THE VALUE OF SERVICES PROVIDED BY THE STOCK OF GOVERNMENT-OWNED FIXED CAPITAL IN THE UNITED STATES, 1948–79

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Expanded measures of government product normally include imputations for the services of government capital. This article discusses several approaches to measuring the value of the services of government capital and focuses on the conceptual and empirical difficulties associated with making such imputations. In addition, four sets of alternative estimates for 1948–79 are presented.

The services of government-owned fixed capital enhance the productivity of the economy and the well-being of society. The capital takes a variety of forms, including school buildings, roads, dams, and military equipment (Table 1). Characteristic of all such capital is a long effective life, resulting in the provision of services over a span of many years. In this study, several estimates of the value of these services based on alternative approaches are provided for 1948–79, in current and constant dollars and by type of governmental unit and type of capital.

Unlike the services of producer durables, the services of government capital are not recognized in the U.S. national income and product accounts (NIPA's). The value of these services is, and always has been, uncertain. They have no market price because government buildings, roads, and other capital are not usually rented out. In most cases, moreover, government structures and equipment lack close parallels with privately-owned capital goods that are rented in the marketplace. Using one of the estimates of services of government capital presented in this study, one can not only rearrange the summary national income and product account to divide government purchases between current and capital purchases (an alternative already available) but also add to current purchases a measure of the services of capital in order to obtain a series for consumption.[1] This measure consists of depreciation, for which the March 1980 *Survey of Current Business* introduced estimates, and a net return, for which the present article provides estimates.[2] For consistency with these changes on the product side of the account, on the income side the net return to capital would be added to national income and depreciation would be added to other charges against GNP.

This study first discusses alternative approaches to the measurement of service value and describes the implementation of one of these approaches based on the principle of opportunity cost. The study then describes the sources and methods used in preparing the estimates and introduces the estimates.

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[1]Parallel estimates of the services of consumer durables were published in the July 1980 *Survey of Current Business*. See A. J. Katz and J. Peskin, The Value of Services Provided by the Stock of Consumer Durables, 1947–77: An Opportunity Cost Measure, *Survey*, July 1980.

[2]See J. C. Musgrave, Government-Owned Fixed Capital in the United States, 1925–79, *Survey*, March 1980.

TABLE 1

GOVERNMENT-OWNED FIXED NONRESIDENTIAL CAPITAL, 1979[1]

Type	Billions of dollars	Percent
Total	1,512.3	100.0
Federal Government	405.5	26.8
Military	223.7	14.8
Equipment	152.5	10.1
Structures	71.2	4.7
Civilian	181.8	12.0
Equipment	29.5	2.0
Structures	152.4	10.1
Industrial Buildings	22.4	1.5
Educational Buildings	1.0	0.1
Hospital Buildings	6.6	0.4
Other Buildings	16.0	1.1
Highways and Streets	11.9	0.8
Conservation and Development	91.0	6.0
Other	3.5	0.2
State and Local Government	1,106.8	73.2
Equipment	63.9	4.2
Structures	1,042.8	69.0
Educational Buildings	213.1	14.1
Hospital Buildings	31.1	2.1
Other Buildings	88.3	5.8
Highways and Streets	447.9	29.6
Conservation and Development	19.6	1.3
Sewer Systems	105.0	6.9
Water Supply Facilities	60.9	4.0
Other	77.0	5.1

[1]Current-dollar end of year net stock, including government enterprises.

MEASUREMENT OF SERVICE VALUE: THE COST APPROACH

There are in theory three possible approaches to the measurement of the value of services of government capital. In the first approach, the value of these services is based on actual market rents for similar capital, in much the same manner as the services of owner-occupied housing in the NIPA's are based on actual housing rents. This approach is impractical because only a small part of all government capital has private market counterparts. For many important categories of government capital, such as highways, dams, and military equipment, for example, no private market counterparts exist.

In the second approach, the value of the services of government capital is estimated directly. For example, to measure the services of a dam, estimates would be made of the value of property saved from flood damage, of the number of days of recreation provided, valued at some imputed (shadow) price, and of any other services resulting from the dam. This approach is used in cost-benefit studies of government capital projects. It is not feasible for valuing the services

of all government capital because for many types of capital the physical services are difficult to measure and the appropriate shadow price is unknown.[3]

In the third approach, which is implemented here, the value of the services is based on the costs of the capital.[4] These costs would provide an *ex ante* lower bound to the expected value of the services if it could be assumed that the investment was made only if the discounted stream of future services from the investment was equal to or greater than its price. This assumption would be realized if the government were to undertake realistic cost-benefit analyses of most capital projects and were to use the analyses as the basis for deciding whether or not to purchase the capital. In reality, many government decisions are made without cost-benefit analyses, and, as a result, even this *ex ante* lower-bound estimate of the service value of government capital is uncertain.[5] Also, the actual services received may differ significantly from *ex ante* estimates of the service value of government capital.

With the cost approach, service value is the sum of two components: depreciation and net return.[6] Depreciation, which represents an annual allowance for the using up of government capital, is based on the capital's purchase price. The net return on government capital is analogous to property income from private capital. For example, the net return on a private office building would be equal to gross rental payments less all expenses, including depreciation. The net return on a government-owned highway is estimated by applying an assumed rate of return to the value of the net stock of the capital. This assumed rate of return, which is intended to measure the productivity of the capital, is often estimated by the rate of return that could have been obtained on alternative investments; hence, it is an opportunity cost. The net stock is derived by deducting accumulated depreciation from accumulated gross investment. Problems that arise in the measurement of depreciation and net return are discussed below along with problems of valuing the services as prices change.

Depreciation

The measurement of depreciation requires an estimate of service lives and the selection of a specific depreciation method and schedule. The estimation of service lives and the selection of a depreciation schedule are both problematic.

[3]An added problem is that the services derive from current inputs (e.g. wages and salaries paid to workers and repair and maintenance expenses) as well as from the capital input. Identification of the services of the capital alone would have to be made before this approach could be implemented.

[4]This approach was recently used by BEA to value the services of consumer durables. See Katz and Peskin, Consumer Durables.

[5]Nevertheless, application of the cost approach to government capital does provide a practical means of estimating service values of specific types of capital where cost-benefit analyses are done routinely. It may also provide better estimates of aggregate service value in the future if cost-benefit analyses become more prevalent and discount rates become a matter of record.

[6]These cost components are derived from the formula that equates the price of the capital to the discounted stream of future services. A third component—the addition of capital losses or subtraction of capital gains—is also derived from the formula. See Katz and Peskin, Consumer Durables, for more detail. Adjustment for price change is discussed later in this section. In measuring the service value of consumer durables, repairs and maintenance were also included as a cost component; such data for government capital are not readily available.

Little evidence exists on effective service lives of most government capital, and on how those service lives have changed over time. In this study, service lives are assumed to be constant over time for most government capital.

Selection of a depreciation method requires a choice of NIPA accounting procedures or of discounted present value techniques.[7] In the NIPA accounting method, depreciation is the cost of an asset allocated over its estimated service life in proportion to its estimated service at each date. In the discounted present value method, depreciation is the decline in the present value of an asset resulting from fewer remaining anticipated services.

Although there is some controversy over which of these methods is conceptually correct, the NIPA method employed by BEA, with a straight-line schedule, yields estimates that lie fairly close to present-value estimates under reasonable assumptions about future services.[8] In this study, the NIPA method with a straight-line schedule is used.

Net return

The rate of return, and hence net return, on government capital cannot be observed. If cost-benefit analyses played an important role in government decisions to invest, the discount rate (or foregone rate of return) used in these analyses would provide one estimate of the rate of return. Consequently, the appropriate discount rate in theory and practical applications of discounting by governments are of interest, and they are discussed, in turn, below.

The appropriate discount rate in theory. The appropriate discount rate to use in government investment decisions is a matter of controversy. Much of the controversy stems from the effects of taxes and risk aversion on rates of return. Taxes cause the rate of return to an investor (the marginal rate of time preference) to be less than the total rate of return on an investment (the marginal productivity of capital).[9] Differences in the riskiness of investments lead to the payment of risk premiums when there is risk aversion; rates of return on risky investments will exceed the rate of time preference by the amounts of the risk premiums. These differences in rates of return make it difficult to determine what is actually foregone when the government invests. The economic literature points to three theoretically-based alternatives: (1) a weighted average of the marginal productivity of capital and the marginal rate of time preference; (2) the marginal productivity of capital; and (3) a rate of return on risk-free investments.

The weighted average alternative is based on the view that government investment displaces both private investment and consumption. The foregone rate of return on investment is the marginal productivity of capital; the rate of return for valuing foregone consumption is the marginal rate of time preference. To implement this alternative, the marginal productivity of capital is often

[7]For a fuller discussion, see Young, A. H. and Musgrave, J. C., Estimation of Capital Stock in the United States, in Usher, D., ed., *The Measurement of Capital*, Chicago, University of Chicago Press for the National Bureau of Economic Research, 1980.

[8]See Faucett, J. G., Estimation of Capital Stocks in the United States: Comment, and Young, A. H. and Musgrave, J. C., Reply, in Usher, D., *op. cit.*

[9]In a simplified world with zero tax rates, the marginal productivity of capital and the marginal rate of time preference would be equal.

estimated by the before-tax rate of return on private business capital and the marginal rate of time preference is often estimated by the after-tax rate of return on household assets; the weights are given by estimates of the relative displacement of investment and consumption. In practice, since it has often been argued that most funds for government investment are raised by taxation and that these funds represent primarily foregone consumption, the discount rate associated with this alternative often approximates an estimate of the marginal rate of time preference.[10]

Arguments for using a discount rate based solely on the marginal productivity of capital are founded on the view that the return to society from private investment is the return before taxes. Although individual investors receive only the net return, the return to society is equal to the gross return.[11] In addition, it is argued that government investment ultimately displaces private saving and investment (not consumption). Underlying this notion is a model in which households determine optimal lifetime consumption patterns. These patterns are temporarily disrupted when the government invests because current consumption would be reduced while future consumption would be augmented by output resulting from the public sector investment. However, the model assumes that households will adjust by reducing current saving in order to achieve the initial (optimal) consumption pattern.[12]

Some propose the use of a risk-free rate of return in discounting government projects because government investments are relatively riskless as a result of diversification and the spreading of risk. The diversification argument for the risk-free rate is that the size and diversity of government investments are greater than for private investments, thereby decreasing the overall risk of government investment.[13] The spreading of risk argument is that government investment results in the spreading of risk over a sufficiently large number of investors (taxpayers) so as to reduce the risk premium below that on private investment.[14] Thus, advocates of this alternative believe that the appropriate discount rate for public investment is a relatively risk-free rate, such as that on government bonds.

Practical applications of discounting by governments. In imputing a rate of return to *existing* government capital, what is relevant is the discount rate the

[10]Proponents of this alternative include Krutilla, J. and Eckstein, O., *Multiple Purpose River Development*, Baltimore, Johns Hopkins Press, 1958; and Marglin, S. A., The Opportunity Costs of Public Investment, *Quarterly Journal of Economics*, 274–89, February 1963.

[11]Baumol, W. J., On the Social Rate of Discount, *American Economic Review*, 788–803, September 1968.

[12]David, P. A. and Scadding, J. L., Private Savings: Ultrarationality, Aggregation and Denison's Law, *Journal of Political Economy*, 225–249, January/February 1974.

[13]The failure of one public project should be offset by the success of another, so that overall risk (as measured by the variance of the return on a portfolio) should approach zero. Samuelson, P. A., Principles of Efficiency: Discussion, *American Economic Review*, 93–96, May 1964.

[14]In the limit, the risk premium goes to zero. Arrow, K. J. and Lind, R. C., Uncertainty and the Evaluation of Public Investment Decisions, *American Economic Review*, 364–78, March 1970. Ironically it has been pointed out that the Arrow–Lind result holds only for non-public goods. See Fisher, A. C. and Krutilla, J. V., Valuing Long-Run Ecological Consequences and Irreversibilities, in Peskin, H. M. and Seskin, E. P., eds., *Cost-Benefit Analysis and Water Pollution Policy*, Washington, D.C., The Urban Institute, 1975.

government actually used in its decisionmaking, not the rate it should have used. Until recently, the explicit use of discount rates in Federal project decisionmaking was not very common, except in the water resource area where cost-benefit analyses were undertaken as long ago as the early 1900s. Economists increasingly emphasized the importance of discounting in the late 1950s and 1960s, yet even by the late 1960s the practice was not widespread.[15] During these early periods, relatively low discount rates were used. Simple rules of thumb were borrowed from business and management; for example, that only projects with returns at least equal to borrowing costs be approved. This resulted in the use of rates on Federal Government debt in evaluating public projects.

In the mid 1960s, some economists began to argue against such low discount rates and in favor of using the rates of return on private business capital. By 1968, these views gained enough acceptance that two schools of thought emerged among Federal agencies using discounting: one that argued for using Federal Government borrowing rates and another that argued for using private business rates of return.[16] Neither school provided clear guidance on the specific discount rate to be used; Federal Government borrowing rates at the time varied between 3 percent and 8 percent while private rates of return varied between 4 percent and 15 percent. Then, in 1972 the Office of Management and Budget, in the first attempt to standardize Federal discounting practices, prescribed use of a discount rate of 10 percent, "...an estimate of the average rate of return on private investment, before taxes and after inflation."[17]

Very little evidence exists concerning the discounting practices of State and local governments in evaluating public projects. A survey of State transportation agencies done in the 1950s showed discount rates ranging from zero to 7 percent.[18] These relatively low rates may reflect the same rule of thumb used in early Federal project assessments, namely, that the discount rate be set equal to the borrowing rate.[19]

Rate of return on government capital. Given the lack of a strong case for choosing a particular rate of return, this study presents estimates of the service value of government capital using four alternative rates: (1) the government borrowing rate; (2) a before-tax rate of return on private business capital; (3) an after-tax rate of return on household assets; and (4) a constant 7-percent rate.

There are four arguments in favor of use of the government borrowing rate. First, many government capital projects are financed by borrowing, and interest paid is a component of the cost of capital. Second, valuation of government

[15]A 1968 survey of 23 Federal agencies found that only 10 agencies used discounting (8 more agencies planned its use in the future). U.S. Congress, Joint Economic Committee, *Interest Rate Guidelines for Federal Decisionmaking*, p. 4, Washington, D.C., U.S. GPO, 1968.

[16]See, for example, U.S. Congress, Joint Economic Committee, *Economic Analysis of Public Investment Decisions: Interest Rate Policy and Discounting Analysis*, Washington, D.C., U.S. GPO, 1968.

[17]Schultz, G. P., Discount Rates To Be Used In Evaluating Time Distributed Costs and Benefits, p. 3, Office of Management and Budget, Circular A-94, March 27, 1972. It should be noted that where legislation prescribes use of an alternative discount rate, agencies are not required to use 10 percent.

[18]Grant, E. L., Ireson, W. G., and Leavenworth, R., *Principles of Engineering Economy*, sixth edition, p. 452, New York, Ronald Press, 1976.

[19]Musgrave, R. A. and Musgrave, P. B., *Public Finance in Theory and Practice*, p. 155, New York, McGraw-Hill Book Co., 1973.

capital costs by the opportunity cost to government, rather than by the opportunity cost to society, is symmetrical with the valuation of government labor costs in the NIPA's by government cost rather than social opportunity cost. Third, as the preceding discussion indicates, it is likely that where cost-benefit analyses have been used, the borrowing rate has until recent years often been the discount rate. Fourth, the government borrowing rate approximates a risk-free rate.[20]

The before-tax rate on private business capital and the after-tax rate on household assets are approximations of the marginal productivity of capital and the marginal rate of time preference, respectively. As such, they can be viewed as rough bounds to the return society foregoes when the government invests, even though they are arbitrary estimates of the rate of return on government capital. The constant 7-percent rate is a rough average of the long-term business and household rates.

Valuation as Prices Change

Valuation of the services of government capital is complicated by changes over time in the general price level and in rates of return (interest rates). Because of these price and rate changes, two difficult issues arise. First, should assumed rates of return to all vintages of capital be identical or should they vary along with the variation in actual rates of return over time? Second, should real or nominal rates of return be used to value current-dollar services?

Current-cost versus vintage framework. This study presents estimates of the service value of government capital using two alternative valuation frameworks. The first is a current-cost framework, which values all vintages of capital by the current-year rate. The second is a vintage framework, which values each vintage of capital by the rate effective in the year of purchase.

The current-cost framework revalues previous years' investments in terms of current prices and current rates of return. It is the framework commonly used to measure and value services of private capital. In this framework, rates of return across vintages are assumed to be constant.

The vintage framework is based on the cost-benefit model discussed earlier, in which investment decisions depend on an assumed discount rate in effect at the time the investment is made. The use of a discount rate in cost-benefit analysis subjects a capital investment to a productivity test: the rate of return of the investment must at least equal the discount rate. A change in the discount rate

[20]Two recent estimates of the service value of government capital use the government borrowing rate. See Eisner, R. and Nebhut, D. H., An Extended Measure of Government Product: Preliminary Results for the United States, 1946–76, Paper presented at the Sixteenth General Conference of the International Association for Research in Income and Wealth, Austria, August 1979; and Kendrick, J. W., *The Formation and Stocks of Total Capital,* New York, Columbia University Press for the National Bureau of Economic Research, 1976. The estimates in this paper differ from these studies primarily because (1) a "vintage framework" is used whereby original rather than current rates of return form the basis of the estimates, as discussed later in the paper; (2) these original rates are averages of government borrowing rates over the year in which the investment is made and the four preceding years; and (3) alternative rates of return are used in addition to the government borrowing rate. For a more complete discussion of the vintage framework, see Martin, F. D., The Value of the Services of Government Capital in the National Income and Product Accounts, 1948–79, unpublished Ph.D. dissertation, University of Maryland, 1982.

leads to a change in the rate of return necessary to pass the productivity test. In the vintage framework, the rate of return may vary across vintages. This is contrary to the assumptions often used in the measurement of returns on private capital.[21]

The vintage framework is an attempt to capture what service values would look like if the simple rules of thumb that were applied where discounting was used had been applied consistently throughout government. While it is clear that formal discounting was not used throughout government, service values produced by the vintage model are interesting in two respects. First, they capture the relatively low discount rates used in formal discounting in earlier periods, for example in analyses of water resource projects. Second, they may embody the implicit discount rates used by decisionmakers who viewed their borrowing costs as their opportunity costs.

Real versus nominal rates of return. Inflation raises the value of tangible capital. It also leads to a rise in nominal rates of return.[22] Consequently, application of the nominal rate of return to the current value of the net stock results in an overestimate of service value.

An example may help to illustrate this point. Consider the case of a bond with a fixed $1,000 face value. If there were no inflation and the rate of return on the bond was 3 percent, a bond with a 1-year maturity would be worth $1,030 at the end of the year (principal plus interest). However, if inflation was 10 percent investors would have to receive $1.10 at the end of the year for $1.00 given up at the beginning of the year if they were to be compensated for inflation; with 10 percent inflation, investors with a rate of time preference of 3 percent must receive $1,133 at the end of the year ($1,030 × 1.10). This is equivalent to a nominal rate of 13.3 percent. Since the increase in the nominal rate is to compensate investors for the loss in purchasing power associated with the principal, it would be inappropriate to also adjust the principal for inflation.[23]

[21]Government capital seems a special case because assumptions of competitive markets do not apply. Moreover, the purchase of government capital involves a once and for all decision. The government can either build or not build a road or a dam; once built, it usually cannot sell the capital and invest the proceeds. If in-place capital could be sold, were subject to an annual productivity test, and the capital's replacement cost measured its market value, then use of the current year's discount rate would be appropriate.

[22]The nominal rate of return in theory equals the rate of time preference, which is a real rate, plus a compensation for expected inflation. The relationship between the real rate, r, and the nominal rate, i, when the expected inflation rate is p, is:

$$1+r=(1+i)/(1+p)$$
$$1+i=(1+r)(1+p)$$
$$i=r+p+pr$$
$$r=i-p-pr.$$

If the real rate and the expected rate of inflation are both relatively low, the real rate is approximately the observed nominal rate less the expected inflation rate ($r \approx i-p$). In recent periods when inflation has been significant, the interaction term, pr, may be important.

[23]If the value of the bond were adjusted to $1,100 to maintain a constant dollar value of $1,000, application of the nominal rate to the revalued principal would yield a real return of 13 percent rather than the required 3 percent (1.13 × $1,100 = $1,243; $1,243/1.1 = $1,130 in real terms).

To calculate a current-dollar net return, then, the real rate should be applied to the current-cost value of the net stock.[24] Real rates are used in this study for the calculation of estimates based on the current-cost framework. However, nominal rates are used in the estimates based on the vintage framework because there is reason to believe that nominal rates were used by most Federal agencies in their investment decisions. The use of real rates in such decisions is a relatively recent phenomenon.[25]

Methodology

The sources and methods underlying the estimates of the service value of government capital in current dollars are presented in Table 2. As shown in the table, the two components of service value are estimated separately. (1) The net return is estimated as the product of the average value of the net stock and assumed rates of return. The stock estimates used are BEA's estimates prepared by the perpetual inventory method, which uses expenditure flows from the NIPA's.[26] Capital of government enterprises and government-owned residential capital are excluded because most of their product is already in GNP.[27] Rates of return differ for the current-cost and vintage frameworks, as detailed below. (2) The depreciation estimates used are part of BEA's stock estimates.

Three alternative rates of return are used in the current-cost framework to develop current-dollar estimates: a before-tax real rate on private business capital, an after-tax real rate on household assets, and a constant 7-percent real rate. The rates of return used in the vintage framework are the Federal Government (nominal) borrowing rate applied to Federal Government capital and State and local government (nominal) borrowing rate applied to State and local government capital. The logic of the vintage framework requires use of the discount rates used by governments in their decisionmaking, but these are unknown, as noted earlier. Averages of rates for the current and four preceding years are used in accordance with directives in the water resource area that have stressed averaging over long enough periods to eliminate cyclical fluctuations.[28] Because different

[24]Use of the real rate is equivalent to the subtraction of capital gains in the calculation of service value. In estimating the net return on an asset V, the relationship between the subtraction of capital gains, pV, from the net return computed with nominal interest rates, iV, and the use of a real rate of interest, r, to impute a net return, rV, is:

$$rV = (i-p)V$$
$$= iV - pV.$$

For this relationship to hold, all prices must rise at the same rate.

[25]It is likely that government decisionmakers not only used nominal rates but that they also assumed little or no price change in their estimation of future services (benefits).

[26]See Musgrave (Government-Owned Fixed Capital).

[27]The value added by government enterprises is in personal consumption expenditures (PCE). Government enterprises include those operated by State and local governments for the purpose of providing residential housing. Consequently, rents associated with the residential capital owned by State and local governments are also in PCE. However, the product of Federally-owned residential capital, which consists entirely of family housing for the armed forces, is not in GNP.

[28]Report to the Inter-Agency Committee on Water Resources, *Proposed Practices for Economic Analysis of River Basin Projects*, p. 24, Washington, D.C., U.S. GPO, revised 1958.

TABLE 2

SYNOPSIS OF METHODOLOGY FOR THE ESTIMATION OF THE CURRENT-DOLLAR SERVICE VALUE OF GOVERNMENT CAPITAL

Component	Methods	Sources
Vintage framework:		
Net return:		
Net stock	Average of end of year net stocks. Net stocks calculated with constant service lives and the Winfrey S-3 pattern of discards; ratio adjusted to BEA stocks to adjust for used assets transferred to other sectors, the destruction of property, and changing service lives for some assets (primarily government-owned, privately operated assets and military equipment); and reflated to current cost by implicit price deflators for government purchases of structures and equipment.	Bureau of Economic Analysis[a]
Rates of return		
Federal capital	Average of Federal borrowing rates for the current and four preceding years. The rate for 1919 to date is that on long-term Treasury bonds and for the years prior to 1919 is proxied by that on American Railroad Bonds.	Bureau of the Census, *Historical Statistics, of the U.S.: 1970,* Part 2, p. 1003, Washington, D.C., Government Printing Office, 1975; Bureau of Economic Analysis, *Long Term Economic Growth,* 1860–1970, pp. 222–23, Washington, D.C., Government Printing Office, 1973; and U.S. Treasury Department, *Treasury Bulletin.*
State and local capital	Average of State and local borrowing rates for the current and four preceding years. The rate for 1919 to date is that on high-grade municipal bonds and for the years prior to 1919 is proxied by that on American Railroad Bonds.	See sources for Federal capital above and Standard and Poor's Corporation, *Standard and Poor's Outlook.*
Depreciation	Replacement-cost depreciation	Bureau of Economic Analysis.

Current-cost framework:		
Net return:		
Net stock	Average of end of year net stocks.	Bureau of Economic Analysis.
Rates of return	Before-tax real rate on nonfinancial corporate capital	Feldstein and Poterba (Rate of Return on Nonfinancial Corporate Capital)[b]
	Average of after-tax real rates on household assets 1948–79:[c] $\sum (0.01 \times R_1 + 0.99 \times R_2 - \dot{P})/32.$	
	R_1: Estimated after-tax yield on assets held by the wealthiest 1 percent of the population. Weighted average of: yields on time and savings accounts and on 3–5 year Treasury bonds; income and capital gain on beginning of year stocks of owner-occupied housing and land, noncorporate business equity, and corporate equities; and rate of return on consumer durables.	Rates: Primarily from Federal Reserve Board, Federal Home Loan Bank Board, Bureau of Economic Analysis, Moody's Investors Service, and Katz and Peskin (Consumer Durables).[d]
	R_2: Estimated after-tax yield on assets held by the remaining 99 percent of households. Weighted average of: yields on time and savings accounts and on 3–5 year Treasury bonds; income return on utility stocks; income and capital gain on beginning of year stocks of owner-occupied housing and land and of noncorporate business equity; and rate of return on consumer durables.	Weights: Flow of Funds, Federal Reserve Board; Smith, J. D., and Franklin, S. D., The Concentration of Personal Wealth, 1922–1969, *American Economic Review*, 162–67, May 1974; and Bureau of the Census, *Statistical Abstract of the United States: 1979*, p. 470, Washington, D.C., Government Printing Office, 1979.
	$\dot{P}$: Expected rate of inflation, estimated for each year by the average rate of increase in the Consumer Price index during the three previous years.[e]	Bureau of Labor Statistics.
	Constant 7-percent real rate.	
Depreciation	Replacement-cost depreciation	Bureau of Economic Analysis.

[a]See Musgrave (Government-Owned Fixed Capital).

[b]Feldstein, M. and Poterba, J., State and Local Taxes and the Rate of Return on Nonfinancial Corporate Capital, NBER Working Paper Series, No. 508, Table 2, column 4, Cambridge, Mass., National Bureau of Economic Research, 1980. The basic income data, which Feldstein and Poterba adjust for State and local taxes, are published and unpublished data from BEA. For a description of these data, see Gorman, J. A., Nonfinancial Corporations: New Measures of Output and Input, *Survey*, March 1972.

[c]When after-tax real rates were calculated for household assets, a number of years were characterized as having negative rates. For this reason, and because there is no strong evidence that marginal rates of time preference fluctuate from year to year, a constant rate is used.

[d]Tax rates are taken from Katz and Peskin (Consumer Durables).

[e]Price expectations have been estimated in the economic literature by simple averages of past inflation rates; by econometric distributed lags based on past inflation rates; by direct observation; or by averages of the latter two techniques. Distributed lag estimates have been found to be quite similar to estimates based on the nominal rate less some simple average of past inflation. Estimates of real rates have ranged between 2 percent on Treasury securities and 3 percent on corporate securities. See Feldstein, M. and Summers, L., Inflation, Tax Rules and the Long-Term Interest Rate, *Brookings Papers on Economic Activity*, 1, 1968; Tanzi, V., Inflationary Expectations, Economic Activity, Taxes and Interest Rates, *American Economic Review*, March 1980; and Yohe, W. P. and Karnosky, D. S., interest Rates and Price Level Changes, Federal Reserve Bank of St. Louis, *Review*, December 1969.

rates are used for Federal Government and for State and local government capital, rates of return will vary across governmental units and types of capital. In contrast, the rates used in the current-cost framework are applied to all government capital regardless of ownership or type, and all net returns are then proportional to the values of net stocks.

There are two estimates of service value in constant (1972) dollars presented in this study. The first estimate is based on the current-cost framework using the constant 7-percent real rate. This estimate is obtained by extrapolating current-dollar service value in 1972 by constant-dollar gross stocks. The second estimate is based on the vintage framework, as detailed earlier in the article.

Service Value, 1948–79

In this section, experimental estimates of the services of government capital are presented for 1948–79. As a result of the uncertainty involved in choosing an appropriate rate of return on government capital, "central" estimates—based on a constant 7-percent rate of return—are emphasized here.

They are provided in current and constant dollars and by type of governmental unit and type of capital. Alternative estimates of service value based on the business rate of return and the household rate of return in the current-cost framework and based on government borrowing rates in the vintage framework are then presented and compared to each other and to the "central" estimates.

Estimates Based on a Constant 7-Percent Rate of Return

The value of the services of government capital in current dollars, based on a constant 7-percent rate of return, was $134.2 billion in 1979. From 1948 to 1979, it increased at an average annual rate of 4.7 percent. Over the same period, constant-dollar service value increased at an average annual rate of 2.0 percent (Table 3).

The changes in service value varied considerably during the period. From 1948–1951, service value declined sharply with reductions in the Federal capital acquired during World War II. From 1951 to 1979, it increased at an average annual rate of 6.8 percent in current dollars and 2.9 percent in constant dollars. During the 1970s, increases were below average in constant dollars but above average in current dollars.

Service value by component. The components of current-dollar service value—depreciation and net return—for selected years are shown in Table 4. In 1979, depreciation was $55.6 billion and the net return was $78.6 billion, accounting for 41.4 percent and 58.6 percent of service value, respectively. The net return on government capital accounted for such a large share of the total service value because the capital is long-lived; hence annual depreciation is small relative to the value of the capital stock on which the net return is calculated.[29] From 1948 to 1979, depreciation increased at an average annual rate of only 3.1 percent

[29]By comparison, the net return on consumer durables in 1977 was only 27 percent of service value. Average service lives of consumer durables are assumed to range from 3 to 14 years. See Katz and Peskin, Consumer Durables.

TABLE 3

SERVICE VALUE IN CURRENT AND CONSTANT DOLLARS, SELECTED YEARS[a]

Year	Billions of dollars	Billions of 1972 dollars
1948	31.9	41.0
1951	21.5	34.2
1959	31.6	44.7
1969	52.7	62.8
1979	134.2	75.9
	average annual percent change	
1948–51	−12.4	−5.8
1951–59	5.0	3.4
1959–69	5.2	3.4
1969–79	9.8	1.9
1951–79	6.8	2.9
1948–79	4.7	2.0

[a]Estimates based on a constant 7-percent rate of return.

TABLE 4

SERVICE VALUE, BY COMPONENT, SELECTED YEARS[a]

Year	Total	Net return	Depreciation
	Billions of dollars		
1948	31.9	10.3	21.6
1951	21.5	10.1	11.3
1959	31.6	16.5	15.2
1969	52.7	30.1	22.6
1979	134.2	78.6	55.6
	Average annual percent change		
1948–51	−12.4	−0.5	−19.3
1951–59	5.0	6.3	3.7
1959–69	5.2	6.2	4.0
1969–79	9.8	10.1	9.4
1951–79	6.8	7.6	5.8
1948–79	4.7	6.8	3.1
	Percent distribution		
1948	100.0	32.2	67.8
1951	100.0	47.2	52.8
1959	100.0	52.0	48.0
1969	100.0	57.2	42.8
1979	100.0	58.6	41.4

[a]Estimates based on a constant 7-percent rate of return.

while the net return increased at a rate of 6.8 percent. There are two primary reasons for these differing growth rates. First, depreciation grew relatively slowly because structures, which are relatively long-lived, were accounting for a larger share of the total stock.[30] Second, the net return grew rapidly because of growth in the net stock of government capital (use of a constant 7-percent rate of return causes the net return to grow at the same rate as the net stock).

Service value by governmental unit. In 1979, the service value of Federal Government capital was $52.3 billion in current dollars, accounting for 39.0 percent of total service value (Table 5). The service value of State and local government capital was $81.8 billion in 1979, accounting for 61.0 percent of total service value. By contrast, in 1948, State and local government service value accounted for only 19.6 percent of the total while Federal Government service value accounted for 80.4 percent.

Services of Federal Government capital increased at average annual rates of 2.3 percent from 1948 to 1979 and 4.8 percent from 1951 to 1979. Most of the Federal service value—around 70 percent in recent years—derives from the stock

TABLE 5

SERVICE VALUE, BY GOVERNMENTAL UNIT, SELECTED YEARS[a]

Year	Total	Federal			State and local
		Total	Excluding military	Military	
	Billions of dollars				
1948	31.9	25.6	4.7	20.9	6.3
1951	21.5	14.0	4.0	10.0	7.5
1959	31.6	19.4	5.3	14.1	12.2
1969	52.7	26.2	8.4	17.8	26.5
1979	134.2	52.3	17.1	35.2	81.8
	Average annual percent change				
1948–51	−12.4	−18.3	−4.8	−22.0	6.1
1951–59	5.0	4.2	3.6	4.5	6.3
1959–69	5.2	3.0	4.7	2.3	8.1
1969–79	9.8	7.2	7.4	7.1	11.9
1951–79	6.8	4.8	5.3	4.6	8.9
1948–79	4.7	2.3	4.3	1.7	8.6
	Percent distribution				
1948	100.0	80.4	14.7	65.7	19.6
1951	100.0	65.2	18.8	46.4	34.8
1959	100.0	61.5	16.8	44.6	38.5
1969	100.0	49.7	16.0	33.7	50.3
1979	100.0	39.0	12.8	26.2	61.0

[a]Estimates based on a constant 7-percent rate of return.

[30]With a lengthening of the average service life of the stock, annual depreciation falls relative to the value of the stock. For structures, depreciation accounted for only 31 percent of service value in 1979 while for equipment it accounted for 64 percent.

of military equipment and structures, which has grown at a less rapid rate than other government capital.

Services of State and local government capital increased much more rapidly than Federal Government services during the 1948–79 period. Since 1948, State and local government service value has increased at an average annual rate of 8.6 percent, largely reflecting rapid growth in the construction of highways, educational structures, and hospitals. Increases were particularly large during the 1970s—averaging 11.9 percent per annum—but they have slowed since mid-decade for two reasons: (1) the school-age population has declined and with it the growth in educational structures, and (2) highway construction has slowed as the interstate highway system approaches completion.

Service value by type of capital. Capital may be classified as equipment or structures, and such a classification is shown in Table 6 for selected years. In 1979, the value of equipment was $42.9 billion, of which $27.8 billion was military equipment, and the value of structures was $91.3 billion, of which $7.4 billion was military structures. From 1948 to 1979, the proportion of total service value attributed to equipment declined from 68.4 percent to 31.9 percent and the proportion attributed to structures increased from 31.6 percent to 68.1 percent. This shift reflects, in part, the post-World War II decline in military equipment

TABLE 6

SERVICE VALUE, BY TYPE OF CAPITAL, SELECTED YEARS[a]

Year	Total			Total Excluding Military		
	Total	Equipment	Structures	Total	Equipment	Structures
	Billions of dollars					
1948	31.9	21.8	10.1	10.9	2.5	8.4
1951	21.5	10.3	11.1	11.5	2.2	9.3
1959	31.6	14.9	16.8	17.5	3.3	14.2
1969	52.7	19.9	32.7	34.9	5.7	29.2
1979	134.2	42.9	91.3	99.0	15.0	83.9
	Average annual percent change					
1948–51	−12.4	−22.0	3.3	1.7	−5.2	3.6
1951–59	5.0	4.7	5.3	5.4	5.5	5.4
1959–69	5.2	3.0	6.9	7.1	5.6	7.5
1969–79	9.8	8.0	10.8	11.0	10.1	11.1
1951–79	6.8	5.2	7.8	8.0	7.2	8.2
1948–79	4.7	2.2	7.4	7.4	5.9	7.7
	Percent distribution					
1948	100.0	68.4	31.6	100.0	23.3	76.7
1951	100.0	48.3	51.8	100.0	18.8	81.2
1959	100.0	47.0	53.0	100.0	18.9	81.1
1969	100.0	37.8	62.2	100.0	16.4	83.6
1979	100.0	31.9	68.1	100.0	15.2	84.8

[a]Estimates based on a constant 7-percent rate of return.

and its more recent relatively slow growth. In addition, construction of structures such as highways and educational buildings grew rapidly, as noted earlier.

Alternative estimates

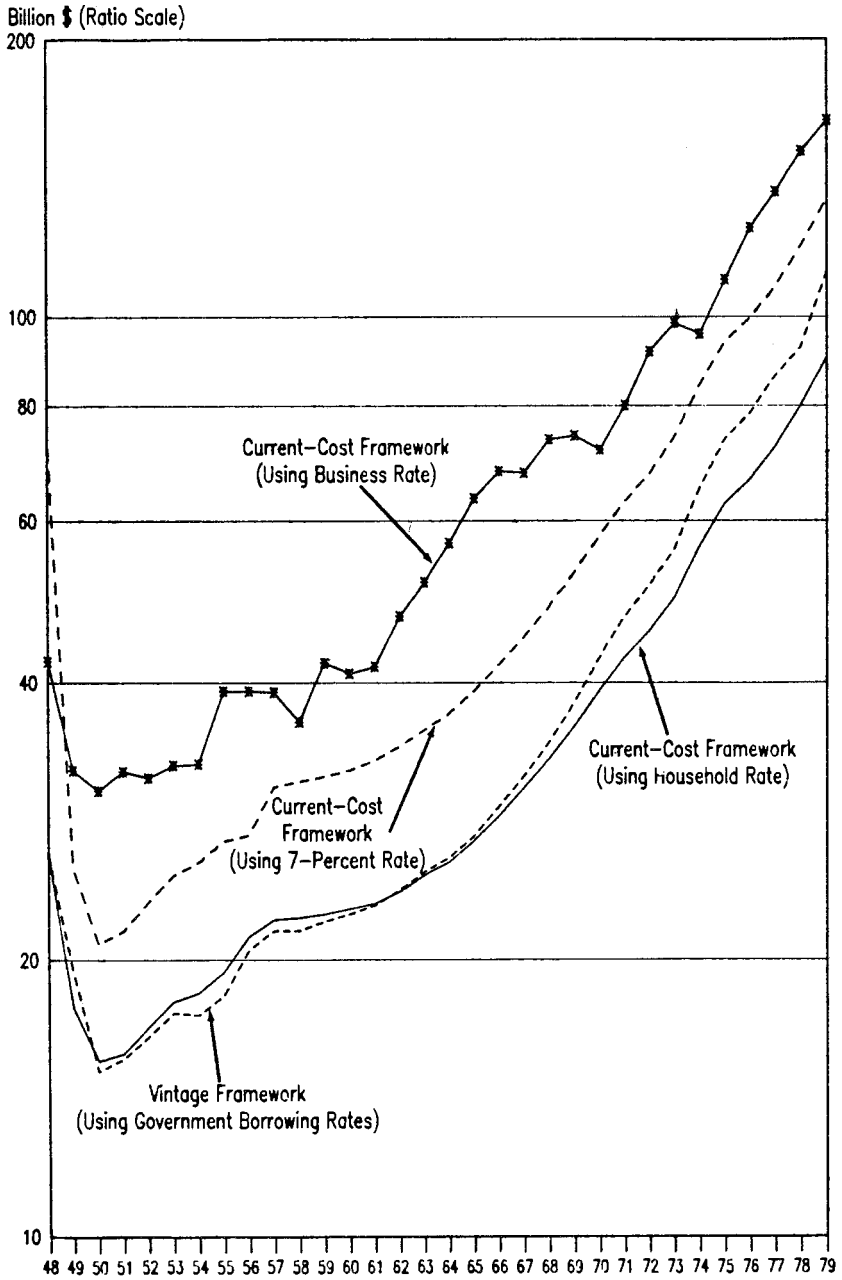
Current-dollar estimates. Table 7 and Chart 1 present alternative estimates of service value. They vary considerably. In 1979, service value was $163.4 billion based on the business rate, $90.1 billion based on the household rate, and $111.8 billion based on government borrowing rates in the vintage framework. These estimates compare with a current-dollar service value estimate based on the constant 7-percent rate of $134.2 billion. Over the period 1948 to 1979, estimates of service value using the business rate were consistently higher than all alternative estimates. Service value estimates using the vintage framework and those using the household rate were similar until the 1970s when they diverged significantly; both were well below estimates using the constant 7-percent rate throughout the period.

TABLE 7

CURRENT DOLLAR SERVICE VALUE AND NET RETURN, BASED ON ALTERNATIVE ESTIMATES, SELECTED YEARS

Year	Vintage framework (using government borrowing rates)		Current-cost framework					
			Business rate		Household rate		Constant 7-percent rate	
	Service value	Net return	Service value	Net return	Service value	Net return	Service value	Net return
	Billions of dollars							
1948	26.0	4.4	42.2	20.6	26.1	4.5	31.9	10.3
1951	15.6	4.2	32.0	20.7	15.8	4.5	21.5	10.1
1959	22.0	6.8	42.0	26.8	22.4	7.2	31.6	16.5
1969	38.0	15.4	74.2	51.6	35.8	13.2	52.7	30.1
1979	111.8	56.2	163.4	107.8	90.1	34.6	134.2	78.6
	Average annual percent change							
1948–51	−15.7	−1.0	−8.8	0.2	−15.5	−0.5	−12.4	−0.5
1951–59	4.4	6.1	3.4	3.3	4.5	6.3	5.0	6.3
1959–69	5.6	8.5	5.9	6.8	4.8	6.2	5.2	6.2
1969–79	11.4	13.8	8.2	7.6	9.7	10.1	9.8	10.1
1951–79	7.3	9.7	6.0	6.1	6.4	7.6	6.8	7.6
1948–79	4.8	8.6	4.5	5.5	4.1	6.8	4.7	6.8
	Percent distribution							
1948	100.0	16.8	100.0	48.8	100.0	17.3	100.0	32.2
1951	100.0	27.2	100.0	64.6	100.0	28.2	100.0	47.2
1959	100.0	31.0	100.0	63.9	100.0	32.3	100.0	52.0
1969	100.0	40.6	100.0	69.6	100.0	37.0	100.0	57.2
1979	100.0	50.3	100.0	66.0	100.0	38.4	100.0	58.6

Chart 1
Alternative Estimates of the Service Value
of Government Capital
1948–1979



These differences in service value estimates reflect differences only in the net return estimates since the depreciation component is identical in all of the alternatives. In 1979, the net return was estimated at $107.8 billion using the business rate, $34.6 billion using the household rate, and $56.2 billion using the vintage framework with government borrowing rates. This compares with a 1979 estimate of $78.6 billion based on the constant 7-percent rate. These differences, in turn, reflect the different assumed rates of return on government capital. The before-tax real rate of return on private business capital fell from 14 percent in 1948 to around 10 percent in the late 1970s. The after-tax real rate of return on household assets was constant at 3.1 percent, as was explained in the methodology section of the article. The "vintage rate" averaged for Federal and State and local government capital, which is used in the vintage framework and is based on nominal government borrowing rates, rose from 3.0 percent in 1948 to 5.0 percent in 1979.[31] The business rate is not only higher than the alternative rates but it fluctuates considerably over the business cycle and from year to year.

Because the "vintage rate" rises from 1948 to 1979 while the business rate falls and the household and 7-percent rates remain constant, the growth in service value estimates based on the vintage framework is larger than for the alternative estimates. From 1951 to 1979, the average annual percent increase in service value using the vintage framework was 7.3 percent as compared with increases of 6.0 percent using the business rate, 6.4 percent using the household rate, and 6.8 percent using the constant 7-percent rate.

Constant-dollar estimates. Service value estimates based on the vintage framework are shown in Table 8. As with the current-dollar estimates, the value

TABLE 8

CONSTANT-DOLLAR SERVICE VALUE, BASED ON ALTERNATIVE ESTIMATES, SELECTED YEARS

Year	Vintage framework (using government borrowing rates)	Current-cost framework (using constant 7-percent rates)
	Billions of 1972 dollars	
1948	55.1	41.0
1951	27.9	34.2
1959	32.5	44.7
1969	45.3	62.8
1979	61.9	75.9
	Average annual percent change	
1948–51	−20.3	−5.8
1951–59	1.9	3.4
1959–69	3.4	3.4
1969–79	3.2	1.9
1951–79	2.9	2.9
1948–79	0.4	2.0

[31]The "vintage rate" in any year is a weighted average of the historical rates associated with the various vintages of capital embodied in that year's capital stock, adjusted for changing prices. The weights are determined by the percent distribution of the vintages of capital in that year's capital stock.

of these services is less than the value based on the current-cost framework with the 7-percent rate. In 1979, these service values were $61.9 billion and $75.9 billion, respectively. From 1951 to 1979, the average annual rate of increase was 2.9 percent in both estimates. However, during the 1970s when the "vintage rate" rose sharply, service value based on the vintage framework increased at a higher average annual rate than did service value based on the current-cost framework with the 7-percent rate: 3.2 percent and 1.9 percent, respectively.