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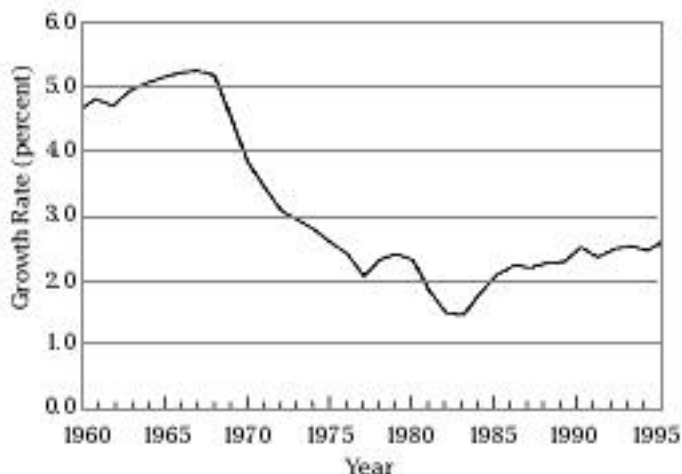
## How Big Should the Public Capital Stock Be?

David Alan Aschauer

The United States, like all countries, invests heavily in its public capital stock--transportation systems, such as subways and highways; water treatment plants and sewer systems; and public buildings, such as schools, fire stations, police stations, and courthouses. Such investment is needed for a strong, flexible, and vibrant economy. Workers need to ride the subway or drive to get to work; companies need to ship goods; manufacturers need to use water and dispose of waste; future workers need to be educated; and businesses need to be protected from fire and crime.

Yet over the past three decades the level of public sector investment has slipped in the United States. The growth rate of state and local government capital stock indicates the decline. As Figure 1 shows, it climbed as high as 5.4 percent per year in the 1960s, but dipped as low as 1.8 percent in the 1980s and was only 2.3 to 2.6 percent per year in the 1990s. Meanwhile, growth in the country's private capital stock--equipment such as trucks, trains, and planes and structures such as office buildings, factories, and warehouses--has increased the demands placed on the available public infrastructure facilities. This deficiency of public investment led to the concerns about an "infrastructure crisis" that were prevalent in policy discussions of the 1980s.

**Figure 1** Growth Rate of State and Local Public Capital Stock



Source: "Improved Estimates of Fixed Reproducible Tangible Wealth

A basic question of public finance is, How big should the public capital stock be? Is it possible to have too much as well as too little public capital? It is easy to recognize economic inefficiency stemming from too little public capital--from congested streets and highways, bursting water mains, crowded schools, and an overburdened criminal justice system. Economic inefficiency stemming from too much public capital is somewhat harder to detect, but is just as important. The tax burden associated with financing and maintaining public capital reduces the returns to private activity, which, in turn, may result in too few trucks in the nation's fleet, trains crawling along on wobbly tracks, factories full of antiquated or obsolete equipment, and airplanes pushing the limits of safety.

This brief reports the results of three statistical studies on public capital and economic growth. The method

private capital. Most previous studies of the effectiveness of public capital assume a linear relationship between public capital and output and so are incapable of estimating the optimal level of public capital spending; they can estimate only whether an increase in public capital spending will increase or decrease growth. The studies on which this brief is based instead assume a nonlinear relationship between public capital and economic growth, that is, a relationship that is positive up to a certain level of public capital but turns negative at levels above that growth-maximizing point. The data used in the empirical analysis cover the 48 contiguous states in the United States from 1970 to 1990, with data sets constructed for the two 10-year periods. This allows for state-specific and temporal effects while maintaining a focus on the long run. The details of the statistical analysis are contained in a series of working papers (Aschauer 1997a, 1997b, 1997c) and the full-text brief. Here we summarize the basic results and conclusions.

employed is an analysis of the relationship between economic growth and the ratio of public capital to

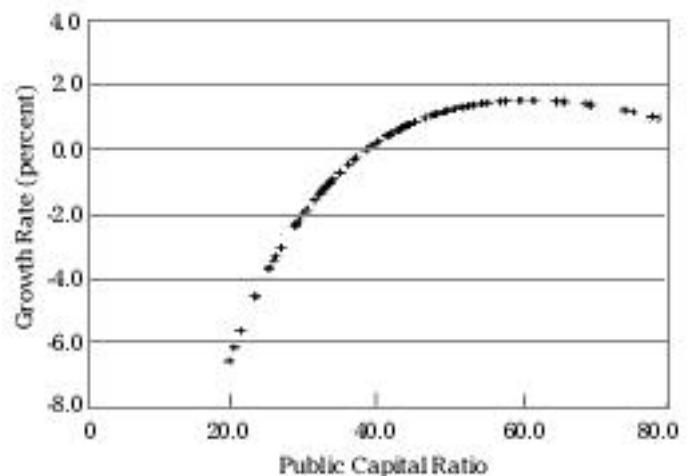
1. *The relationship between public capital and economic growth is nonlinear.*

2. *The estimated growth-maximizing public capital stock is approximately 61 percent of the private capital stock. A range of estimates is obtained using various methods, but the range is fairly narrow, between 59.7 percent and 63.9 percent for the output-growth-maximizing ratio and between 56.8 percent and 61.3 percent for the employment-growth-maximizing ratio.*

3. *The ratio of public capital to private capital (called the public capital ratio) falls short of the growth-maximizing level in 87.5 percent of the observed cases. The average public capital ratio is 44.6 percent, 26 percent (or 16 percentage points) below the growth-maximizing level of 61 percent (see Figure 2).*

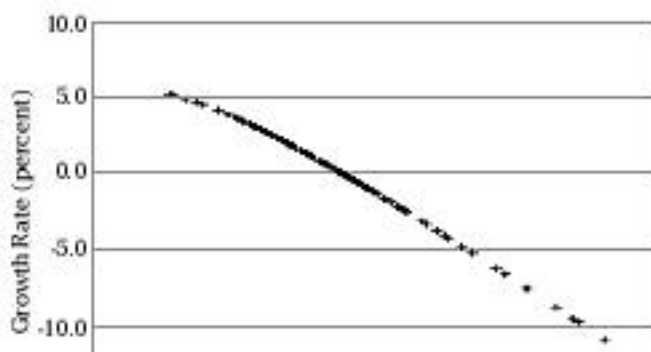
4. *The level of total government spending is higher than the estimated growth-maximizing ratio to private capital of 4 percent. Investment is only a small portion of total government spending. The total also includes current consumption spending (such as military salaries and transfer payments), which is not expected to have the same positive effects on economic growth as investment spending. Figure 3 shows that the ratio of total government spending in all 48 states in both decades (all 96 observations) was above the growth-maximizing level. The sample average ratio is 14 percent, suggesting that for the average state a one standard deviation increase in government spending would decrease output growth per worker by 1.3 percent per year.*

**Figure 2** Economic Growth and Public Capital Ratio

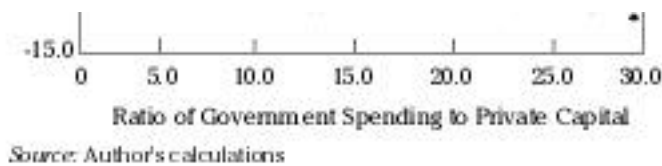


Source: Author's calculations.

**Figure 3** Economic Growth and Ratio of Government Spending to Private Capital



5. *Both "core" capital (such as streets and highways, water and sewer systems) and "other" public capital (such as educational buildings, hospitals, conservation projects, and development structures) have positive growth effects, with urban infrastructure such as water and sewer capital having a particularly high impact. Core public capital may have a larger impact than other public capital. Growth-maximizing values are estimated to be 44 percent for core and 31 for other, with actual average values around 27 and 18 percent, respectively. The data indicate a deficient level of core public capital for 94 of the 96 observations and a deficient level of other public capital for 90 of the 96 observations.*



6. *The magnitude of the growth effects of public capital depends on the output elasticity of public capital and on how far its value diverges from the optimizing level of 61 percent.* The data imply that a one standard deviation (5 percentage point) increase in

the public capital ratio would cause an estimated 1.4 percent increase in the annual growth rate of output per worker. This is a substantial result, suggesting that for many states an insufficient level of public investment may have been responsible for relatively sluggish productivity and economic growth in recent decades. For the average state in the sample the gross static (or, initial) impact of an increase in the public capital ratio is an increase in output growth of around 0.8 percent per year and in employment growth of some 0.3 percent per year.

7. In order to understand the relationship between government capital and economic growth, it is important to take into account the means of financing both the original acquisition of capital and the maintenance of capital over its useful lifetime. Here we assume that acquisition is financed by municipal bonds and maintenance by taxes. *Both debt and taxes have a significant negative impact on output and employment growth. The negative impact reduces but does not reverse the positive impact of public capital on growth.* The net effect is calculated by subtracting the financing impact from the growth impact. The financing clearly matters for economic performance, but growth impacts of public capital, however financed, are still large and positive.

8. *The impact of an increase in public capital stock on growth would have been greater in the 1980s, when the public capital ratio was further from the growth-maximizing level, than in the 1970s.* This confirms statistically the notion, prevalent in the policy discussions of the 1980s, of an "infrastructure crisis" in the United States.

9. *There are somewhat lower growth effects from public capital in the Snowbelt than in the Sunbelt.* The net growth effects for the average state in both the Snowbelt and Sunbelt are positive, which justifies increased public capital investment in both regions of the country. The public capital ratio is considerably higher in the Snowbelt than in the Sunbelt so that growth effects of an increase in public capital are somewhat larger in the Sunbelt. However, after calculation for differences, the output and employment growth effects are nearly the same across the regions.

10. *Public capital has dynamic (or, long-run) impacts: a persistent effect on economic growth and a substantial cumulative effect on output and employment.*

### **Attaining the Optimal Level of Public Capital**

The empirical results reported here indicate that in most areas of the United States during the 1970s and 1980s the levels of public capital were below the levels that would have maximized the rate of economic growth. Given that there has been no great change since then, the public capital stock, in this sense, is too small. One way to boost the growth rate of output is through an increase in the public capital stock, with the initial acquisition of public capital financed by debt and the maintenance of public capital financed by ongoing taxes. As we have seen, the public capital stock augments growth by providing services to the private sector, while the associated higher taxes detract from growth by reducing the returns to private economic activities. However, the analysis of static and dynamic effects indicates that for nearly all states the positive effect of the increase in the public capital stock dominates the negative effect of financing by taxes, with the net result of an increase in economic growth from an increase in public sector capital.

At the same time, the analysis suggests that for nearly all states total government spending was above the level that would have maximized output growth. In that sense, the overall level of government spending is too high. Therefore, another way to boost the growth rate of output is through a decrease in the overall level of government spending, with an associated cut in taxes. The overall level of government spending stimulates growth much the same way that investment spending stimulates growth, except that the adverse effects of financing dominate the stimulative effects of spending at a much lower level. Growth would be boosted

through a reorientation of government spending at the state and local level away from government consumption to government investment.

Consider, for instance, what the empirical results of this brief have to say about a permanent \$100 per capita reduction in government consumption spending and an equal \$100 per capita increase in expenditures on physical public capital. The permanent \$100 increase in government investment is capable of supporting a permanent increase in the public capital stock of, perhaps, \$1,000; assuming a real interest rate on municipal bonds of 4 percent per year, a physical depreciation rate of 5 percent per year, and a population growth rate of 1 percent per year, to service the debt associated with the purchase of the public capital requires \$40 per capita, while to maintain the public capital against physical depreciation and growth in the labor force requires \$60 per capita.

In 1996 the state and local net public capital stock amounted to \$13,392 per capita and the net stock of private nonresidential capital was \$31,392. Consequently, the \$100 per capita switch from public consumption to public investment implies a 7.5 percent rise in the public capital stock per capita and a 6.8 percent increase in the ratio of public to private capital. Using the empirical results of this brief, such a switch would cause an initial increase of 0.33 percent in the annual growth rate of output per worker and a cumulative rise in output per worker of 3.0 percent after some 40 years.

Placed in proper historical perspective, these results shed light on appropriate federal policy for the coming years. Over the period from 1960 to 1996 the total value of national wealth--including tangible assets such as plant and equipment, inventories, residential structures, consumer durables, and land and intangible assets such as education and research and development--expanded from \$16.8 trillion to \$57.7 trillion (in 1996 dollars), at an average rate of 3.4 percent per year. (These and subsequent wealth statistics are from the 1998 federal budget [U.S. Office of Management and Budget 1998, Tables 2?4].) During the same time federally financed wealth grew from \$2.2 to \$4.3 trillion, at an average yearly rate of 1.9 percent. Thus, if federal investment had kept pace with overall investment, the nation's stock of assets would be higher by some \$3 trillion.

Furthermore, looking within the various categories of federally financed investments, the source of this drag on national wealth building can be isolated to be physical capital, such as infrastructure, rather than intangible capital, such as education and research and development. While federally financed physical capital grew by 1.1 percent per year, well below the growth rate of national capital, education and research and development capital rose at annual rates of 6.1 and 4.2 percent, well above the growth rate of national capital. As a general rule, then, since 1960 the federal commitment to expanding educational capital and research and development capital has far exceeded its commitment to augmenting physical capital.

State and local governments have done much better than the federal government in providing funding for physical capital facilities. From 1960 to 1996 state and locally financed physical capital advanced from \$900 billion to \$2.6 trillion, which represents a yearly rate of growth of 2.9 percent. Yet even this more substantial commitment was not enough to maintain the public capital stock against growth in the private capital stock, with the result that the ratio of public capital to total national capital had been declining by 0.5 percent per year.

Recently, both the administration and Congress have placed a new emphasis on adequately funding education--investment in our nation's human capital stock. This is, without doubt, good economic policy, as the available empirical evidence shows that the stock of human capital is well below the optimal level in the United States. However, the empirical evidence summarized here suggests that a parallel emphasis on adequately funding infrastructure also constitutes good economic policy, one that will require a reversal of the current and projected future policy stance regarding our nation's public capital stock.

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## About the Author

David Alan Aschauer is a research associate at the Levy Institute and Elmer W. Campbell Professor of Economics at Bates College. One area of his research builds on his long-term investigation of the effect of federal expenditures (especially infrastructure investment) on economic growth and development. He is developing a new methodology for research in this area to provide further empirical evidence linking public capital and the performance of the national, state, and local economies. In Aschauer's second area of research, the desirability of a productivity budget for the federal government, he is examining reasons for the use of public sector debt rather than current taxation for the financing of public expenditures that raise long-term productivity growth. Among his other Levy Institute publications is "Public Capital and Economic Growth," in *Public Infrastructure Investment: A Bridge to Productivity Growth?* (Public Policy Brief No. 4). Aschauer received a Ph.D. from the University of Rochester.

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