NBER WORKING PAPER SERIES

INCOME ORIGINATING IN THE STATE AND LOCAL SECTOR

Charles R. Hulten

Robert M. Schwab

Working Paper No. 2314

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
July 1987

The research reported here is part of the NBER's research programs in Taxation and Productivity and project in State and Local Government Finance. Any opinions expressed are those of the authors and not those of the National Bureau of Economic Research.

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ABSTRACT

In this paper we develop an accounting framework for the state and local sector which is consistent with the accounting framework for the private sector of the economy. We show that the public sector capital stock generates an imputed return which takes the form of a reduction in local taxes and that failure to recognize this income distorts the measurement of the output of this sector, confuses the debate over federal tax reform, and hides the distinction between general subsidies for capital formation. Our implementation of those accounts for the 1959-1985 period indicates that current national income accounting procedures misstate the amount of income originating in the state and local sector; in recent years this misstatement has been on the order of $100 billion. We also show that the state and local sector is one of the more capital intensive sectors of the economy.

Charles R. Hulten
Chairman, Department of Economics
University of Maryland
College Park, MD 20742

Robert M. Schwab
Department of Economics
University of Maryland
College Park, MD 20742

Income Originating in the State and Local Sector*

Charles R. Hulten and Robert M. Schwab

I. Introduction

Viewed as an industry, state and local governments constitute one of the largest sectors of the U.S. economy. In 1985, state and local governments accounted for 8 percent of GNP and 13 percent of total employment, according to data from the U.S. National Income and Product Accounts (NIPA). Only two two-digit SIC industries, real estate and retail trade, contributed more to GNP, and only retail trade accounted for more employment.

State and local government is, however, not generally regarded as an industrial sector of the economy. Whereas analysis of industry data proceeds within the framework of production theory, analysis of the state and local sector is typically based on the theory of demand. The theoretical literature stresses problems of demand revelation for public goods (e.g., the literature inspired by Tiebout), and the empirical literature is oriented toward explaining the demand for public expenditures with a heavy emphasis on the median voter model.

This difference in perspective is doubtless the result of institutional differences between the public and private sectors. Private goods are exchanged in voluntary transactions between consumers and producers, and it is natural to separate supply and demand decisions. Public sector goods, on the other hand, are generally distributed directly to consumers and "paid for" indirectly through taxation. Since supply decisions are made by governments controlled by consumer-voters, it is easy to ignore the distinction between production and consumption and to focus only on the demand for public sector goods.

This demand-side focus obscures some important supply-side aspects of the state and local sector. In particular, the demand-side approach fails to account for the income flows originating in the sector, and this failure has a number of important implications. First, conventional measures of income originating in the general component of the state and local sector only include wages and salaries. Capital income is implicitly assumed to be zero, despite the fact that (as we show below) this sector is one of the most capital intensive in the U.S. economy. Consequently, NIPA dramatically understates the relative size of the sector.

Second, the failure to account for capital income obscures the true nature of federal government subsidies. In the recent debate over federal tax reform, termination of the tax exempt status of municipal bond interest and the elimination of the deduction for state and local taxes were two options considered. It was not generally recognized that the subsidy to the sector arises from the nonrecognition of the "equity" income accruing to state and local capital. State and local capital is treated like owner-occupied housing under the federal tax code; the noninterest portion of income accruing to capital is excluded from the tax base.

Third, the demand-side approach to the state and local sector cannot readily deal with the distinction between general subsidies, such as the deductibility of state and local taxes and general revenue sharing, and subsidies for capital formation, such as the exemption of municipal bond interest and matching capital grant programs. This distinction is important, because capital subsidies encourage the use of capital through output and factor substitution effects while general subsidies only involve output effects. The inability to distinguish between the two types of subsidies is analogous to the inability to distinguish between excise taxes and an investment tax credit in the private sector.

Fortunately, there is no inherent reason to exclude supply-side considerations from the analysis of the state and local sector. As shown in Hulten (1984), the production of public sector goods is analogous to the production of household goods (including owner-occupied housing); capital, labor, and intermediate inputs are purchased and transformed into output, which is distributed directly within the household. There is no explicit measure of output in either case, but in both cases a shadow value of output is implicit in the maximization of utility subject to the relevant expenditure constraint.

This shadow valuation of output gives rise to an implicit system of income and product accounts for the state and local sector. The purpose of this paper is to develop this accounting framework. The remainder of the paper has the following organization. In Section II, we develop a theoretical model of a simple economy in order to clarify the role of capital income in the state and local sector. Section III implements the accounting framework developed in II. We present aggregate estimates of the gross output of state and local governments for the 1959-1985 period and then compare them to the estimates in NIPA. Section IV offers a brief summary and conclusions.

II. Theoretical Considerations

Nearly all local public goods and services are provided directly to consumers without charge and then financed indirectly through taxes. Since these goods are not bought and sold in markets, no direct measure of the value of the goods and services produced in this sector is available. It is therefore impossible to develop independent measures of both sides of the conventional accounting equation which relates the value of output to the value of inputs.

This observation does not, however, imply that it is impossible to construct an appropriate income and product account for the state and local sector. In this section of the paper we show that such a system of accounts is implicit in standard optimization models of state and local governments. In order to make our argument clear, we first develop a very general model of a simple economy. We then add important institutional details to our model which allow us to focus on the provision of local public goods.

A Static One Sector Model

We begin with a one good model in which output Q is produced with capital K and labor L via a production function $Q=F(K,L)$. Under constant returns to scale, Euler's equation yields $Q = F_K K+F_L L$, where F_K and F_L are the marginal products of capital and labor. This expression implies a rudimentary accounting framework which allocates the value of output to the inputs since F_K and F_L can be interpreted as the shadow prices of capital and labor.

Profit maximization adds additional structure to this simple accounting framework. If product and factor markets are perfectly competitive, then the necessary conditions for profit maximization require firms to hire each input up to the point that the value of the marginal product of that input equals its factor price. Thus $F_K = P^K/P^Q$ and $F_L = P^L/P^Q$, where P^K, P^L, and P^Q are the prices of capital, labor, and output. Euler's equation then implies that

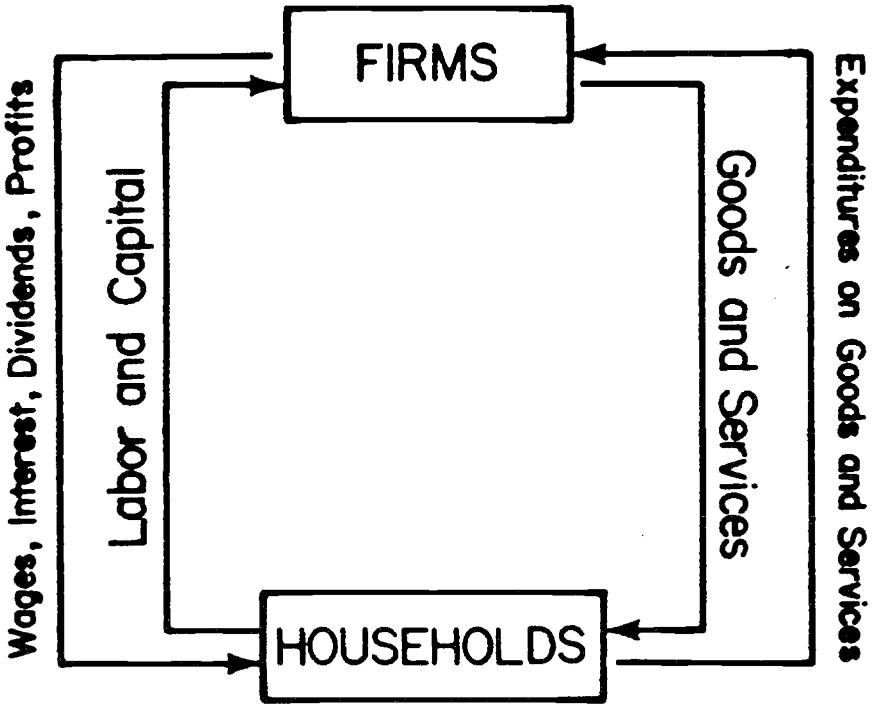
$$(1) \quad P^Q Q = P^K K + P^L L$$

for each firm. Aggregating over firms yields the fundamental equation of income and product accounting. It states that the value of output (revenue) observed from market transactions equals the payment for capital services (dividends, interest, rents, retained earnings, etc.) and the wage bill. This equation therefore generates a simple "T" account and corresponds to Section A, Table 1, of the U.S. National Income and Product Accounts.

Households play two roles in such a model. First, they supply capital and labor to firms. Second, these households purchase a quantity of Q which satisfies the constraint that their expenditures equal the sum of their capital and labor income. The aggregation of this budget constraint requires that $P^Q Q$ equals the sum of $P^K K$ and $P^L L$ and therefore generates a set of personal income and outlay accounts which are analagous to Table 2 of Section A of NIPA. Factor and goods prices are determined through the interaction of supply and demand. We can characterize this economy with a familiar "circular flow" diagram shown in Figure 1.

This simple accounting model could be generated without the assumption of optimizing behavior by tracking commodity and money flows between agents in the economy. It is important to stress, however, that such a set of accounts also arises from optimizing models where markets are not present. In an optimally planned economy without money or markets, the clockwise flow of commodities would be generated by the planners, but an implicit counterclockwise flow of values exists via shadow prices implied by

Figure 1


FIRMS
HOUSEHOLDS
Wages, Interest, Dividends, Profits
Labor and Capital
Goods and Services
Expenditures on Goods and Services

optimization. We draw on this result when we turn to the accounting for public goods for which there are no explicit markets.

Intertemporal Aspects of the Simple Model

The model presented in the preceding section is essentially static in that the capital stock is fixed and the technology is constant. We can introduce dynamic aspects into the model by allowing consumers to make intertemporal decisions, either because they live for more than one period or because they wish to leave a bequest to their heirs.

In such a model, consumers can trade consumption in one period for consumption in another by setting aside some of one period's output to increase the stock of capital. Society faces two constraints. First, the aggregate production function constraint in this model requires that $Q_t+I_t = F(K_t,L_t,t)$, where Q_t is consumption at time t and I_t is the amount of the homogenous good set aside for investment. Second, society is constrained by the identity that the stock of capital at the end of year t+1 is equal to the existing stock after depreciation plus any investment made during the year. We assume that capital depreciates at a constant rate δ, and therefore the perpetual inventory equation can be written[1]

$$(2) \quad K_{t+1} = I_t + (1-\delta)K_t.$$

The dynamic version of our simple model requires us to draw a distinction between the asset price of capital and the user cost of capital. A consumer who purchases a unit of capital for his portfolio pays the asset price P_t^I, which in our one good model must equal the price of the consumption good P_t^Q. The replacement value of the capital stock held by the household sector, which owns all factors of production, is therefore $P_t^Q K_t$.

The price of capital from the standpoint of the producer is the cost of using (or, renting) one unit of the consumers' capital for one period. It is this price, P^K_t, which is equated to the value of the marginal product of capital under profit maximization. P^K_t is also the amount which is received by households (in the form of dividends, interest, rents, etc.). Therefore, the value of owning one unit of capital W_t is the present value of the P^K_t generated over the life of the asset. Since capital depreciates at the rate δ, this must be given by[2]

$$(3) \quad W_t = \sum_{\tau=0}^{\infty} \frac{(1-\delta)^{\tau} P^K_{t+\tau}}{(1+r)^{\tau+1}}$$

The discount rate r in equation (3) is derived from the intertemporal utility maximization problem and represents the tradeoff between consumption in successive years. That is, the marginal rate of substitution between consumption in year t and year t+1 is $1/(1+r)$. For simplicity, we assume that r is constant.

The capital values P^Q_t and W_t are not necessarily equal. Tobin's marginal "q" ratio is, indeed, defined as the ratio of the two values:

$$(4) \quad q_t = \frac{W_t}{P^Q_t}$$

However, the optimal investment program implied by the optimization of the intertemporal utility function has the property that, in the absence of adjustment costs in changing the stock of capital, $q_t = 1$. That is, the value of the income generated by the stock of capital is equal to the reproduction cost of the stock.

When $q_t=1$, $W_t=P^Q_t$. If the economy is in equilibrium and therefore prices are constant, equation (3) yields the well known Hall and Jorgenson (1967) expression for the user cost of capital.[3]

$$(5) \quad P^K = P^Q(r+\delta).$$

As we argue in subsequent sections of this paper, the public sector analog to (5) is extremely useful in attributing capital income in the state and local sectors, since communities typically own the capital they use and annual payments to capital are not observed.

A balance sheet for our simple economy is embedded in the framework underlying equation (4). The "asset" side of the ledger contains the reproduction value of the capital stock, $P^Q_t K_t$; this is the amount that could be obtained if the physical capital were sold. The "liability" side of the ledger contains claims on the income flow generated by the capital, W_t; this is the amount that could be obtained if the rights to the income were sold. This distinction is somewhat artificial in our simple model, but takes on significance when we allow consumers to transfer physical capital to firms in exchange for financial claims against the capital (e.g. stocks and bonds).

Intertemporal considerations also influence the structure of the income and product accounts. The flow of capital payments from firms to households must now include a depreciation component. Net national income in this economy will then equal gross income, measured either as the sum of factor payments or as the value of output, less depreciation. An investment and saving account must be constructed to balance the production of investment goods with consumer saving.

A Three Consumer Good Model with a Public Sector

The jump from a one sector accounting model to an N sector model is, in principle, straight forward. Each sector is characterized by its own technology and its own income and product account, each developed along the lines set out above. The separate sectoral flows can then be aggregated to form an economy-wide set of accounts. The main complication arises when some sectors use the output of other sectors. In this case, intermediate inputs must be netted out in the aggregation across sectors.[4] We ignore this complication in this discussion.

With this in mind, we turn to the problem of accounting for public sector output. For reasons which will become apparent below, we begin with a simple model in which three goods are produced; a private sector good Z, housing H, and a local public good X. As above, Z and H are produced by profit maximizing firms operating in perfectly competitive markets.

Initially we assume that communities rent capital and that they charge a user fee equal to marginal cost, P^X. If a community is to attract households it must produce local public goods at minimum cost. The necessary conditions for cost minimization imply that marginal cost equals the price of each input divided by that factor's marginal product, and therefore P^X equals P^K/F_K and P^L/F_L. Under constant returns, marginal cost is independent of the scale of output and the value of the output equals the value of the inputs used to produce that output:

$$(6)\ P^X X = P^K K^X + P^L L^X.$$

It is therefore clear that the fact that one of the goods is produced by state and local governments does not in any fundamental way change the set of accounts we would construct to characterize this economy.

Suppose, now, that instead of renting capital, the community buys the stock of capital it needs for the production of local public goods. By analogy to the private sector, the change in the form of ownership will have no impact on the nature of our accounting framework. Private firms typically own the capital they use. The implicit income from this capital equals the explicit rent that would be charged in competitive markets; in a simple world without taxes, the appropriate per unit rental would be the Hall and Jorgenson user cost in (5).

This may seem a trivial observation, but it contains a fundamental insight that is lost in most analyses of the public sector; the allocation of capital to the public sector production implies a return to capital. This return is equal to $P^K K^X$, and reflects the fact that consumers allocate their capital so that at the margin the net return from all uses is equal, i.e., the income from allocating capital in one use equals the opportunity cost of using capital in other uses.

This is a rather unconventional view of the public sector, in that it suggests that income should be attributed to the residents of a community because they "own" streets, schools, etc. Clearly, communities never send their citizens a check which represents a payment for the use of capital; how, then, can it be claimed that capital "income" from schools and streets should be attributed to the local citizenry?

In order to address this issue, it is helpful to again consider the private sector for the moment. A share of stock represents a claim to a portion of the future income of a corporation and, equivalently, a claim to a portion of the corporation's physical stock of capital. These shares can be bought and sold and their value is determined in a stock market.

Is there a public sector analog to the stock market? When a consumer purchases a home in a community, that consumer simultaneously purchases a share in a corporation which produces goods, i.e., the consumer purchases a share of the community's capital stock. These shares may be bought and sold, though the market does not function quite like a stock market since the shares in these public corporations can only be transferred when a home is transferred. These public corporations also differ from private corporations in that the goods they produce are only consumed by the owners of the enterprise. These differences aside, the value of a house must equal the value of housing capital and the value of a share, i.e., the value of a community's public capital stock (net of outstanding debt) is capitalized into the value of homes in that community.

This capitalization argument allows us to characterize the user cost for a community which owns the stock of public capital. Suppose a community purchases a unit of capital at the beginning of a year with P^I tax dollars. The community uses the increment to its capital stock to produce local public goods and, in the process, the unit of capital depreciates to $(1-\delta)$; housing values are thus higher by $(1-\delta)P^I$ at the end of the year as a result of the unit investment. The community incurs an opportunity cost of rP^I since the P^I dollars required to purchase the capital could have been invested at the rate r. Therefore the cost of using this unit of capital for one year is $P^I+rP^I-(1-\delta)P^I$, or $(r+\delta)P^I$. But clearly this is equivalent to the user cost P^K in (5); given capitalization, the cost of capital facing communities who own capital is the same as the imputed user cost. P^K can then be interpreted as the additional end-of-year rent that the community would charge for the rental of its housing, in view of the additional public capital owned by the community.

Now consider the form of this payment. We could think of local governments setting a tax on its citizens as consumers equal to the cost of producing local public goods $P^K K + P^L L$ and then using a part of those tax proceeds to pay a "dividend" to its citizens as shareholders equal to $P^K K$. Of course, communities do not do this; they simply net out the dividend and set a tax of $P^L L$. Therefore the returns on public capital take the form of lower taxes. It then becomes necessary to impute the income generated by the public capital stock, just as the income from owner occupied housing must be imputed.

Finally, as we noted above, state and local governments rarely rely on user fees. But a local government acting solely in the interest of its citizens will act "as if" decisions were made by a utility maximizing representative voter. In a median voter model, this representative voter is the one who prefers the median level of local public goods; in a Tiebout model, communities are homogeneous and therefore any voter can be considered as the representative voter. The relevant cost of local public goods in this maximization problem is its shadow price P^X. Therefore local taxes in these models are equivalent to user fees and all of the points that we made above in a world where governments set user charges equal to the unit cost of production continue to hold.

<u>Bond Financed Public Capital</u>

It is not difficult to show that in the context of our simple model the method of financing the acquisition of public sector capital has no impact on the cost of using that capital. Suppose the community we have considered had issued P^I dollars of bonds when it bought a unit of capital. The interest on those bonds would be rP^I dollars. The value of housing in this community would rise by $P^I(1-\delta)$ dollars as a result of the larger capital stock and fall by P^I dollars because of the debt which must be repaid. These three terms together represent the cost of using capital for one period; they equal

$P^I(r+\delta)$, as in the all equity case.

The Federal Government

The federal government influences the cost of local public goods in at least two important ways. First, local taxes are deductible. Therefore, if the federal tax rate is t, then the marginal cost of local public goods from the perspective of the community is $(1-t)P^K/F_K$ and $(1-t)P^L/F_L$. From society's perspective, marginal cost is unchanged and therefore federal taxation introduces a wedge between the social cost of producing local public goods and their benefits.

We might then ask; how we should treat this implicit subsidy in our system of accounts if we wish to put the state and local sector and the private sector on the same footing? From the perspective of an income and product account, the inputs used in the state and local sector must be valued at their market prices. This follows directly from the fact that these accounts are derived from Euler's equation. The value of output received by a producer equals the cost of inputs purchased by that producer. Thus if a firm receives $100 in revenue, which is then paid to the owners of the labor and capital used to produce the firm's output, the set of accounts should value that output at $100, even if a subsidy to the buyer reduces the net cost to $50.[5]

The federal government also influences cost by offering grants to state and local governments which offset part of the cost of acquiring public sector capital. These grants typically take one of three forms.

As Bradford and Oates (1971) argue, nonmatching grants are equivalent to an increase in income for the citizens of a community. An open ended matching grant under which the federal government pays θ percent of the cost of all units of capital effectively reduces the cost of acquiring capital to $(1-\theta)P^I$.

Therefore a more general expression for the cost of public sector capital is

$$(7)\ P^K = P^I(1-\theta)(r+\delta).$$

Matching grants thus play the same role in the cost of capital in the public sector as do investment tax credits in the private sector.

The effects of closed ended matching capital grants depend on the level of capital chosen by the community. If a community purchases less capital than the maximum level the federal government will subsidize, then the program is functionally equivalent to an open ended matching grant; in this case the price of public sector capital is $P^I(1-\theta)(r+\delta)$. If a community purchases more capital than the federal government will subsidize, then the program is functionally equivalent to a nonmatching grant; the relevant price of capital is $P^I(r+\delta)$ and the community receives additional income equal to the subsidy on capital. Finally, if the community chooses exactly the quantity the federal government will subsidize, we can show that it behaves "as if" it faces a shadow price of capital $\gamma P^I(r+\delta)$, where γ lies between $(1-\theta)$ and 1.

By analogy to the private sector, we calculate a cost of capital which fully reflects the implications of federal taxes and subsidies to producers. Thus, for example, the Hall and Jorgenson user cost incorporates tax rates, the investment tax credit, and the present value of depreciation deductions. Therefore, because our objective is to develop accounts for the state and local sector which parallel those for the private sector, our imputed cost of capital is net of capital grants.

III. The Production of State and Local Public Goods

An important implication of the preceding analysis is that an income and product account can be constructed for the state and local government sector even though there is no independent measure of sectoral output. In this section of the paper we develop estimates of state and local output and input for the period 1959 to 1985. We then compare our results to those obtained directly from NIPA.

We begin by examining the technology used in the production of local public goods. The relationship between purchased inputs and output can change for two reasons. First, technical and managerial innovation may occur. Thus, for example, computers may allow communities to better regulate the flow of traffic, police to respond more quickly to emergencies, and teachers to improve their students' understanding of algebra.

Second, the production of local public goods depends on purchased inputs as well as the characteristics of the citizens. Bradford, Malt, and Oates (1969) drew the important distinction between what they termed D-output and C-output. D-output is the direct output of a local public agency, such as the number of city blocks patrolled, the average time to respond to a reported fire, and the number of hours of mathematics instruction in the public schools. The amount of D-output produced depends only on purchased inputs. C-output is the public service output that enters citizens' utility functions, and would include the level of public safety and the level of education achievement. The level of C-output depends on the amount of D-output and the characteristics of the population. For example, with identical expenditures for education, children in white-collar or upper-income communities may show greater educational achievement than children in blue-collar or low-income communities.

Both effects may alter the quantity of output obtained from a given amount of input. To allow for this possibility, we define A as an index of total factor productivity and assume that A enters the production function as a Hicks neutral change parameter. We also extend our previous specification of technology by including services S and non-durable intermediate goods G as well as labor L and capital K as inputs. The technology can then be written as

$$(8)\ X = AF(K, L, S, G).$$

We continue to assume that the production function exhibits constant returns to scale and that communities hire each factor of production up to the point that the value of the marginal product of that factor equals its price, and that output is priced at marginal cost, P^X. As noted above, this implies that the value of output must equal the value of the inputs required to produce that output:

$$(9)\ P^X X = P^K K + P^L L + P^S S + P^G G.$$

In the construction of private sector accounts, an independent estimate of $P^X X$ is available. Data on the current account inputs $P^L L$, $P^S S$, and $P^G G$ are also available and capital stock K can be estimated using the perpetual inventory method (2), given estimates of investment spending. The user cost can therefore be estimated as the residual that causes (9) to hold.

The situation is obviously different for the public sector. Independent estimates of $P^X X$ are not available, but $P^X X$ can be imputed given estimates of the values on the right hand side of (9). The values $P^L L$, $P^S S$, and $P^G G$ are available from NIPA, and K can be estimated using a perpetual inventory method. This implies that $P^X X$ can be imputed given an imputed value for the unobserved user cost P^K. This procedure is thus the converse of the procedure for constructing the private sector account, and the "value" of output constructed in this way is a cost based measure.

Equation (9) defines the value of the goods and services produced by state and local governments in a manner which is consistent with theory and the underlying technology. It differs from the total purchases of state and local governments E which is the measure of output in many studies, and which is defined as

$$(10)\ E = P^I I + P^L L + P^S S + P^G G.$$

The difference between these two concepts is $(P^I I - P^K K)$; purchases are not an adequate measure of output because they include the acquisition of capital and exclude the cost of using the services from the existing stock.

The estimation of real output X also requires indirect methods. Total differentiation of the technology in (8) implies

$$\begin{aligned}(11)\ d\ln X = d\ln A &+ s^K d\ln K^X + s^L d\ln L^X \\ &+ s^G d\ln G + s^S d\ln S\end{aligned}$$

where s^K, s^L, s^G, and s^S represent output elasticities. The marginal productivity conditions imply that these output elasticities equal each factor's share of the community's cost of producing local public goods, e.g., $s^K = (P^K K^X) / (P^X X)$.

If X were a private good, then we would have independent estimates of the growth rates of X, K, L, S, and G. In that case we could infer productivity growth (the growth rate of A) as a residual. But X cannot be observed directly; we can estimate $P^X X$ but we cannot separate price and quantity without additional information.

We are therefore forced to construct our accounts in a somewhat different way. We impose an estimate of productivity growth (zero in the estimates presented below), and then infer the growth rate of output as the share weighted growth rates of inputs.[6] While this is clearly an arbitrary assumption, it is consistent with the estimates in Hulten (1984) and elsewhere. We choose 1982 as our benchmark and then use these growth rates to estimate constant dollar aggregate output for the state and local sector for the 1959 to 1985 period.

The estimation of X via (11) permits $P^X X$ to be separated into price and quantity components. P^X has the ready interpretation as the marginal cost of producing X. We therefore rely on the assumption that communities are cost minimizers in our estimation of the real output of the state and local sector.

The assumptions underlying our estimates are clearly arguable. It may not be appropriate to characterize the various functions of state and local governments by a single production function. Furthermore, public decision makers may have objectives other than the efficient production of goods and services. The assumption of a zero rate of productivity growth is at best a compromise between competing points of view.

The framework of this paper is not, however, without merit. As Solow (1957) argues, the production theoretic framework should not be viewed as true per se, but rather as a systematic and explicit framework for organizing data. In this context, it should be noted that this framework, however imperfect, has the virtue of defining the theoretically correct measure of public sector output. It is clearly superior to a framework which implicitly assumes that there is no public sector capital (or that it has no value); police officers ride in squad cars, children sit in classrooms, and water flows through pipes. While our estimates of P^K and K^X may be problematic, they must represent an improvement over current practice.

Moreover, the total purchases approach to output measurement will almost never yield a valid measure. While total purchases may be the right concept for the analysis of cash flow and budget constraint problems, it is hard to justify its use in problems relating to the demand for and production of goods and services, except in the extreme circumstance of steady state growth.

In a more positive vein, our approach (embedded in the identity in (9)), has the sensible property that it defines the value of gross output as the value of resources withdrawn from the production of other goods and services. While this value is not necessarily equal to the value to the consumer of the goods produced, it does focus on the cost of producing those goods.

Data

The basic data source for our estimates is Part 3 of the U.S. National Income and Product Accounts. NIPA provides data on various aspects of state and local economic activity, including the purchases of goods and services, transfer payments, and the activities of government enterprises. Since the focus of the paper is the production of goods and services, we omit transfer payments from the analysis and include government enterprises with general government.

Table 1 sets forth state and local current dollar expenditures on structures and equipment, employee compensation, and purchases of intermediate goods and services; Table 2 presents the corresponding data in constant 1982 dollars. It is clear from Table 2 that real gross investment fell sharply after 1968, and this decline has sparked a deep concern over

Table 1

TOTAL PURCHASES
STATE AND LOCAL GOVERNMENT SECTOR
(Billions of Current Dollars)

year	total purchases	compensation of employees	nondurable goods	services	expenditure on capital goods	expenditure on structures	expenditure on equipment
1959	47.4	24.4	3.7	5.2	14.2	12.8	1.4
1960	50.8	27.0	3.9	5.6	14.3	12.7	1.6
1961	55.2	29.3	4.2	6.1	15.5	13.8	1.7
1962	58.6	31.8	4.2	6.2	16.3	14.5	1.8
1963	63.8	34.6	4.4	6.7	18.0	16.0	2.0
1964	69.1	37.8	4.5	7.2	19.5	17.2	2.3
1965	76.3	41.4	5.0	8.5	21.4	18.9	2.5
1966	85.0	46.4	5.3	9.6	23.8	21.0	2.8
1967	94.5	51.9	5.7	10.8	26.1	23.1	3.0
1968	105.7	58.5	6.3	12.4	28.4	25.2	3.2
1969	116.3	65.6	7.3	14.2	29.2	25.6	3.6
1970	129.4	74.5	8.5	16.7	29.7	25.8	3.9
1971	143.6	83.1	9.9	19.4	31.2	27.0	4.2
1972	156.5	92.0	10.8	21.8	31.9	27.1	4.8
1973	174.1	102.9	12.4	24.2	34.7	29.1	5.6
1974	199.2	113.3	15.8	28.6	41.6	34.7	6.9
1975	224.9	127.6	19.8	33.2	44.3	36.5	7.8
1976	242.2	140.1	23.0	35.7	43.4	35.0	8.4
1977	260.9	152.9	26.7	39.0	42.3	33.3	9.0
1978	291.8	167.6	29.4	44.6	50.2	40.2	10.0
1979	322.7	183.4	34.3	49.5	55.4	44.1	11.3
1980	360.8	203.3	40.1	54.9	62.5	49.9	12.6
1981	390.5	221.8	45.1	62.7	60.8	47.3	13.5
1982	418.4	240.3	47.3	71.3	59.5	44.8	14.7
1983	444.9	256.1	48.7	79.2	60.9	44.3	16.6
1984	479.1	274.1	51.2	86.8	66.9	48.2	18.7
1985	521.8	318.1	46.3	81.6	75.8	55.0	20.8

Table 2

TOTAL PURCHASES
STATE AND LOCAL GOVERNMENT SECTOR
(Billions of Constant 1982 Dollars)

year	total purchases	compensation of employees	nondurable goods	services	expenditure on capital goods	expenditure on structures	expenditure on equipment
1959	192.7	108.6	12.4	19.0	52.8	48.6	4.2
1960	200.7	114.3	13.1	20.1	53.3	48.6	4.7
1961	212.2	119.8	13.8	21.3	57.4	52.6	4.8
1962	218.8	123.7	13.9	21.7	59.5	54.4	5.1
1963	232.2	129.5	14.7	23.5	64.5	58.8	5.7
1964	246.8	137.8	15.0	25.0	69.0	62.7	6.3
1965	264.9	146.1	16.4	28.6	73.8	67.0	6.8
1966	281.7	154.7	16.8	31.5	78.7	71.3	7.4
1967	295.6	160.2	17.5	34.4	83.5	75.8	7.7
1968	312.9	168.3	19.3	37.9	87.3	79.3	8.0
1969	321.4	175.4	21.8	40.7	83.5	75.0	8.5
1970	331.5	183.2	25.2	44.7	78.3	69.4	8.9
1971	344.4	191.1	28.6	48.4	76.3	67.1	9.2
1972	354.9	198.5	30.7	51.9	73.8	63.6	10.2
1973	366.9	205.9	31.9	54.4	74.6	63.1	11.5
1974	379.7	213.0	32.7	58.2	75.8	63.1	12.7
1975	389.0	218.1	36.7	61.6	72.6	59.9	12.7
1976	393.2	220.8	41.0	62.1	69.3	56.4	12.9
1977	396.6	225.2	44.7	62.9	63.9	50.8	13.1
1978	412.2	231.1	46.4	66.4	68.3	54.8	13.5
1979	416.9	236.4	46.3	67.9	66.3	52.2	14.1
1980	418.9	239.9	44.8	67.3	66.9	52.5	14.4
1981	417.6	241.7	45.2	68.8	61.9	47.7	14.2
1982	418.4	240.3	47.3	71.3	59.5	44.8	14.7
1983	425.1	240.7	49.7	74.5	60.2	43.9	16.3
1984	435.7	242.6	51.7	77.2	64.1	46.2	17.9
1985	449.0	264.0	46.7	69.4	69.0	49.5	19.5

the condition of the public infrastructure.[7] Real labor compensation continued to rise through the 1970's and then remained roughly constant until 1985.

Table 3 expresses the expenditure data as shares. It shows that relative expenditures on services and nondurables rose very rapidly over the period. In 1959, these two categories together represented 18.7 percent of total state and local expenditures; by 1984 this figure had risen to 28.8 percent. Labor's share remained roughly constant during this time. In sharp contrast, the share of state and local expenditures devoted to capital expenditures fell from 30.0 percent in 1959 to 14.5 percent in 1985, a decline of more than one-half.

As we argued above, the basic difference between the total purchases concept of expenditure summarized in Tables 1 through 3 and the value of gross output lies in the treatment of capital. In particular, the theoretically correct measure of output requires us to replace investment expenditures (column 6 in Tables 1 and 2) with an estimate of the value of the current flow of capital services.

The valuation of capital services requires two steps; (i) the calculation of constant dollar stocks of each of three types of capital assets, and (ii) estimation of the per unit service price for each asset. The stocks of depreciable assets, structures and equipment, can be estimated through the perpetual inventory method in equation (2); the capital stock in the current year equals the capital stock in the previous year less depreciation plus investment during the previous year. The real investment series in (2), I_t, for structures and equipment are based on columns 6 and 7 of Table 2 for the 1959-1985 period and unpublished data from the Bureau of Economic Analysis (BEA) for the earlier period. Sufficiently long time series are available so that the initial stocks can be ignored in the recursive

Table 3

EXPENDITURE SHARES

year	compensation of employees	nondurables	services	capital expenditure
1959	0.514	0.077	0.110	0.300
1960	0.531	0.077	0.111	0.281
1961	0.532	0.077	0.110	0.281
1962	0.543	0.072	0.106	0.279
1963	0.543	0.070	0.105	0.282
1964	0.548	0.065	0.105	0.282
1965	0.543	0.065	0.111	0.281
1966	0.545	0.063	0.113	0.279
1967	0.549	0.061	0.114	0.276
1968	0.554	0.060	0.117	0.269
1969	0.564	0.063	0.122	0.251
1970	0.575	0.066	0.129	0.230
1971	0.579	0.069	0.135	0.217
1972	0.588	0.069	0.139	0.204
1973	0.591	0.071	0.139	0.199
1974	0.568	0.079	0.143	0.209
1975	0.567	0.088	0.147	0.197
1976	0.578	0.095	0.147	0.179
1977	0.586	0.102	0.149	0.162
1978	0.575	0.101	0.153	0.172
1979	0.568	0.106	0.154	0.172
1980	0.563	0.111	0.152	0.173
1981	0.568	0.115	0.161	0.156
1982	0.574	0.113	0.170	0.142
1983	0.576	0.109	0.178	0.137
1984	0.572	0.107	0.181	0.140
1985	0.610	0.089	0.156	0.145

application of (12).[8]

The estimation of the rate of depreciation, δ, is another matter, however. No systematic data are available and therefore indirect methods are required. The study by Boskin and Robinson (1986), based on the depreciation study of Hulten and Wykoff (1981), estimates depreciation rates of approximately 13.1 percent for equipment and 1.9 percent for structures, and we have used those estimates in our work. These rates of depreciation are somewhat lower than the rates implied by the BEA assumptions on asset life and retirement distribution.

BEA provides unpublished estimates of current dollar land purchases. We use a 1958 benchmark from Goldsmith (1962) and a price deflator for land based on Bureau of the Census index for land in the non-agricultural sector and Department of Agriculture estimates of the value of rural land.

Table 4 presents estimates of the stocks of structures, equipment, and land in current and constant dollars. The deflators for structures and equipment are obtained from NIPA, and refer to the replacement cost of these assets.[9]

If all assets were rented in competitive markets, then the observed rental prices would serve as the appropriate rental prices in the calculation of the value of local public goods as specified in (10) and the growth of output as specified in (11). Unfortunately, this is not the case and we must therefore impute these rental prices.

Equation (7) provides the basis for this imputation. The user cost of capital, as shown in (7), equals $P^I(1-\theta)(r+\delta)$, where θ is the federal matching rate, r is the discount rate, δ is the rate of economic depreciation, and P^I is the asset price of capital. The estimates of the rate of depreciation and the asset price embedded in our user cost calculations are the same as those we discussed above. Estimates of the

Table 4

PRICE AND QUANTITY OF THE CAPITAL STOCK
(Value in Billions of Current Dollars)

	structures			equipment			land		
year	price	quantity	value	price	quantity	value	price	quantity	value
1959	0.264	653.8	172.4	0.333	24.0	8.0	0.260	107.7	28.0
1960	0.261	689.4	180.1	0.340	25.0	8.5	0.261	111.0	29.0
1961	0.263	724.4	190.5	0.354	26.4	9.4	0.261	114.6	29.9
1962	0.267	762.6	203.8	0.353	27.7	9.8	0.261	118.7	31.0
1963	0.272	802.0	218.1	0.351	29.2	10.2	0.262	122.9	32.2
1964	0.274	844.9	231.7	0.365	31.0	11.3	0.265	127.8	33.8
1965	0.282	890.9	251.4	0.368	33.2	12.2	0.272	132.9	36.2
1966	0.294	940.4	276.5	0.378	35.6	13.5	0.282	138.0	38.9
1967	0.304	993.0	302.2	0.390	38.3	14.9	0.291	142.9	41.6
1968	0.318	1049.2	333.6	0.400	41.0	16.4	0.306	147.5	45.1
1969	0.341	1107.8	377.7	0.424	43.6	18.5	0.329	152.0	50.0
1970	0.372	1160.9	431.5	0.438	46.3	20.3	0.348	156.2	54.3
1971	0.402	1207.3	485.1	0.457	49.1	22.4	0.373	160.6	59.9
1972	0.426	1250.6	532.2	0.471	51.8	24.4	0.400	164.6	65.8
1973	0.461	1289.5	594.1	0.487	55.2	26.9	0.433	168.6	73.0
1974	0.550	1327.1	730.4	0.543	59.4	32.3	0.490	172.3	84.5
1975	0.610	1364.0	831.6	0.614	64.3	39.5	0.547	175.9	96.3
1976	0.621	1396.9	867.6	0.651	68.5	44.6	0.588	179.3	105.4
1977	0.655	1425.7	933.9	0.687	72.3	49.7	0.641	182.1	116.7
1978	0.734	1448.3	1063.3	0.741	75.9	56.2	0.707	184.6	130.5
1979	0.846	1474.4	1246.7	0.801	79.4	63.6	0.784	186.8	146.4
1980	0.950	1497.5	1422.3	0.875	83.0	72.6	0.868	189.1	164.1
1981	0.992	1520.4	1508.1	0.951	86.5	82.2	0.952	191.4	182.1
1982	1.000	1538.0	1538.0	1.000	89.2	89.2	1.000	193.6	193.6
1983	1.010	1552.4	1568.6	1.018	92.2	93.9	1.005	195.8	196.7
1984	1.044	1565.6	1634.3	1.045	96.3	100.6	1.031	198.0	204.1
1985	1.111	1580.8	1756.2	1.067	101.5	108.3	1.046	200.4	209.6

subsidy parameter are based on Schneiderman (1975) and U.S. General Accounting Office (1983).[10]

As noted above, the user cost of capital is determined endogenously in growth analyses of the private sector. Specifically, the private rate of return in (5) is allowed to adjust so as to equate the right and left hand sides of (9). This procedure yields an ex post estimate of the rate of return which can be shown to provide an adjustment for capacity utilization (Berndt and Fuss (1986), Hulten (1986b)). This approach is not available in the public sector and we require an exogenous value of r in order to impute P^K on the right side of (9).

The choice of an appropriate discount rate is not clear. In equilibrium, arbitrage should insure that the rate of return on all capital in the same risk class is the same. But, recent work by Gordon and Slemrod (1983, 1984) and Hulten (1986a) suggests that the arbitrage assumption may not be a good guide to the selection of an appropriate discount rate. Lacking a better alternative (or, at least, one that commands wide spread acceptance), we select the long term nominal interest rate on municipal bonds, less long term expected inflation, as our rate of discount for public sector capital income. This assumption is attractive in that the municipal bond market is the major source of funds for the acquisition of public sector capital.

We thus require a measure of long term expected inflation. There has been a great deal of research on the formation of short term expections, and a number of alternative approaches have been developed, including distributed lag models, rational expectations models, and the use of survey data.[11] Long term expected inflation, however, has received less attention. We have used the following procedure. Joseph Livingston, a Philadelphia journalist, began in 1946 to survey roughly 50 economists for their forecasts of inflation (as measured by the Consumer Price Index) for the coming 6 and 12 months. We base our long term estimate of inflation on these short term forecasts, using the following method. We denote the 12 month Livingston forecasts made in period t by π^e_{t+1}.[12] We assume that the Livingston respondents form their expectations by looking at past actual inflation, π_{t-s}, according to the process

$$(13) \quad \pi^e_{t+1} = \alpha_0 + \Sigma\, \alpha_s \pi_{t-s}.$$

We estimate the parameters of (13) and then generate forecasts for future periods π^e_{t+2}, π^e_{t+3}, etc. by replacing past actual inflation in (13) with forecasts for earlier years. Long term expected inflation is the average forecast rate for the coming five years.

Our estimates of long term expected inflation are shown in the second column of Table 5. Standard and Poor's nominal interest rates on high grade municipal bonds are shown in the third column. The last column represents our estimates of the real interest rate in the state and local sector. These estimates are consistent with the patterns noted by Blanchard and Summers (1984) and others; real interest rates remained roughly constant through the 1960's, fell during the 1970's, and then rose sharply in the first half of the 1980's.

Inasmuch as the choice of appropriate discount rate is problematic, we present alternative estimates (which parallel the calculations presented in the text) in an Appendix. These alternative calculations assume that the appropriate discount rate is the real *ex post* return in the private sector.[13] The estimates of gross product in the Appendix can then be interpreted as the marginal opportunity cost of resources employed to produce local public goods.

Current Dollar Accounts

The gross output account for the state and local sector is shown in

Table 5

REAL AND NOMINAL INTEREST RATES

year	expected inflation	nominal interest rate	real interest rate
1958	0.21	3.56	3.35
1959	0.93	3.95	3.02
1960	0.96	3.73	2.77
1961	0.92	3.46	2.54
1962	1.01	3.18	2.17
1963	0.73	3.23	2.50
1964	0.84	3.22	2.38
1965	0.74	3.27	2.53
1966	1.16	3.82	2.66
1967	1.34	3.98	2.64
1968	2.09	4.51	2.42
1969	2.11	5.81	3.70
1970	2.64	6.51	3.87
1971	3.11	5.70	2.59
1972	3.24	5.27	2.03
1973	3.25	5.18	1.93
1974	4.37	6.09	1.72
1975	3.93	6.89	2.96
1976	4.91	6.49	1.58
1977	5.27	5.56	0.29
1978	5.10	5.90	0.80
1979	5.88	6.39	0.51
1980	6.82	8.51	1.69
1981	6.74	11.23	4.49
1982	5.89	11.57	5.68
1983	5.28	9.47	4.19
1984	5.00	10.15	5.15
1985	3.48	9.18	5.70

Table 6 and represents our implementation of equation (9). The last column is the sum of the implicit rentals on three types of capital; structures, equipment, and land. The third, fourth, and fifth columns show employee compensation, expenditures on nondurable goods, and services. The second column is the sum of the last four, i.e., the value of output equals the sum of the factor payments given Euler's theorem (under constant returns to scale). Table 7 presents the corresponding factor shares.

Tables 6 and 7, which focus on gross output, present a rather different picture of the state and local sector than do Tables 1 and 3, which focus on expenditure. As shown in Table 3, capital's share of expenditures fell by nearly 16 percentage points from 1959 to 1985; in contrast, capital's share of gross output was unchanged.

This pattern reflects the rapid accumulation of capital in the state and local sector during the 1950's and 60's. This was a period when the baby boom generation began to reach school age and therefore the needs for additional educational facilities rose sharply. Further, the ambitious interstate highway program was begun during this period, while rapid suburbanization led to additional infrastructure requirements. These factors led to an investment boom. After the boom ended, the consequent larger capital stock continued to generate the capital income imputed in this paper. Therefore capital's share of output remained roughly constant while its share of expenditures fell sharply. High real rates in the 1980's also played an important role.

These considerations have some important implications for measuring the growth of output over time. As shown in Tables 1 and 6, current dollar gross output in 1959 was about 15 percent lower than expenditure; in 1985 it was 6 percent higher. Our estimates therefore imply that the production of local public goods grew faster than the total purchases approach suggests.

Table 6

GROSS OUTPUT ACCOUNT FOR THE STATE AND LOCAL SECTOR
(Billions of Current Dollars)

year	output	labor compensation	nondurables	services	capital
1959	41.4	24.4	3.7	5.2	8.2
1960	45.0	27.0	3.9	5.6	8.5
1961	48.3	29.3	4.2	6.1	8.7
1962	50.7	31.8	4.2	6.2	8.4
1963	55.2	34.6	4.4	6.7	9.5
1964	59.2	37.8	4.5	7.2	9.6
1965	65.9	41.4	5.0	8.5	11.1
1966	73.8	46.4	5.3	9.6	12.5
1967	82.4	51.9	5.7	10.8	13.9
1968	91.9	58.5	6.3	12.4	14.6
1969	108.2	65.6	7.3	14.2	21.1
1970	123.2	74.5	8.5	16.7	23.5
1971	132.8	83.1	9.9	19.4	20.3
1972	144.1	92.0	10.8	21.8	19.4
1973	160.0	102.9	12.4	24.2	20.6
1974	181.0	113.3	15.8	28.6	23.4
1975	215.6	127.6	19.8	33.2	35.1
1976	223.8	140.1	23.0	35.7	25.0
1977	235.0	152.9	26.7	39.0	16.4
1978	264.8	167.6	29.4	44.6	23.3
1979	292.0	183.4	34.3	49.5	24.8
1980	338.9	203.3	40.1	54.9	40.6
1981	403.1	221.8	45.1	62.7	73.4
1982	450.6	240.3	47.3	71.3	91.7
1983	462.3	256.1	48.7	79.2	78.3
1984	506.1	274.1	51.2	86.8	93.9
1985	556.2	318.1	46.3	81.6	110.2

Table 7

INCOME SHARES OF GROSS OUTPUT

year	labor	nondurables	services	capital	structures	equipment	land
1959	0.589	0.088	0.126	0.198	0.158	0.024	0.016
1960	0.598	0.087	0.125	0.190	0.151	0.024	0.014
1961	0.607	0.088	0.125	0.180	0.143	0.024	0.013
1962	0.628	0.083	0.122	0.166	0.132	0.024	0.010
1963	0.627	0.080	0.122	0.171	0.138	0.023	0.011
1964	0.639	0.076	0.122	0.162	0.129	0.023	0.010
1965	0.628	0.076	0.128	0.168	0.134	0.023	0.011
1966	0.628	0.072	0.130	0.170	0.136	0.023	0.011
1967	0.630	0.070	0.131	0.169	0.136	0.023	0.011
1968	0.637	0.069	0.135	0.159	0.127	0.022	0.009
1969	0.606	0.068	0.131	0.195	0.159	0.023	0.013
1970	0.604	0.069	0.136	0.191	0.157	0.021	0.013
1971	0.626	0.075	0.146	0.153	0.125	0.020	0.009
1972	0.639	0.075	0.151	0.135	0.109	0.019	0.007
1973	0.643	0.078	0.151	0.129	0.104	0.018	0.006
1974	0.626	0.087	0.158	0.129	0.105	0.019	0.006
1975	0.592	0.092	0.154	0.163	0.133	0.021	0.009
1976	0.626	0.103	0.159	0.112	0.088	0.019	0.005
1977	0.651	0.114	0.166	0.070	0.052	0.017	0.001
1978	0.633	0.111	0.168	0.088	0.068	0.018	0.002
1979	0.628	0.117	0.170	0.085	0.065	0.018	0.002
1980	0.600	0.118	0.162	0.120	0.095	0.020	0.005
1981	0.550	0.112	0.156	0.182	0.148	0.022	0.012
1982	0.533	0.105	0.158	0.203	0.165	0.024	0.015
1983	0.554	0.105	0.171	0.169	0.135	0.023	0.011
1984	0.542	0.101	0.172	0.186	0.149	0.024	0.013
1985	0.572	0.083	0.147	0.198	0.160	0.024	0.014

This result has important implications for econometric work on state and local governments; those studies which rely on expenditures as a measure of the output in this sector have systematically mismeasured their dependent variable.

This pattern is more dramatic if we focus on value added rather than gross output. Value added in the private sector is the sum of compensation of employees and the value of capital services, i.e., the private sector analogs to the sum of the third and sixth columns in Table 6. NIPA defines value added for the state and local sector as the sum of compensation of employees and the adjusted current surplus of government enterprises.

Table 8 compares these two measures. Our 1985 estimate of value added for the state and local sector is 122 billion dollars greater than the corresponding NIPA value. Figure 2 presents our estimates of value added as a percentage of the NIPA numbers for the 1959-1985 period. It shows that in 1985 NIPA understated the output of this sector by nearly 40 percent.

<u>Constant Dollar Accounts</u>

The preceding sections developed a set of current dollar gross output accounts for the state and local sector. We now turn to a corresponding set of constant dollar accounts. The key issue here is the separation of value into prices and quantities.

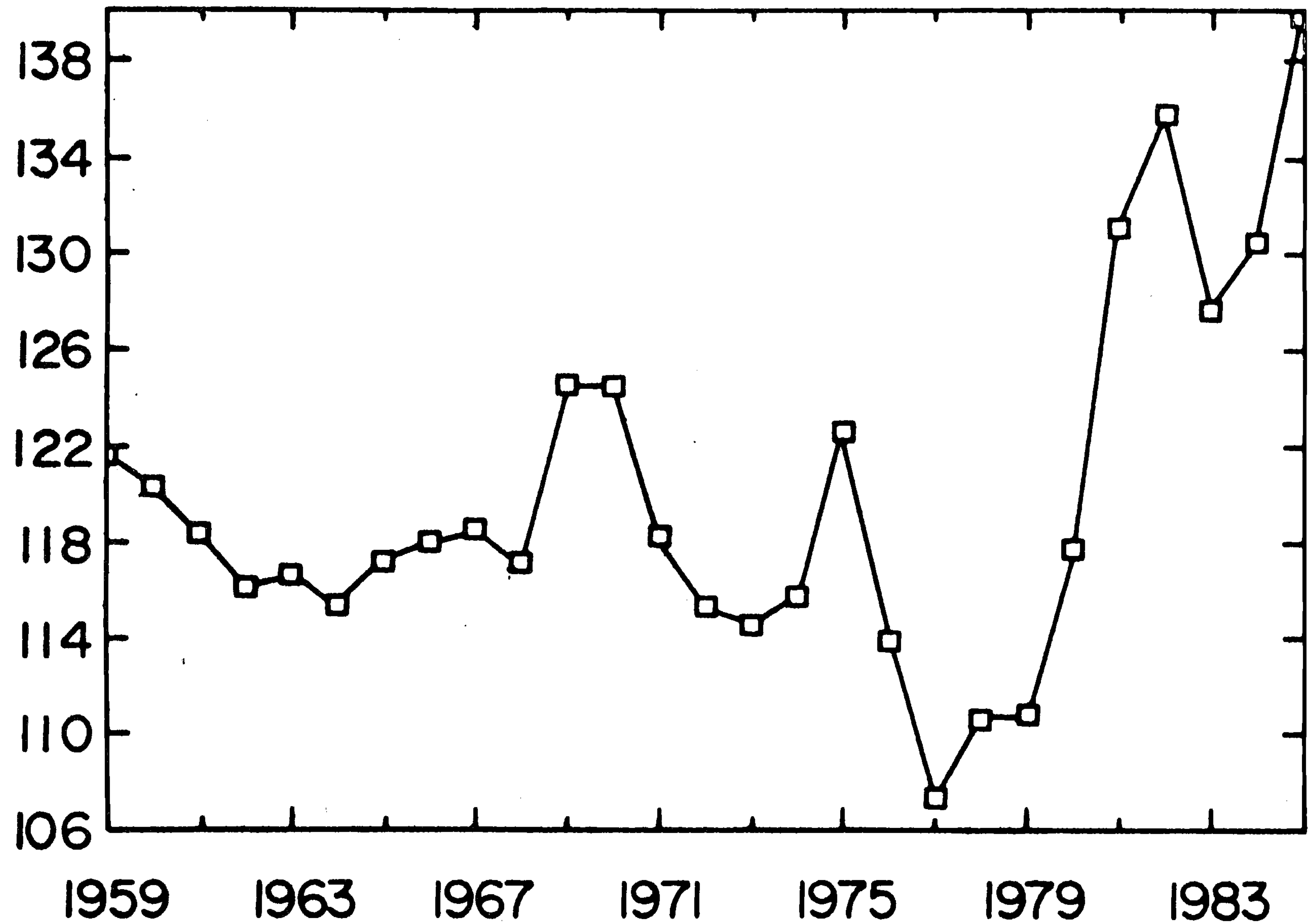
We outlined our approach to estimating the growth rate of output earlier; assuming productivity growth is zero, it equals the share weighted growth rates of the inputs.[14] The growth rates of labor, intermediate goods, and intermediate services are based on the factor payments in Table 5 and price indices from NIPA; the required share estimates are reported in Table 7.

For capital, we use 1982 as our benchmark and expand our benchmark to

Table 8

year	NIPA value added	Hulten-Schwab value added
1959	26.8	32.6
1960	29.5	35.5
1961	32.1	38.0
1962	34.7	40.3
1963	37.8	44.1
1964	41.1	47.4
1965	44.8	52.5
1966	49.9	58.9
1967	55.6	65.9
1968	62.4	73.1
1969	69.6	86.7
1970	78.7	98.0
1971	87.5	103.4
1972	96.6	111.4
1973	107.8	123.5
1974	118.1	136.7
1975	132.6	162.6
1976	145.0	165.1
1977	157.7	169.3
1978	172.7	190.9
1979	188.0	208.2
1980	207.4	243.9
1981	225.4	295.3
1982	244.7	332.0
1983	262.2	334.4
1984	282.4	368.1
1985	306.3	428.3

Figure 2


138
134
130
126
122
118
114
110
106
1959
1963
1967
1971
1975
1979
1983

other years with a Divisia index of capital growth. This index is defined as the growth rates of structures, equipment, and land from Table 4 weighted by each asset's share of payments to capital. Thus in continuous time, the growth rate of capital would be given by

$$(14)\ d\ln K = \Sigma\, v_i d\ln K_i$$

where i refers to structures, land, and equipment and v_i equals the ith factor's share of total rentals $P_i^K K_i / \Sigma P_i^K K_i$. Output is also benchmarked to 1982.

The prices and quantities of output and inputs are shown in Table 9. That table suggests that we divide 1959-1985 into two sub-periods. As shown in Table 10, from 1959 to 1975, the real gross output of state and local governments grew at an average rate of 5.3 percent per year. In sharp contrast, output grew only 2.3 percent per year from 1975 to 1985. This reflects the slower growth of real input used in this sector, which in turn is linked to the slowdown in the growth of government in the 1970's (and possibly to the slowdown in growth throughout the economy during this period).

Table 9

CONSTANT DOLLAR GROSS OUTPUT ACCOUNT
(Quantities in Billions of Constant 1982 Dollars)

	OUTPUT		CAPITAL		LABOR		SERVICES		NONDURABLES	
year	price	quantity	price	quantity	price	quantity	price	quantity	price	quantity
1959	0.247	167.5	0.011	746.6	0.224	108.6	0.274	19.0	0.295	12.4
1960	0.255	176.5	0.011	784.0	0.236	114.3	0.280	20.1	0.301	13.1
1961	0.261	185.4	0.011	822.1	0.245	119.8	0.285	21.3	0.306	13.8
1962	0.265	191.3	0.010	862.9	0.257	123.7	0.286	21.7	0.303	13.9
1963	0.274	201.5	0.010	905.5	0.267	129.5	0.287	23.5	0.301	14.7
1964	0.277	213.4	0.010	952.8	0.275	137.8	0.290	25.0	0.300	15.0
1965	0.288	228.8	0.011	1004.4	0.283	146.1	0.296	28.6	0.305	16.4
1966	0.304	243.1	0.012	1059.7	0.300	154.7	0.304	31.5	0.317	16.8
1967	0.323	255.0	0.012	1118.8	0.324	160.2	0.313	34.4	0.328	17.5
1968	0.339	271.0	0.012	1180.7	0.348	168.3	0.327	37.9	0.329	19.3
1969	0.377	287.3	0.017	1244.0	0.374	175.4	0.350	40.7	0.335	21.8
1970	0.404	305.1	0.018	1302.7	0.406	183.2	0.374	44.7	0.337	25.2
1971	0.413	321.8	0.015	1355.7	0.435	191.1	0.402	48.4	0.347	28.6
1972	0.428	336.9	0.014	1406.1	0.464	198.5	0.420	51.9	0.353	30.7
1973	0.456	350.8	0.014	1455.1	0.499	205.9	0.444	54.4	0.389	31.9
1974	0.495	365.6	0.016	1505.8	0.532	213.0	0.491	58.2	0.482	32.7
1975	0.563	383.2	0.023	1556.9	0.585	218.1	0.538	61.6	0.540	36.7
1976	0.570	392.6	0.016	1602.9	0.635	220.8	0.574	62.1	0.562	41.0
1977	0.582	403.5	0.010	1646.6	0.679	225.2	0.620	62.9	0.598	44.7
1978	0.634	418.0	0.014	1684.2	0.726	231.1	0.671	66.4	0.632	46.4
1979	0.683	427.6	0.014	1723.7	0.776	236.4	0.730	67.9	0.741	46.3
1980	0.781	434.0	0.023	1759.7	0.847	239.9	0.816	67.3	0.895	44.8
1981	0.908	443.9	0.041	1792.4	0.918	241.7	0.912	68.8	0.997	45.2
1982	1.000	450.6	0.050	1817.4	1.000	240.3	1.000	71.3	1.000	47.3
1983	1.010	457.8	0.043	1839.8	1.064	240.7	1.063	74.5	0.980	49.7
1984	1.084	466.8	0.050	1864.2	1.130	242.6	1.125	77.2	0.989	51.7
1985	1.161	479.0	0.058	1892.5	1.205	264.0	1.176	69.4	0.992	46.7

Table 10

AVERAGE ANNUAL GROWTH RATES OF INPUTS AND OUTPUT

	output	capital	labor	services	nondurables
1959-1975	0.053	0.047	0.044	0.074	0.068
1975-1985	0.023	0.020	0.019	0.012	0.024
1959-1985	0.041	0.037	0.034	0.050	0.051

IV. Summary and Conclusions

We have developed in this paper an accounting framework for state and local governments which is consistent with representative voter models of this sector. We have shown that this framework is in principle the same as the accounting framework for other sectors of the economy. We have also shown that the capital income in this sector appears as a reduction in taxes, to the extent that capital is not financed by debt. We have also found that the nondebt value of the public capital stock should be capitalized in housing values, and that the analysis of housing values can yield the implicit rent on public capital.[15]

We have not implemented a complete accounting framework; this would involve the construction of income, expenditure, and wealth accounts for the state and local sector, and substantial revisions in other sectoral accounts (particularly housing). This is beyond the scope of this paper and we have, instead, limited our empirical work to constructing an income and product account for the state and local sector. This has involved the measurement of capital stocks and the imputation of capital income to the sector.

Our empirical results indicate that current national income accounting procedures substantially underestimate the amount of income originating in the state and local sector. In recent years, the size of this understatement is on the order of $100 billion. This can hardly be considered a negligible amount. There is, correspondingly, an overstatement of income in the housing sector, but we have not estimated the size of this effect.

This missing income has important policy implications. The debate over tax reform focused on the various ways that the federal government sudsidizes the production of local public goods. The federal tax treatment of part of the income accruing to state and local capital was discussed - the income reflected in municipal bond interest - but, since less than half of state and local capital formation is financed by debt, a large portion of the capital income originating in the sector was ignored.

Our results also present a rather different picture of the sector than might be obtained, for example, from the well-known study by Baumol (1967) or from NIPA. We find that labor productivity - output per unit of labor input - grew at an average annual rate of 0.6 percent, even under our assumption that there was zero total factor productivity growth; by contrast, NIPA procedures imply that labor productivity growth was virtually zero.

Moreover, we find that the state and local sector is in fact relatively capital intensive. According to data from the Bureau of Labor Statistics, the capital-output ratio in private business was approximately 3.1 in 1982. For the state and local sector, we find that the ratio of capital to gross output was 4.1 in that year; the ratio of capital to value added was 5.6. If productivity growth in this sector has in fact been slow, it cannot be attributed to the fact that the production of local public goods is labor intensive.

The asssumptions underlying some of our methods and some of our conclusions are clearly arguable. But our point is not that NIPA misstates the size of the state and local sector by \$75 billion, \$100 billion, or \$150 billion. Rather, our point is that capital income in the state and local sector is not zero, and that our estimates suggest that the magnitude of the measurement error for this sector is large.

APPENDIX

This Appendix presents an alternative set of accounts based on the assumption that the appropriate discount rate for the state and local sector is the real *ex post* return in the private sector. The numbering of these tables parallels the text. Thus, for example, Table A-6 in this Appendix (which presents estimates of current dollar gross output based on the constant real rate) is the analog to Table 6 in the text.

As can be seen, the estimates in the Appendix and the estimates in the text of the paper are very similar. For example, as shown in Table A-8, 1985 value-added in the state and local sector under our *ex post* real rate series is $415.7 billion; under our *ex ante* real rate series, value-added is $428.3 billion.

Table A-6

GROSS OUTPUT ACCOUNT FOR THE STATE AND LOCAL SECTOR
(Billions of Current Dollars)

year	output	labor compensation	nondurables	services	capital
1959	41.8	24.4	3.7	5.2	8.6
1960	45.2	27.0	3.9	5.6	8.7
1961	48.8	29.3	4.2	6.1	9.1
1962	53.8	31.8	4.2	6.2	11.6
1963	58.9	34.6	4.4	6.7	13.2
1964	64.8	37.8	4.5	7.2	15.2
1965	74.2	41.4	5.0	8.5	19.4
1966	82.8	46.4	5.3	9.6	21.6
1967	90.4	51.9	5.7	10.8	21.9
1968	99.0	58.5	6.3	12.4	21.7
1969	108.7	65.6	7.3	14.2	21.6
1970	119.9	74.5	8.5	16.7	20.3
1971	136.7	83.1	9.9	19.4	24.2
1972	152.7	92.0	10.8	21.8	28.1
1973	167.9	102.9	12.4	24.2	28.4
1974	182.8	113.3	15.8	28.6	25.2
1975	217.3	127.6	19.8	33.2	36.8
1976	235.6	140.1	23.0	35.7	36.8
1977	258.0	152.9	26.7	39.0	39.4
1978	287.9	167.6	29.4	44.6	46.4
1979	317.7	183.4	34.3	49.5	50.5
1980	350.8	203.3	40.1	54.9	52.5
1981	389.8	221.8	45.1	62.7	60.1
1982	422.9	240.3	47.3	71.3	64.0
1983	456.0	256.1	48.7	79.2	72.0
1984	502.0	274.1	51.2	86.8	89.9
1985	543.6	318.1	46.3	81.6	97.6

Note: the figures in this table are based upon an alternative real rate of interest.

Table A-7

INCOME SHARES OF GROSS OUTPUT

year	labor	nondurables	services	capital	structures	equipment	land
1959	0.583	0.087	0.124	0.206	0.165	0.024	0.017
1960	0.596	0.087	0.124	0.193	0.154	0.024	0.015
1961	0.602	0.087	0.124	0.187	0.149	0.025	0.014
1962	0.591	0.078	0.115	0.215	0.174	0.024	0.017
1963	0.587	0.075	0.114	0.224	0.182	0.024	0.018
1964	0.584	0.070	0.112	0.235	0.191	0.024	0.020
1965	0.558	0.067	0.114	0.261	0.213	0.025	0.023
1966	0.560	0.064	0.116	0.260	0.213	0.025	0.022
1967	0.575	0.063	0.119	0.243	0.198	0.025	0.020
1968	0.591	0.064	0.125	0.219	0.179	0.024	0.017
1969	0.603	0.067	0.131	0.199	0.162	0.023	0.014
1970	0.621	0.071	0.140	0.169	0.138	0.021	0.010
1971	0.608	0.073	0.142	0.177	0.145	0.020	0.011
1972	0.603	0.071	0.143	0.184	0.151	0.020	0.012
1973	0.613	0.074	0.144	0.169	0.139	0.019	0.011
1974	0.620	0.086	0.156	0.138	0.112	0.019	0.006
1975	0.587	0.091	0.153	0.169	0.139	0.021	0.010
1976	0.595	0.098	0.151	0.156	0.127	0.020	0.010
1977	0.593	0.103	0.151	0.153	0.124	0.019	0.010
1978	0.582	0.102	0.155	0.161	0.130	0.020	0.010
1979	0.577	0.108	0.156	0.159	0.129	0.020	0.009
1980	0.580	0.114	0.156	0.150	0.121	0.021	0.008
1981	0.569	0.116	0.161	0.154	0.124	0.021	0.009
1982	0.568	0.112	0.169	0.151	0.120	0.022	0.009
1983	0.562	0.107	0.174	0.158	0.125	0.022	0.010
1984	0.546	0.102	0.173	0.179	0.143	0.023	0.012
1985	0.585	0.085	0.150	0.180	0.144	0.024	0.012

Note: the figures in this table are based upon an alternative real rate of interest.

Table A-8

year	NIPA value added	Hulten-Schwab value added
1959	26.8	33.0
1960	29.5	35.7
1961	32.1	38.5
1962	34.7	43.4
1963	37.8	47.8
1964	41.1	53.1
1965	44.8	60.8
1966	49.9	67.9
1967	55.6	73.9
1968	62.4	80.3
1969	69.6	87.2
1970	78.7	94.7
1971	87.5	107.3
1972	96.6	120.1
1973	107.8	131.3
1974	118.1	138.4
1975	132.6	164.4
1976	145.0	176.9
1977	157.7	192.3
1978	172.7	214.0
1979	188.0	233.9
1980	207.4	255.8
1981	225.4	281.9
1982	244.7	304.3
1983	262.2	328.1
1984	282.4	364.0
1985	306.3	415.7

Note: the figures in this table are based upon an alternative real rate of interest.

Table A-9

CONSTANT DOLLAR GROSS OUTPUT ACCOUNT
(Quantities in Billions of Constant 1982 Dollars)

	OUTPUT		CAPITAL		LABOR		SERVICES		NONDURABLES	
year	price	quantity	price	quantity	price	quantity	price	quantity	price	quantity
1959	0.260	160.7	0.011	760.4	0.224	108.6	0.274	19.0	0.295	12.4
1960	0.267	169.2	0.011	798.4	0.236	114.3	0.280	20.1	0.301	13.1
1961	0.274	177.9	0.011	837.3	0.245	119.8	0.285	21.3	0.306	13.8
1962	0.293	183.9	0.013	878.7	0.257	123.7	0.286	21.7	0.303	13.9
1963	0.304	193.7	0.014	921.8	0.267	129.5	0.287	23.5	0.301	14.7
1964	0.316	205.1	0.016	969.3	0.275	137.8	0.290	25.0	0.300	15.0
1965	0.337	219.9	0.019	1020.9	0.283	146.1	0.296	28.6	0.305	16.4
1966	0.355	233.5	0.020	1076.1	0.300	154.7	0.304	31.5	0.317	16.8
1967	0.369	244.7	0.019	1135.0	0.324	160.2	0.313	34.4	0.328	17.5
1968	0.381	259.8	0.018	1196.8	0.348	168.3	0.327	37.9	0.329	19.3
1969	0.397	274.0	0.017	1260.5	0.374	175.4	0.350	40.7	0.335	21.8
1970	0.413	290.6	0.015	1320.1	0.406	183.2	0.374	44.7	0.337	25.2
1971	0.445	307.2	0.018	1373.8	0.435	191.1	0.402	48.4	0.347	28.6
1972	0.474	321.9	0.020	1424.2	0.464	198.5	0.420	51.9	0.353	30.7
1973	0.501	334.9	0.019	1472.2	0.499	205.9	0.444	54.4	0.389	31.9
1974	0.525	348.2	0.017	1522.2	0.532	213.0	0.491	58.2	0.482	32.7
1975	0.596	364.8	0.023	1573.4	0.585	218.1	0.538	61.6	0.540	36.7
1976	0.630	374.1	0.023	1618.4	0.635	220.8	0.574	62.1	0.562	41.0
1977	0.671	384.7	0.024	1658.1	0.679	225.2	0.620	62.9	0.598	44.7
1978	0.724	397.8	0.027	1690.8	0.726	231.1	0.671	66.4	0.632	46.4
1979	0.781	406.9	0.029	1726.1	0.776	236.4	0.730	67.9	0.741	46.3
1980	0.853	411.2	0.030	1759.1	0.847	239.9	0.816	67.3	0.895	44.8
1981	0.933	417.7	0.034	1791.6	0.918	241.7	0.912	68.8	0.997	45.2
1982	1.000	422.9	0.035	1817.4	1.000	240.3	1.000	71.3	1.000	47.3
1983	1.059	430.4	0.039	1840.6	1.064	240.7	1.063	74.5	0.980	49.7
1984	1.143	439.1	0.048	1865.3	1.130	242.6	1.125	77.2	0.989	51.7
1985	1.207	450.3	0.052	1894.1	1.205	264.0	1.176	69.4	0.992	46.7

Note: the figures in this table are based upon an alternative real rate of interest.

NOTES

* We thank Joan Soulsby for her very fine work as a research assistant on this project and Helen Ladd and John Haltiwanger for their comments and suggestions.

1. In a discrete time model, it is important to specify the timing of all transactions. We have adopted the following convention. At the beginning of period t, firms "inherit" a stock of capital K_t and contract with labor L_t. Production takes place during the period. At the end of the period, output is sold, workers are paid, and an investment I_t is made. The perpetual inventory equation in (2) and the cost of capital discussed below are consistent with this convention.

2. The $P^K_{t+\tau}$ in (3) refers to the user cost of a new asset τ years in the future. The expression $(1-\delta)^\tau P^K_{t+\tau}$ is thus equal to the user cost of a τ year old asset which has "shrunk" to $(1-\delta)^\tau$ of its original "size."

3. We assume that there is no inflation so that the distinction between nominal and real rates of return can be ignored, and that there are no taxes or subsidies. Our assumption about inflation implies that the investment good price does not change, and therefore that there is no capital gain term in (5). The implicit rental payment is assumed to occur at the end of the year.

4. There are actually two types of "T" accounts that can be constructed at the sectoral level; (i) gross output accounts that include the value of intermediate inputs, and (ii) value added accounts which net out intermediate inputs and which therefore measure the sector's contribution to total GNP. The latter measures the income which originates in the sector (i.e., capital and labor income); the former measures the output which is produced and the allocation of the value of this output to the factors of production. Except under certain restrictive assumptions, gross output is the appropriate concept in the econometric estimation of production functions.

5. To see this point in another context, consider other federal programs which subsidize consumption directly (such as food stamps) or indirectly (such as the deduction for medical expenses). The national accounts would measure the output of the food and medical sectors as the sum of the payments to factors of production.

6. As we argued above, dln A captures productivity growth as we normally think of it in the private sector as well as the effects of changes in community characteristics, so a zero rate does not necessarily imply a static technology. For example, a change in society which increases criminal activity could offset technical improvements in law enforcement, leaving output (public safety) unchanged.

7. See for example The National Council on Public Works Improvement (1986) and Hulten and Peterson (1984).

8. The investment series extends back to 1850 for structures and back to 1902 for equipment. Since the capital stock estimates in this paper begin in 1958, the influence of the initial benchmark is very small. At a 1.9 percent rate of depreciation, only 12.4 percent of the 1850 structures benchmark survives in 1959.

9. It should be noted that the estimates in Table 4 refer to stocks rather than to a flow of services. In the absence of data or procedures (e.g. Berndt and Fuss (1986)) to correct for variations in the rate of utilization, we are forced to assume that the utilization rate remains constant. This may be a highly dubious assumption for public sector capital, since much of this capital is in networks (e.g. roads, sewers, water distribution) and it is frequently cost effective to build capacity in advance of need. Conversely, it is hard to expand existing capacity as demand increases (roads in crowded urban areas), or to reduce the capital stock as demand decreases. Returns to scale in the construction of infrastructure, and regional and demographic shifts, almost certainly lead to variations in the utilization of the measured stock of capital.

10. By law, virtually all capital grants are matching grants. It might be reasonable, however, to argue that in fact these grants have many of the characteristics of lump sum grants. Under this view, the federal government establishes an aggregate level of funding and invites communities to compete for these funds. Our formulation of the user cost implicitly assumes that the grants are in fact matching grants.

11. See Huizinga and Mishkin (1986) for a review of the literature in this field.

12. See Carlson (1977) for a discussion of the Livingston survey.

13. We thank Barbara Fraumeni for providing this series to us.

14. Our calculations are based on the discrete approximation to (9) in which differences in logarithms weighted by the average share in two successive periods replace the share weighted logarithmic differentials. Diewert (1976) shows that this approximation is exact if the underlying technology is translog.

15. We believe that this last result points to a promising area for future research; hedonic studies of housing values may ultimately lead to direct estimates of user cost of capital and thus obviate the need for the imputation methods developed in this paper. But, even if this proves to be impossible, future research should examine the imputation of rental income to the housing sector. Part of the income and wealth attributed to the housing sector properly belongs in the government sector, and this may suggest a revision of current national income accounting procedures.

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