

Is Public Infrastructure Undersupplied?

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Over the past decade, infrastructure issues intermittently have moved toward the forefront of the domestic policy agenda. The coming year promises to intensify debate. By September 1991, Congress must re-authorize the federal highway program. Unlike past re-authorizations, this time Congress almost certainly will have to set new priorities and incorporate new principles of cost sharing for highways, since the original mission of the federal highway program will have been accomplished. Sometime in 1991-92, workers will complete the last segments of the interstate highway network, bringing to an end an era of road-building that began with Dwight D. Eisenhower in 1956 and has dominated infrastructure spending since that time. Any consensus that Congress reaches regarding the definition of a new federal role in the highway program, or the appropriate use of price incentives in grant programs, is likely to spill over to the financing of other infrastructure functions.

This paper sets out to provide an introductory perspective on the current infrastructure policy debate. It begins by considering the record of public capital spending. Most of the studies claiming extreme erosion of infrastructure investment start their story with the 1960s, which turned out to have been the peak period for infrastructure spending. A somewhat longer perspective better captures the wave pattern that has characterized infrastructure investment, but the impression of a secular decline in gross investment is weakened. In this perspective, the late

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1970s and early 1980s still stand out as a period when the net public capital stock (after depreciation) almost ceased to grow.

It is one thing to demonstrate that capital spending has declined. It is another to prove it is also too low. Is public capital undersupplied? Recent approaches to this question have emphasized the role of infrastructure as an intermediate good contributing to private production. In a series of studies, Aschauer has argued that public capital enters strongly into the private sector's production function, raising the productivity of both private capital and labor. His findings imply rates of return to infrastructure investment as high as 50 to 60 percent. Insofar as these returns vastly exceed those available to private investment, they imply that, yes, public infrastructure capital is undersupplied.

Infrastructure also yields final consumption services for households. In many states, households still vote directly on the bond issues used to finance capital projects, or on the tax and fee revenues raised to recover initial investment costs. As a result, direct evidence is often available regarding household demand for infrastructure spending. The evidence of undersupply, using consumer willingness to pay as expressed in bond referenda, is almost as strong as the evidence derived from production function studies. Over the past six years, 80 percent by value of all state and local infrastructure bond proposals have passed. The average margin of voter approval exceeded 66 percent, a substantially higher approval rate than found in any other kind of expenditure referendum. These results imply that, at least in recent years, taxpayer-consumers have been willing to buy more infrastructure capital than was actually provided by public authorities.

This paradox merits more attention than it has received. How can one account for the apparent undersupply of infrastructure? Aschauer's results imply that private producers can benefit more in terms of private output from a dollar of public investment than they can from a dollar of their own investment in private plant and equipment. Since the costs of public investment are shared with households, it would seem that, out of self-interest, business groups should be lobbying violently for tax hikes to finance an expanded public capital budget; and, if this fails, they should volunteer to pay the costs of additional public capital investment entirely on their own. Furthermore, the recent rates of voter approval of infrastructure projects at referendum imply that, with even modest leadership from the business community, it should be possible to stitch together a politically persuasive constituency for greater infrastructure spending. Either the empirical results are exaggerated, or the political system has failed to undertake high-payoff investments that also have broad political support.

The possibility that recent studies have overstated infrastructure benefits will be explored throughout the conference. This paper consid-

ers various explanations that could account for undersupply in the face of genuine demand. The argument offered is that political leaders have overreacted to what might be called the "fear of rejection at referendum." Since the taxpayer revolt of the 1970s, the very act of referendum voting—and the possibility it brings of public repudiation—appears to intimidate officials. Rather than designing capital proposals that satisfy the median voter, they seem to aim higher (or with more risk aversion) to win support from as large a majority of the electorate as possible in order to minimize the chance of rejection. This tendency has been exacerbated in some states by formal changes in the laws, which now require super-majority approval for capital financing issues. Infrastructure spending at the state and local level has become misaligned with taxpayer-voter preferences, in part because officials are reluctant to put forward capital proposals that go as far as the majority of voters want.

The paper concludes by considering how this political bottleneck on infrastructure spending can be broken. Traditional decision-making mechanisms are badly equipped to handle joint consumer and producer demand for publicly provided goods. Referenda and other voting proxies incorporate the principle of "one man, one vote." No device is available for weighting votes by willingness to pay or by economic stake in the outcome. Business, for its part, is accustomed to expressing its expenditure demands largely through lobbying. As a result, a good deal of political ingenuity in recent years has gone into inventing institutions that can legally invest in infrastructure without submitting to the referendum process. This strategy seems to be a mistake. The most striking cases of turnaround in state or local infrastructure spending have occurred precisely where new business-consumer alliances have taken their case to the public and asked for voter support. Typically, these proposals have included a redesigned tax or fee package that has targeted a greater share of costs to business and users, thereby relieving the cost burden on the general taxpayer who must approve the new spending.

Trends in Public Capital Investment and Capital Stock

The first warnings of an impending infrastructure crisis were issued more than a decade ago by authors who called attention to the sharp decline in public capital investment. This decline has been measured in several ways. For example, the National Council on Public Works Improvement (1988) reported a drop in public works capital outlays by all levels of government from 2.5 percent of GNP in 1963 to about 1.2 percent of GNP in 1978 and 1.0 percent in 1984. Growth in the public

capital stock, net of depreciation, fell to less than 1 percent per annum between the late 1970s and mid 1980s.

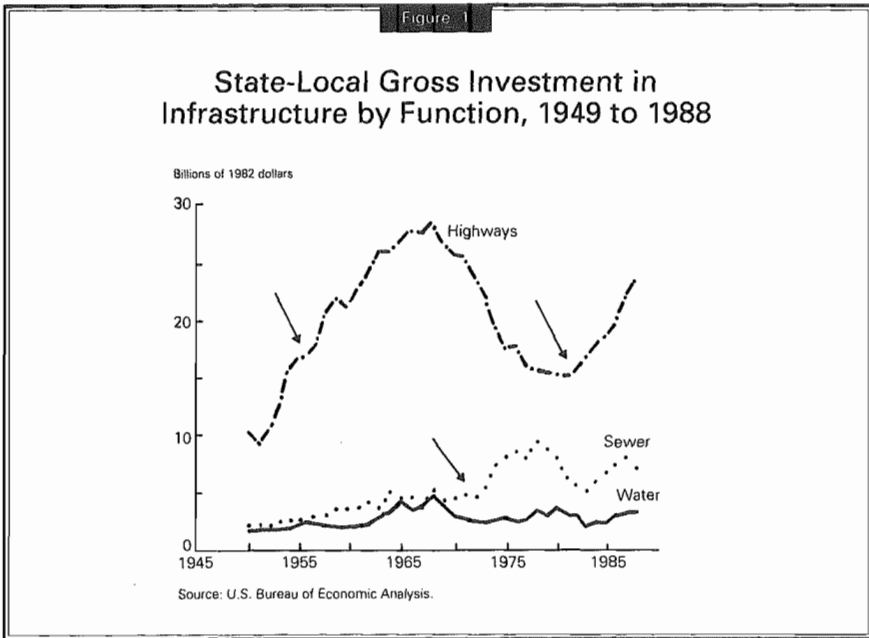
It is true that maintenance and operations costs associated with infrastructure facilities rose substantially over the same period. This makes interpretation of the capital spending data alone somewhat problematic. As large capital programs, such as the construction of the interstate highway system, are completed and the first generation of facilities built under the program matures, it is natural that the infrastructure spending mix should shift toward maintenance. Indeed, until legislative modifications in federal highway financing were made in 1982, one of the principal criticisms of federal highway aid was that it was inefficiently directed almost exclusively to new construction. Now, some 40 percent of federal highway funding goes for repairs and rehabilitation of existing roads and bridges.

More active maintenance throws into question some of the assumptions about depreciation that are built into estimates of the public capital stock. In principle, depreciation rates should be treated as endogenous. Better maintenance and repair can stretch the useful life of infrastructure facilities, and even keep them in as "good as new" condition for a significant period.¹ The assumption, used by the Bureau of Economic Analysis and others in estimating capital stocks by the perpetual inventory method, is that depreciation schedules are fixed exogenously and not affected by maintenance practice. This assumption may exaggerate the rate of slowdown in capital stock accumulation that occurs when, as recently, public works spending shifts toward maintenance away from capital construction.

Figure 1 places gross investment in three of the core infrastructure functions in somewhat longer perspective. It shows that the 1968–71 level of capital spending for highways was the product of a decade's climb in gross capital investment. From a longer perspective, the decline in gross investment may seem to be more a cyclical receding from the initial impetus of the highway program than a secular trend. As Tarr (1984) has pointed out, broad cyclical swings have long characterized infrastructure investment in the United States, as one wave of building programs subsides and another begins to rise.

Figure 1 also illustrates the central role of federal legislation and federal aid in initiating the major waves of public capital formation. Critical legislative dates are highlighted in the figure. In 1956 Congress passed the federal highway program. In 1982 it boosted the federal gas

¹ In their examination of capital spending in 433 New Jersey communities, Holtz-Eakin and Rosen (1989) find that they cannot reject (at the 5 percent level) the hypothesis that depreciation *net of maintenance* is zero for local infrastructure

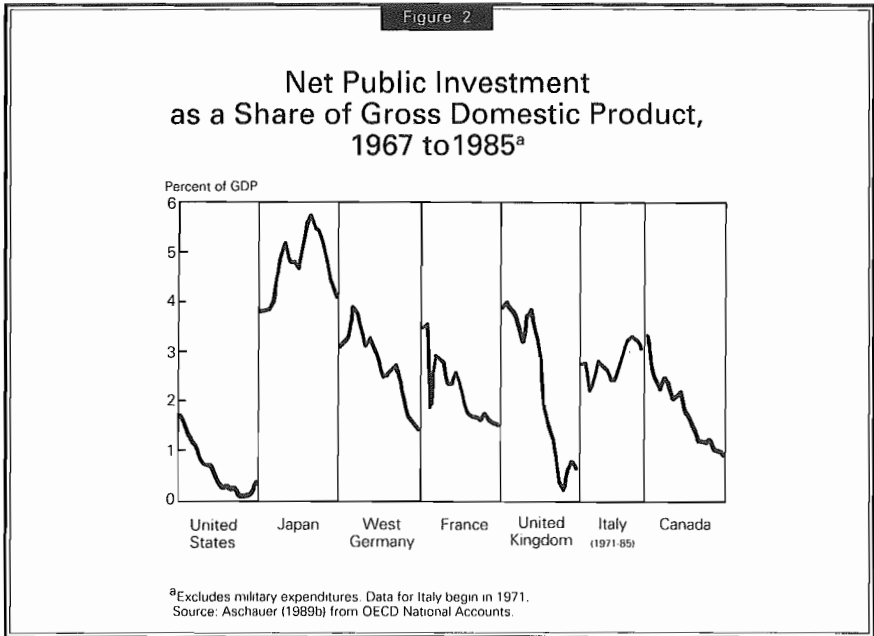


tax to augment the highway trust fund. Both measures triggered strong growth in highway investment; ironically, the two pieces of legislation were adopted, twenty-six years apart, at almost the same level of real state and local gross investment in roads and highways. Wastewater investment began its upward swing shortly after passage of the 1972 Water Pollution Control Act, which first incorporated grants for municipal treatment facilities.

International comparisons also extend the frame of reference for capital spending. A comparison of net public investment as a share of gross domestic product in the Group-of-Seven countries, for example, seems to show investment trends for several European countries comparable to those in the United States (Figure 2).²

In fact, interpretation of these trends points to some important definitional issues that underlie current discussions. "Infrastructure" spending has been equated with public nonmilitary investment and, in the United States, with state and local investment. Many infrastructure functions, however, can be provided by either the public or the private

² See Reidenbach (1986) and Jackson (1988) for further detail of infrastructure issues in Germany and the United Kingdom, respectively.



sector. In fact, in response to budgetary pressures on government, a tendency has developed to shift previously public capital responsibilities into private hands. The most widely publicized privatization efforts are those that involve complete and sudden breaks with public supply—for example, the building of private toll roads or the United Kingdom's sale of regional water authorities to the private sector.

The precipitous decline in government infrastructure spending in the United Kingdom during the 1970s, however, stems in part from another kind of privatization. During this time government changed from a significant land developer and investor in land improvements to a net seller of improved land. The growth in the net sales of improved land, which enter into OECD's national income accounts as negative capital formation by government, alone accounts for more than one-half of the real decline in general government capital investment between the years 1975 and 1982. This substantially distorts any cross-national estimates attempting to relate productivity decline to measured decline in public capital formation.

Another example of the impact of public-private classification on the recorded growth of infrastructure capital occurs in Sweden. At first glance, Sweden appears to be an interesting exception to the pattern of decline in the growth rate of public capital stock—especially in the

transportation and communication sector. However, closer examination shows that total sectoral capital growth has been the product of two strikingly different trends (Sundberg and Carlen 1989). Telecommunications investment has been rising rapidly, while highway investment has been falling. The fact that in Sweden both are public responsibilities masks a shift in investment pattern that in other nations would reveal itself as a relative decline in the public capital stock. As privatization initiatives accelerate, it would seem important to begin measuring infrastructure capital in functional terms, summed across the public and private sectors, as well as according to ownership or source of financing. Government-produced infrastructure may be of special interest because of the way expenditure and financing decisions are made. If, largely for historical reasons, infrastructure networks serving fast-growing sectors of the economy have been assigned to the private sector while networks serving manufacturing and slower-growth sectors are in public hands, the shift toward lesser intensity of public capital in production may reflect not a failure of government supply but an orderly change in factor usage that would occur regardless of public or private provision.

Is Public Infrastructure Undersupplied?

The mere fact that infrastructure investment has suffered a steep or persistent decline does not mean that the country should invest more in public capital. In considering whether public infrastructure is undersupplied or oversupplied, analysts have pursued two quite different lines of study, reflecting the joint nature of infrastructure services. Public capital simultaneously provides inputs into private production and yields direct services to final consumers. When infrastructure is viewed as part of the private-sector production function, the desirability of further investment can be judged by the rate of return it generates in terms of private output. If the return to infrastructure investment exceeds that available from other investment opportunities, the public capital stock ought to be expanded.

How the optimal level of public capital for final consumption should be decided is perhaps less clear. Many infrastructure needs studies imply that public officials should first make an expert judgment regarding the quality of infrastructure services that is appropriate for the citizenry, as well as the condition of the underlying capital, and then find ways to pay for this desired level of output and maintenance. In many states, however, voters have substantial opportunity to vote directly on infrastructure programs and their financing. Under a taxpayer-voter model of state and local government, public officials ought to supply the level of final infrastructure services that consumers

are willing to pay for, either as expressed directly through their votes in bond and other referenda or indirectly in general elections.

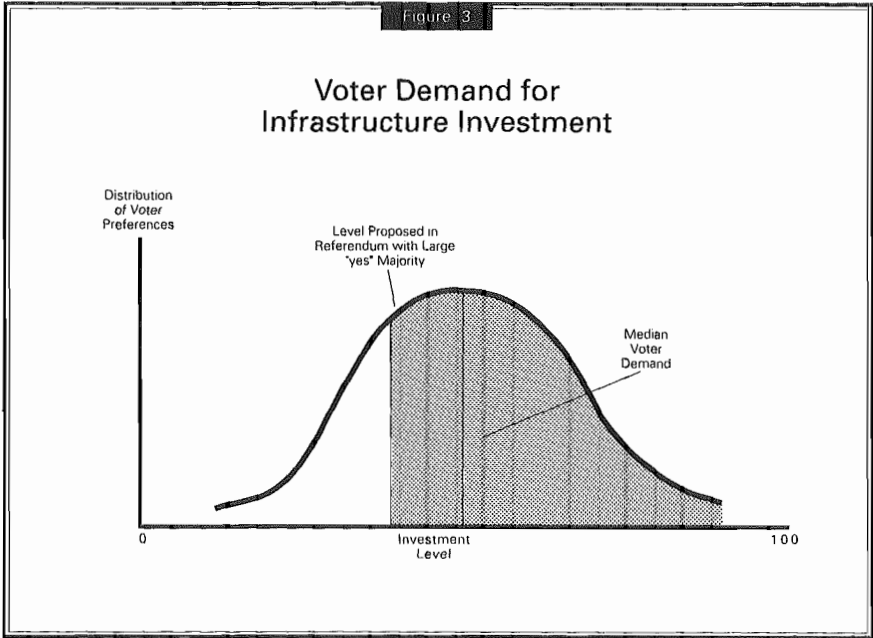
Recent literature has devoted its principal attention to the payoff in private sector production from investment in public capital stock. This line of analysis was initiated by Aschauer (1988a, 1988b, 1989a, 1989b) and extended by Munnell (1990), among others. It represents public infrastructure—especially core infrastructure—as entering directly into private production functions. Therefore, increases in the public capital stock produce increases in private output, and increases in public capital usage relative to other factors of production increase the productivity of both private capital and labor.

The empirical findings have been striking. In his original studies, Aschauer reports results that imply rates of return to public investment as high as 50 to 60 percent per annum. The decline in the growth of the public capital stock since the 1960s is found to explain by far the largest part of the slowdown in private sector productivity growth over the same period. In some of the studies, a dollar of public investment yields more private output gain than does a dollar of direct, private investment. These results are so strong that skepticism has been expressed as to whether they simply reflect coincident trends in infrastructure investment and productivity growth since the 1960s rather than a causal linkage.³ Taken at face value, however, the findings imply that public infrastructure capital is presently greatly undersupplied, *even if infrastructure facilities have no value in providing final services to consumers.*

Taxpayer-Voter Demand

Whether infrastructure capital is undersupplied from the point of view of the taxpayer-voter has received less analytical attention. A partial answer to this question can be obtained from a closer look at voters' revealed preferences as expressed in bond elections and other referenda. The measure is admittedly imperfect, because only part of state and local infrastructure spending passes through the referendum process. (In 1988, \$26 billion of new bond proposals for capital invest-

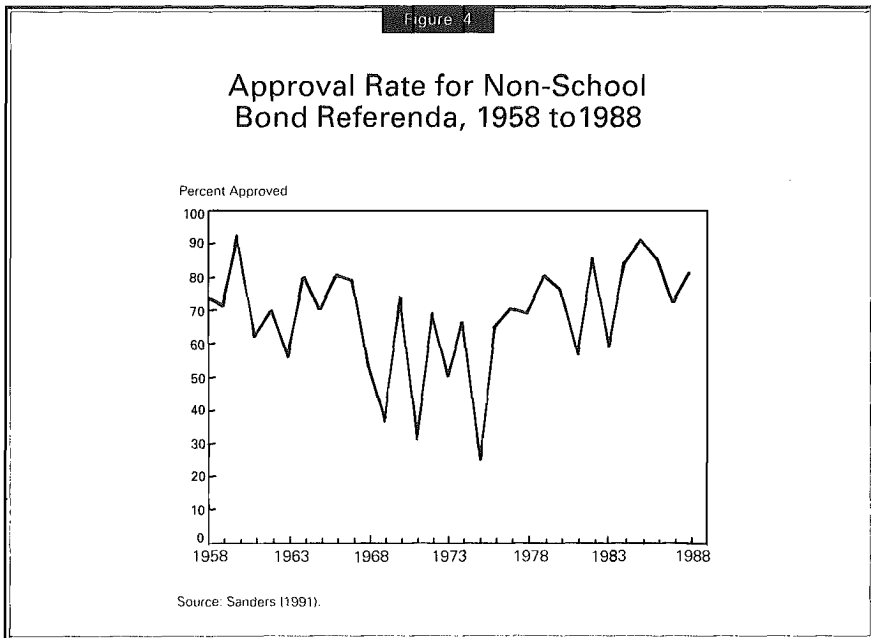
³ For example, see Schultze (1990) and Hulten (1990). The risk of attributing too much significance to parallel trends can also be seen in international comparisons. As noted in the text, the steep decline in net infrastructure investment recorded in the United Kingdom (Figure 2) is to an important degree an accounting artifact created by government changeover from being a land developer to a net seller of developed land. Given Aschauer's cross-country analysis of productivity change (1989b), the disposition of government assets in the United Kingdom would by itself have been sufficient to depress the U.K. productivity growth rate by 1.2 percentage points. The coincidence of this (reported) slowdown in public capital formation with productivity decline also is likely to produce overestimates of the productivity impact of infrastructure capital.



ment, excluding refinancing, were submitted to voters, of which \$21 billion were approved. This compares with total state and local gross investment in 1987–88 of \$104 billion.) However, referendum results may be taken as a general proxy for citizens' broader spending preferences.

If states and localities with referenda procedures truly tried to satisfy the median voter, they would submit frequent bond proposals for voter consideration in order to assess voter demand. Bond approval rates and margins of passage should hover near 50 percent. That is, if local officials attempt to design capital programs that match the median voter's preference, bond elections should be closely contested. High majorities voting "yes" in bond elections imply that even after a new project is built, infrastructure still will be undersupplied, relative to simple majority preferences.

The relation between bond referendum approval rates and desired spending is illustrated in Figure 3 under the assumption of a normal distribution of voter preferences. The percentage of voters in favor of an infrastructure bond proposal will be the cumulative percentage who desire at least this much investment spending (shown as the shaded area in the diagram). A high rate of voter approval implies that many voters who would vote against an infrastructure proposal that just



matched median-voter demand nonetheless support the actual proposal, because it involves a lower level of investment.

The record of infrastructure bond referenda voting suggests that, since at least 1984, voters have been willing to support higher levels of public infrastructure investment (Figure 4). Between 1984 and 1989, on a value basis 80 percent of infrastructure bond proposals were approved at public ballot.⁴ Even this figure understates the extent of public support, because the lowest approval rates were registered in states that require more-than-majority margins for bond approval. The margins by which spending proposals have passed have also been high. Since 1984, the average infrastructure bond proposition submitted to referendum has commanded more than 66 percent voter approval—a rate of support exceeding that recorded for any other type of referendum.

Voter support for infrastructure initiatives has not been a permanent feature of the fiscal landscape. During the early 1970s in particular, bond approval rates occasionally reached as low as 30 percent as public exasperation with state and local expenditure growth manifested itself

⁴ Infrastructure bonds are defined to include the following functions: roads and highways; water and sewer; public buildings (including jails and general government facilities); and education. Education is the largest single category.

as opposition to all classes of public spending, including infrastructure financing.

Besides the broad cyclical swings in voter support visible in Figure 4, annual voting outcomes have a strong sawtooth pattern. The low points in voter approval come in odd-numbered years—the years without general elections, when voter turnout is much lower. The most ardent voters have been those opposed to new tax and spending proposals. General voters, who tend to vote on referendum propositions only during general elections, have been far more likely to vote in favor of new infrastructure projects.⁵ The annual fluctuation in voting outcomes was most marked during the 1970s and early 1980s, when a core group of tax opponents regularly voted against and defeated bond and tax proposals during “off” years. Over the past few years, the passionate division of the electorate into opponents of spending and others seems to have subsided.

All in all, the record of taxpayer voting suggests a history of clearly expressed preferences that correlates well with actual state and local investment patterns. Bond rejection rates surged for the first time in 1968. That date also marks the high-water mark in state and local infrastructure investment, and the beginning of a long period of slowdown in public capital formation. Voter approval now has recovered and stabilized. The reasons for taxpayers’ change of heart are not completely clear, but they seem to combine diminished opposition to government spending in general with special support for infrastructure proposals. Years of low state and local investment, coupled with more evidence on the consequences of cutbacks, appear to have convinced the electorate that, at the margin at least, it is now appropriate to increase infrastructure commitments.

Explaining the Undersupply of Infrastructure Capital

Arguments that affirm an undersupply of public infrastructure require a political explanation. With two powerful constituencies demanding more public investment—a business community that perhaps can gain as much from government-financed infrastructure investment as from its own capital spending, and an electorate that appears disposed to approve higher levels of public capital outlays—what political mechanisms could frustrate these demands? Why should public capital remain undersupplied?

⁵ This is consistent with the survey findings of Gramlich, Rubinfeld, and Swift (1982), who found that nonvoters generally opposed tax limits and were more likely to support public spending than those who voted.

Benefit Spillovers

One class of explanations for undersupply emphasizes the spillover benefits inherent in some types of infrastructure systems. As long as some of the benefits from public capital facilities spill over to users outside the local taxing district, local taxpayer-voters, looking only at their own benefit-cost trade-off, will choose to provide a suboptimal level of infrastructure capital.

Spillover benefits are dealt with most efficiently by the pricing system. A universal user charge system, in which all users, regardless of place of residence, pay a fee that covers the marginal costs they impose on a network, will automatically balance demand and supply. (An additional fixed subsidy may be necessary for networks that show declining marginal costs.) Where user fees are impractical, the same result can be approximated through intergovernmental matching grants. A higher level of government compensates the local jurisdiction for the share of system costs imposed by nonresidents. Faced with a lower tax price, local voters will demand the optimal level of infrastructure provision.

The system of matching grants used in the United States, however, has capped allocations. The matching provisions do not apply at the margin where expenditure decisions are made.⁶ Under these circumstances, state or local governments will still undersupply infrastructure that generates spillover benefits.

The practical importance of the spillover argument to infrastructure supply decisions is unclear. Spillover benefits certainly are present in some networks, such as road systems used by out-of-state drivers. They are likely to be particularly important in the networks used by business, where greater national market orientation is to be found. The spillover argument therefore may help to explain why the business sector has not asserted more leadership in demanding higher levels of local infrastructure investment. Local firms are able to use capital networks paid for by other jurisdictions for part of their business; conversely, any infrastructure that local business helps pay for through local taxes will be used in part by outsiders who do not have to pay.

⁶ Seen from a local perspective, the "capping" of categorical matching grants may be exaggerated. Few of the federal grant programs operate by simply matching local spending up to a fixed amount. Many involve discretionary determinations of which local projects will be eligible for federal matching. Thus, the federal highway program has included discretionary bridge projects. Other highway funds and Environmental Protection Agency grants for municipal wastewater treatment have had fixed allocations at the state level, but competition by state criteria for individual project eligibility. Local jurisdictions thus face the possibility of stretching or shrinking federal matching dollars based on the projects they propose.

The spillover share of use for almost all infrastructure systems, however, is well under 50 percent. Even after discounting the reported aggregate private returns to exclude the share attributable to externalities, and therefore not captured locally, recent estimates of the private sector payoff to infrastructure investment imply that the local return should be enough to generate strong business support for infrastructure investment financed through local general taxes. Thus, the paradox remains. Why has business not been more active, and more successful, in demanding increased state and local capital outlays?

Spillovers, of course, do not help account for the paradox of apparently unmet infrastructure demand from household voters. Voting in bond elections reflects the pricing rules and grant system currently in use. A reform of user charges or the grant structure, so as to shift more of the incremental capital costs to outsiders, might well induce local voters in the future to support still higher levels of infrastructure spending, but current voting already takes into account any caps on federal or state grant aid.

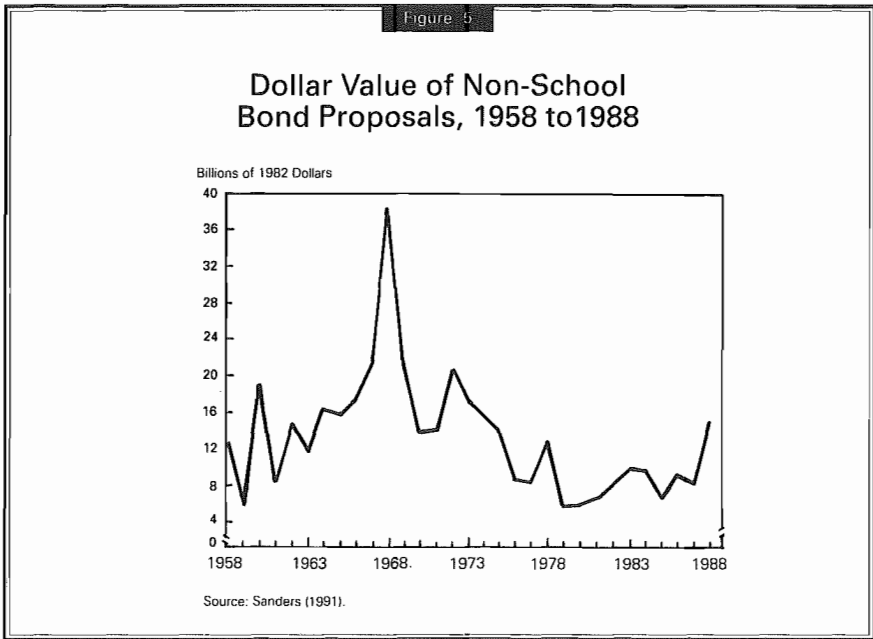
Voting Requirements

When public officials are asked to identify the principal constraint on expanding infrastructure investment, their answer is the need to submit bond or tax proposals to the electorate for voting.⁷ The tax revolt of the 1970s and early 1980s has left a strong residue of apprehension. Out of fear of rejection, officials have been reluctant even to *propose* expenditure and tax increases for voter consideration.

The intimidation effect can be seen by comparing Figures 4 and 5. In the early part of the period, bond approval rates were very high, and public officials appeared to ratchet upward capital spending proposals in response to these high rates of voter approval. By 1968, the volume of bond proposals submitted to the public in referendum exploded to \$40 billion. However, that year also brought a steep decline in voter approval rates, which continued to fall in 1969 and in off-year elections thereafter.

In response, public officials began to back away from infrastructure bond proposals. The dollar volume of bond initiatives fell sharply (Figure 5). This process was accelerated by the imposition of new state tax and spending limitations, some of which required super-majority

⁷ For example, in a survey conducted by the National League of Cities, 35.9 percent of all cities stated that the major obstacle to increased local infrastructure spending was the need to secure voter approval at referendum, a larger percentage of respondents than identified any other obstacle. Among cities that actually are required to seek voter approval, this was overwhelmingly cited as the principal obstacle.



votes to override tax or borrowing ceilings. Only recently, after years of strong voter support for infrastructure proposals, has the volume of spending initiatives submitted to the electorate by state and local officials begun to rise again.

The potentially distorting effects of agenda setting on the referendum process have been pointed out by others (for example, Romer and Rosenthal 1978). A commonly expressed fear has been that local officials can manipulate expenditure outcomes upward by proposing excessive spending levels, to which the only alternative may seem continuation of the status quo or reversion to a lower level of spending if the proposal is defeated. The data presented here suggest a more realistic fear is that risk-averse local officials will be intimidated by the voting process into proposing less infrastructure spending than voters are willing to support.

A special case where local voting requirements clearly have imposed inefficiency and underspending on capital expenditure decisions occurs in states that have imposed super-majority voting rules for bond or tax approval. Local governments in California, Massachusetts, Missouri, Washington and other states have had to secure two-thirds or other extraordinary margins of voter approval to pass bond initiatives or tax overrides. Other states (for example, Michigan) have required voter

approval at referendum plus a super-majority legislative approval for state bond initiatives. The requirement that more than a majority of voters approve a new bond issue has been devastating to tax-supported bond financing and infrastructure investment. California, for example, has fallen from one of the leaders in per capita highway investment to last or next to last in the nation, as the result of bond-voting and tax restrictions.⁸

Public officials have sought to circumvent the limitations placed on tax-supported infrastructure by creating special districts and special authorities outside of the general government structure. These are typically empowered to raise project revenues and issue bonds for capital spending as long as they do not tap the general taxing authority. Authorities that are exempted from state bond limitations, such as the city redevelopment authorities in California, have had to take on a broad and otherwise inexplicable array of capital financing responsibilities.

We thus are presented with the curious juxtaposition of states and localities failing to respond in full to voters' apparent willingness to increase capital spending, while continuing to search for complicated institutional ways to avoid public referenda in the future. The picture can be reconciled only by visualizing governments that distrust the electorate, and therefore are reluctant to interpret their positive voting signals too literally.

Failure to Take Advantage of the Joint Products of Infrastructure

As emphasized earlier, the typical infrastructure facility delivers joint products—input services to private producers as well as final services to household consumers. The combined demands of these two groups should be able to sustain aggregate infrastructure demand that exceeds the levels supported by either source on its own. Business and consumer demands are not entirely separable, of course—households presumably value the same congestion savings in the journey to work as producers. Nonetheless, the areas of overlap are limited.

Unfortunately, the mechanisms normally used to express infrastructure demand at the local or state level are ill-suited for aggregating business and consumer preferences. Most referendum voting operates under the principle of "one man, one vote." Unless the tax costs of a

⁸ Econometric studies of state capital spending have found debt ceilings to have significantly depressing effects on capital outlays (Bunch 1988; Burstein 1984). When these studies are reformulated to identify states that must submit tax-supported bonds for voter approval, either because of general constitutional provisions or because they are at a debt ceiling that requires voter approval to override, the depressing effect on capital spending is much stronger.

project can be allocated so that cost shares are matched with willingness to pay, voting results are likely to underrepresent efficient infrastructure provision levels, since each voter's opinion is counted equally rather than being weighted by willingness to pay.⁹ As a result, business demand is likely to be underrepresented in traditional referenda. Business can be more effective in government through lobbying and logrolling arrangements, but this demand too has proved difficult to unite with the interests of final consumers. In states where ultimate voter approval is required for most infrastructure financing, business persuasion of the legislature in any event may be an insufficient condition for realizing greater infrastructure investment.

The jurisdictions that have achieved the most dramatic turnarounds in infrastructure investment are those that have managed to forge a business-taxpayer alliance to take the case for infrastructure spending to the public. Business typically has taken the lead in organizing and financing these alliances, and sometimes has accepted a mix of general taxes and fees that falls more heavily on the business community, in order to increase voter support. In effect, some of the producer surplus generated by higher levels of infrastructure spending is spent on the campaign to achieve that investment. For example, in Cleveland, Ohio, the business community took the lead in demanding higher levels of capital spending, in order that the region could restore its business cost competitiveness. Business leaders organized the voter campaign in support of an increase in the local income tax rate, once they were assured that one-half of the increased revenues would be earmarked exclusively for capital reinvestment and they were guaranteed a role in identifying specific project priorities for future investment. The recent campaign to increase California's gas tax and dedicate the proceeds to transportation investment was similarly a joint business-citizen effort organized by business. The constitutional proposal, which increases state capital spending on highways by an estimated \$15.5 billion over ten years, passed with 52 percent of the vote. If subject to the super-majority voting standard of an ordinary local bond proposal, it would have failed.

⁹ Some voting systems have attempted to weight votes in a way that approximates willingness to pay. For example, it has been common in Texas and some other states to weight votes in municipal utility districts by the number of individual lots the owner possesses. That is, the decision whether to install utility networks is decided on a "one lot, one vote" basis. A developer may control 1,000 lots or more and therefore have his economic interest represented far more strongly in the referendums than an individual owner. This system has been shown to lead to much higher demand for infrastructure provision.

Conclusions

In the end, the undersupply of public infrastructure is as much a problem of political economy as pure economics. The view most commonly expressed by public officials is that they know more public investment is desirable, but their hands are tied by an electorate that does not share their opinion and makes the final determination about expenditure levels. The evidence reviewed here suggests that this explanation for undersupply of infrastructure is spurious. If anything, voters appear to be ahead of public officials in their willingness to support the costs of increasing public capital investment. Nevertheless, a great deal of political ingenuity during the past two decades has been devoted to circumventing the need for voter approval of infrastructure spending proposals. Over the long run, this effort is likely to be counterproductive. Proponents of stronger infrastructure investment seem to be better off taking their case directly to the public.

The debate over public capital's role in private productivity so far has been pitched at the national level, with the implication that if the claims of linkage are borne out, the appropriate response would be greater federal funding for infrastructure programs. Why this should be so is not explained. Ordinary state and local spending systems should be able to channel and accommodate any sustained increase in demand for infrastructure. If spillover benefits are a significant deterrent to local expenditure choice, the user fee and grant systems should be revamped so that at the margin local price signals induce efficiency. Otherwise, the major impediments to demand expression seem to be state and local officials' fear of the voting process and the uncertainty of the business sector about how best to combine its demands with those of final consumers. Public voting behavior with respect to infrastructure finance has stabilized a great deal over the past decade. Voters appear willing to support spending programs where cost-sharing arrangements have been tailored to reduce the burden on the general taxpayer. Therefore, it should ultimately be up to the business sector to resolve the current debate over the productivity impact of public capital, by deciding whether the infrastructure payoff justifies business shouldering a significant part of new investment costs at the state and local levels.

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Discussion

*Alan S. Blinder**

According to a popular view that has found its way into many newspapers and magazines, the sharp decline in the rate of spending on public infrastructure capital since the 1960s has left the United States with a serious shortfall of public capital. Awareness of this problem is not new. I can remember a business conference in the early 1980s at which Amitai Etzioni and I spoke. I was listening as Etzioni concluded his remarks with some advice given only half in jest: "If you come to a bridge on your way home, don't cross it." At that time, the Mianus River bridge was still standing.

Until recently, the evidence for a shortfall in public infrastructure was mainly anecdote and opinion. Lately, however, Aschauer (1989) and others have given this popular view more scholarly cachet by adducing econometric evidence that (1) the marginal productivity of public capital is extremely high compared to that of private capital and (2) the falloff in public investment accounts for much of the productivity slowdown in the United States.

All this has led many commentators, including me, to advocate more public spending on infrastructure (Blinder 1988, 1989). About a year ago, I testified at a Joint Economic Committee hearing on the subject. Congressman Lee Hamilton asked four of us whether we would favor an additional \$15 billion in infrastructure spending, if that meant increasing the federal budget deficit by \$15 billion. I believe he was surprised when three of the four said yes (U.S. Congress, Joint Economic Committee 1989).

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In his interesting paper for this conference, George Peterson does not really dispute this common view. He starts out as if he *might* by bringing up several measurement issues. First, he points out that highway spending spurted from 1950 to about 1968 and then declined until about 1982. (See Peterson's Figure 1.) Thus comparing the early 1980s (the cyclical trough) with the mid-1960s (the cyclical peak) exaggerates the decline. Second, he notes that most infrastructure can be provided either publicly or privately. Since the mix of public versus private infrastructure differs across countries, and on occasion changes dramatically within a single country, international comparisons of levels or trends are hazardous.

Peterson is correct on both counts. However, the second problem is irrelevant to time series studies of U.S. infrastructure, since our public/private mix has not changed. Regarding the first problem, Peterson's Figure 1 seems as exaggerated (in the opposite direction) as the numbers he criticizes. After all, it is hardly germane to compare *absolute levels* of spending in two years almost four decades apart. Peterson's graph shows that spending on highways was about two and one-half times higher in 1988 than in 1950. But the U.S. population was 62 percent larger and real GNP was three and one-third times as large. So highway spending declined as a share of GNP, just as everyone has been saying. Finally, I would have thought that the demand for public infrastructure capital has an income elasticity greater than one. (Compare, for example, the relative infrastructures of rich and poor countries.) If so, we should expect infrastructure to grow faster than GNP. Plainly, it has not.

In the end, Peterson accepts the evidence for undersupply of infrastructure. Two pieces of evidence persuade him.

The first is Aschauer's finding that public capital has a very high rate of return, perhaps as high as 50 to 60 percent. Here I would like to underscore an important point that Peterson makes, but does not emphasize. Many of the most important benefits from public infrastructure do not accrue to businesses and/or are not counted in the GNP. If I spend less time waiting at airports, I am happier; but the improvement in my well-being does not appear in GNP. If my car and my back absorb fewer shocks from potholes, I am surely better off; but GNP may even decline as a result of fewer car repairs and doctors' bills. The only benefits from public infrastructure that get into Aschauer's calculations are the ones that add to GNP. That these alone might account for a 50 to 60 percent return (or even half that much) is amazing to me.

Peterson's second type of evidence is a creative idea—creative, at least, to an economist. He points out that about 25 percent of infrastructure spending proposals are subject to direct approval or disapproval by voters and that, lately, such referenda have passed about 80 percent of the time—and by majorities averaging 66 percent. Such an overwhelm-

ing record of voter approval amid a taxpayer revolt suggests that Americans actually want more infrastructure than they are getting and are willing to pay for it.

I agree and would enter just two qualifying remarks. First, if (1) the median voter theory is correct, (2) politicians know voter preferences, and (3) politicians fear losing at the polls (as Peterson says), then all public bond issues should win approval. So an 80 percent victory record is hardly amazing. What *is* surprising is the two-to-one average margin of victory. It suggests either an extreme degree of risk aversion among politicians, or that something is wrong with either (1) or (2) above. The second remark is just a question for Peterson: Are the 25 percent of infrastructure projects that are submitted to referenda a random sample of the population? I simply do not know.

The most interesting parts of Peterson's paper come next. If you accept the case that infrastructure has been undersupplied, you come face to face with a question: Why? Peterson mentions three possibilities that I would like to discuss.

First, and foremost in his mind, is politicians' fear of rejection by the voters. I find this a plausible hypothesis, and not just because of the evidence Peterson offers. Anyone who lived in tax-revolting America in the 1980s must find it believable that politicians asked voters to tax themselves only with great trepidation. After all, Ronald Reagan was watching.

Peterson's analysis contains an implicit political model that might be missed: the number of bond proposals that politicians bring to the voters is a function of approval rates in the recent past. A reasonable idea. As a macroeconomist, however, I feel duty-bound to report that this is not a rational expectations model unless lagged approval rates are the best predictor of the current probability of approval. It may, however, be a good model despite potentially "irrational" expectations. How else, for example, can you explain the fact that the members of Congress display so little political courage even though their reelection rate approximates their body temperatures?

Of course, Peterson's tacit model is more substantial than this. Referendum approvals lead, with a distributed lag, to more construction and hence to a higher infrastructure stock. And more infrastructure, in turn, lowers the public's appetite for still more, hence reducing approval rates. If we put all of these pieces together formally, I suppose we would end up with a cobweb model of infrastructure spending. Before we conclude that everything is nicely regulated, let me remind everyone that cobwebs need not converge.

Peterson's second explanation for undersupply is a more conventional economic one: externalities. Since some of the benefits from an infrastructure project accrue to people outside the jurisdiction that pays

for it, underinvestment can be expected from a social point of view. I agree again. Peterson suggests user fees as the right way to deal with this problem, and I agree yet again. However, the problem is a bit trickier than Peterson indicates when an infrastructure project has public good aspects. In those cases, a free rider problem exists even *within* the jurisdiction, and user fees may not do the job. In fact, in some cases user fees can be positively harmful. For example, a toll booth can make an uncongested bridge congested.¹

Peterson's third explanation is the only one with which I must take exception. He argues that the political process systematically underweights the benefits that infrastructure gives to businesses (as opposed to those it gives directly to consumers). I find this notion implausible on two grounds.

First, it presupposes a very thick form of corporate veil—almost an iron curtain. After all, each of us is both a consumer and a producer, and nothing says that we voice—or vote—only our interests as consumers. On the contrary, every stockholder, manager, and employee of every corporation that can benefit from more infrastructure spending is capable of making herself heard in our democracy. Many of them do. I always thought it was the consumers who were the silent majority.

Second, as one who grew up under the American system of government-by-lobbyist, I have a hard time believing that business interests do not get a fair hearing in state legislatures. In fact, it seems to me that business lobbyists are all too successful when it comes to regulatory issues, antitrust enforcement, trade protection, special tax favors, and the like. Why should I believe that these same interest groups suddenly become impotent when it comes to voicing their demands for infrastructure? In addition, we all know—or, rather, I *thought* we all knew—that large companies often extort favors from state and local governments by threatening to move their plants or offices to another jurisdiction. Why is it that they cannot clamor for more roads, bridges, and schools?

I think they can. In fact, I would like to advance a different hypothesis: that business is not in fact pushing for more infrastructure (and for the taxes that go with it) even though it might be in its own interest to do so. That, some Chicago economist will object, would be irrational. But Peterson can hardly raise that objection after assuming irrational behavior by politicians and an iron corporate veil! More seriously, I think we are entitled to see some evidence before we accept Peterson's hypothesis that, on this one issue, corporations are political eunuchs. Are the potential users of infrastructure (not the road builders)

¹ Once I waited in a long line to pay a five-cent toll on a bridge near Philadelphia!

in fact lobbying hard for more spending, but failing? I'm from New Jersey: show me.

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Discussion

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George Peterson advances the hypothesis that the decline in public infrastructure spending during the past decade or so is largely cyclical rather than reflective of a secular trend. After a period of stagnation, he now sees demand for infrastructure increasing on the part of both the public and business. For him the critical question is why public capital is undersupplied, in the face of demand from two powerful constituencies. As a historian, my interest is in examining his hypothesis about the cyclical nature of infrastructure provision as well as exploring the conditions in which upturns in infrastructure spending have occurred in the past. My remarks are primarily intended as an historical addendum to both Peterson's paper and the focus of the conference as a whole.

The Cyclical Nature of Infrastructure Investment

An examination of the history of the infrastructure in nineteenth and twentieth century America reveals a series of cycles or bursts of spending followed by periods of retrenchment and stability, not necessarily marked by any regularity. This characteristic relates to spending for capital infrastructure by both the private and public sectors. Private sector spending has been tied relatively closely to the general business cycle (with some notable exceptions, such as electric traction construction in the 1890s and telephone sales in the 1930s), while public sector expenditure is somewhat more complicated. The public sector has

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engaged in infrastructure formation in periods of rapid urbanization and economic development, but it has also undertaken infrastructure construction for countercyclical purposes. Federal government activity during the New Deal is the most famous example of such countercyclical spending, but both municipal and state governments also followed the practice in the nineteenth century. In fact, for municipal governments this pattern often created debt crises.

Infrastructure construction was marked not only by a cyclical funding pattern but also by occasional shifts in the level of government doing the spending. That is, while some infrastructure historically has been provided by all levels of government—city, county, state and federal—the role of major provider has often shifted from one governmental level to another. The major impetus for change was an inability to finance infrastructure spending because of constitutional limitations resulting from previous overspending. These shifts also increased the role of the private sector. A brief history of the major cycles of nineteenth and twentieth century infrastructure spending illustrates this generalization.

The concept of “the state” acting as a service provider rather than a regulator of the economy was a relatively new one in the nineteenth century. In the decades of the 1820s, ’30s, and ’40s, however, state governments were especially active in providing capital for transportation infrastructure. These projects were either under state control or were “mixed enterprises,” combining public and private construction and operation. State interest in these projects included promotional goals, a desire for public profit, concern over the limitations of private corporations, and the provision of employment. These state public works projects reached a peak in the 1820s and ’30s, but spending dropped sharply after the depressions of 1837 and 1857 due to overinvestment, high taxes, and corruption. In addition, state constitutional restrictions on borrowing, passed after the depressions, forced many states to follow a pay-as-you-go policy, which severely restricted new projects.

Municipalities and counties, convinced that their economic futures depended on access to transportation, often filled the infrastructure investment gap. State legislatures passed hundreds of laws permitting local aid grants for construction projects. During the middle of the century, city governments increasingly assumed the function of service providers, investing in streets, waterworks, and sewers, as well as other infrastructure elements. Some of these projects, such as street improvements, were financed by assessments on abutters or even general tax revenues, but increasingly cities came to depend on borrowing to finance infrastructure construction. As historian Eric Monkkonen notes,

during the period after 1850, the "issuance of debt changed from a rare expedient to the norm for cities" (1984, p. 129).

Cities invested heavily in infrastructure improvements in the years from 1866 to 1873, and per capita municipal debt increased from \$6.36 in 1860 to \$13.38 in 1870, at a time when state debt only increased from \$8.17 to \$9.15 (current dollars). A sharp economic downturn in the early 1870s, however, forced many municipalities to default on their obligations. State legislatures responded by establishing limitations on municipal debt based on a percentage of assessed valuation, inserting debt limitations in city charters, and requiring devices such as sinking funds and voter approval of bonds. By 1880, more than half the states had constitutional limitations on city debt, usually a set proportion of the tax base. In the 1890s, however, as urban population soared, state limitations were eased and instruments to bypass them, such as public authorities, were created. As a result, city borrowing for capital improvements resumed, continuing until World War I.

The 1920s witnessed a return to the earlier, nineteenth century pattern of heavy state involvement in transportation improvements, especially road construction and surfacing. The generative factor was the automobile, which became widely available as production costs dropped dramatically. The federal government also provided funds for road construction on a matching basis. The most important innovation, however, was the enactment of the gasoline tax, beginning with Oregon in 1919. By 1929, all states had approved the tax, which became the principal source of highway revenues. These user fees provided 60 percent of the funds for the increase in highway expenditures between 1913 and 1930.

In the 1930s, the federal government assumed its largest role in infrastructure investment to that time. Various federal agencies, especially the Public Works Administration, provided between 60 and 65 percent of all public construction from 1933 to 1938. This unprecedented intervention was aimed at four goals: relieving mass unemployment; developing the use of public works as a yardstick by which to measure the performance of private enterprise; "priming the pump"; and winning political support for the Democratic party. Heavy federal involvement in infrastructure spending continued during World War II, but primarily for the war effort rather than civilian needs. In the decades since the end of the war, federal involvement in infrastructure construction has gone through the familiar cycles of contraction, expansion, and then contraction, with the largest spending devoted to the interstate highway system, urban mass transit, and environmentally related technologies such as sewage treatment facilities.

The history of infrastructure provision, therefore, shows a cyclical pattern in terms of both levels of funding and governmental involve-

ment, rather than any consistent trend. And, these cycles did not necessarily follow any regular pattern. In addition, every period of limitation was not necessarily followed immediately by great expansion in investment, even though demand appeared to exist. Periods of large public investment required a combination of factors, not all demand-related. In short, the history does not necessarily guarantee that we are on the eve of a new burst of spending for infrastructure.

Public and Private Provision of Infrastructure

Although it is widely believed that today's movement towards privatization represents the first major shift from public to private supply of infrastructure, history provides many instances of shifts in both directions. A good example is water supply. Well into the nineteenth century, householders either obtained their own water supplies (from wells and cisterns) or relied upon private water companies. Increasingly during the century, however, the inability or unwillingness of private companies to meet the needs of growing cities to provide water for fire protection, household uses, and industrial purposes forced municipalities to assume this function. At the time of the Civil War, about 42 per cent of the 136 waterworks in the nation were publicly owned, including those of the nation's sixteen largest cities. The trend towards public ownership reversed during the decade after the depression of 1873 when municipal spending was capped, but resumed once again by the 1890s. In 1914, about 70 per cent of the nation's waterworks were municipally owned and, by 1925, municipalities and public authorities owned about 82 percent of the nation's waterworks, servicing between 85 and 90 percent of the population. Data are sparse for the intervening years, but by 1989, 58 percent of the nation's 59,621 water systems were privately owned, serving about 20 per cent of the population. Private, investor-owned companies have increased in number and share of the population serviced, but most large city systems remain publicly owned.

The provision of other elements of the infrastructure has also shifted from the private to the public sector. Bridges, for instance, made a transition from being largely privately owned (with tolls) in the nineteenth century to largely public ownership in the twentieth. Municipal transit was mainly private until World War II, although various forms of public ownership or mixed public/private construction and operation existed in some large cities such as New York. In the 1950s, as private transit companies experienced heavy losses, many were acquired by city governments and by public authorities created for that purpose. With the creation of the Urban Mass Transportation Admin-

istration in 1964, the federal government became a major player in the provision of transit services. Other urban services, such as waste collection, have over the past two centuries shifted back and forth between private and public provision because of dissatisfaction with the quality of service, a failure to fulfill contract provisions, and political change. In contrast, citywide sewerage systems have been almost entirely publicly constructed and operated from the time of their first appearance in American cities in the 1850s.

Why Periods of Rapid Infrastructure Construction Occur

One of Peterson's major arguments is that although public demand for infrastructure spending exists, the various anti-tax campaigns of the 1980s have made public officials excessively timid about advancing infrastructure spending programs. McDonald and Ward (1984) have recently suggested, however, that this type of behavior is the norm for local public officials, not the exception. That is, because of restrictive fiscal ideologies, vested bureaucratic interests, and failure to achieve consensus on fiscal expansion, "local politicians" have usually been "timid, seemingly inert, and always incremental" in regard to spending (p. 32). One might ask, then, under what past conditions has rapid infrastructure investment occurred?

An examination of past periods of rapid infrastructure formation, such as the mid-1890s through 1914 and again 1921 to 1929, suggests a combination of factors on the demand and supply sides. First, these were periods of great city growth and therefore of increased city building, which created a large demand for services in order to create a more viable and operative environment. Some of these demands required infrastructure that would facilitate production, while others were more oriented toward providing an infrastructure for consumption, although the two have often overlapped. Since urban commercial elites usually believed that infrastructure was linked to economic development, they often supported public spending for infrastructure, especially for downtown improvements.

A second important factor in generating investment was the appearance and adoption of new technological innovations. New technologies have played critical roles in driving infrastructure cycles because they often require additional infrastructure for their implementation and lead to an expansion of urbanized areas that require other forms of services. This process has been most identified with the automobile, but it was also true of other transport technologies such as the steam locomotive, the street railway, and the airplane. Some of these technol-

ogies, such as the steam railroad or the automobile, increase mobility; the automobile also provides flexible mobility. Yet, they often require inflexible infrastructures, such as roads, highways, viaducts, railroad stations, and garages, that can become barriers to change.

Large expenditures for infrastructure have often been undertaken because policymakers believed that the technologies involved would help solve major problems facing society. In the nineteenth century, for instance, municipalities often invested in systems of piped-in water because they had experienced disastrous epidemics and/or fires and wanted to avoid them in the future. A further incentive for the adoption of waterworks was the lower fire insurance rates that would result. Investments in sewers resulted from the realization that they would substantially reduce mortality and morbidity, as well as from a desire to eliminate the nuisances created by overflowing cesspools and flooding. In the early twentieth century, municipalities made large expenditures for water treatment technologies because of a concern over the disastrous health effects of drinking sewage-polluted water. The technology itself evolved because of advances in bacterial science. Closer to our own time, huge federal investments in sewage treatment technologies have taken place since 1972 because of a concern over environmental deterioration and the health effects resulting from pollution. Here a rise in leisure time and leisure activities appears to have changed public values, making voters willing to pay for environmental quality.

Conclusion

This brief history of infrastructure investment and construction affirms the essential cyclical nature of investment patterns, the shifting proportions of public and private ownership, and changes in the level of government providing the service. It also suggests that bursts of infrastructure spending do not necessarily result from concerns over infrastructure deterioration and inadequacy of service. Rather, such periods of rapid increase in investment occur because of a combination of factors on the demand and supply sides. On the demand side, population changes, especially rapid city growth, concern over social problems susceptible to a technological solution, and political developments appear most important. On the supply side, capital availability and technological innovation loom the largest.

The contrast between our own time and periods of rapid infrastructure investment in the past is informative because it highlights the extent to which today's conditions differ from past periods of expansion. Those earlier periods were marked by major urbanization and critical technological change, as well as by new funding mechanisms and

sources of capital. While the United States has experienced the emergence of a new urban form—the decentralized “outer” city—in the past 25 years, this new “city” has primarily generated extension and retrofitting of old technologies rather than technological innovations. The major exceptions in regard to technology have been communications advances. These developments, however, have essentially been involved with increasing the efficiency of existing systems rather than replacing them. Real interest rates are relatively high, and while some new funding mechanisms have appeared, no major innovations, such as creation of an infrastructure bank, have occurred. What the history appears to say is that we are in a period unlike any past period of infrastructure “growth” in regard to its configuration of social, political, fiscal, and technological forces. This suggests that those interested in expanding infrastructure investment should avoid strategies that emphasize massive needs at enormous cost and should opt instead for a variety of flexible approaches.

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Little historical writing is available on municipal spending patterns, although the literature on the history of urban infrastructure is expanding as a general topic. Unless otherwise noted, all material used in this comment has been derived from three of my previously published articles. Full citations can be found in:

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