State and Local Policy, Factor Markets and Regional Growth

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Abstract: A large and growing literature to explain how state and local policies affect factor markets, firm location and economic growth has developed in three distinct threads. These threads have variously emphasized how policy and natural amenities affect regional economic growth or firm location; how variations in policy and natural amenities can lead to persistent wage differentials across regions; and how regional variation in factor inputs, including public capital, affects output. In this article, we expand the modeling framework of Roback and Gyourko and Tracy to integrate these threads into a single inquiry about how state and local policies—including the provision public capital—affects factor markets and economic growth. Using the model as the basis for estimation, we find that state and local policies have a more profound influence on the private capital-to-labor ratio in a region than on private output. Furthermore, the evidence suggests that the growth of government—either in the form of services or public capital—discourages private sector growth.

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1. Introduction

State and local governments are an important source of economic policy in the United States. The extent to which these policies affect private factor markets determines the extent to which state and local government influences employment, industry composition and economic growth. Therefore, a large and growing economics literature has developed to explain how state and local policies affect factor markets, firm location and economic growth.

To some extent, however, the literature has divided into three relatively distinct threads. One thread of the literature examines how state and local policy and natural amenities affect regional economic growth or firm location (e.g. Carlino and Mills 1985, Bartik 1985 and 1988, Carlton 1983, Papke 1991, and Gray 1997). Another thread emphasizes how differences in state and local policy and natural amenities can lead to persistent regional differentials in wage rates (e.g. Roback 1982, Beeson and Eberts 1989, Gyourko and Tracy 1989, and Haughwout forthcoming). The third thread examines whether the United States has sufficient public capital by examining how regional variation in factor inputs affects regional output (e.g. Aschauer 1989, Munnell 1990, Holtz-Eakin 1994, Bartik 1996, Garcia-Milà, McGuire and Porter 1996, Morrison and Schwartz 1996, Kelejian and Robinson 1997, Boarnet 1998, Button 1998, Fernald 1999, and Puig-Junoy 2001).

In this article, we expand the modeling framework of Roback (1982) and Gyourko and Tracy (1989) to draw together the three threads of previous inquiry into a single inquiry of how state and local policy—including the provision of public capital—affects factor quantities and, consequently, economic growth. Econometric implementation of the model involves two steps. The first step is to estimate how state and local policy and natural amenities affect private capital and labor in a state. The second step is to estimate how private and public capital and labor contribute to state economic growth, while allowing private capital and labor to respond endogenously to the other variables in the model.[2]

Estimation of the model allows us to examine how state and local policies—including the provision of public capital—affect private factor quantities and economic growth. Our analysis addresses an empirical avenue in the debate on whether public capital is under provided that was first identified by Garcia-Milà, McGuire and Porter (1996) and has remained largely unexplored. We find that state and local policies have a more profound influence on the private capital-to-labor ratio in a region than on private output. Furthermore, the evidence suggests that growth of government— whether it be in terms of services or infrastructure—appears to discourage growth of the private sector.

2. An Equilibrium Model of Factor Markets

A general equilibrium model of factor markets provides insight into the various types of government influence. We model activity in the land, labor and capital markets as arising from

[2] The model's reduced form provides a theoretical foundation for much of the existing literature relating state and local policy to variations in regional growth.

the interaction between workers and firms taking as given government activity and allowing for differentials in unemployment between jurisdictions. The representative individual seeks to maximize utility in the jurisdictional choice, and when employed sells one unit of labor at the market wage. The representative firm takes prices as given and seeks to maximize profits. By assumption, the representative agent is free to move among jurisdictions, but must work, consume and pay taxes in his chosen jurisdiction.

The representative individual's utility can be described as:

$$U = U(q, N, L, A_j, G_j) \tag{1}$$

where q is the quantity of goods consumed by the representative individual, N is the quantity of land consumed by the representative individual, L is quantity of labor supplied and equals unity if the worker is employed and zero if the worker is unemployed, A_j is a vector of natural amenities found in jurisdiction j, and G_j is a vector of state and local government services provided in jurisdiction j and includes public capital.

The representative individual's budget constraint is:

$$P(1+\tau_{sj})\, q \;+\; n_j(1+\tau_{nj})N \;=\; w_j\, L_j(1-\tau_{wj}) \;+\; I(1-\tau_{ij}) \tag{2}$$

where P is the national price of good q, τ_{sj} is the sales tax in jurisdiction j, n_j is the rental rate for land in jurisdiction j, τ_{nj} is the land rental tax rate imposed by state and local governments in jurisdiction j, w_j is the wage rate in jurisdiction j, τ_{wj} is the labor income tax rate imposed by state and local governments in jurisdiction, I is nonlabor income, and τ_{ij} is the tax rate on nonlabor income imposed by the government in jurisdiction j.

Combining equations 1 and 2 with the unemployment rate for jurisdiction *j* yields an expression for indirect utility:

$$V_j = V(w_j(1-\tau_{wj}),\ \Upsilon_j,\ I(1-\tau_{ij}),\ P(1+\tau_{sj}),\ n_j(1+\tau_{nj}),\ A_j,\ G_j) \qquad \textbf{(3)}$$

For a representative individual, utility in jurisdiction *j* is a function of the after tax wage rate, the unemployment rate (Υ_j), after tax nonlabor income, the tax inclusive price of goods, the tax inclusive rental rate on land, natural amenities and the provision of government services. Our inclusion of the unemployment rate in the indirect utility function represents a potentially important departure from the approaches taken by Roback (1982), Gyourko and Tracy (1989). Its inclusion allows for Neumann and Topel's (1991) finding that regional variation in unemployment rates and wages can be persistent and explained in equilibrium.[3]

Labor mobility assures equal (constant) expected utility across jurisdictions in the long run:

$$V_j = \overline{V} \qquad \textbf{(4)}$$

Production in each jurisdiction can be described as:

$$Q_j = Q(L_j,\ K_j,\ N_j,\ A_j,\ G_j,\ R_j) \qquad \textbf{(5)}$$

where Q_j is the output of the good in jurisdiction *j*, L_j is the quantity of labor employed in jurisdiction *j*, K_j is the quantity of private capital used in jurisdiction *j*, N_j is the quantity of land

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[3] See also Harris and Todaro (1970).

used for production in jurisdiction j and R_j is a vector of state and local regulation in jurisdiction j. Because all workers in the jurisdiction sell one unit of labor, $L_j(1+\Upsilon_j)$ is the number of residents in jurisdiction j.

Firms in jurisdiction j maximize profits as follows:

$$\max \quad \pi_j^* = P \cdot Q_j - w_j L_j - r_j(1+\tau_{rj})K_j - n_j(1+\tau_{nj})N_j \qquad \textbf{(6)}$$

where r_j is the rate of return on capital in jurisdiction j and τ_{rj} is the tax rate on capital.

Combining equations (5) and (6) yields an indirect profit function for production in jurisdiction j:

$$\pi_j^* = \pi^*(P,\ w_j,\ r_j(1+\tau_{rj}),\ n_j(1+\tau_{nj}),\ A_j,\ G_j,\ R_j) \qquad \textbf{(7)}$$

Profits in jurisdiction j are a function of the price of goods sold, wages (inclusive of taxes), the rate of return on capital, the tax inclusive rental rate on land, natural amenities, state and local government services, and state and local regulation.

Capital mobility assures that the after-tax rate of return is equalized across jurisdictions in the long run. Therefore,

$$r_j = r \qquad \textbf{(8)}$$

where r is the national rate of return on capital. The quantities of capital used in each jurisdiction will adjust until any regional variation in the before-tax rate of return to capital reflects only state and local taxes on capital.

The free entry and exit of firms assures that economic profits are reduced to zero over the long run:

$$\pi*_j = 0 \tag{9}$$

Following Gyourko and Tracy (1989) each pair of equations (3) and (4) and (7) and (9) can be solved for the tax inclusive rental price of land, $n_j(1+t_{nj})$. Combining the resulting expressions yields a reduced form equation for the long-run equilibrium wage rate in each jurisdiction:

$$w_j = w(\tau_{i_j}, \tau_{w_j}, \tau_{s_j}, \tau_{r_j}, P, r, I, A_j, G_j, R_j, \Upsilon_j) \tag{10}$$

As shown in equation (10), equilibrium wages in a jurisdiction are a function of tax rates on nonlabor income, wages, goods, and capital, national prices for output and capital, nonlabor income, the jurisdiction's natural amenities, government services, government regulations, and the unemployment rate. In long-run equilibrium, differences in wages represent compensating differentials for differences in the right-hand-side variables, and equation (10) serves as the basis for the empirical literature attempting to explain persistent variation in wages across regions. As shown, regional variation in land tax rates are capitalized into land values and do not affect wages.

Similarly, one can combine the four equations to yield a reduced-form equation for the long-run equilibrium rental price of land:

$$n_j = n(\tau_{I_j}, \tau_{w_j}, \tau_{n_j}, \tau_{s_j}, \tau_{r_j}, P, r, I, A_j, G_j, R_j, \Upsilon_j) \tag{11}$$

As shown by equation (11), wage tax rates are capitalized into land values, even though regional variation in property tax rates are not reflected in wages. Because land is immobile, its price reflects all the aspects of the jurisdiction, including policy.

Given these long-run equilibrium equations for factor prices and a well-behaved production function (equation 5), we follow Haughwout (1998) to obtain reduced-form equations for factor quantities.[4]

$$L_j = L(\tau_{i_j}, \tau_{s_j}, \tau_{n_j}, \tau_{r_j}, \tau_{w_j}, P, r, I, A_j, G_j, R_j, \Upsilon_j) \qquad \textbf{(12)}$$

$$K_j = K(\tau_{i_j}, \tau_{s_j}, \tau_{n_j}, \tau_{r_j}, \tau_{w_j}, P, r, I, A_j, G_j, R_j, \Upsilon_j) \qquad \textbf{(13)}$$

$$N_j = N(\tau_{i_j}, \tau_{s_j}, \tau_{n_j}, \tau_{r_j}, \tau_{w_j}, P, r, I, A_j, G_j, R_j, \Upsilon_j) \qquad \textbf{(14)}$$

These three equations for factor quantities provide a basis for estimating the effects on factor markets, and similar forms to equations (12) and (13) have been used in some of the empirical literature on the effects of state and local policy on regional economic growth, but without formal derivation and without the inclusion of public capital as a government service.

For each jurisdiction, labor, capital and land depend on the same set of variables: the nationally determined prices for output and capital, nonlabor income, local amenities, the local unemployment rate, and the full spectrum of state and local governmental policies. One striking

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[4] In this context, a well-behaved production function supports a technology set that is a nonempty closed convex set with freely disposable inputs and outputs (for further discussion, see Fare and Primont 1995).

feature of the set of equilibrium conditions is the pervasive effect of government policies. A government's choices concerning tax rates have larger repercussions than merely the market in which the tax is levied. For example, although sales taxes are levied only on the consumption of output, they can distort all dimensions of the factor markets except for the price of capital. Similarly, wage taxes influence not only the labor market but also the quantities of capital and land used in production.

3. Output

Substituting equations (12), (13) and (14) into the production function (5) yields a reduced form relating state and local fiscal policy, the provision of public capital, natural amenities, government regulation and other variables to output.

$$Q_j = Q(\tau_{i_j}, \tau_{s_j}, \tau_{n_j}, \tau_{r_j}, \tau_{w_j}, P, r, I, A_j, G_j, R_j, \Upsilon_j) \tag{15}$$

Similar forms to equation (15) have been used in the empirical literature on the effects of state and local policy on regional economic growth without formal derivation and without the inclusion of public capital as a government service. Some output models are made more interesting by introducing related dynamics such as population growth (Carlino and Mills 1985) or the development of innovative capacity (Riddel and Schwer, this volume).

An alternative strategy is to estimate the production function as it is originally written, while recognizing that the quantities of private capital and labor are endogenous and must be instrumented.[5]

$$Q_j = Q(\hat{L}_j, \hat{K}_j, N_j, A_j, G_j, R_j) \quad \textbf{(16)}$$

The right-hand-side variables in equations (12) and (13) provide convenient instruments for labor and private capital. Similar forms to equation (16) have been used in the empirical literature on whether the United States has sufficient public capital without instrumenting labor and private capital and without the inclusion of state and local government services other than public capital.[6]

4. Empirical Analysis

Equations (12) and (13) provide a basis for estimating the effects of public capital, as well as state and local expenditures and taxes on the private capital and labor in a state. Equations (15) and (16) provide two differing estimation strategies for determining how public capital and state and local fiscal policy affect output. We explore both approaches using a panel of state-level data for the 48 contiguous U.S. states from 1977-1992. First, we estimate equations (12),

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[5] Some may regard the quantity of land as endogenous in an economic sense, but the available data make it an exogenous variable that is time invariant and captured as state-level fixed effects.

[6] In a somewhat different approach, Pereira (2001) examines impulse responses obtained from simulations of a vector autoregressive model with equations representing output, private employment, private investment and various measures of public capital investment. This approach necessitates the omission of other measures of state and local policy.

(13) and (15). Second, we estimate equation (16) using the right-hand-side variables from equations (12) and (13) as the instruments for private capital and labor. We find that the growth of government is not associated with faster growth of the private sector. On the contrary, the growth of government— whether it be services or infrastructure—appears to discourage growth of the private sector.

4.1 Data

Alicia Munnell's data (Munnell 1990) are frequently used to examine productivity and economic growth (e.g. Morrison and Schwartz 1996, Kelejian and Robinson 1997). However, her estimates of the private capital stock leave room for improvement. Basically, Munnell decomposes U.S. estimates of private capital into state-level estimates using information from industry censuses to identify each state's share of U.S. capital for that industry in census years. She then assumes that the state shares of private capital are constant for a multi-year period centered on the census year. "Data from the 1972 Census were used to apportion among the states the BEA national stock estimates for 1969 to 1974; 1977 shares were used for the 1975 to 1979 stock estimates; 1982 shares were the basis for the estimates from 1980 to 1984 and 1987 data were used to apportion national asset totals for 1985 and 1986." (Munnell 1990, pg. 97). Thus, the private capital stocks in each industry in a state are assumed to grow at the national rate in most years. Private capital stocks in each industry in a state are assumed to grow at rates different than the national rate only during the one year intervals from 1974 to 1975, 1979 to 1980 and 1984 to 1985.

Munnell's apportionment strategy has unfortunate consequences for the temporal patterns of growth of the private capital stocks in each state. In 1975, 1980 and 1985, growth rates are exaggerated in each industry to "catch up" for the five-year deviations in the state's growth rate from the national average. In all other years, the cross-sectional variations in the growth of private capital arise solely from changes in the industrial composition of the states.

We improve on Munnell's data in three ways. First, rather than assume that state capital stocks grow at the national rate in most years, we use an interpolation strategy that is akin to the Chow-Lin procedure. Our interpolation strategy allows each industry's capital stock to grow at a state-specific ratio to the U.S. growth rate for that industry. Second, we base our estimates on improved measures of the U.S. capital stock that were not available to Munnell. Finally, we update Munnell's series to cover the period 1967-92. See the appendix for further details on the construction of the private capital stock series.

We estimate net public capital stocks for each state by apportioning the BEA national estimates for state and local government capital. Following Munnell, we use annual data on government capital outlays since 1958 to generate perpetual-inventory estimates of public capital stocks for each state. We sum these estimates across the states and assign each state a share of the national public capital stock according to its share of the sum-of-states estimate. As in Munnell, the analysis yields capital stock estimates for highways, sewers and water supply systems and total state and local government capital.

We differ from Munnell in a number of ways, however. Most obviously, we have extended the data set to cover the period 1967-1992. We have also incorporated improved estimates of national public capital stocks that were not available to Munnell. Munnell followed the BEA by constructing net capital stocks presuming straight-line depreciation schedules and a modified Winfrey S-3 retirement pattern. More recently, however, the BEA has adopted a strategy in which the annual geometric rate of depreciation is a function of the average service life for each type of capital. According to the BEA, the average service life for highways is 45 years, while the average service life for sewers and water supply systems is 60 years. The average service life for other types of state and local government capital ranges from seven years for typewriters and calculating machines to 80 years for new single-family residences. These figures imply that the annual geometric rate of depreciation is a constant for highways and water and sewer systems, and a function of the composition of net stocks for total public capital. The implicit annual depreciation rate for the national estimate of aggregate state and local public capital has increased sharply since 1958, implying a large shift in composition over that period. Where Munnell assumed that the composition of public capital was stable through time, we accommodate the shift toward assets with shorter service lives by using the implicit national depreciation rate when calculating perpetual inventory estimates for the states. See the appendix for further details on the construction of the public capital stock series.

The remaining data in the panel come from a variety of sources. Data on unemployment rates, private real gross state product and private employment in each state come from the Bureau of Labor Statistics and the BEA. Data on taxes and other characteristics of the state fiscal environment come from the Census and Survey of Governments. We construct proxies for effective tax rates by dividing state and local government revenues from sales, property, individual income, and corporate income by gross state product. All other components of the government budgets are also deflated by gross state product to facilitate a balanced-budget interpretation. Those other components include net transfers from the federal government; net revenues from utilities; and net expenditures on higher education, other education, health and hospitals, welfare, and general government services.[7] Because crime is a potentially important disamenity, we also include data on the total crime rate in each state from the FBI's Statistics of Crime. State-level fixed effects capture omitted state characteristics while time fixed effects capture national, business cycle variations.

For purposes of estimation, capital, labor and output are transformed into log first differences, while the remaining variables—tax rates, spending rates, crime rates and unemployment rates—are expressed as first differences.[8] To allow for diminishing returns to the size of the public sector, we also include a measure of government size (direct operating expenditures as a share of GSP in levels.) Following Garcia-Milà et al. (1996), we lag all of the independent variables one year so that they are at least nominally predetermined. Because consistent data on real gross state product are only available since 1977, our analysis covers the period 1979-1992.

4.2 Reduced-Form Estimation

Our first approach is to estimate equations for capital (12), labor (13) and the reduced form equation for output (15). To improve the efficiency of estimates from a panel with a short time series and many cross sections, we use the block-diagonal covariance structure suggested by

[7] The omitted category is miscellaneous revenues and deficit spending. All of the spending variables are expressed net of user fees (see Taylor 1995).

[8] For ease of exposition, we also multiply all of these variables by 100.

Gunther and Schmidt (1993). Because the Gunther-Schmidt approach allows for correlation among the residuals for all states within a designated group, it can also capture some of the spatial correlation among states.[9] We consider two grouping strategies—clustering the states according to census region, and clustering the states according to industrial mix.[10] The estimation is generally insensitive to the grouping strategy (see Tables 1a and b).[11]

For the most part, the increased provision of public capital does not appear to attract the private factors of production. None of the types of public capital are associated with rising private employment. Growth in water and sewer capital has a significantly negative relationship with both private capital and labor.

Government expenditures and taxation variables enter the estimation symmetrically with a balanced-budget constraint. Thus, the coefficient on a tax or revenue variable reflects the effects of increasing that budget component while holding constant all other included budget components. This means that the revenue and expenditure variables are evaluated against a change in the omitted variable. The selection of the omitted variable is key to interpreting the

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[9] We also adjust each equation for state-specific temporal autocorrelation using Cochrane-Orcutt Iterative Least Squares to estimate the autocorrelation coefficient. Estimated autocorrelation coefficients range from -.48 to .93 for the employment equation, .37 to .95 for the private capital equation, and -.72 to .80 for the gross product equation.

[10] We use the SAS CLUSTER procedure to cluster states into nine groups according to industrial mix (see Appendix table A1). Our measures of industrial mix are the shares of GSP in each major industry group in the state—agriculture, mining, construction, manufacturing, retail trade, wholesale trade, TCPU (transportation, communications and public utilities), services, FIRE (finance, insurance and real estate) and government.

[11] The major exception is the estimated relationship between private employment and highways or water and sewer capital, which is smaller when the states are clustered by census region then it is when they are clustered by industrial composition.

results. If the omitted variable represents a particularly attractive source of revenue, the coefficients on expenditures and most other revenue sources will be negative.

In the reported tables, the omitted variable is miscellaneous revenues and deficit spending. Thus, the property tax coefficient would be interpreted as the impact of a budgetary shift toward property taxes and away from miscellaneous revenues and deficit spending. Similarly, the coefficient on the health and hospitals variable would be interpreted as an increase in health expenditures financed by an increase in miscellaneous revenues. If we wish to determine the impact of increasing expenditures on health and hospitals financed by property taxes, we simply add the coefficients together.

In a balanced budget context, the analysis suggests that both capital and labor are most attracted to states where the public sector is relatively small (the coefficient on government size is significantly negative) and where spending growth is concentrated in general government services rather than health, education or welfare. Growth in educational spending appears particularly unattractive; there is no budgetary reallocation to finance primary and secondary education that is positively associated with growth in private employment or private capital. This contrarian result may arise from the explosion in educational expenditures during the sample period and the well documented inefficiencies in translating educational spending into educational services (e.g. Hanushek et al. 1996, Grosskopf et al. 2001). Interestingly, private capital strongly favors reallocating educational spending from primary education to higher education while private employment appears indifferent between the two. However, there is no other budgetary reallocation to finance higher education that is statistically significant and positively associated with growth in private capital.

On the revenue side, labor strongly favors states with growing sales taxes over states with growing property taxes. In fact, rising property taxes are particularly unattractive to labor. Any budgetary reallocation that would cut property taxes is associated with faster growth in private employment. One possible explanation is that rising property tax revenues may reflect rising property values and a generally rising cost of living, which would discourage in-migration.

On the other hand, capital appears generally indifferent to the revenue source. Regardless of the clustering strategy, the coefficient on the least preferred revenue source—individual income taxes—is not significantly different from the coefficient on any other revenue source.

To some extent, the effects that public capital and state and local fiscal policy have on private output are similar to those on labor. The signs of the coefficients on public capital in the output equation are the same as those on labor. The effects of changes in the composition of state and local government spending on the growth of private output are essentially the same as those on labor growth. In addition, an increase in property taxes is the least attractive way to boost state and local government revenue from the perspective of private employment and output growth.

Nonetheless, the effects of government policy on output are not just a weighted average of the effects on private capital and labor. For example, changes in the sources of revenues seem to have somewhat different effects on output than might be expected from the labor and output equations. A shift from sales taxes into income taxes is insignificant for both private labor growth and private capital growth, but significantly positive from the perspective of private output growth. Given the theory implies that taxes influence output only to the extent that they influence factor allocations, the differing results on the revenue side suggest that state-to-state differences in the composition of the private sector may be affecting the estimates.

4.3 Instrumental Variables Estimation

Our second approach to estimating the effects of state and local policy on private output is to estimate equation (16) using instrumental variables. The effects of state and local policy on private factors are captured in the auxiliary equations. Therefore, the coefficients on state and local capital and fiscal policy in the primary equation should reflect only direct productivity effects, and not those operating indirectly through the factor markets.

We estimate equation (16) using the right-hand-side variables from equations (12) and (13) as the instruments for private capital and labor. Because the residuals from (12) and (13) were correlated, we use three stage least squares. The data were adjusted using the same autocorrelation coefficients as in the reduced-form output equation. Because we could not reject the hypothesis that state fixed effects on output were jointly zero, they were not included in the primary equation for output, although they are included in both of the auxiliary equations.

Table 2 compares the reduced-form estimates of the output equation (15) with the estimates for the output equation obtained with three stage least squares (3SLS). The 3SLS estimates show that an increase in private capital or labor increases private output. Government services are significant in the reduced-form estimation but insignificant in the 3SLS estimation, suggesting that such services influence output growth primarily through their influence on factor accumulation.

The previous literature suggests that increased provision of public capital is unlikely to reduce gross state product directly (Garcia-Milà, McGuire and Porter, 1996), and indeed, we find that increases in public highways and water and sewer capital have no effect on the growth of private output beyond their effects on private capital and labor. However, we also find that an increase in other state and local public capital has a significantly negative effect on output growth in addition to its negative on private labor and negligible effect on private capital. Taken at face value, this finding would seem to imply that other state and local public capital has been increased to the point of negative returns.

Coupled with the equations for private labor and capital, the 3SLS results suggest that although the increased provision of public highways and water and sewer capital has no direct effect on private output growth, it reduces private output by deterring labor in-migration and private capital formation. Increased provision of other state and local public capital directly reduces output growth while it also discourages labor in-migration and has no apparent effect on private capital formation. In any case, however, we find the increased provision of public capital reduces the growth of private output.

5. Conclusions

Our analysis expands the modeling framework of Roback (1982) and Gyourko and Tracy (1989) to integrate into one what have previously been three distinct threads in the literature. One thread examines how state and local policy and natural amenities affect economic growth. Another thread examines how differences in state and local policy and natural amenities can lead to persistent differentials in wages across regions. A third thread examines whether the United States has sufficient public capital.

We use the modeling framework to examine how state and local fiscal policy and the provision of public capital affects the labor and private capital in a state and, consequently, its economic growth. Consistent with the previous literature, we find that some state and local government expenditures more than offset the negative effects of the taxes used to finance them. Others do not. On net, the analysis suggests that private capital and labor grow most rapidly in states with smaller public sectors.

We also find that the increased provision of public capital may discourage labor in-migration. According to the theoretical framework we employ, the discouraging effects on labor in-migration arise through capital inflows bidding up property values and increasing the cost of living. We also find that some forms of state and local public capital have been increased to the point that (for the average state) further increases reduce output. The net effect is that the increased provision of state and local public capital appears to reduce private gross state product—although total output per capita may be higher.

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Table 1a: Reduced-Form Estimation, Clustered by Industrial Mix									
	Private Employment			**Private Capital**			**Private Gross State Product**		
	β	σ	**T Statistic**	β	σ	**T Statistic**	β	σ	**T Statistic**
Intercept	14.5531	1.2368	11.77	6.1631	0.8829	6.98	4.4254	1.6791	2.64
Highway Capital	-0.2041	0.0303	-6.74	-0.0301	0.0159	-1.89	-0.2175	0.0541	-4.02
Water & Sewer Capital	-0.1016	0.0134	-7.60	-0.0206	0.0056	-3.68	-0.1346	0.0253	-5.33
Other S&L Capital	-0.0843	0.0146	-5.77	0.0046	0.0104	0.45	-0.1629	0.0406	-4.01
Sales tax	0.2282	0.1815	1.26	0.1528	0.0882	1.73	-0.3567	0.3472	-1.03
Property tax	-1.5245	0.1617	-9.43	0.0489	0.0597	0.82	-0.5085	0.2996	-1.70
Individual Income tax	-0.0419	0.1542	-0.27	-0.0496	0.0571	-0.87	0.4933	0.3111	1.59
Corporate Income tax	-0.1419	0.3498	-0.41	0.1912	0.1474	1.30	3.0888	0.6306	4.90
Net Intergovernmental Revenue	-0.0808	0.1243	-0.65	0.0369	0.0456	0.81	-0.3245	0.2599	-1.25
Net Revenue from Utilities	0.2379	0.1970	1.21	0.0885	0.1422	0.62	0.9147	0.5702	1.60
Higher Education Spending	-0.7219	0.1501	-4.81	-0.1182	0.0663	-1.78	-1.5525	0.3482	-4.46
Elementary and Secondary Education	-0.7421	0.1442	-5.15	-0.3910	0.0678	-5.77	-1.5535	0.3178	-4.89
Health and Hospitals	-0.0579	0.2266	-0.26	-0.0735	0.0707	-1.04	-0.5040	0.4747	-1.06
Welfare	-0.4168	0.1753	-2.38	-0.0677	0.0689	-0.98	-0.9938	0.3536	-2.81
General Government Services	0.3394	0.0808	4.20	0.0187	0.0352	0.53	0.3792	0.1953	1.94
Government Size	-0.7975	0.0538	-14.82	-0.1535	0.0363	-4.23	-0.0610	0.0910	-0.67
Crime Rate	-0.0003	0.0001	-2.30	-0.0002	0.0000	-3.98	-0.0004	0.0002	-1.82
Unemployment Rate	-0.4273	0.0297	-14.39	-0.0256	0.0132	-1.95	-0.2477	0.0638	-3.88
Adjusted R-square		0.8616			0.6471			0.7100	

Note: All of the equations also include time and state fixed effects.

Table 1b: Reduced-Form Estimation, Clustered by Census

	Private Employment			Private Capital			Private Gross State Product		
	β	σ	T Statistic	β	σ	T Statistic	β	σ	T Statistic
Intercept	12.7701	1.2862	9.93	5.8778	0.8715	6.74	3.4394	1.7543	1.96
Highway Capital	-0.1271	0.0382	-3.33	-0.0353	0.0180	-1.96	-0.1746	0.0554	-3.15
Water & Sewer Capital	-0.0578	0.0138	-4.18	-0.0246	0.0062	-3.95	-0.0936	0.0223	-4.19
Other S&L Capital	-0.0727	0.0186	-3.90	0.0102	0.0119	0.86	-0.1554	0.0371	-4.19
Sales tax	0.2402	0.2042	1.18	0.1677	0.0898	1.87	-0.2849	0.3315	-0.86
Property tax	-1.4823	0.1755	-8.45	0.1337	0.0654	2.05	-0.4593	0.2828	-1.62
Individual Income tax	0.0742	0.1808	0.41	-0.0016	0.0688	-0.02	0.6585	0.3086	2.13
Corporate Income tax	0.0698	0.3850	0.18	0.0705	0.1619	0.44	3.4388	0.6393	5.38
Net Intergovernmental Revenue	-0.1260	0.1399	-0.90	0.0526	0.0521	1.01	-0.2769	0.2440	-1.13
Net Revenue from Utilities	0.2005	0.2520	0.80	0.0464	0.1414	0.33	0.3127	0.4545	0.69
Higher Education Spending	-0.6495	0.1769	-3.67	-0.1403	0.0694	-2.02	-1.3395	0.3356	-3.99
Elementary and Secondary Education	-0.6184	0.1610	-3.84	-0.4223	0.0684	-6.18	-1.6839	0.3096	-5.44
Health and Hospitals	0.1125	0.2570	0.44	-0.1655	0.0965	-1.71	-0.7380	0.5016	-1.47
Welfare	-0.6460	0.2130	-3.03	-0.1000	0.0905	-1.10	-0.8748	0.3720	-2.35
General Government Services	0.2228	0.0966	2.31	0.0121	0.0375	0.32	0.2157	0.1961	1.10
Government Size	-0.6959	0.0603	-11.55	-0.1663	0.0358	-4.65	0.0235	0.1040	0.23
Crime Rate	-0.0003	0.0001	-2.15	-0.0003	0.0001	-4.93	-0.0005	0.0002	-2.32
Unemployment Rate	-0.4292	0.0352	-12.20	-0.0181	0.0141	-1.29	-0.1992	0.0639	-3.12
Adjusted R-square	0.8592			0.6471			0.7070		

Note: All of the equations also include time and state fixed effects.

Table 2: Policy and the Growth in Private Gross State Product						
	Reduced-Form Estimation			3SLS Estimation		
	β	σ	T statistic	β	σ	T statistic
Intercept	4.4254	1.6791	2.64	-1.5829	1.0430	-1.52
Private Capital				0.4574	0.1150	3.98
Private Employment				0.5117	0.1089	4.70
Highway Capital	-0.2175	0.0541	-4.02	-0.0683	0.0865	-0.79
Water & Sewer Capital	-0.1346	0.0253	-5.33	-0.0211	0.0403	-0.52
Other S&L Capital	-0.1629	0.0406	-4.01	-0.1194	0.0585	-2.04
Sales tax	-0.3567	0.3472	-1.03			
Property tax	-0.5085	0.2996	-1.70			
Individual Income tax	0.4933	0.3111	1.59			
Corporate Income tax	3.0888	0.6306	4.90			
Net Intergovernmental Revenue	-0.3245	0.2599	-1.25			
Net Revenue from Utilities	0.9147	0.5702	1.60			
Higher Education	-1.5525	0.3482	-4.46	-0.9993	0.6901	-1.45
Elementary and Secondary Education	-1.5535	0.3178	-4.89	-0.8626	0.5694	-1.51
Health and Hospitals	-0.5040	0.4747	-1.06	-0.8539	1.0612	-0.80
Welfare	-0.9938	0.3536	-2.81	-0.2600	0.8002	-0.32
General Government Services	0.3792	0.1953	1.94	0.2636	0.3341	0.79
Government Size	-0.0610	0.0910	-0.67	0.0327	0.0625	0.52
Crime Rate	-0.0004	0.0002	-1.82	0.0003	0.0004	-0.73
Unemployment Rate	-0.2477	0.0638	-3.88			
Adjusted R-square		0.7100			0.5938	

Note: Both of the equations include time fixed effects. The reduced form equation also includes state fixed effects. The reduced-form estimation is clustered by industrial mix.

7. Appendix

Our estimates of private capital stocks differ from Munnell's in two key respects. First, we differ because we use revised estimates of Fixed Reproducible Tangible Wealth that were not available to Munnell. Second, we use a different interpolation strategy for non-census years.

In census years, we follow Munnell in apportioning the U.S. capital stock to the states according to each state's share of economic activity in that industry. To interpolate the state-level capital stocks in noncensus years, we calculate the rate of change between census years in the U.S. capital stock and the apportioned state-level capital stock for each industry. Let β_s be the ratio of those rates of change.

$$\beta_s = \frac{\ln(K_{s,T+n}) - \ln(K_{s,T})}{\ln(K_{US,T+n}) - \ln(K_{US,T})}$$

Assuming that state-level capital stocks grow at this state and industry-specific ratio to the U.S. growth rate for that industry (β_s) then the state-level capital stocks in non-census years would be

$$K_{s,T+j} = K_{s,T+j-1} \cdot e^{\beta_s \ln\left(\frac{K_{US,T+j}}{K_{US,T+j-1}}\right)}.$$

If βs were estimated rather than calculated, and assumed to be constant in all periods, then our interpolation technique would be a version of the familiar Chow-Lin interpolation strategy. Because the series we are interpolating are short (only five censuses are available for some industries) we chose not to use an estimation-based interpolation technique.

Unfortunately, the above technique generates implausibly volatile estimates of β_s for construction and agriculture. Therefore, we use a different strategy for interpolating these capital stocks. We assume that for each intercensus period construction (agricultural) capital grows at a state-specific constant rate γ_s

$$\gamma_s = \frac{\ln(K_{s,T+n}) - \ln(K_{s,T})}{n}$$

We then calculate the sum of the state estimates in each period and calculate the ratio of that sum to the national estimate. All state-level estimates of the construction (agricultural) capital stock are then deflated by this ratio so that in each year the sum of the state estimates equals the national estimate.

Our estimates of net public capital stocks also differ from Munnell's estimates in a number of ways. Most obviously, we have extended the data set to cover the period 1967-1992. We have also incorporated improved estimates of national public capital stocks that were not available to Munnell. Munnell followed the BEA by constructing net capital stocks presuming straight-line depreciation schedules and a modified Winfrey S-3 retirement pattern. More recently, however, the BEA has adopted a geometric depreciation strategy. To reflect the change in BEA techniques, we calculate our perpetual-inventory estimates of net capital stocks in each state for period t as

$$N_{tj} = \sum_{i=1}^{t} I_{ij}(1 - \delta_j / 2)(1 - \delta_j)^{t-i}$$

where $t \geq i$, N_{tj} is the net capital stock of asset type j, I_{ij} is investment in year i, and δ_j is the annual geometric rate of depreciation for type of asset j.[12] In turn,

$$\delta_j = R_j / T_j$$

where T_j is the average service life for asset type j in years and R_j the declining balance rate for asset type j. According to the BEA, the average service life for highways is 45 years, while the average service life for sewers and water supply systems is 60 years. The average service life for other types of state and local government capital ranges from seven years for typewriters and calculating machines to 80 years for new single-family residences. The declining balance rate (R_j) is .91 for government structures and 1.65 for state and local government equipment. These figures imply that the annual geometric rate of depreciation is 0.0202 for highways, 0.0152 for water and sewer systems, and a function of the composition of net stocks for total public capital. We calculated the implicit annual depreciation rate for the national estimate of aggregate state and local public capital, and use this implicit depreciation rate in our calculations. Such an approach accommodates the large shifts in the composition of aggregate state and local government capital that were evident in the national data.

[12]See U.S. Department of Commerce (1999).

Appendix Table A1
State Clusters According to Industry Mix

1	GA, IL, KS, MN, MO, NJ, OR
2	AL, AR, IN, KY, MI, MS, NC, OH, SC, WI
3	CA, CT, MA, NY, RI
4	AZ, CO, FL, MD, UT, VA
5	DE, ME, NH, PA, TN, VT, WA
6	LA, MT, NM, OK, TX, WV
7	ID, IA, NE, ND, SD
8	WY
9	NV