older x School district primarily serves suburbs of small MSA	-.29 ** (.11)	-.28 ** (.11)	-.28 ** (.11)
Percentage age 65 or older x School district primarily serves Non-MSA location	-.49 ** (.053)	-.45 ** (.055)	-.40 ** (.055)
Adjusted R-squared	.57	.57	.57
Number of observations	13,141	13,141	13,141

Notes: Numbers in parentheses are standard errors. Significantly different from zero with 95 percent confidence. Significantly different from zero with 99 percent confidence. Both regressions control for demographic characteristics of the residents of the school district, school district specific characteristics, and state fixed effects.

Table 10
School Spending Regression Results for States with and without Major Restrictions for School Districts, National Sample

Dependent Variables: Log of Total School Expenditures per Pupil, SY 1989/90

Explanatory Variable	(1) Mandated Spending	(1) Minor Restrictions	(2) Mandated Spending	(2) Minor Restrictions	(3) Mandated Spending	(3) Minor Restrictions	(4) Mandated Spending	(4) Minor Restrictions	(5) Mandated Spending	(5) Minor Restrictions
Population density, 1990 (in 1’000 persons/sq. kilometer)	.0024 (.0087)	.045 ** (.0082)	-.015 (.024)	-.027 (.022)	-.022 (.024)	-.071 * (.029)	-.021 (.024)	-.073 ** (.029)	-.020 (.023)	-.078 ** (.028)
Homeownership rate, 1990	.053 (.091)	.19 ** (.043)	.042 (.095)	.16 ** (.044)	.050 (.096)	.16 ** (.044)	.011 (.093)	.18 ** (.043)	-.0069 (.093)	.16 ** (.042)
Population density x Homeownership rate			.035 (.044)	.13 ** (.038)	.026 (.048)	.099 ** (.040)	.032 (.045)	.13 ** (.038)	.032 (.045)	.14 ** (.037)
Percentage age 65 or older, 1990	-.57 * (.24)	.11 (.11)	-.57 * (.24)	.074 (.11)	-.59 ** (.24)	.019 (.11)				
Population density x Percentage age 65 or older					.14 (.20)	.38 ** (.16)				
Percentage age 75 or older, 1990							-.90 * (.42)	-.50 ** (.16)		
Population density x Percentage age 75 or older							.27 (.40)	.65 * (.30)		
Percentage age 85 or older, 1990									-2.6 * (1.1)	-2.1 ** (.33)
Population density x Percentage age 85 or older									1.3 (1.2)	2.7 * (1.1)
Adjusted R-squared	.21	.47	.21	.47	.21	.47	.21	.47	.21	.47
Number of observations	1,185	8,323	1,185	8,323	1,185	8,323	1,185	8,323	1,185	8,323

Notes: Numbers in parentheses are standard errors. Significantly different from zero with 95 percent confidence. Significantly different from zero with 99 percent confidence. All regressions control for demographic characteristics of the residents of the school district, school district specific characteristics, and state fixed effects. School districts are considered to have minor restrictions if the state does not equalize local tax rates and have a median foundation tax rate below 28/1000ths. NM, CA, and HA are classified as having state mandated expenditures. The remaining states are not included in the regressions.

Appendix

Appendix A
Proof of Positive Correlation between Land Availability and Land Supply Elasticity

Consider a residential land supply curve with a positive intercept p_F (present value of future land rents from farming) and a residential land price p that increases with the percentage of developed land $H/\bar{H}$, where H is the developed residential land area and where $\bar{H}$ is the total land area in a representative community. Below p_F no land will be developed as residential land and the whole community area is farmland. The land supply curve can be expressed as:

$$H = \begin{cases} (p-p_L)^{1/n} & if\ (p-p_L)^{1/n} < \bar{H} \\ \bar{H} & if\ (p-p_L)^{1/n} \geq \bar{H}. \end{cases} \tag{A1}$$

Differentiating H with respect to p gives:

$$\frac{\partial H}{\partial p} = \begin{cases} \frac{1}{n}(p-p_L)^{\frac{1-n}{n}} & if\ \ (p-p_L)^{1/n} < \bar{H} \\ 0 & if\ \ (p-p_L)^{1/n} \geq \bar{H}. \end{cases} \tag{A2}$$

Hence, the residential land supply elasticity can be expressed as:

$$\varepsilon^S = \begin{cases} \varepsilon^S = \frac{\partial H}{\partial p}\frac{p}{H} = \frac{\frac{1}{n}(p-p_L)^{\frac{1-n}{n}}\ p}{(p-p_L)^{1/n}} = \frac{1/n}{1-p_L/p} & if\ \ (p-p_L)^{1/n} < \bar{H} \\ 0 & if\ \ (p-p_L)^{1/n} \geq \bar{H}. \end{cases} \tag{A3}$$

From (A3) follows that as long as $p_L > 0$ and $H < \bar{H}$ the residential land supply elasticity is always decreasing in the amount (or percentage) of developed residential land:

$$\frac{\partial \varepsilon^S}{\partial H} = \frac{-p_L(p-p_L)^{\frac{1-n}{n}}}{nH^n} < 0. \tag{A4}$$

Appendix B
School Spending Regression Results for Base Specification, National Sample

Dependent Variable: Total School Expenditures per Pupil, School Year 1989/90

Explanatory Variable	(1) All Districts	(2) Mandated Spending	(3) Minor Restrictions
Population density (in persons/square kilometer), 1990	.024 **	.0024	.045 **
(in ‘000)	(.0057)	(.0087)	(.0082)
Homeownership rate in school district, 1990	.15 **	.053	.19 **
	(.032)	(.091)	(.043)
Median household income, 1990	.057 **	-.23 **	.052
	(.022)	(.070)	(.028)
Gini coefficient	-.078	-.67 **	-.10
	(.099)	(.26)	(.12)
Percentage of households with children	-.37 **	-.37 *	-.37 **
	(.067)	(.15)	(.089)
Percentage of population, age 65 and up	.059	-.57 *	.11
	(.086)	(.24)	(.11)
Percentage of children who “speak English not well”	.55 **	.37	.44
	(.16)	(.19)	(.27)
Percentage of children below poverty	.20 **	-.15	.22 **
	(.042)	(.097)	(.057)
Percentage of children at risk	.28 **	.45 **	.24
	(.084)	(.15)	(.13)
Percentage of adult residents with a college education	.77 **	.59 **	.81 **
	(.043)	(.12)	(.058)
Difference % non-whites among children in school age	.15 **	.023	.24 **
(5-19) - % non-whites among elderly residents over 65	(.045)	(.087)	(.068)
Ethnic fractionalization, 1990	.079 **	-.054	.035
	(.032)	(.073)	(.044)
Percentage Black population	-.0050	-.0055	-.021
	(.036)	(.12)	(.050)
Percentage Asian population	-.38 **	-.054	.60
	(.12)	(.12)	(.34)
Percentage Hispanic population	.036	-.13 *	.099
	(.039)	(.057)	(.053)
Number of schools in school agency	-.0020 **	-.0030 **	-.0028 **
	(.00029)	(.00058)	(.00039)
Number of schools in school agency, squared (in ‘000)	.0021 **	.0052 **	.0055 **
	(.00065)	(.00087)	(.0015)
Percentage of students enrolled in special education schools	.39 **	2.8	.39
	(.15)	(2.3)	(.33)
Percentage of students enrolled in vocational schools	.24	2.9 **	.13
	(.17)	(.73)	(.14)
Percentage of students enrolled in other schools/alternative	.15	.27	-.22
schools	(.29)	(.35)	(.37)
Agency is independent local school district, SY 89/90	-.10 **	-.21 **	-.085 **
	(.035)	(.015)	(.033)
Agency is union component local school district, SY 89/90	-.11 **		-.11 **
	(.037)		(.036)
Agency is supervisory union adm. center, SY 89/90	-.16 **		-.13 **
	(.044)		(.041)
State and federal revenue per pupil, SY 89/90	.038 **	.16 **	.042 **
	(.0072)	(.039)	(.010)
Constant	7.6 **	10.1 **	7.5 **
	(.26)	(.93)	(.33)
Adjusted R-squared	.57	.21	.47
Number of observations	13141	1185	8323

Notes: Numbers in parentheses are standard errors. Significantly different from zero with 95% confidence. Significantly different from zero with 99% confidence. School districts are considered unrestricted if the state does not equalize local tax rates and have a median foundation tax rate below .004, otherwise districts are considered restricted.