

INFRASTRUCTURE ISSUES

FINDINGS AND RECOMMENDATIONS OF THE NATIONAL COUNCIL ON PUBLIC WORKS IMPROVEMENTS

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Introduction

The quality of a nation's infrastructure is a critical index of its economic vitality. Reliable transportation, clean water, and safe disposal of wastes are basic elements of civilized society and a productive economy. In its final report, Fragile Foundations: A Report on America's Public Works, the National Council on Public Works Improvement concluded that there is convincing evidence that the quality of America's infrastructure is barely adequate to fulfill current requirements and insufficient to meet the demands of future economic growth and development.

The Council concluded that unless we dramatically enhance the capacity and performance of the nation's public works, our generation will forfeit its place in the American tradition of commitment to the future. Without such an effort, our legacy will be modest at best. At worst, we will default on our obligation to the future, and succeeding generations will have to compensate for our failures.

The Council found that most major categories of public works in the United States are performing at only passable levels. Water supply and water resources remain in reasonably good shape, due in part to the mixture of self-reliant publicly and privately owned systems, although some public water systems suffer from low subsidized pricing structures, stricter water purity standards and numerous cases of source contamination.

Highways, Roads and Streets

The Council evaluated the highways, roads, and streets as being in relatively good condition. In 1984, the capacity of U.S. roads swelled from increased motor fuel tax earnings. Since 1985 improved pavement conditions have helped with the steady rise in usage of roads, bridges, and highways, although increased congestion, especially in urban areas, plays a significant role in future plans. For example, in Los Angeles County congestion causes an annual loss of \$57 million in wasted time and 72 million gallons of wasted gasoline. Since 1985 higher user taxes, supporting greater investment, have assisted in spending keeping up with current needs. However, future population increases, increased travel patterns, and regional shifts will demand further expansion.

Wastewater Treatment

Other public works systems, primarily those designed to protect our environmental quality, have serious and growing problems. Secondary wastewater treatment facilities, serving over 75 % of the U.S. population, protect the nation's drinking water and environment. Despite the federal government's investment of \$44 billion in sewage treatment facilities since 1972, water quality throughout the U.S. has neither improved nor deteriorated. This paralysis is attributed to population growth, major industrial expansion, uncontrolled runoff from farmlands, and highways and declining productivity at many facilities.

Solid Water Management

The Council viewed solid waste disposal and management to be in a dire predicament. From 1960 to 1985 waste disposal per person multiplied 35 % — from 2.3 to 3.1 pounds per person each day. Per capita spending on solid waste facilities during this same period increased over 80%. With current more stringent environmental regulations, the cost of garbage disposal will increase more rapidly in the future. After the enactment of the RCRA and other amendments, few new landfills opened, while numerous existing ones closed. Massachusetts had five hundred active landfills in 1970. In 1980, they decreased to four hundred and further reductions have left many fewer landfills in operation.

Since large amounts of time are required to site and develop landfills or waste-to-energy facilities, planning to avert a crisis must begin.

Hazardous Waste Disposal

The situation for hazardous waste disposal is just as critical. Each year industry generates two tons of hazardous waste per person. Little is known about the current capacity of U.S. hazardous waste management facilities to deal with the tremendous increase in its generation. Most treatment, storage, and disposal facilities are onsite and managed by private firms. The Bureau of Census estimates the private cost of hazardous waste management reached nearly \$2.5 billion in 1984. Just as with solid waste, long lead times are required to plan hazardous waste facilities, so again action must occur now.

A Strategy for the Future

To respond to these concerns, the Council formulated and presented to the Congress and the President a comprehensive strategy for enhancing the capacity and performance of the nation's public works. The Council called for a national commitment, from the public and private sector, to increase by up to 100% the amount of capital that

the nation invests annually in new and existing infrastructure. The Council recognized that such a commitment is only one of many critical claims on the nation's resources. Therefore, they supported appropriate actions to redress the imbalance between consumption and savings so that future infrastructure commitments will not be shortchanged and this generation can act responsibly to meet its stewardship responsibilities.

Mobilizing adequate financing to meet our current and future public works needs should be guided by the following principles:

- + Users and other beneficiaries should pay a greater share of the cost of infrastructure services.
- + The federal government should be a reliable partner in financing public works.
- + States should develop comprehensive infrastructure finance strategies.
- + Local governments should give budgetary priority to funding the maintenance of existing facilities and we as shareholders in America's capital stock, should demand no less.

The Council recognized that spending more money was not the only appropriate response. The Council felt that the capacity and performance of the nation's infrastructure could be improved through other means besides just spending more. They were concerned that steps be taken to ensure that resources spent on the nation's infrastructure be spent as efficiently as possible. As a result, they concluded that a strategy to upgrade America's infrastructure must incorporate other tactics in addition to increased investment. Thus, the Council also recommended,

- + Clarification of the respective roles of the federal, state, and local gov-

ernments in infrastructure construction and management to increase accountability

- + More flexible administration of federal and state mandates to allow cost-effective methods of compliance
- + Accelerated spending of the federal highway, transit, aviation, and waterways trust funds
- + Removal of unwarranted limits on the ability of state and local governments to help themselves through tax-exempt financing
- + Strong incentives for maintenance of capital assets and the use of low-capital techniques such as demand management, coordinated land-use planning, and waste reduction and recycling
- + Additional support for research and development to accelerate technological innovations and for training of public works professionals
- + A rational capital budgeting process at all levels of government

Conclusion

Progress on all of these matters is important. No single approach by itself will be adequate. More money alone will not suffice. More effective management alone will not get the job done. Technology will not save the day. The complexity of these systems and their attendant problems demand a broad-based strategy to be pursued simultaneously.

The longer the delay in implementing such a comprehensive strategy, the greater the cost to the nation and to each of us individually. Such an agenda, however, cannot be accomplished in a short period. The nation's infrastructure problems can only be dealt with effectively if we begin to mobilize resources now, and if all levels of government and the private sector dedicate themselves to a sustained effort. Elected officials and the public at large must recognize that capital expenditures are not the only cost of public works; rather, the expense incurred through delays in providing needed services, added to the value of local economic opportunities, often can exceed direct budget costs. To reach this goal by the turn of the century, we must start now to rebuild what we have neglected, to repay where we have borrowed, and to invest again in our future and our children's future.

WATER RESOURCES INFRASTRUCTURE REVIEW*

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This paper reviews the three reports forming the basis for the U.S. National Council on Public Works Improvement water resources infrastructure related findings. It also reviews the soon to be published proceedings of a NATO Advanced Research workshop on Urban Water Infrastructure. The purpose of the review is to provide a consolidated background for future consideration of Water Resources Infrastructure needs. It was prepared for the 1990 ASCE Fort Worth Water Resources Infrastructure Symposium and has been reprinted here with minor modifications with ASCE consent.

The U.S. National Council on Public Works Improvement was created in 1984 to assess the state of the U.S. infrastructure. The Council was to specifically analyze: age and condition changes, methods of finance, trends in financing methods, maintenance needs, and expenditures needed for improvement. Water resources is one of nine infrastructure categories examined by the Council. The categories are: streets, roads, highways and bridges, airports, mass transit, solid waste facilities, hazardous waste facilities, intermodal transit and three categories of water infrastructure: waste-water treatment, water supply, and water resources. Waste water and water supply were separated from the rest of water resources primarily because of differing financing and regulatory considerations for infrastructure in these categories. The water resources infrastructure category reviews navigation, flood control, urban drainage, dam safety, navigation, flood control, urban drainage, dam safety, irrigation, agricultural drainage, erosion, hydropower, recreation, and fish and wildlife needs.

The water resources category received not only the highest grade for the three water categories, but the highest of all infrastructure categories examined by the council. Still physical and financial

water resources needs exist for both new works and improved management of old works. New works with Federal participation are likely to be smaller in number and size. A primary concern is also to develop and improve forums for intergovernmental planning, financing and coordination, including technology transfer. Improving user pay and beneficiary identification practices is a basic theme along with increasing the efficiency of existing projects. Specific functional areas meriting special concern are: urban stormwater management, exacerbated by pending stormwater quality discharge regulations; safety of non-Federal dams, levees, and floodwalls, due to current under-investment and institutional fragmentation; and shore line erosion, an emerging problem which is also related to climate change. Water supply system needs are dominated by evolving requirements to meet new safe drinking water standards. With regard to water supply, small water supply systems are a particular problem with 86.5 % of maximum contaminant level violations occurring in these systems. Capital costs for facilities to meet standards are disproportionately higher in these systems and ability to successfully operate less certain. It appears questionable as to whether the same level of operational efficiency achieved in large systems can ever be expected of small systems, leading to further questions of the economic wisdom of capital investment policies based on the same standards. With regard to wastewater, the massive U.S. water quality program has been a success in that overall the nation's waters have not deteriorated over the past two decades despite increasing population, and in many instances, a marked improvement exists. More improvement is needed but, currently wastewater systems improvements are marked by declining economic efficiencies. From 1978 to 1986, the total value of wastewater facilities rose 25 % to \$138 billion, while the volume of treated effluent increased only

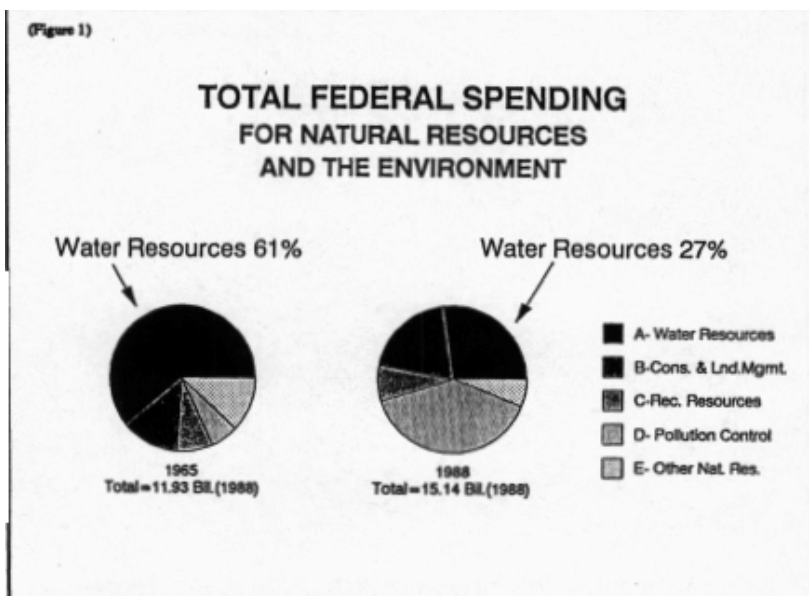
6 %. Yet, one-third of all plants are not now being operated to meet existing standards. The non-Federal responsibility for funding improvements to meet standards will be increasing in the future due to reduced Federal funding. This is expected to increase pressure for more cost efficient design and operation.

Capital spending for all levels of government for public works has remained roughly the same in constant dollars from 1960 through 1985 and is equally split between non-Federal and Federal levels of government. However, spending for operations and maintenance has tripled in the same time period with most of the increased cost borne by non-Federal levels of government. At the same time, the relative share of all government spending for public works has declined from about 20 % in 1950 to less than 7 % in 1984. Other priorities for spending have also shifted slightly, probably reflecting increased environmental sensitivity and regulation. The water resources share of Federal spending for natural resources and the environment has declined from 61 % in 1965 to 27 % in 1988 (see Figure 1), offset predominantly by increases in spending for conservation and pollution control. Much of the pollution control emphasis has been directed to wastewater management mandated by P.L. 92-500 with non-Federal financial emphasis

also shifting accordingly.

In summary, the water resources category was judged by the Council to have met past and current needs more successfully than other infrastructure categories. However, the study still recommends both development and management improvements focusing on improving inter-governmental coordination, financing, and user pay issues as well as several functional areas of special concern. The wastewater and water supply studies also identified both new development and management needs, but received slightly lower ratings by the Council. Recommendations in these categories identify improved financial management and full cost pricing, regional and integrated water quality/quantity planning and management, more flexible regulation recognizing cost, and research and technology transfer improvements to varying degrees as common themes.

An over-riding common theme to U.S. water related infrastructure concerns reflected in the Council's report is cost and efficiency. The report recommendations reflect the two different models which have dominated past implementation practice: regulatory with fixed standards for wastewater and water supply environmental concerns, and benefit-cost for most other aspects of water resources. The regulatory approach has been most strenuously applied only within the last two decades, reflecting the importance of non-monetary environmental concerns. Increased spending has accompanied this shift in emphasis and significant environmental gains have been achieved. Recent evidence of decreasing cost effectiveness, however, is probably the principal reason the Council scored wastewater and water supply infrastructure categories slightly lower than other water resources functions. The benefit-cost model applied to most other aspects of water resources probably contributed heavily to a higher score. Given the high future costs forecast for wastewater and water supply cate-



gories, the inability to operate to meet standards in some systems and the lack of ability to adjust standards for appropriate site specific conditions, some pressure to achieve future savings through a more flexible approach incorporating benefit-cost analysis might be expected in the future. Overall, more explicit management attention might also be expected for improving the operation of existing systems and developing complementary institutional cost efficiency decision-making structures.

The NATO Advanced Research Workshop was organized under a NATO grant to enhance scientific cooperation made as a result of an application through the Urban Water Resources Research Council of the American Society of Civil Engineers. The Water Research Center in the United Kingdom cosponsored the workshop, and managed the on-site arrangements.

The proceedings represent the contributions of thirty-five participants selected for their personal expertise from sixteen countries.

The areas of broadest consensus for follow-up policy research emerging from workshop deliberations are:

- + Improved asset management and capital budgeting processes;
- + Demand management and water conservation practice along with user pay and pricing principles;
- + Comparative analysis of regulatory and cost efficiency processes and appropriate methodologies for the conduct of national assessments.

Improved asset management and capital budgeting discussion indicated that future work might include: reasons that public systems often

experience more short-falls than private systems, priority setting and value for money, need for systems approaches, problems of small systems, worker/organizational effectiveness, and need for performance or level of service standards.

Similarly, demand management, conservation, user pay and pricing future work might include, among other issues: effects of cost sharing and subsidies, best practice techniques, response to the “green” movement, demand modeling, improved beneficiary identification, and institutional arrangements to assess costs.

With regard to comparing regulatory and cost efficiency processes and conducting national assessments, discussion would indicate inclusion of: benefit evaluation and presentation; comparison of differing regulatory approaches; centralized versus decentralized approaches; cross referencing air, land, and water standards to reflect costs; scientific and health risk confirmation for standards; operating standards and benefits; approaches; and international training and exchange programs.

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** The opinions expressed are the abstracted result of the author's review of selected works and do not represent those of the U.S. Army Corps of Engineers.

MEETING TOMORROW'S ENVIRONMENTAL INFRASTRUCTURE CHALLENGE

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Introduction

In 1988 the National Council on Public Works Improvement completed its two-year mission of analysis and review for the President and the Congress. The Council's final report, Fragile Foundations,¹ was a call to arms for renewed public and private attention to public works —before it is too late. Not surprisingly, the Council found that our environmental and transportation systems are “barely adequate,” even for today's needs. Unless we change course dramatically —and soon — our public works will be “insufficient to meet the demands of future economic growth.”

Overall, the nation earned a grade of “C minus” for public works — hardly something the world's largest industrial power can be proud of. Hazardous waste management facilities earned only a “D” — the lowest grade of all, while water supply reached as high as a “B minus” and water resources received the highest grade of all, a “B.” Wastewater and solid waste received a “C” and a “C minus” respectively. Most tangibly, the Council called for at least a doubling of spending on capital improvements — \$50 billion more a year for starters. About half of that increase would be for highways.

Public works are an everyday necessity. They get us to and from work, provide a cool drink of water on a hot day, allow us a wide range of recreational options, and get raw materials to factories and finished products to market. Environmental projects, in particular, have another

important goal— they impact the quality of the environment in which we live as well as our health and the health of ecosystems.

The importance of public works, however, goes beyond these factors. Public works build economic productivity and productivity generates economic wealth. For example, studies conducted by Dr. David Aschauer of the Federal Reserve Bank of Chicago show a direct link between the decline in public investment and the decline in total productivity. Indeed, he has shown that more than one-half of the nation's drop in economic productivity can be traced to the drop in public investment.² The most significant single factor in the recent decline in U.S. productivity has been the drop in public works investment. In other words, building better roads, treatment plants, and Water purification systems is not pork barrel. They are the bones and muscle that allow the rest of the economy to prosper.

This paper provides a review of public works spending, with a focus on the need for funding of environmental programs through the year 2000 and beyond. One conclusion is clear: additional funding of environmental programs is necessary to maintain the current level of environmental quality. Further improvements will require still more resources. To meet this challenge, innovative financing techniques will be required. Additional funding from traditional mechanisms, such as taxes and user fees, will also be necessary.

¹ *Fragile Foundations: A Report on America's Public Works*, National Council on Public Works Improvement, February 1988.

² *Public *Investment* and Productivity Growth in the Group of seven," in *Economic Perspectives*, David Aschauer, Federal Reserve Bank of Chicago, September/October, 1989.

Aschauer's definition of public investment is somewhat loose, than public works, and includes housing and schools, but public works accounts for uses than 70 percent of the total made he uses the two interchangeably.

Public Works Spending: Past and Future

For the past twenty years, the U.S. has steadily devoted less and less of our resources to public infrastructure. From 3.7 % of our gross national product in the early 1960s, public works accounts for only 2.6 % of GNP today.

Furthermore, while routine maintenance has kept pace with the economy, capital spending has dropped almost out of sight — from 2.4 % of GNP in the early 1960s to 1.2 percent today. Capital builds new facilities, but it also restores existing stock, thus when capital drops, so does the quality of our baseline public works. When these numbers are adjusted for depreciation, we have been investing less than 0.5% of our GNP for some fifteen years. Of the developed world, only Great Britain comes close to this dismal record. Net of depreciation, Japan devotes four to six percent of its GNP in public investment. Even with more than one trillion dollars of net investment in public works, how long can we live off the past?

Environmental programs, a major component of public infrastructure spending, have fared better than average over the past twenty years. While investment in our transportation future nearly stopped in the 1960s and early 1970s, environmental investments did not level off until the 1980s. Currently, annual expenditures on environmental programs at the federal, state, and local level are approximately \$40 billion,³ divided among the major environmental programs as follows:

- + Water quality (including wastewater treatment) —40 %;
- + Drinking water —35 %;
- + Solid waste — 14 %;
- + Air quality —3 %;
- + Other programs —2 %.

A number of factors will affect the level of future spending on environmental programs and who will foot the bill. Three trends stand out.

Future Costs Will Significantly Exceed Current Spending Levels

In 1987 state, local, and federal government together spent \$40 billion for environmental protection, compared to \$31 billion a year a decade earlier. If recent trends continue, it will be necessary to increase spending by nearly 40 % to over \$55 billion per year by the year 2000 simply to maintain 1987 levels of environmental quality. In addition to the funds required to maintain 1987 levels of environmental quality, we estimate that \$5.3 billion a year is the amount of local government spending needed to comply with twenty-two new environmental regulations by the year 2000.

Together, these gaps represent a difference of nearly \$21 billion between what government spent in 1987 and what we expect them to spend in 2000 for environmental protection. In other words, a 50 % increase in environmental spending is needed over the next ten years to comply with current regulations.

The gap could narrow if we are more efficient in meeting environmental goals. However, these estimates are conservative, since they do not include the costs to EPA and the states of many new regulations under development, the costs associated with the future congressional mandates (such as the forthcoming reauthorization of the Clean Air Act), and the growing number of new state and local environmental mandates.

The Local Share of Public Environmental Spending Will Increase

Local spending is projected to increase significantly by the turn of the century. In 1981 local spending was about \$26 billion, or 76 % of the government share of environmental costs. By the year 2000, localities will need to spend over \$48 billion to maintain 1987 levels of environmental quality and will bear 87 % of government costs for environmental protection. Adding in the \$5.3

³ AU dollar figures in this paper are expressed as 1988 dollars unless otherwise trend.

billion a year in expenditures to meet new regulations increases the local share to nearly 90 %.

Although little is known about future state outlays for environmental programs, trends identified in a recent EPA study suggest that by the year 2000, states will need to spend more than twice the amount spent in 1987 to administer water programs.⁴ State administrative costs could triple by 2000 if the air and solid waste programs impose similar demands.

These increases are attributable to three factors. First, state and local spending is increasing due to the phasing-out of EPA grants to build wastewater treatment plants. Second, the cost of providing a base level of environmental protection to a growing population obviously increases as the population increases. But beyond these factors, real-dollar outlays for environmental protection have outpaced inflation in response to demands by the American public for cleaner waters, safer drinking water, and more responsible handling of municipal garbage. For example, the average real dollar cost per person of operating the nation's wastewater treatment plants has more than doubled from \$15.80 in 1960 to \$37.20 in 1984.

Household Costs in Small Communities Will Increase Dramatically

Costs to households of environmental regulations are measured by increased user charges, increased general taxes, and/or reduced levels of services in other municipal programs. There are also indirect costs, such as when private industries pass their share of environmental costs to households in the form of price increases for goods and services.

The annual real cost of environmental programs for the average household is expected to increase by 54 % from \$419 in 1987 to \$647 in 2000. Over the same period, however, household costs for small cities are expected to increase more dramatically. In cities with fewer than five hundred

people they will more than double, from \$670 in 1987 to \$1,580 in 2000. The financial impact of environmental costs on households can be examined by measuring costs as a percentage of household income. The results show a significant impact on households in small cities (less than five hundred population), for whom expenditures are expected to increase from 2.8 % to 5.6 % of household income between the years 1987 and 2000. On average, impacts are much less for households in all other city size categories, with projected increases from about one-half percentage point to 1.8 % of household income by the year 2000.

Where do We Look for Solutions?

Demand for environmental services coupled with tight fiscal resources has spawned two innovations: public-private partnerships and state revolving loan funds. We also suggest a third approach — state chartered solid waste facilities corporations. Each has a potentially large role to play in environmental finance in the future.

Public and Private Partnerships

As communities across the country have faced the high costs of building environmental projects and reduced availability of federal funds, a search has begun for alternative approaches to project construction and finance. Some communities have found that cooperation between the public and private sectors has facilitated completion of needed environmental projects. These public-private partnerships are defined as any arrangement in which responsibility is shared for at least one stage of the project: proposal, selection, financing, design, construction, ownership, or operation. Benefits from public-private partnerships can include reduced project costs, faster project completion, guaranteed performance, and possibly, assistance with project financing.

Public-private partnerships can achieve cost savings over projects built under some govern-

⁴ *State Funding Study, Details of State Needs, Funding Gap*, U.S. Environmental Protection Agency (August 8, 1958). Trends in the State Funding Study were extended from 1995 to 2000 in order to provide consistent data for this report.

ment programs. A realistic expectation for cost savings from public-private partnerships developed after the Tax Reform Act of 1986 is 10 to 15 %, with 20 % savings an upper bound in most cases. Few of the public-private partnerships built since 1986 have included cash equity in any of the wastewater facilities constructed, due to the removal of tax credits and accelerated depreciation from the tax laws. Nevertheless, some projects are under way which were initiated after the 1986 tax reform. These projects customarily include construction of a facility by a private firm for a fixed price coupled with a cash-backed plant operation agreement for up to twenty years. Typically, financing is provided by the public agency and environmental performance is guaranteed by the private partner.

Three examples of public-private partnership projects initiated after the 1986 changes in the tax law are wastewater facilities built in Mount Vernon, Illinois; Edgewater, New Jersey; and Clinton, Kentucky⁵. In Edgewater, New Jersey, a 6-MOD secondary plant has been completed for \$9.9 million. The original budget was expected to be \$16 million if constructed under the guidelines for the EPA Construction Grants Program. By using a public-private partnership, the plant was completed sooner and at the same price as if a State Revolving Fund loan had been used. In Mount Vernon, Illinois, a secondary plant was built for \$3 million less than the lowest cost public construction alternative. The plant was completed less than a year after the contract was signed with a construction firm. It is meeting BOD and effluent requirements by wide margins. The State of Kentucky has a wastewater privatization law which was used successfully by the community of Clinton, Kentucky to build a 3000 gallon per day wastewater treatment facility. The facility cost was 30 % less than an EPA grant plant would have cost.

State Revolving Loan Funds

Another place to look is the State Revolving Loan Fund program, established under Title VI of the 1987 amendments to the federal Clean Water Act. The SRF, as it is known these days, receives federal grants and matches them twenty cents on the dollar. These funds are then repackaged as loans to communities at interest rates that range from 4 to 8 percent. As loan payments come in, they are re-lent to fund new projects, and so the fund revolves — in perpetuity barring defaults. Some states' SRFs are designed to leverage the initial capitalization by borrowing against the grants and a portion of the anticipated loan payments. Such schemes can increase funding velocity by a factor of 2 or even 3. By using SRF funds to guarantee or ensure local debt, funding velocity can be increased by a factor of 10 over straight grants-in, loans-out arrangements.

Why not expand this concept to fund more types of local public works? Infrastructure banks are not a new idea. Texas has had one since 1957 and Ohio since 1968. Louisiana's is three years old. An expanded infrastructure bank would not be a free lunch — but it would be a very cost-effective lunch.

Solid Waste Facilities Corporations

State-supported solid waste partnerships with private vendors through a solid waste facilities corporation represents a third solution. These new state-chartered entities could be responsible for promoting the development of integrated solid waste management facilities across the state, in locations and sizes that suit natural demographic service areas.

Facilities would be designed to accept garbage from a wide area (countywide systems are probably inefficient in most areas), separate the feedstocks, recycle materials as the markets allow, incinerate residuals, and generate steam or elec-

⁵ future examples of public-private partnerships for water, wastewater, and solid waste can be found in *public-private partnership Case studies Profiles of Successes in providing Environmental Services*, prepared by Apogee Research, U.S. EPA. September. 1989.

tricity as by-products. Revenues would accrue from tipping fees, the sale of recovered materials and/or products, and the sale of steam or electricity. Secondary products such as recycled plastic products, paper, glass, or rubber could be produced in co-located plants, financed and leased in the same manner as the waste management facilities. Such a complex might take the form of a solid waste industrial park. To add revenue to the transaction, facilities might consider accepting municipal wastewater sludge to mix with refuse for composting. The final product could be sold as a soil conditioner.

The state would be responsible for providing the land for such facilities and financing the capital plant. Private vendors would be responsible for designing individual unit processes, operating them, and guaranteeing performance. Individual communities would commit to long-term contracts (as allowable under some state privatization statutes) to deliver their refuse of a certain mix and in a certain quantity. As a condition of entering into such a contract, each community would have to develop a source reduction and separation program with measurable milestones that would be approved by the state (many communities are already well on their way toward such a program).

States have several options to finance such facilities. The most obvious is revenue bonds secured by franchise fees pledged by private operators (ultimately secured by tipping fees paid by households and businesses in participating communities). A second option is lease-purchase financing. A third option is a pooled financing for the participating communities.

Perhaps a more innovative alternative is to sell units of capacity to waste-hauling firms, whose livelihood depends on adequate disposal capacity. In exchange for cash, haulers would receive the right to future capacity in the integrated waste

management, facility once built. Such rights would be marketable during the useful life of the facility in a market that the state would operate. Presumably, such rights would increase in value as available disposal capacity grew scarce (as it would if only a limited number of adequately sized facilities were constructed).

Conclusion

To maintain environmental quality and meet recently enacted regulations, environmental spending must increase by 50% in real dollars over the next ten years. This will be a challenge to all levels of government. Environmental programs will face keen competition for funds with other important programs. In this day and age in which everyone in Washington and in many states and localities live in fear of the “T” word, it may appear that funding for these environmental programs would be nearly impossible to come by. Recent evidence suggests, however, that the public may be more supportive of such expenditures than we think.

The public, as the everyday customer of our water systems and our highways is more aware of the problems our political leaders have been avoiding. Last year some 349 bond referendums were approved, totaling some \$14 billion in new public investment, much of it for public works.

This is more than twice the total approved in the two previous years. This is good news indeed, because even with assistance from innovative programs such as public-private partnerships and revolving loan funds, additional money must be raised. Money must be raised to pay for plants built through public-private partnerships. Money must be raised to repay loans from state revolving loan funds. Money must be raised for a wide variety of environmental programs if this nation is to maintain and improve the level of environmental quality we demand.

INFRASTRUCTURE AND THE ECONOMY

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Introduction

Often, we hear claims that we face an infrastructure “crisis” in the United States. Such warnings usually arise when a dramatic failing of our infrastructure occurs, such as a bridge collapsing, a dam bursting, or medical waste washing up on our coastline. Lately, the buzzword has been “congestion” on our streets and highways, due to an apparently inadequate transportation network. In light of such concern about our infrastructure needs, in my recent research I have focused on the importance of our infrastructure for our ability to produce, for our growth prospects, and for our international competitiveness. This article summarizes some of the results of this research. Specifically, I address the following three questions:

- + Is there a strong and robust link between investment in our nation’s infrastructure and growth in productive efficiency?
- + Does public nonmilitary capital accumulation lift corporate profits?
- + Does public capital investment raise the national (private plus public) investment rate?

Infrastructure and Productive Efficiency

Since 1982, the United States has staged a truly remarkable economic performance. An expansion of output well into its seventh year, the longest in any peacetime period in American history; an addition of 21 million jobs, an average of 3.1 million a year; a fall in the unemployment rate from 10.8% of the labor force to 5.1%; an inflation rate seemingly under control and minute in com-

parison with the double-digit rates of price increase that exploded during the 1970s—all are signs of a vital, growing economy.

Still, troubling clouds have been gathering on the economic horizon. For instance, the rate of growth of total factor productivity has fallen from 1.8% per year during the 1960s to .8% in the 1970s and .7% in the early 1980s (1.2% in 1986). The reasons for the productivity slump are many and varied. One reason, of course, was the series of oil shocks beginning in late 1973; an increase in the price of oil renders the capital stock partially obsolete and less productive. Another reason was the cessation of the shift in the labor force from relatively inefficient farm occupations to relatively efficient urban occupations. Finally, after peaking in the 1960s, research and development spending began to fall in the 1970s, thereby diminishing the pace of improvement of the associated technological change. It should be noted, however, that even after taking account of all the usual sources of the productivity decline, a large portion—roughly 1% per year—is left unexplained; hence the “productivity puzzle” much lamented by economists.

Further, labor productivity growth has been very low in the United States relative to other countries in the Group of Seven; while productivity growth has been a dismal .6% per year in the United States, it has been an impressive 2.9% in West Germany and 3.1% in Japan. This inferior productivity performance is at the heart of our “competitiveness” problem and associated chronic deficits in international trade. A country in which the growth in production per capita slips below growth in consumption per person must finance the excess consumption either by reducing physi-

cal investment (and thereby future consumption) or by importing the goods from overseas. To a large extent, the United States has followed the latter course, evidenced by 1987 trade deficits with Western Europe of \$26 billion and with Japan of \$56 billion. In the words of Harvard economist Robert Reich, “~o]ur nation’s growing economic problem.. .is due neither to the federal budget deficit per se, nor to foreigner’s unwillingness to treat us fairly. It is due to our overwhelming failure to invest in our collective productivity, and the consequent decline in our capacity to add value to the world economy.”

Economists and policymakers who are concerned with declining private sector productivity typically focus on the role of private investment in plant and equipment. The standard argument is that increases in the quantity and quality of private capital goods generate more output per worker. The potential importance of nonmilitary public capital—a general public infrastructure—is ignored. This neglect is troublesome for two reasons. First, the nonmilitary public capital stock (combined federal, state and local) is sizeable, varying from between 44% and 59% of the private nonresidential fixed capital stock. Hence, to ignore the influence of public capital on private production appears unjustifiable. Second, the ratio of public to private “productive” capital stocks peaked at end of year 1964. While private investment spending as a share of gross output has declined during the last two decades, nonmilitary public investment spending has declined even more, from 3.4% of GNP during the 1960s to 2.0% during the early 1980s. Thus, the slide in public capital accumulation may be partly responsible for the slump in private sector productivity.

In a series of published papers (see References), I have found strong and robust empirical evidence to substantiate the claim that a shift in government spending priorities away from public investment and into public consumption has resulted in a deterioration in the flow of public services and consequently in an erosion of productivity growth. Indeed, the growth rate of the

nonmilitary public capital stock is highly correlated with the growth rate of (total factor) productivity in the United States over the post-World War II period. My detailed statistical work indicates that a “core” infrastructure (streets and highways, mass transit, airports, water and sewer systems, and electrical and gas facilities) bears the strongest correlation with productivity. Quantitatively, as much as 60 percent of the productivity slump in the United States can be attributed to neglect of our core infrastructure.

We would also expect that countries which sustain a high level of public investment relative to output would experience higher productivity growth than countries that do not invest in infrastructure. Confirmation is not difficult to find; Japan has invested about 5.1% of output in public facilities and achieved productivity growth of 3.1% per annum, while the United States has had a low public investment ratio of .3% and inferior productivity growth of .6% per year.

Thus, a root cause of the decline in the competitive position of the United States in the international economy may be found in the low rate at which our country has chosen to add to its stock of highways, port facilities, airports, and other facilities which aid in the production and distribution of goods and services. In the words of Nancy Rutledge, past Executive Director of the National Council on Public Works Improvement, “~i]f we spend too little on public works...society loses more than the direct public cost. In the long run, our ability to compete in the international economy will be weakened, and our standard of living will suffer.”

Public Infrastructure and Private Profits

I hope to have shown that an adequate and well-maintained infrastructure is of critical importance to the process of productivity improvement. The public capital stock makes private labor more efficient and should make private capital more profitable. The 1950s and 1960s were characterized by a rising share of output devoted to public

investment and a payoff in the form of climbing profits to the nonfinancial corporate sector, the 1970s and early 1980s, on the other hand, have shown falling public investment shares and profitability. Quantitatively, my statistical results suggest that a one percentage point increase in the nonmilitary public capital stock (16 billion dollars in 1985) is estimated to result in a rise in the corporate profit rate of 10 basis points (1/10 of one percentage point). Consistent with these results, in 1985 and 1986 we have seen a modest increase in public investment as well as in corporate profitability.

Public and National Investment

Public capital has been shown to be essential to private sector productivity and profitability. I adhere to the recommendation of the National Council on Public Works Improvement that the United States should boost its spending on infrastructure facilities to some \$90 or \$100 billion a year.

However, in an economy already operating at or near its capacity limits, we would need to know where the resources for the higher level of public investment would come from. Would raising public investment merely result in a displacement of private investment, so that national investment would be left unaffected? There are a number of reasons to suspect that such a “crowding out” of private investment spending might arise. To the extent that publicly provided capital serves as a substitute for private capital in private sector production, firms require less private capital to produce the same level of output. In addition, higher public sector demand in the capital goods market raises capital goods prices, thereby lowering the demand for investment goods by the private sector. Finally, the increased government demand creates a general scarcity of resources, a rise in inflation-adjusted interest rates, and a further contraction of capital spending.

But we have seen that a higher public capital stock also raises the profitability of private

capital and, thereby, lifts stock market values. This improves the incentives and increases the ability of firms to accumulate capital, thereby “crowding in” private investment expenditure. New highways allow faster transportation of goods from factory to market; the availability of mass transit allows firm to hire good workers at reasonable wages.

What, then, would have been the net effect on the national investment rate if we had raised the public investment rate during the 1970s and 1980s to the level maintained during the 1950s and 1960s? Based on my statistical model, if we had maintained this higher level of nonmilitary public investment during the 1970s and 1980s, the rate of return to private capital would not have fallen as it actually did and, in 1986, would have been equal to 10.8% instead of its historical value of 7.7%. There would have been no “falling rate of profit” in the United States for economists—let alone stockholders—to worry about.

The immediate response of private investment would have been negative as a result of higher capital goods prices and interest rates, and national investment would be left mostly unaffected. However, by the end of 1974 the positive influence on the profitability of private capital would have come to dominate, and national investment would have been higher. By 1986, national net nonresidential investment would have equalled 5.3% of the private capital stock as opposed to its actual value of 2.2%. Clearly, the government can exert a positive influence on the course of national investment and, in so doing, on our rate of economic growth as well.

Conclusion

Large public sector deficits of recent years have brought attention to the overall scale of government activity in the economy. Some argue that the government should spend less, and others that it should tax more. Both of these responses to the problems posed by the federal budget deficit contain merit.

However, the evidence presented here suggests that more attention should be paid to the composition of the government's expenditure, particularly to the effects various spending patterns may have on the macroeconomy's profitability and productivity. While total government spending mounts, investment in public works slides. Indeed, the share of total government outlays dedicated to public investment declined from nearly 9% in 1965 to a mere 6% in 1985. By reorienting our public spending priorities so as to upgrade and expand the public capital stock, we can be confident we will heighten the productivity of our work force and improve our position in the increasingly competitive international marketplace.

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