A COMMISSION REPORT

FINANCING PUBLIC PHYSICAL INFRASTRUCTURE

ADVISORY COMMISSION ON INTERGOVERNMENTAL RELATIONS
Washington, D.C. • June 1984

A-96

Advisory Commission on Intergovernmental Relations

June 14, 1983

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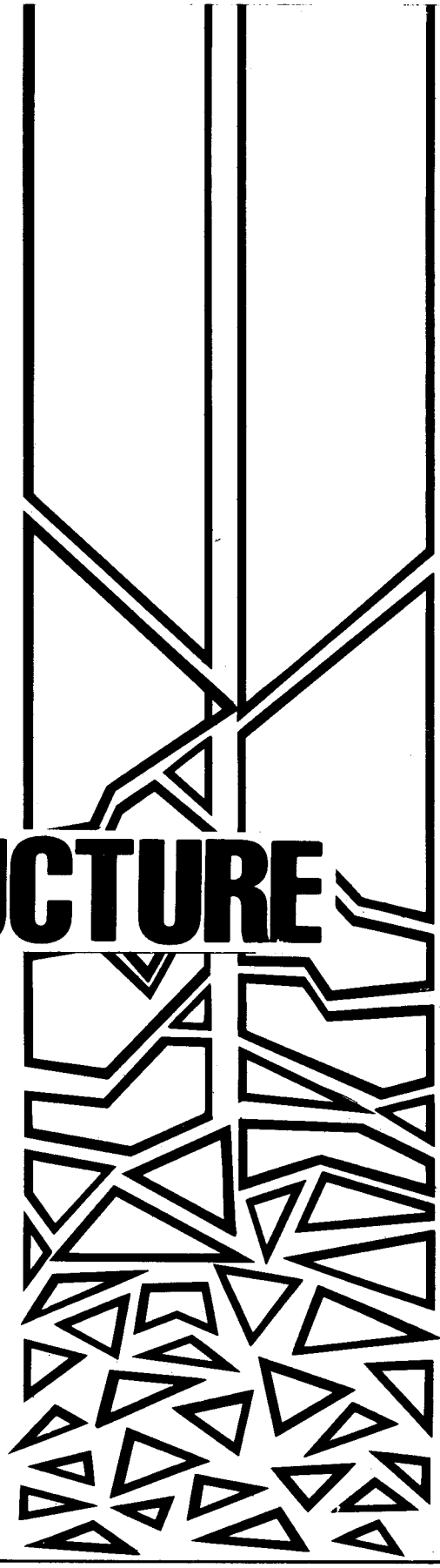

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Preface

In March 1983, the Advisory Commission on Intergovernmental Relations asked its staff to study the intergovernmental aspects of financing public physical infrastructure, drawing heavily on the recent work of other analysts and organizations. The staff reported back to the Commission in December 1983, at which time the Commission adopted the findings contained in the first section of this report.

This report examines:

- The post-war trends (for example changes in the location and age distribution of the American population) that both give rise to concerns about physical infrastructure and influence solutions to demonstrated problems.
- Concerns about the rate of new physical infrastructure investment and about the condition of the existing physical infrastructure, as well as its economic role.
- The remedial forces currently at work that are helping to solve physical infrastructure problems.

The Commission has concluded that the problems of public physical infrastructure differ sharply from place to place and from facility type to facility type. Some of the most serious problems are currently being remedied through efforts by each level of government, using existing financing mechanisms. Current efforts by state and local governments can, however, be assisted by better coordinating actions among different governments, by balancing capital and maintenance needs against each other in federal aid programs, by allowing flexibility in such aid programs' construction standards, and by emphasizing infrastructure-related research and development.

If, though, problems with the physical infrastructure continue to plague the intergovernmental system then the Commission in all likelihood will be required to look at this issue again, this time from a more systemic point of view, rather than emphasizing financing mechanisms alone. A systemic viewpoint would examine the structuring of relationships between states and their localities, possibly suggesting how such state-local relationships can be restructured to overcome problems of infrastructure disinvestment.

Robert B. Hawkins, Jr.
Chairman

Acknowledgments

This report was written by Mark David Menchik, senior analyst, with the assistance of Emmeline Rocha. Karen Kirkwood, Harolyn Nathan, Ruth Phillips and Arlene Preston provided secretarial assistance, along with Cassandra Baldwin.

In this work, the Commission and its staff have benefited from the help of many individuals and organizations. Special gratitude is owed to the participants at the "critics' session" where the draft report and alternative recommendations were discussed before consideration by the Commission. Full responsibility for the content and accuracy of this report rests, of course, with the Commission and its staff.

S. Kenneth Howard
Executive Director

John Shannon
Assistant Director
Taxation and Finance

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Summary of Major Findings and Conclusions

Warnings about the nation's crumbling infrastructure have become commonplace. There have been inventories of infrastructure condition, dollar estimates for new construction and previously deferred maintenance, and suggestions for new mechanisms to finance the physical infrastructure. Taking an intergovernmental perspective, this report concentrates on matters of financing.

The last decade has witnessed reductions in new physical infrastructure investment from the historically high level of the late 1960s. Because the work of the major postwar investment programs has been substantially accomplished, the current level of new investment appears low, but only in comparison with previous levels. The work of building schools, streets, and water and sewer lines for an expanding and mobile population has largely been completed, along with much of the Interstate Highway System, many public transit systems and wastewater treatment facilities. These national investments are long-lived; consequently the total, depreciated value of the nation's capital stock has stayed virtually constant through the last eight years, despite the slowing of new investment.

Much attention has been devoted to infrastructure deterioration, caused by overuse or, alternatively, by inadequate or deferred maintenance. Specific cases of deteriorated facilities have been dramatic—even tragic—such as the collapse of an interstate highway bridge in Connecticut or a broken water line in New

York City's garment district, but these cases do not necessarily establish the existence of a problem that is nationwide in scope and nationally uniform in severity. In fact, although most analysts have found important instances of deferred maintenance, they disagree about the amount of funds needed to reverse that condition.

Whether funds are devoted to maintenance or to new construction, the demands for physical infrastructure spending vary sharply from community to community, depending on the condition of existing facilities, the requirements imposed by the local mix of population and economic activity, and recent economic or population growth, to name only a few circumstances. Citizen preferences as to how to spend the local tax dollar are important, too.

Some parts of the country are harder hit by physical infrastructure problems than others, particularly older cities in the northeast and midwest. These cities, moreover, may be least able to afford new construction or costly maintenance. However, there are many old facilities that have been kept in good working condition through conscientious maintenance. Lack of maintenance is more likely to cause deterioration than age alone.

The public's safety is an important governmental concern and despite national attention and federal funding, some bridges are still unsafe. Additionally, the Congressional Budget Office has indicated that the unchecked deterioration of individual wastewater treatment plants threatens national standards. Although the safety concerns in these two functional areas seem to be the most serious of those that have been extensively studied, public officials should continue to monitor carefully and repair the facilities within their jurisdiction. Such conscientious attention can help prevent dam breaks and the collapse of bridges and roadways.

The ability of state-local governments to finance improvements is also affected by circumstances beyond their control. For example, the default on some of the bonds issued by the Washington (State) Public Power Supply System has hurt the municipal bond market for all borrowers. The federal budget deficit is also important. When the national government borrows to finance its deficit, it competes with states and localities in the capital market, exerting an upward pressure on interest rates. The key infrastructure role played by federal grants to states and localities is yet another indication that infrastructure finance is a matter of intergovernmental concern.

It can be politically important to estimate the cost of needed physical infrastructure work; such figures provide a stimulus to action. Even so, the notion that public policy should simply derive from meeting estimated needs can be misleading, even risky, if wrongly used. Identifying and estimating needs may start the governmental budgeting process that sets fiscal priorities, but they cannot by themselves dictate the outcome of that process. Few needs are so paramount that they should be met regardless of cost. As the budget process sets priorities, reconciling fiscal resources and service demands, standards of need are often reconsidered. User charges—not solely an alternative financing mechanism—can help planning and budgeting, establishing a useful feedback between a facility's financing, on the one hand, and what its patrons consider its use to be worth, on the other.

The problems encountered in financing our public physical infrastructure are both real and difficult. But the very large and scary costs of physical infrastructure "needs" that originally sustained the "crisis" designation should not paralyze responses to these problems. Some of those cost estimates would require state-local tax increases of about 40%, increases which are constitutionally or legally impossible in many states and politically impossible in all. Given its own fiscal problems, the national government is not currently likely to bestow much additional grant support. Fortunately, a far more optimistic conclusion comes from a survey conducted by the National League of Cities and the U.S. Conference of Mayors: "... a steady investment over a number of years could, and would enable communities to start work on the capital assets ranked as highest priorities by the respondents. There is no short-term, inexpensive or easy solution to America's infrastructure problems. But there can be a solution and it can be managed."

FINDINGS

1. The Commission finds that although

some of the nation's public physical infrastructure is suffering serious problems, most infrastructure problems are manageable with existing financing mechanisms. Coordinated federal, state and local action, however, is required in many instances to make existing programs more efficient in physical infrastructure renewal.

Applying a variety of financing mechanisms, many of the governments responsible for public physical infrastructure are now acting to repair, modernize and augment existing facilities, as judged appropriate in particular circumstances. Enhanced intergovernmental coordination (specifically suggested below) can aid in these actions, mitigating costly and burdensome intergovernmental requirements and avoiding efforts that are at cross purposes.

2. The Commission finds that, spurred by governmental and citizen awareness of the problems, policymakers at all levels of government are taking corrective action to address many physical infrastructure concerns.

For example:

- The federal *Surface Transportation Assistance Act of 1982* has begun to pump an estimated $6 billion per year into the federal-aid highway system and into public transit. The Bridge Replacement and Reconstruction Program has devoted about $900 million per year to eliminating bridge deficiencies. As a consequence of these and other actions, federal infrastructure spending has increased from $19 billion in fiscal year (FY) 1982 to $25 billion in FY 83.
- Recovery from the recession and austerity in continuing spending obligations are now brightening the state-local fiscal picture in many places. Spurred by the availability of funds, there has very recently been a sharp increase in the award of construction contracts.
- Since the beginning of 1981, 34 states have increased motor fuel taxes; 19 in 1983 alone. With few exceptions, the increased revenues are earmarked to transportation. On November 8, 1983, the nation's voters approved 89% of the bond issues put before them, the highest approval rate in the last quarter century. Notably, New Yorkers approved a $1.25 billion state bond issue for constructing and maintaining roads and bridges. This success in raising tax and bond revenues shows citizens awareness of some serious physical infrastructure problems and also augurs well for the effectiveness of officials acting to resolve those problems.

3. The Commission finds that Congress can improve existing federal programs by balancing both capital and maintenance needs against each other, by allowing flexibility in required construction standards, and by emphasizing research and development to stretch the infrastructure dollar further.

Through intergovernmental grants, Washington plays a leading role in financing facilities such as major highways and public transit. Such grants typically support a far larger share of construction costs than the costs of operation and maintenance—when the latter costs are shared at all—causing a bias toward new construction (perhaps in excess of true demand) and against maintaining existing capital stock. At the same time, unnecessarily rigid and uniform national construction standards inflate costs. Inappropriate national standards also forego opportunities for tailoring projects to community circumstances and desires, potentially stiffling innovation. Congressional support of infrastructure research and development can, however, lead to greater efficiency, by taking advantage of recent technological advances and by applying these advances to physical infrastructure concerns.

4. The Commission* finds that, given the pressure to reduce massive federal deficits, it is unlikely that the federal government will soon be able to provide states and localities with additional large-scale aid programs for capital facilities. At least for the next few

Dissent of Representatives Frank and Weiss, Senator Sasser, Governor Matheson, and Assemblyman Passannante:

To the extent that Point 4 can be read as suggesting that there be no increase in federal funds for state and local infrastructure, we disagree. We do agree that the reordering of the priorities of federal spending could release additional funds for aid to state and local infrastructure projects without in any way increasing the deficit.

years, most additional funds will have to come from state-local tax sources, user charges and bond financing.

State-local governments' spending and borrowing from their own sources demonstrates not only that physical infrastructure problems are being treated seriously but that steps are being taken to resolve these problems. To the extent, however, that major increases in federal revenues, cutbacks in national responsibilities, and reallocations of national spending priorities are all unlikely in the short term, Washington will not soon be in a position to make large increases in its infrastructure spending.

Deficit reduction will have to come first on the federal fiscal agenda. Approaching $200 billion, the size of the current federal budget deficit is underscored by the fact that it is about $25 billion larger than the 1983 tax collections of all state governments combined. It is necessary to go back to World War II to find another year when the federal budget deficit was greater than total state tax collections. Moreover, the annual interest now paid to holders of the $1.3 trillion debt exceeds by a wide margin the total amount of federal aid payments flowing to all state and local governments.

Part I

Forces and Issues

INTRODUCTION

Recent times have been tumultuous ones for the nation's public physical infrastructure. The country has seen the tragic collapse of a Connecticut highway bridge and the bursting of a New York City water main, which caused a power outage. Units Four and Five of the Washington (State) Public Power Supply System defaulted on their bond obligations. Totalling $2.3 billion, this municipal bond default may have been the biggest in American history, and imperils the financing of other projects. But 1983 also marked the 100th anniversary of the Brooklyn Bridge. A marvel of engineering and public finance when first built, the bridge has helped New York City grow, is in generally good condition today, and is still a vital transport link. This piece of our physical infrastructure remains a source of pride; perhaps the same care can be devoted to other facilities.

Overview

This report takes a second look at infrastructure concerns. It concentrates on financing public physical infrastructure, including streets, highways, bridges, water systems, sewers, roads, airports, jails and other public buildings and facilities.[1] The first part sets the stage by outlining the forces now influencing infrastructure finance and evaluating the problems that, many believe, have been caused by past neglect of public facilities. The second part of this report emphasizes suggested solutions to infrastructure concerns.

Foundations of Infrastructure Concerns

Four recent trends have seemingly conspired to cause difficulties and to heighten concern about the size, quality and economic significance of the nation's investments in public physical infrastructure. These trends are: (1) the nationwide tax revolt, leading to austerity at all levels of government; (2) the wearing down of many facilities built during the 1950s and early 1960s which may now require extensive repair, rebuilding or even replacement; (3) population movements and demographic changes, causing reduced demand for certain facilities (e.g., schools in many communities); and (4) major changes in the private market for tax-exempt capital.

Austerity in Government

California's Proposition 13 and current high federal budget deficits symbolize the pressures on budgets generally and the difficulty of increasing real spending for most domestic programs. Where then will the money come from to finance infrastructure revitalization? Austerity certainly is a fact of fiscal life, but it should not lead officials (or citizens) to believe that

spending choices cannot be made. The current tax revolt was preceded not just by growth in all spending categories, but by a shift away from brick-and-mortar infrastructure projects to human service and entitlement programs that are typically financed by current revenues, not borrowing. Indeed, on average, state and local governments are bearing lighter debt burdens than they did 20 years ago.

Even though governments still have fiscal choices to make, current pressures to hold the line on taxing and spending tend to make these choices more difficult. Faced with fiscal limits or a large deficit, few spending increases will find favor with the voters. Given this situation, concern about physical infrastructure problems can provide a necessary stimulus to action.

With constrained ability to increase taxes—not to mention debt limits—most state and local governments are restricted in issuing general obligation bonds. These constraints can lead to issuing revenue bonds or to "off-budget" and other concealed forms of borrowing that do not directly threaten the jurisdiction's credit rating or exceed limits on its outstanding debt.

In fact, however, the state-local fiscal situation is improving. Spending cuts and revenue increases have combined to change the net fiscal balance of many states and localities from negative to positive. As will be detailed below, citizens and officials have set their priorities, increased gas tax revenues are being earmarked to transportation, and construction contracts for all components of physical infrastructure are now being signed.

Aging of Postwar Facilities

Much of the Interstate Highway System is showing its age, as are other of the many facilities built in the 1950s and early 1960s. The extensive construction done then necessitates extensive repair or replacement now. The interstate roads had a 20-year design life, before major work was to be done to them. Many of these roads have already "aged" beyond their design life, without the planned work having been done. But while some roads are due for replacement, other links in the planned network have yet to be completed. As a consequence, federal funding for the maintenance of the existing system (limited as such funding is) competes with funds for the system's completion.

Although the problem of having many facilities age at once is of particular concern for the Interstate Highway System, it is not limited to these roads. A new generation of wastewater treatment plants, sometimes inadequately maintained and often overloaded by seepage into leaky sewer pipes, frequently needs attention.

The timing coincidences do have a bright side. They create a short-term problem that is remedied when facilities are repaired; they need not cause an indefinitely continuing concern if the repairs are made. The aging of so many facilities at once does suggest, however, that care and replacement of worn facilities potentially capable of meeting current demands may be a more pressing problem than expanding them. This situation also provides a special opportunity to apply infrastructure-related research and development work in the hope of obtaining more efficient strategies for maintenance and modernization.

Demand Change

The populations and workplaces that the facilities of the 50s were built to serve have themselves been shifting. People and jobs have moved from city to suburb, from large to small towns and into the countryside, and from the frostbelt to the sunbelt. This migration sharply increased demand for facilities in the communities that were net "destinations," but the facilities in the "origin" communities have remained in place, requiring at least minimal maintenance.

Some of the important changes in demand are aggregate reductions, however, not shifts within the nation. The school age population has shrunk from its baby boom high. Automobile travel has stopped its burgeoning growth. Reductions in aggregate demand, of course, remove pressures to expand the nation's physical infrastructure.[2]

Changes in The Tax-Exempt Capital Market

Although they are not pictured on magazine covers, certain changes in the market for tax-exempt capital may have had profound effects on infrastructure financing. Some of these

changes may, moreover, be cause for grave concern about future financing. The current borrowing practices rely on a healthy and efficient private market for government debt—perhaps the oldest form of public-private cooperation. Fortunately, public awareness of municipal bonds is now higher than might be expected, as shown by a recent survey of homeowners.[3] Most important, even if there are major changes in financing public infrastructure, it is likely that governments will continue to rely on the private debt market for at least some of their funds. Many of the new and old state-level "investment pools" and "development banks" operate as intermediaries between state-local governments and debt markets, rather than replacing the latter.

Tax-exempt interest rates have shot up. In 1970 they averaged 6.2%, rising to 11.3% by 1982. (Rates peaked in January 1982, at just over 13%.) Not only have these high interest rates greatly increased the cost of governmental borrowing, but, additionally, the gap between taxable and tax-exempt rates has narrowed, reducing the accustomed cost advantage of governmental borrowing in the tax-exempt market. In 1979 tax-exempt interest rates averaged 62% of taxable rates, but were fully 79% in 1982. Tax-exempt interest rates have been volatile too, causing postponements and cancellations of new bond issues.

While interest rates were heading upward, the volume of new issues (measured in constant dollars) skyrocketed, more than tripling in the last 25 years. The increased volume has increased the competition for loanable funds, bidding up interest rates. A second phenomenon has acted to narrow the gap between taxable and tax-exempt rates. Individuals generally buy municipal bonds only if the after-tax interest exceeds that from taxable bonds, which depends on the individuals' marginal tax rates. The *Economic Recovery Tax Act of 1981* has lowered marginal tax rates for most payers, forcing tax-exempt issuers to offer higher interest rates in order to be competitive. By the same token, to be able to sell the higher volumes, issuers must appeal to individuals in lower tax brackets who face lower marginal tax rates and who thus demand tax-exempt interest rates closer to taxable rates.

Much of the increased volume of tax-exempt borrowing has been devoted not to traditional public works (like bridges and sewers), but to arguably private purposes such as retail businesses (part of economic development projects) and residential mortgages. Possibly, such private-purpose bonds have been "crowding out" traditional infrastructure finance.

Creative financing mechanisms are another growing change in the market for tax-exempt debt. Zero-coupon municipal bonds (they pay no interest but are sold at a discount from face value), tax-exempt commercial paper (a flexible form of short-term finance), and letters of credit to guarantee repayment are but three of the mechanisms that have been employed, leading to the widespread use of once-esoteric forms of financing. For example, a 1983 survey of cities conducted by the National League of Cities (NLC) found that 6% of the cities using creative financing employed zero coupon and other deeply discounted bonds. Fully 21% of those cities issued tax-exempt commercial paper and 47% relied on letters of credit. Altogether, a third of all the cities surveyed used at least one creative financing technique.[4]

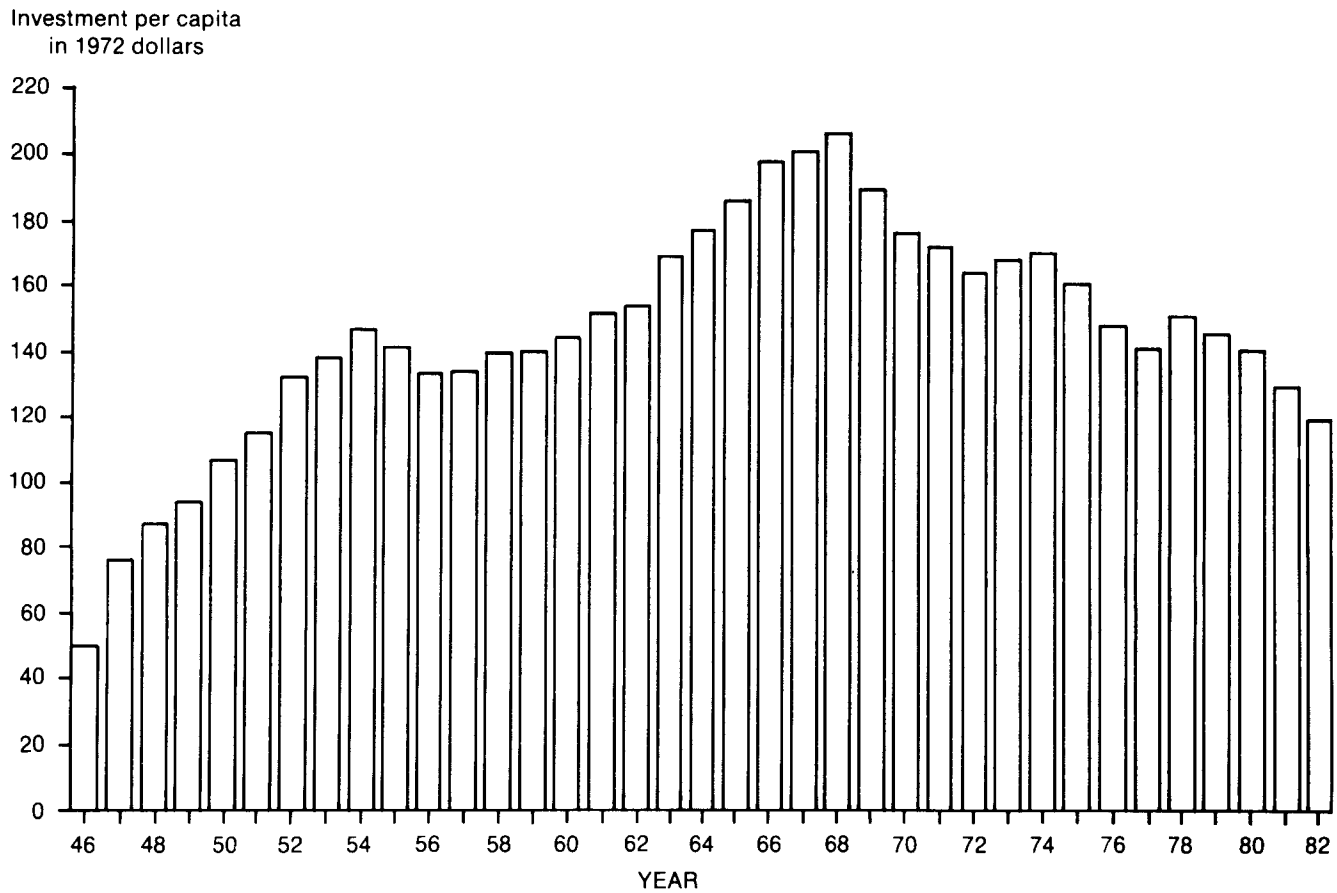
The most controversial forms of creative financing, however, are those based on ERTA. Using sale-leaseback arrangements and the like, governments—which pay no tax—can take advantage of corporate tax breaks. Sometimes these tax breaks have been applied to infrastructure financing, as when a government sells one of its buildings to a private owner but continues using the building under a leasehold. Of all the cities surveyed by NLC, 14% were engaged in sale-leaseback arrangements. A total of 36% used another form of tax-exempt lease.

Varieties of Problems with Physical Infrastructure

Any category of public spending that includes recreation centers and sewage treatment plants, superhighways and back alleys, and both water lines and trolley lines is certainly a diverse one. Because "public physical infrastructure" encompasses a wide range of facilities, infrastructure problems differ sharply by facility type. Infrastructure problems also differ geographically. Some jurisdictions have

Graph 1

NEW PUBLIC CAPITAL INVESTMENT, 1946 TO 1982



Note: The capital investment data exclude the costs of operation, suppliess, maintenance and routine short-term repairs—current, rather than capital spending—which are unavailable in a comparable time series. A year's capital spending includes new, additional and replacement infrastructure investment; unfortunately, we cannot separate these components.

SOURCE: ACIR staff computations, based on unpublished estimates from the U.S. Bureau of Economic Analysis (BEA), using the GNP implicit price deflator. Population figures were obtained from the U.S. Department of Commerce, Bureau of the Census, *Current Population Reports*, Series P-25, No. 939 and No. 802. Population estimates in all figures include armed forces overseas and Alaska and Hawaii for 1959 to 1982. Military infrastructure is excluded in all figures. Figures shown are for calendar years unless otherwise indicated.

trouble paying for snow clearance; others are beset by alligators in inland waterways. Infrastructure problems certainly differ between growing and declining areas. And, although virtually all governments are responsible for physical infrastructure, their exact responsibilities differ sharply, even within one level of government. We may make a fourfold division of infrastructure problems, as follows:

- Inadequate new construction, leading to too-small or overly distant facilities or causing users to rely on facilities that are outworn or otherwise inefficient. In some cases a facility judged valuable may be missing altogether, such as a community lacking sewage treatment. To address one aspect of this concern, we will take an aggregate look, examining the national rate of new infrastructure investment. Postponed until Part II is a discussion of the published "needs" and "standards" that have appeared in the debate on infrastructure.
- Deferred or otherwise inadequate maintenance of the existing capital stock, in some cases threatening public safety.

Probably more common are instances where neglect has increased a facility's lifetime cost, that is, where postponed maintenance costs more in the long run. Inadequate maintenance can reduce user benefits, too. Potholes not only make driving slower and less comfortable, they increase the private cost of vehicle repair.

- Physical infrastructure inadequate to serve economic needs, perhaps hurting the competitiveness of the nation as a whole; perhaps weakening the economy of particular areas.
- Problems with financing. Such problems can postpone or even prevent new construction or repairs. They force hard choices to be made between infrastructure and other important objects of public spending.

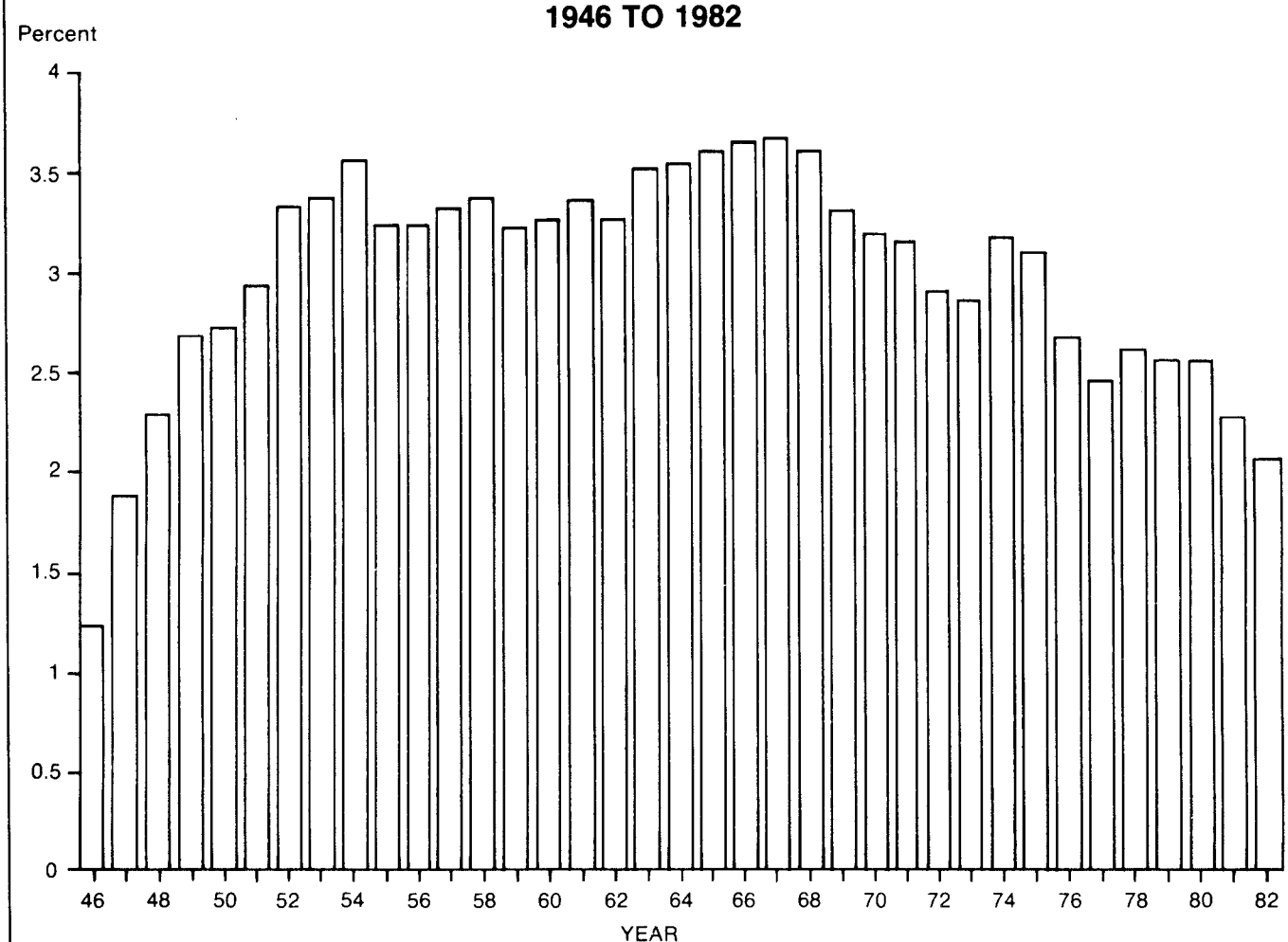
Evidence on the first three topics is presented below while that on financing alternatives appears in *Part II*.

EVALUATING THE NATIONAL CUTBACK IN INFRASTRUCTURE INVESTMENT

Graph 1 presents nationwide estimates of

Graph 2

NEW PUBLIC CAPITAL INVESTMENT AS A PERCENT OF GNP, 1946 TO 1982



SOURCE: ACIR staff computations, based on unpublished BEA estimates. GNP figures from U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, April 1983 for the year 1982, the October 1982 issue for 1950 to 1981 and December 1980. Table 7 for 1946 to 1949.

Table 1

GROWTH RATES OF STATE-LOCAL CAPITAL OUTLAYS BY FUNCTIONAL CATEGORY, 1950–82

(in constant 1972 dollars)

	Five Year Averages						Annual		
	1950–54	55–59	60–64	65–69	70–74	75–79	79–80	80–81	81–82
Structures[1]	8.4%	4.7%	6.4%	2.9%	−1.4%	−5.1%	−0.5%	−10.0%	−6.7%
Education Buildings	12.3	−0.9	6.7	3.0	−1.9	−11.0	5.4	−23.1	−15.8
Hospitals	−7.5	3.9	0.7	9.0	2.2	−13.2	−4.5	4.1	−12.0
Other Buildings	4.3	2.3	6.0	13.6	6.1	−6.8	9.9	−9.1	−7.8
Highways	10.6	6.7	5.0	0.3	−6.5	−7.6	1.1	−1.2	5.3
Conservation and Development	0.0	6.1	17.4	−0.7	−10.3	−4.8	9.8	0.0	−1.2
Sewers	5.6	7.8	8.2	0.0	12.3	2.2	−9.3	−22.2	−13.7
Water Supply	6.0	−2.4	11.8	−1.2	−3.6	0.1	20.5	−14.7	−7.8
Equipment	7.6	−8.1	7.5	13.3	7.6	−3.2	−7.3	−2.3	−3.3
ALL STRUCTURES AND EQUIPMENT	8.3%	3.6%	6.4%	4.0%	0.0%	−4.8%	0.9%	−8.7%	−5.8%

[1]Including structures not separately classified.

SOURCE: Computed from unpublished Bureau of Economic Affairs data.

new investment in fixed, government-owned capital facilities from 1946 to 1982, after controlling for inflation and population changes. Capital investment (comprising purchases and construction of structures and fixed equipment) is the most visible public spending for physical infrastructure. The data on capital investment exclude, however, the costs of operations, supplies, maintenance and routine short-term repairs—current, rather than capital spending—which are not available in a comparable time series. By and large, a year's capital spending includes both new and additional infrastructure investment and replacing an existing structure or piece of equipment; unfortunately, we cannot separate these components.[5]

After World War II, domestic capital investment rose rapidly. Measured in 1972 dollars, spending per person next rose from $106 in 1950 to a 1968 high of $207. Thereafter the rate of capital investment generally declined.

Expressing capital spending as a percentage of the gross national product (GNP) provides a fuller historical context. (See *Graph 2*.) From 1952 to 1967, the growth in real capital spending was stimulated by a growing economy, so its percentage of GNP stayed about level. In other words, for fifteen years increases in real spending simply kept pace with growth in the economy. By the end of the 1970s, however, capital spending accounted for a smaller share of GNP.

Looking at capital spending from this historical perspective, two summary observations emerge. First of all, real capital investment (per capita) has indeed decreased from its 1968 peak. Second, capital investment seems to have been deferred by shortages immediately after World War II but rose sharply in the 1950s and 1960s with the building of schools for baby-boom pupils, the Interstate Highway System and many new or expanded airports. The early and mid 1970s saw the growth of water and sewer projects. Shortly thereafter public attention (and public funds) seemed to shift away from "brick-and-mortar" projects into human service and entitlement programs.

The relatively smooth paths of *Graphs 1 and 2* are not duplicated if one examines individual state-local infrastructure functions. *Table 1* is limited to facilities owned by states and localities (often partly paid for by federal grants) and is not computed per capita (because it compares different functions), but it does correct for inflation to provide historical patterns. Most important, it presents not the levels of

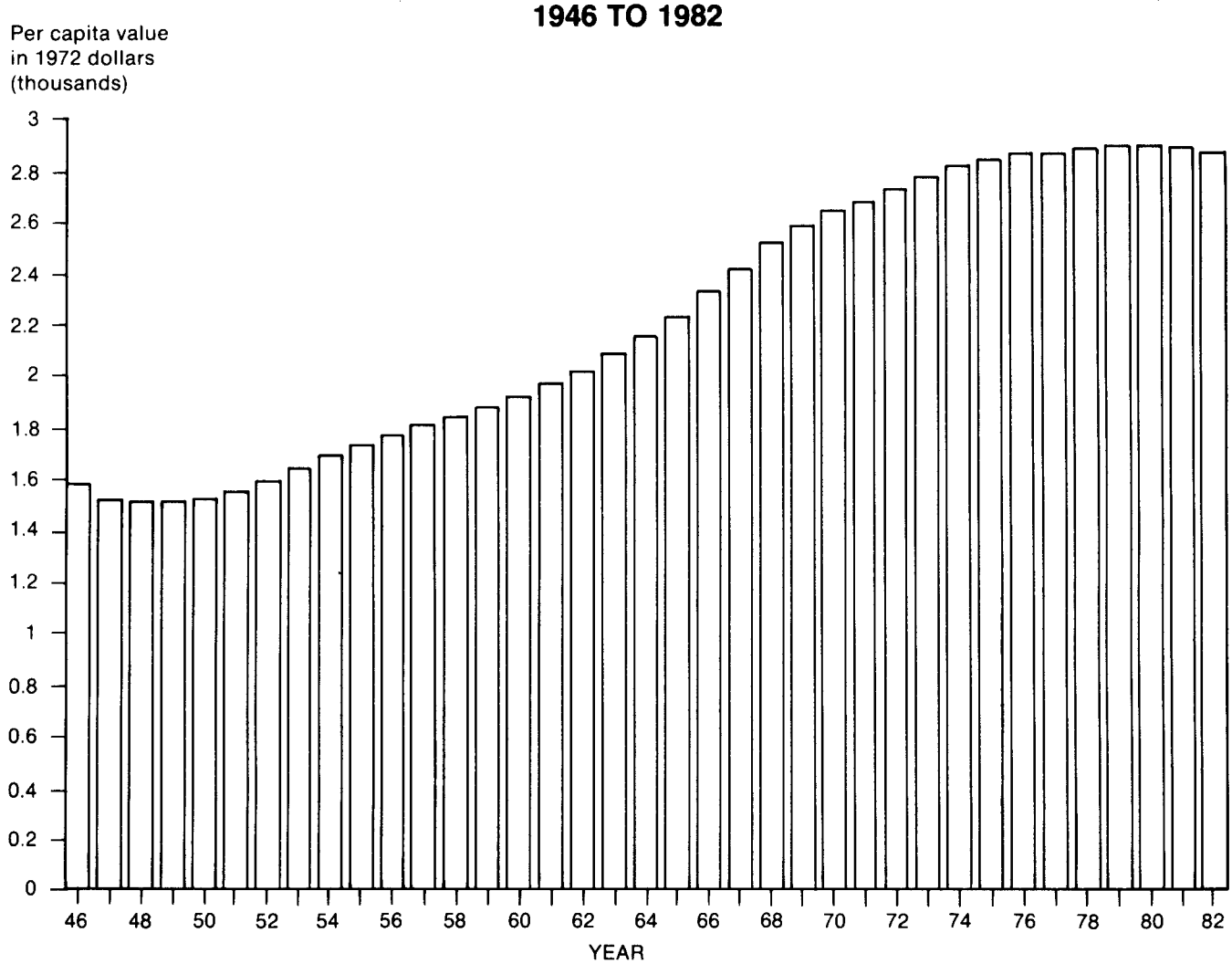
capital outlays in each year but annual percentage changes in those outlays. *Table 1* shows that, of all functions, new investment in educational buildings grew the fastest from 1950 to 1954. Throughout the 1950s, highway outlays grew quickly. After 1970, however, the rate of new investment generally decreased for these two functions. Conservation projects expanded quickly in the early 1960s as did water supply systems. The greatest rate of expansion in sewer investment occurred during the early 1970s, stimulated by federal water-quality mandates and federal grants for wastewater treatment projects.[6]

Fluctuations in infrastructure investment are explained not just by trends in public concerns and government programs, but by the durability of new investments. Physical infrastructure is long lived. Except when it replaces an existing facility, each year's gross investment adds to the total capital stock.

The nation built new schoolhouses to educate the baby-boom children but, once built, there was no need to continue construction at the same rate. Similarly, once in place, wastewater treatment plants have a long operating life—there is relatively little subsequent need for reinvestment. The Congressional

Graph 3

TOTAL DEPRECIATED VALUE OF THE NATION'S PUBLIC CAPITAL STOCK, 1946 TO 1982



[1]Including structures not separately classified.
SOURCE: Computed from unpublished Bureau of Economic Analysis data.

Budget Office emphasizes the advantages of maintaining important links in the Interstate Highway System. At the same time, they estimate that of all the uncompleted but planned links in that system, fully 70% of new construction costs would go to projects judged not of national significance.[7] Alternatively, federal funds might better go into maintaining existing high-priority links.

That capital investments are long lived and thus cumulative, is shown by the value of total national capital stock. The total capital stock at any moment is estimated to be the sum of past new investments, depreciated by time and wear. (The rate of depreciation is naturally influenced by levels of use and maintenance; the latter will be discussed shortly.) Of course the value of the total capital stock, net of depreciation, can never be known exactly, but the BEA estimates in *Graph 3* are instructive. They disclose that the value of the public capital stock is far more stable than the new investment shown in *Graphs 1 and 2*. There is growth, especially in the 1950s and 1960s, and stability in the late 1970s and early 1980s, as annual investment just about kept pace with annual depreciation. Since its historical high in 1979, however, the capital stock has declined by only 0.8% through 1982. In the last eight years the nation's capital stock has not expanded, but neither is there evidence of significant contraction.

Summary

Different national patterns of physical infrastructure investment are apparent. Adding together all infrastructure functions, the rate of new investment generally increased from the 1950s to the mid-60s, declining thereafter. Individual infrastructure functions, however, have displayed very different patterns. New investment in school buildings was highest during the 50s to accommodate baby-boom pupils. The fastest buildup of water supply investment, on the other hand, occurred in the early 60s; for sewer facilities, the construction peak was during the early 1970s. The overall decline in the rate of new investment is therefore associated with the completion of major types of new facilities. Although requiring maintenance, these facilities are long lived. Consequently the total, depreciated value of the nation's capital stock has been remarkably constant during the past decade, despite slower addition of new facilities. No nationwide analysis, however, can pinpoint localized deficiencies in physical infrastructure investment which, unhappily, may particularly occur in the same communities whose existing facilities are in poor condition. We now turn, therefore, to problems of maintenance and condition, including the geographic aspects of such problems.

EVALUATING PROBLEMS OF DEFERRED MAINTENANCE AND POOR CONDITION

During their lives, infrastructure facilities must be operated and maintained. Unfortunately, we have no aggregate dollar figures on operation and maintenance outlays. (It is difficult, for example, to separate school janitors' salaries from school teachers', though only the former maintain the physical infrastructure of education.) But most observers agree with the Congressional Budget Office which finds

> The most pervasive problem affecting the nation's infrastructure is physical deterioration resulting in mounting needs for repair, rehabilitation and replacement. Many components of infrastructure systems show the effects of aging, and some are approaching the end of the "design lives" planned by their engineers and builders. Aging problems are compounded by the cumulative effects of inadequate maintenance and repair.[8]

The CBO goes on to cite instances of specific problems: interstate highways having exceeded their "design lives;" certain locks on inland waterways that are 80 years old, having been designed for only 50 years of safe, efficient service; municipal water mains 100 years old that leak 40% of their contents; severely leaking or blocked sewer pipes; and unreliable wastewater treatment where there has been inadequate plant maintenance. The CBO also mentions that New York City's subway cars—both young and old—now break down, on the average, once for every 6,500 miles trav-

eled. Better maintained in 1971, the older subway cars used then broke down only every 24,000 miles. Where bridge pavement is poorly maintained, road salt leaks onto the bridge's steel structure, corroding it. The neglect of proper maintenance can be very costly, leading to higher repair bills in the long run. Such neglect can also waste facility users' time and money. On poorly maintained roads, automobile operating costs increase by almost a third. And in the worst cases, safety is threatened.[9]

Additional evidence of badly deferred maintenance appears in a careful survey conducted in 1979 by the Port Authority of New York and New Jersey. Examining various cities in the region they serve, it finds that, estimated from then-current data, Elizabeth, NJ, would replace the city's water lines every 300-400 years, instead of every 75 years, as judged necessary. Elizabeth was replacing its sewer lines at the rate of every 600-800 years, instead of every 100 years. And the city was rebuilding its streets not every 40 years, but on an estimated cycle of every 400-500 years. Of the four cities studied in detail, Elizabeth was the slowest in its sewer line and street work. But even the city—New York—whose sewer practices were closest to compliance with the standard was replacing its sewer lines on a cycle of every 250-300 years, not every 100 years.[10]

Which types of infrastructure are in the worst condition and most justify speedy renewal? The CBO, looking at federally aided public works in the nation as a whole, judged that work on the Interstate Highway System (both roads and bridges) had the highest priority. Problems with wastewater treatment facilities may threaten compliance with national standards for ambient water quality. And the CBO also emphasized replacing outmoded air traffic control facilities, though existing ones are still safe. The nation's airports themselves, federal water facilities (dams and navigation works), and public transit were judged matters of less pressing or widespread concern. There, the need to reverse past neglect, modernize facilities, or expand overburdened facilities was judged to be less immediate. CBO suggested that in many instances overburdened facilities were caused by unjustifiably low user charges pushing demand beyond reasonable levels.[11]

How widely are maintenance and related problem distributed through the urban physical infrastructure? Perhaps the best evidence is provided by the Urban Institute's careful studies of maintenance spending, its observations of facility conditions, and its reports on objective measurements of difficulties such as equipment breakdowns. Drawing on a just-published study of 62 cities, it found:

> ... condition ratings show two divergent patterns: (a) a concentration of structurally deficient bridges in the northeast and north central regions and in fiscally stressed, large and declining cities and (b) a concentration of functionally obsolescent bridges in the south and north central regions and in growing cities. ...
>
> Overall measures of condition for water and sewer systems have not been developed, but specific indicators ... suggest that *cities most vulnerable to problems are doing the least to correct them.* ... cities with the highest proportion of combined sewers and backup rates also cleaned the smallest proportions of pipeline annually.

The authors go on to establish some generalizations:

> Cities in the northeast, for example, have higher rates of unaccounted-for water, have a greater number of deficient bridges, and appear to have deferred the largest amount of street maintenance. Cities in the south and west have capital needs more associated with growth, such as narrow bridges and roads that are inadequate to meet increased traffic levels and water and sewer systems that need expansion.
>
> The data sometimes contradict the common perception that the infrastructure repair backlog for all facilities is concentrated in the northeast and midwest and in older cities. Rates of water distribution pipeline breaks and sewer collection system breaks, for example, are highest in the younger and growing cities of the south and west. *Age alone does not appear to be*

a good indicator of system condition, particularly for transit systems and water and sewer pipelines. The condition of today's facilities is importantly influenced by local maintenance practices, as well as local soil conditions, intensity of system usage, original construction methods and other factors. The use of a simple proxy, such as the age of a city or the age of the capital systems themselves, fails to capture many of the most important variations in the actual condition of capital.

Cities that are losing population (and hence use of capital facilities) do not show a measureable decrease in infrastructure problems. If anything, *fiscally stressed cities that need to support an infrastructure system with shrinking tax bases exhibit more problems in the physical condition of their facilities.*[12] [Emphasis added].

A prior Urban Institute study of 28 cities also found conditions varying sharply from place to place. The older cities of the northeast, midwest, and southeast tended to have the oldest facilities in the worst condition. However, inadequate maintenance, not age, was found to be the direct cause of most failures in wastewater treatment plants. The new and modern plant in San Jose, CA, had the second highest failure rate of all those studied.[13]

A very different form of study corroborates the Urban Institute's finding that physical infrastructure conditions differ from city to city, and from function to function. Analyzing a questionnaire survey of 809 mayors and city managers, the National League of Cities and the U.S. Conference of Mayors concluded that "Cities' infrastructure needs vary widely. ... there are significant differences among the respondents in terms of priorities and in terms of the condition of specific types of public facilities. This strongly supports the view that any national effort in this area should rely primarily on local planning and local priorities, within broad national purposes."[14]

Fixed potholes notwithstanding, routine preventive maintenance causes little short-term improvement in a facility's appearance or performance. Maintenance can be costly and its beneficial effects are often hidden underground. Financially strapped governments may therefore skimp on maintenance to support functions that are more immediately pressing, like human service programs. Public libraries have their support groups, but where are the "Friends of the Sewers"?

Washington's intergovernmental infrastructure financing programs may contribute to maintenance difficulties, implicitly and indirectly, but no less definitely. One observer points out that

> Federal programs in support of capital outlays have probably ... had an effect [on deferred maintenance]. In areas such as highway construction and waste water treatment, the federal government assumes a large share of capital outlay costs and no share of maintenance. By lowering the relative price of construction, federal aid tends to make it more attractive compared with maintenance. In addition, by diverting state funds used for match, new construction assistance has reduced the state income available for maintenance and other nonaided functions."[15]

For example, federal mass transit aid pays 80% of the cost of new buses (but was reduced recently to 75%), providing little incentive to keep old buses in repair. Of the $12.7 billion per year currently spent in the Federal-Aid Highway Program, only $2.3 billion goes to "4R" work on the Interstate Highway System. (The "4Rs" are repair, resurfacing, restoration and reconstruction.) Reconstruction, which takes much of the funds, often means new construction of added lanes and interchanges, not the rebuilding of existing highway components.[16]

The lack of intergovernmental concern with operating and maintenance costs reflects a bias toward capital-intensive aid programs, i.e., new construction, rather than maintaining existing physical infrastructure. This bias can be explained perhaps by supposing that officials (and citizens) have an "edifice complex," but more specifically it seems likely that higher governments want to avoid operational involvement and continuing expenses. When recipient governments bear the operating costs,

they may be motivated to greater efficiency, it can be argued. For example, once the plant is built, wastewater treatment costs are strongly influenced by the condition of the sewer pipes, whose maintenance is a local responsibility. Throughout Wisconsin, the seepage into sewer pipes (caused by cracks and loose joints) accounted for 84% of the total flow, sharply increasing treatment costs.[17] Badly designed intergovernmental operating subsidies for wastewater treatment might conceivably encourage poor local maintenance of the sewer lines.

Another potential role for the national government is supporting additional research and development for improving the efficiency of physical infrastructure maintenance, operation and new construction. Only a few examples need be cited. As was mentioned, eroded bridge surfaces can leave the bridge structure unprotected, vulnerable to damaging corrosion. Can better and more cost-effective means for protecting bridge decks be developed? The chemicals used to control snow and ice contribute to bridge corrosion, as well as corroding the underbodies of both automobiles and road maintenance equipment. Can less corrosive chemicals be developed? More generally, research and development in robotics and in electronic controls might aid in more efficient maintenance techniques and in cheaper, more reliable ways to control the machinery of public buildings.

Summary

In many places, and for many functional categories, the physical infrastructure is aged, deteriorated or outdated—sometimes all three. Although some of the physical infrastructure in worst condition appears in the older cities of the northeast and midwest, age alone is not a good predictor of infrastructure deterioration. Good maintenance can keep old facilities in fine condition. By the same token, new facilities will quickly deteriorate if they are poorly maintained. Analysts should particularly distinguish unsafe facilities, on the one hand, from those that are aged, deteriorated, outmoded or congested. All these aspects of poor condition are disturbing but they have different consequences for the population and the economy, potentially leading to different spending priorities.

EVALUATING THE ECONOMIC ROLES PLAYED BY PHYSICAL INFRASTRUCTURE

Many observers have argued that a renewed and modernized public physical infrastructure is necessary for the nation's economic growth and world economic competitiveness. Roger J. Vaughan, for example, has said that "if we continue with past policies of papering over the widening cracks in our public works, then economic recovery will stumble over ill-paved roads and ruptured water mains."[18]

Pat Choate and Susan Walter give examples of how inadequate infrastructure can cripple a local economy. "As a rule of thumb, when a community wastewater treatment system is operating at 80% of capacity, that community will be unable to add additional industrial load. A Department of Commerce survey ... reports that ... 46% of ... [wastewater treatment] systems are operating at 80% of capacity or higher. When deficient transportation, publicly operated solid waste and toxic waste disposal sites, and other public facilities essential to private sector investment are also considered, at least one-half (and more likely two-thirds) of the nation's communities are unable to support modernized investment *until* major new investments are made in their basic facilities that undergird the economy."[19]

Although these two views are widely held they have met with considerable skepticism. George E. Peterson and Mary John Miller opine:

> At present we know next to nothing about the use of public capital facilities by business firms of various industrial classifications. ... Until these basic pieces of the business-and-infrastructure puzzle are put together, we will be unable to go beyond unsupported (and often extreme) speculation about the role of capital in the next generation of industrial modernization.[20]

The controversy over infrastructure's economic role cannot easily be resolved but per-

haps it can be clarified by considering three key questions: (1) the difficulty of precisely determining infrastructure's role in the economy; (2) the economic roles that may be played, in general, by the condition of an area's physical infrastructure as well as specific linkages between particular facilities and an area's ability to attract and retain particular forms of economic activity; and (3) infrastructure's role in job creation.

Trying to Determine the Economic Roles

Business and employment location decisions are so complex and multifaceted that it is difficult to identify precisely how any one factor affects them. Many questionnaire studies have asked executives to rank the importance of various locational factors but answers to such hypothetical questions may not reliably reveal the actual tradeoffs made in reaching location decisions.[21] To avoid using questionnaires, other studies have analyzed data on changes in employment location.[22] The latter studies have not been definitive, either. It is statistically difficult to isolate the various components of locational choice, some of which (e.g., "business climate") are difficult to quantify. In general, U.S. employment is shifting from the Snowbelt to the Sunbelt and from many larger metropolitan areas to many small metropolitan and nonmetropolitan areas. The relative condition of the local physical infrastructure may well play a role in these shifts but other—perhaps more important—forces are certainly at work as well.

Aiding an Area's Economic Growth: General and Specific Roles

Although it cannot be proven incontrovertibly, an area that offers a well maintained, modern, and efficiently financed public physical infrastructure must certainly have a comparative locational advantage over a similar area not so favored.[23] Similarly, potholed streets, congested highways or airports, and backed-up sewers may only confirm the perception that a community is in economic decline. Whether correct or not, the perception of decline can prevent a community from attracting the very jobs it needs to insure its recovery. Renewal of the physical infrastructure can certainly play an important role in a community's economic renaissance.

The economic role of infrastructure also depends on specific establishments' needs for particular facilities. For example, many manufacturing plants use municipal facilities for wastewater treatment. If the municipal facility is operating at or above capacity, a new or expanded manufacturing plant may either have to treat its own effluent or locate elsewhere. Businesses relying on railroads or trucks often need good transportation links to the national network. Similarly, a modern port may attract both shipping and harbor-based jobs.

Clearly, infrastructure investment can protect and expand an area's comparative locational advantage. But, as with other investment decisions, there are difficult choices and important tradeoffs to be made. Will scarce tax dollars be spent better by filling potholes or by providing job training? In the long term will tax dollars spent on modernizing public capital facilities be justified by the hoped-for economic growth? Not only do spending preferences vary from community to community but it is difficult to choose which public investments will in time prove worthwhile.

Job Creation or Job Shifting?

Another widely discussed role that physical infrastructure may play in the economy is in job creation. Additional investment in physical infrastructure produces publicly provided jobs, a very "visible" addition to employment opportunities. "Job shifting" is, however, a more precise term for this process than job "creation." When public spending is increased to build infrastructure, those funds come from the pockets of the public, reducing the money remaining to be spent privately. Thus, more public spending (on physical infrastructure or anything else) means less private spending which means fewer jobs through the private sector. Consequently, additional investment in public physical infrastructure effectively shifts labor demand from supermarket checkers and bakers to construction workers and bus drivers, for example.[24] Moreover, because outlays for physical infrastructure are less labor intensive than

the economy as a whole (i.e., the former uses less labor relative to capital equipment), such job shifting may cause a net, nationwide reduction in labor demand, though one that is difficult to estimate precisely.

It is important to recognize, however, that job shifting can serve the objectives of public policy. Additional infrastructure investment increases total national investment, a widely supported goal. A state or national program of infrastructure renewal that is targeted on distressed urban areas can provide much-needed jobs there. Public spending for physical infrastructure stimulates demand for certain industries (and for their skilled workers) that have been hard hit in recent years, such as construction and steel. For example, the passage of the federal *Surface Transportation Act of 1982* caused several steel companies to consider the demands imposed by bridge reconstruction.[25]

Summary

Although the roles played by physical infrastructure in an area's economy have not been established with any precision, infrastructure renewal can certainly contribute to an area's economic renaissance. All else equal, outdated facilities in poor condition probably impede an area's efforts to attract new economic activity or even to retain existing jobs. Officials at all levels of government—and citizens, too—must continue to decide which infrastructure projects are effective in stimulating the local economy as well as cost-effective in doing so, considering alternative demands for public funds. Cost-effectiveness is a particularly important concern when tight budgets make infrastructure investment compete, say, with educational spending, which is investment in human capital.

In addition to its possible role in stimulating the private economy, investment in public physical infrastructure provides government-funded jobs by shifting funds from the private to the public sectors. Such shifting occurs when additional government revenues are collected for pay-as-you-go financing or, alternatively, when additional government revenues are collected for debt service. In either case the extra dollars collected for public physical infrastructure cannot be devoted to the private economy, whether for households or businesses. Properly done, job shifting can be a worthwhile public action, helping the nation by concentrating resources on certain critical areas and workers. However, because job shifting does not create "new jobs," hard choices must be made.

CONCLUDING COMMENTS

That many problems of the public physical infrastructure are both *specific* and *localized*, as we have seen, argues for solutions that need be neither national nor apply to all infrastructure facility types. Infrastructure renewal can assist economically lagging communities but may not be considered cost-effective everywhere. The physical infrastructure concerns of the 1950s—crowded schoolrooms and demand for the Interstate Highway System—have been replaced by leaky water pipes and the demand for proper maintenance of Interstate Highways. Many cities in the northeast, for example, are beset by structurally deficient bridges and potholed streets, while cities in the south and west have narrow bridges and inadequate water and sewer systems. Carefully designed, built and maintained, some old facilities are still in good condition, providing valuable service. On the other hand, poor maintenance or overuse can quickly degrade new investment, as shown by the new subways cars whose neglect causes them to break down more often than their older predecessors.

Part II

Where Do We Go From Here?

Having set the stage by reviewing and assessing evidence about concerns for the public physical infrastructure, various remedies will be discussed. First, we sketch out alternative financing mechanisms, many of which would greatly alter existing practices. Also worthy of consideration is how stated standards of need contribute to making choices in infrastructure investment. Arguing that need standards are only one basis for priority setting (which involves an assessment of both benefits and costs) we turn next to user charges, a financing mechanism that can automatically tie funding to users' benefits. User charges, moreover, can be fitted into current financing practices. Relying primarily on existing financing mechanisms, a wide variety of governments have recently been devoting more funds to physical infrastructure. Conclusions follow.

ALTERNATIVE FINANCING MECHANISMS

A truly major national program of infrastructure spending may require financing mechanisms sharply different from those currently used.[26] Although the new mechanisms differ widely among themselves, they (or others) could be employed if infrastructure problems cannot be solved otherwise. To cite a hypothetical example, the nation might choose to rely on a federal infrastructure bank (a revolving

loan fund) if the national private market for tax-exempt debt was deemed unable to provide either adequate funds for infrastructure loans, or loans at a low enough interest rate. We will simply list the most-discussed proposals, many of which are related to each other:

Federal

- A reborn "Reconstruction Finance Corporation," a kind of national development bank, has been proposed by Felix Rohatyn, the head of New York City's Municipal Assistance Corporation. It would provide subsidized loans nationwide.[27]
- A national capital budget to guide federal infrastructure spending, designed to make such outlays a more effective tool of national policy.[28] An inventory of existing and needed infrastructure might be made as a step in this process.
- A study sponsored by Congress's Joint Economic Committee has suggested reevaluating the construction standards applied to state-local participation in most federal programs of infrastructure aid. They point out that "... in some situations these standards appear unreasonable and unrelated to local needs," adding that "The historical development of these federal infrastructure standards, while in the health and safety interests of the nation, has been determined more by interested professional groups than by consumers." They conclude that "The bill for infrastructure development is high enough without having to pay for facilities which are designed to standards which may no longer be appropriate."[29]
- The Congressional Budget Office has discussed applying three strategies for federal public works spending:

  —increased reliance on user charges. These would, it is believed, not only provide an additional funding source but encourage fiscal discipline, helping to avoid low-priority projects. User charges, however, are criticized as disproportionately burdening the poor. This criticism is discussed shortly.

  —limiting the federal role by returning certain responsibilities to the states and (possibly) reducing the federal cost-sharing percentage in certain intergovernmental grant programs.

  —redirecting federal spending to mitigate the current bias toward capital spending, i.e., by making specific maintenance and operating costs eligible for federal support.[30] The study for the Joint Economic Committee addresses similar concerns.[31]

State and State-Local

- The proposal of Governor Michael Dukakis for a "Massachusetts Development Bank" (requiring an earmarked tax increase) would be largely independent of federal funds, but would offer certain centralized planning aids as well as subsidized financing for state physical infrastructure activities.[32]
- Governor Thomas Kean's proposal for a "New Jersey Infrastructure Bank" would establish a state-subsidized revolving loan fund, based in part on existing federal infrastructure grants, to be repaid as loans.[33]
- Without heavy direct subsidies, state governments might facilitate local physical infrastructure investment and maintenance by a variety of means:

  —Expanding the use of local government investment pools, now operating in several states. These pools serve as intermediaries between localities (generally small ones, issuing little debt) and the private capital market.[34]

  —Expanding the use of dedicated funds and single-purpose agencies. The latter, supporters claim, would more reliably and efficiently build and maintain physical infrastructure than would general-purpose governments using general tax revenues. These mechanisms might increase infrastructure spending and could possibly "shield" needed spending from political pressures.[35]

- One very general strategy, widely discussed, is decentralizing (from the federal level) both fiscal and administrative responsibilities for physical infrastructure construction and maintenance so that state governments pay a larger share of the costs and undertake more of the planning, management and administration of the facilities and systems.[36]

MEETING NEEDS OR SETTING PRIORITIES?

Well publicized estimates for the cost of restoring and modernizing the nation's public physical infrastructure have derived from determinations of unmet investment needs. Similarly, a determination of facility needs might well be part of one alternative financing mechanism: a national capital budget.

The Associated General Contractors of America, for example, has estimated that the nation needs to invest $3.03 trillion in its public physical infrastructure; another widely quoted figure is for $2.5 trillion.[37] Such large sums, along with reports of unsafe and deteriorated facilities, have done much to draw public attention to our physical infrastructure. Politically important as needs estimates are, though—they certainly can spur action—the notion that public policy should merely meet estimates of infrastructure needs can be misleading, even risky, if wrongly used.

Risking Paralysis of Action

The large needs that have been estimated may, paradoxically, have tended to paralyze the very corrective actions that the estimates were intended to spur. Thus, according to one observer:

> To meet the needs that have been documented in recent studies, state and local governments would have to increase taxes by about 40%. This would be constitutionally or legally impossible in many states, and politically impossible in all.[38]

More recent assessments have been less discouraging, however. In summarizing the results of their survey, the National League of Cities/U.S. Conference of Mayors strike an encouraging note, saying that "Infrastructure needs are great, but we need not be paralyzed by their magnitude."[39] That report also says the problems are manageable. The Congressional Budget Office and a study sponsored by Congress' Joint Economic Committee have each come up with figures that not only are smaller, but are closer to current spending levels. For example, the latter study estimates needed physical infrastructure spending to be $1,157 billion from 1983 to 2000, compared to $714 billion in projected "resources."[40]

Setting Priorities

Identifying and estimating needs may start the public and governmental budgetary processes that set fiscal priorities, but they cannot themselves dictate the outcome of these processes. Particularly at a time of austerity, budgeting reconciles competing needs, not just for infrastructure, but for education, human services and defense, to give only three examples.[41]

> Although needs gaps are usually thought to be filled by additional spending, they can be closed by reconsidering and reducing the needs standards that have given rise to the investment gap. This is not a matter of redefining infrastructure needs to make them disappear, but of recognizing that needs always exceed resources and that, with budgets as tight as they now are, priorities must be selected even within 'needs' categories.[42]

Finely detailed, carefully articulated, and properly used, need standards can inform the political and budgetary process of priority setting; in other words, the making of public choices. Standards of need can communicate past engineering experience and current practice; they can also communicate the choices made by other governments. Improperly used, however, need standards force governments, taxpayers and facility users into straitjacket uniformity. They can constrain choice to priorities set under the circumstances of other times and other places, which is particularly risky given the many localized responsibilities for physical infrastructure.

The key test is whether or not standards of need are being used simply as a *framework* for expressing public preference in order to set spending priorities. Failing that, need standards may be used to forestall public choice, improperly substituting for the tradeoffs essential to priority setting.

Standards for highway design are a case in point, highlighted by the 55 mile-per-hour speed limit. Roads built to that limit are naturally less expensive than those designed for higher speed limits. However a road designed (say) for cars traveling at 65 mph, but used at 55 mph—an "overengineered highway"—is safer than one designed for the lower speed. There is thus a choice between the improved safety of an expensively overengineered highway, on the one hand, and a less expensive road, on the other. The latter choice, although less safe in itself, can free up funds for safety improvements elsewhere. It is likely that different citizens and officials, working with different road systems, will choose various design levels for new highways. Serving solely as a framework or guideline, an "average" standard for road design can facilitate this process only if it does not substitute for the difficult tradeoffs to be made.

By relying on state-specific and locally compiled estimates of needs for infrastructure facilities, the study conducted for the Joint Economic Committee avoided rigid uniformity. Actual infrastructure funding decisions should continue to rely on well-functioning political and budgetary processes in states and localities. Doing this helps to articulate the preferences and resolve the tradeoffs involved in financing public physical infrastructure.

USER-CHARGE FINANCING

An alternative (or supplement) to financing through general tax revenues, user charges are an increasingly important means for physical infrastructure finance, as they are for financing other public services. In fiscal year (FY) 82, localities (the level of government most relying on user charges) derived 32.8% of all their own-sources from such charges, compared to 28.5% in FY 77. User charges potentially add to economic efficiency, linking financing to use. (As was just mentioned, it is important that the politics and budgeting for physical infrastructure express and integrate various preferences and priorities.)

Infrastructure user charges have been employed rather widely, having been levied for access to public facilities (e.g., golf courses, tennis courts and stadiums), for utility-like services (such as water, sewer and sanitation charges), for transportation-related services (such as parking, tolls and the like), and on a wide variety of other occasions such as for certain health and housing services.

However, user charges are not always practical and, even when they are, are not always judged desirable policy. For example user charges are frequently critized as being unfair to the poor. We will discuss many of the concerns pertinent both to user charges and other forms of "benefit-based" infrastructure financing.

Potential Advantages of User-Charge Financing

Applied well, user charges:

- Provide a means of fiscal discipline for both service providers (i.e., governments) and facility users. For the former, planning based on user charges can avoid unjustifiably expensive ("goldplated") design and operation. Unpriced facilities are not "free"—their use incurs cost to their operators and, ultimately, citizens. Particularly when facilities are congested, user charges encourage users to make more efficient, less costly use.
- Can encourage better maintenance, providing both the funds and the incentive for proper care of long-lived facilities.
- Offer more efficient allocation of public resources than financing through general taxes, via the "price signals" provided. These signals can improve public planning and budgeting choices, as well as governments' everyday decisions on both capital and operating spending.
- Provide widened choice. For example, charges are often imposed for facility use during congested times, but not otherwise. Compared to nonprice means of

allocating facilities, user charges allow the user to go at either time. If he uses the facility at peak hours, his fees can defray the cost of facilities large enough to handle peak-hour congestion.

FISCAL DISCIPLINE AND PRIORITY SETTING

When budgets are tight and citizens criticize public spending, officials should especially consider whether the cost of a new public investment is, in time, justified by the benefits the investment provides. User charges can help do that by serving a dual role: simultaneously indicating both the cost of facility use and the value the user places on his use of the facility. Referring to the latter role, if a potential user does not judge the use of a facility worthwhile—given the stated user charge and other personal spending choices—he will not use it. For that nonuser, the facility use is not worth its fee; for others who are users, it is worthwhile. Consequently the revenues collected (combining the number of users with the charge each pays) signal how highly the public values the facility. User-charge revenues are thus a clearcut indication of the benefits the facility provides and that its users are willing to pay for.

User charges are, in this way, forces for fiscal discipline. Applied to planning and budgeting, user charges can help avoid wasting money on unneeded, overly large, and overly expensive facilities whose costs are not justified by their user charge revenue and, in turn, by their worth to the public. At the same time such fees encourage disciplined facility use by individuals. Would-be users must decide to pay the charges. That discourages the unconsidered use of "free" facilities, use that may be costly to the facility operator but little valued by the heedless user.

Because they signal a facility's value to its clientele, user charges can contribute to setting priorities for public spending. Even when charges defray only part of a facility's cost they do indicate that the facility is being used by those who value it highly enough to make the payment.

ENCOURAGING BETTER MAINTENANCE

Imposing user charges on a facility may provide the revenues needed for its proper maintenance, and this may be true regardless of whether or not these funds are restricted to maintenance expenditures. That is because of the stated role of user charges as a "feedback mechanism," between financing and facility characteristics, notably including the level of maintenance. Few users will visit poorly maintained facilities, automatically cutting user charge receipts. Facility operators may then find that they have to reduce the level of user fees; because a deteriorated facility is worth less to a user, he or she will not pay as much for its use. If poor maintenance immediately and automatically reduces funding, facility operators are strongly encouraged to take good care of the capital investments they are responsible for.

EFFICIENT ALLOCATION

Many infrastructure facilities are congested, particularly at certain times. Instead of allocating users to different hours administratively (or setting up special requirements for peak hour patrons) establishing fees allows potential users to make their own choices. The facility must typically be built big enough to handle peak loads. "Smoothing out" use can prevent the need to add extra capacity, saving money in the long term. At the time, those who value the convenience (to them) of using the facility at peak times may consider the fee charged to be worthwhile, particularly if nonpeak patronage incurs a reduced fee or none at all. Individuals can decide for themselves when to use the facility, based on the cost of their use.

The cost of facility use varies with characteristics other than its timing. Take as an example the municipal provision of water and sewer lines to new construction. The cost of these hookups often varies extensively from place to place even within one jurisdiction, depending in part on the distance from existing lines. Why shouldn't those building in high cost locations be charged commensurately? With geographically uniform charges the alternative—an inferior one—is having those who build in low-cost locations effectively subsidizing those in high cost places.

WIDENED CHOICE

Not only can user charges allow the users

themselves to decide whether or not to use peak hours or high-cost locations, they can help finance a wider range of facilities (or facility types) than a government might otherwise choose to build. Particularly with tight budgets, it is always difficult for officials to justify building an expensive facility when there is a cheaper but lower-quality alternative. Similarly, how can scarce funds be devoted to facilities serving a very narrow group of users, when there are more widely felt needs to be met? User charge financing can help solve this perennial problem, not just by providing additional funds but by allowing the direct beneficiaries of an expensive or specialized facility to help pay for it, without burdening others.

General Considerations for Imposing User Charges

Just as with any financing mechanism, or any procedure that can "ration" the use of public facilities among citizens, particular applications of user charges should be carefully and specifically considered. Several of the most important considerations are discussed below.

IDENTIFYING AND CHARGING USERS

It is easy to identify the users of public water lines. They are those individuals and organizations who are hooked up to those lines, who can be charged according to their level of use. This is not the case with those who benefit from street lighting, a group that includes visitors to an area, not only residents and businesses there. In general, public services can be arranged on a continuum, ranging from services like water supply to those like street lighting. At the water supply end of the continuum, there are services for which individual users can be easily and inexpensively identified and charged, ideally in accordance with their use levels. Generally, services at this end of the continuum are such as to allow the easy exclusion of nonusers, consistent with not charging them. By the same token, it should be easy to estimate the additional costs incurred by both additional users and additional use, so that accurate fees can be levied.

At the other end of the continuum there are public services where it is impossible or impractical to identify or charge the user (or exclude the nonuser), much less to charge user fees according to the level of patronage. An extreme example is national defense, inescapably and uniformly provided to all citizens at the same "level," regardless of their preferences for the amount of military spending. Subnational public services toward this end of the continuum also include those, like education, with a public interest in individual service use. The benefits of an educated citizenry are considered to extend to the entire society, not just to the individuals involved. With many services, however, the judgment as to whether or not there is a public interest in service provision is a difficult one to make, and public choices may differ from community to community. One community may be so concerned about education as to devote considerable of its resources to schools and to fill the public libraries with not only books and magazines but records and videotapes. Another community may choose to devote its resources to infrastructure for economic development or, alternatively, to recreational facilities.

In practice, most public services occupy intermediate positions on our continuum, which is why the implementation of user charges usually requires debate, compromise, and approximation. Thus, although the use of municipal water supplies is fully measured by a water meter, it can be costly to buy and install it. If that cost is deemed to be too high, the municipality is likely to estimate a property's water use based on (say) whether it is residential or commercial and the front footage. This approximation to the amount of water use is certainly better than charging all users the same amount, but is not perfect either. Despite attempts to conserve scarce water, a frugal homeowner will receive the same bill as a not so frugal neighbor with the same size lot who consistently overwaters his lawn. In this instance the frugal homeowner is effectively "cross-subsidizing" his neighbor's extensive water use.

Even if they are calculated only approximately, user charges can, however, be levied for many of the uses made of the public infrastructure. Collections of motor fuel taxes are approximately related to highway use. As another example, merchants sometimes band together to ask city government for improved

lighting in commercial sections. With a special assessment district the merchants receiving the benefit—improved lighting often draws additional customers—pay for its cost. Strictly speaking, this application of special assessment districts (a form of "benefit capture") is not a user charge, because individual walkers do not pay for the privilege of having their path lit. Even so, shopkeepers (directly) and perhaps customers (indirectly, through higher prices) do pay for the higher level of this public service that the special assessment district provides.

SETTING USER CHARGES

When detailed costs are known accurately then, in principle, a user should be charged the cost his use incurs on a facility. (In the case of a user paying less than his true added cost, some other revenue source—some other person or group—will implictly be subsidizing him.) In other words, users should ideally pay their own way, no more, no less. This is called marginal cost pricing because the cost charged is that incurred on the margin of additional use.

In practice marginal cost pricing is difficult to implement and approximations are usually employed, whose accuracy varies. Public agencies rarely keep the detailed, facility-specific records needed to estimate marginal costs and, at a time of retrenchment, may fear that such records will be used to close down high-cost operations. Even with good records, however, difficulties arise. Aside from incidental expenses, the marginal cost of using a crowded public tennis court is related to the "congestion" (i.e., the delays) it imposes on would-be tennis players. On the average, those congestion costs can be estimated by asking people how much they would pay to play without a wait, but reserving time at peak hours is simpler than imposing the theoretically precise user charge. Nevertheless, any tennis court charge related to congestion automatically encourages play at less crowded times.

Particularly for services used by the affluent (or those services without good substitutes) hard-pressed governments are often tempted to hike user charges to as high a level as possible. In that case the facility user might pay more than the cost actually incurred, implicitly contributing to other expenses, perhaps to general revenue. Such a practice violates the principle of marginal cost pricing (by imposing cross-subsidization) but can have other advantages. Notably, fees that are heavily borne by those of high incomes can prevent a system of user charges from having a regressive effect, that is, burdening the poor the most.

Another consideration is the practical ability to revise fees, corresponding to changes in costs. If cumbersome rules or a citizenry keen on keeping its payments low make it difficult to increase fees in inflationary times, they may lag behind true costs. One possibility in this case is having a facility (such as a tennis court) operated privately through a franchise, when the franchise agreement is flexible enough to allow the fees, in time, to recover costs.

PAY-AS-YOU-GO FINANCING V. DEBT SERVICE

Those who finance long-lived facilities must always choose between pay-as-you-go and debt financing, or perhaps a combination of the two. Although the first alternative avoids adding to debt, it is impractical in most cases of user-charge finance, generally requiring users of existing facilities to pay heavy fees for the construction of new facilities that they cannot yet enjoy. (The Transportation Trust Fund, containing proceeds from the national tax on motor fuels has, however, been generally successful in applying charges from past vehicle use to pay for current construction.) Usually more practical, however, is either to use tax financing or to incur indebtedness for facility construction. Thereafter, the user charges may pay part or all of the debt service. If user charge revenues are adequate, they may be devoted to secure the loan.

ALTERNATIVES TO USER CHARGES

User charges may not only be impractical in specific instances, they may be judged undesirable. Aside from the issue of equity (discussed below), many officials and citizens think it is improper to allocate or ration the use of publicly owned facilities by a system of fees. These facilities, it is argued, should be open to all citizens and on all occasions, as schools and courtrooms are. This argument, however, applies better to those infrastructure facilities

everywhere judged to be the basic right of all citizens than to the use of public tennis courts and marinas, or to the water that fills private swimming pools. Sometimes the public judges general-tax finance of infrastructure facilities to be fair, especially if the tax burden is borne by those most able to pay (or supports those utility-like services deemed essential for all citizens). At other times, though, the general principle that those who benefit from a facility should pay for it surely is worthy of consideration.

The Matter of the Equity of User Charges

User charges are frequently criticized as being inequitable. Four general issues bear on this criticism:

- Which public infrastructure use is being charged for and what are the income levels of those who pay for such use?
- Can user charges be designed to be fair to low income persons?
- What is the alternative to user charge financing? For example, if a local tax system bears heavily on the poor (i.e., is regressive), then infrastructure financing through general tax revenues may be just as regressive as user charge financing.
- Often overlooked is the intrinsic *equity* of user charges because those who do not use a particular infrastructure facility do not pay for it.

WHO PAYS INFRASTRUCTURE USER CHARGES?

Because the word "infrastructure" covers such a wide range of facilities, the income levels of their users often vary from facility to facility. Where there are sewer lines, sewer usage is essentially universal. (Some residential sewer charges are paid directly by owner-occupants, though, and others by landlords. The amount paid also varies.) The renting of public buildings by aerobic dance groups or the use of public tennis courts is not so widespread, however. User charges for these activities are generally borne by the aerobic dancers and the tennis players, small segments of the population.

Which income and other population groups bear a specific infrastructure user charge depends heavily on who uses the infrastructure services and to what degree. If desired, a jurisdiction can levy user charges only on particular infrastructure services disproportionately consumed by persons who are not poor.

DESIGNING EQUITABLE USER CHARGES

Not only can a jurisdiction avoid levying user charges on those infrastructure services disproportionately consumed by the poor, but it is also possible to design the application of many user charges in a way deemed equitable. Directly or indirectly, certain user charges can be means tested, so that those considered unable to pay would not be required to do so, or would pay at a reduced rate. Intergovernmental aid programs could discourage user charges in economically distressed communities while encouraging them elsewhere.

Many proponents of user charges have pointed out that, for sewer, water, gas, electrical and other utility-like services, two part user charges combine equity with economic efficiency. In two-part charges the first part is for the hookup and the second part, varying with the level of use, is for the water or electricity actually consumed. Two-part user charges make it easy to establish "lifeline" rates, which can be especially low for light users. Those who can take advantage of lifeline rates are frequently the elderly and others with limited ability to pay but often any light user, young or old, can benefit from these reduced rates.

USER CHARGES V. MORE EQUITABLE ALTERNATIVES

A regressive set of user charges might still be chosen by a community concerned about its poor if the alternative is even more regressive. Ordinarily there are three alternatives to governmental user charge financing: (1) financing with the existing tax structure, (2) financing via an added tax, and (3) private provision of the infrastructure service.

If the tax system is already progressive, then raising rates to apply it to infrastructure finance (either pay-as-you-go or for debt service) will not disproportionately increase the tax burdens of the poor. If the current tax system is

regressive, on the other hand, raising tax rates will especially increase low income tax burdens. (Although state and local tax systems are less likely to be regressive than they were in the past, some still are regressive, especially localities heavily dependent on an antiquated property tax.) If, however, taxes are not raised but other public spending is cut back, one must discern whether these spending cutbacks especially hurt the poor.

One must similarly analyze the equity-effects of the two other alternatives to user-charge financing. A new tax can be progressive or regressive. And if citizens, failing to get improved infrastructure from government, must seek additional infrastructure services from the private, profitmaking sector it is unlikely that the poor will get reduced prices there. As an example of the latter point, streets in poor condition subject automobiles to accelerated wear. In the short run, this practice may save on tax-supported street maintenance but, indirectly, it inflates the generally private cost of vehicle maintenance.

HORIZONTAL EQUITY

By and large, the notion of equity that has been considered above is called "vertical equity," relating payments to individuals' incomes, i.e., their ability to pay. However, user charges score well on another definition of equity, that is, horizontal equity. We judge an infrastructure financing system to be horizontally equitable if persons in similar circumstances—those who make the same infrastructure use—pay the same amounts. User charges mean that nonusers do not subsidize users (nor need light users necessarily subsidize heavy users) which generally occurs with financing through general tax revenues. User charges also allow individuals to cut back on their payments by economizing on their facility use.

REPRISE

The equity impacts of user charges for infrastructure services depend heavily on specifics: the specific notions of equity applied; the specific infrastructure services being charged for; and the equity consequences of alternatives to user-charge financing. A careful analysis of these specifics is not easy; nevertheless, even a partial analysis avoids a dangerously facile response ("They're inequitable!") to the claimed economic efficiency of user charges. And the results of a careful analysis may be surprising. For example, a recent study of public transit in several metropolitan areas came up with the conclusion that as presently financed and operated many of these systems result in the poor subsidizing the transit use of the nonpoor.[43] this anomaly occurs partially because the inner-city poor take much shorter rides than the nonpoor who travel in the outlying sections of many metropolitan areas. With most existing fee schedules, those who take short rides are charged almost as much as the longer distance riders.

Other Forms of Benefit Capture

User charges are just one way to "capture" publicly provided infrastructure benefits through revenue collections. One-time special assessments and continuing special assessment districts within a locality are both ways to charge property owners for public improvements that especially benefit them, for example. Tax-increment financing (TIF) is another mechanism for benefit capture. Simply described, in an area slated for substantial public investment, TIF "freezes" property assessments (for accounting purposes only) at their pre-project levels. As the project raises property values and hence property-tax collections, the increment in those collections goes to a fund which pays the project's cost.

To the extent that infrastructure improvements make an area a better place in which to live, work, or do business, they raise property values and thus property tax collections, even without tax increment financing. By the same token, well targeted infrastructure investment can conceivably also increase local collections of sales, income and business taxes. A locality, planning strategically, can view much infrastructure spending as an investment to be recouped through future increases in general tax revenues. At the same time, applying a general tax to recover public investment effectively taxes both direct and indirect beneficiaries of that public spending within the jurisdiction being taxed.

Water charges, fees for recreation facilities,

motor fuel taxes, special assessment districts, and tax increment financing are different financing mechanisms that are appropriate in different circumstances. What these devices have in common, however, is that each fiscally captures the benefits of public spending, an approach that is often useful to take.

REMEDIAL FORCES AT WORK

Whether it is financed by taxes or user charges, maintenance of the physical infrastructure can be deferred just so long before skimping on that "invisible" task leads to some very visible problems and also to public demand for remedial action. Compared to only a few years ago, the whole topic of physical infrastructure has risen on the public agenda, producing a ferment in which new ideas are developed and added resources are applied. In order to apply added resources to physical infrastructure problems, creative financing mechanisms have been employed, states have helped localities in a variety of ways, and more revenues have been collected. No one financing mechanism—new or old—has emerged as dominant, probably because of intergovernmental variation in fiscal circumstances and choices as well as variation in particular infrastructure problems.

Federal Actions

- In the 1982 fiscal year the special Bridge Replacement and Reconstruction Program made $900 million available for federal-aid bridges. This program has the potential to eliminate threats to bridge safety, as do other federal programs to eliminate bridge deficiencies.[44]
- The *Surface Transportation Assistance Act of 1982* raised the federal motor fuel tax by five cents a gallon, starting April 1, 1983. The added revenues of roughly $6 billion per year substantially increase the 1982 fiscal year figure of $9 billion for the entire federal-aid highway program.[45]
- As a consequence of these and related actions, federal infrastructure spending has increased from $19 billion in fiscal year 82 to $25 billion in FY 83, even though the latter includes funds from only a half year of the increased gasoline tax. (See *Table 2*.)

State-Local Actions

Current plans and emerging actions of states and localities may have the greatest consequences of all for infrastructure financing. The loan bank being discussed in Massachusetts shows this state's interest in infrastructure improvement. For example, proponents of the Massachusetts Development Bank, while not denying or criticizing the possibility of expanded federal aid, have declared that infra-

Table 2

FEDERAL FUNDING FOR SELECTED PUBLIC WORKS INFRASTRUCTURE
(In billions of dollars of budget authority)

Program Area	Predominant Type of Spending	Fiscal Year 1982	1983
Highways	Grants to states	$ 8.9	$13.5
Public transit	Grants to localities	3.7	4.3
Airports	Grants to localities	0.5	0.8
Water resources	Direct expenditures	3.8	4.3
Wastewater treatment	Grants to localities	2.4	2.5
Total		$19.3	$25.4

SOURCE: Congressional Budget Office, *The Federal Government in a Federal System*, August 1983, p.33.
Note: This table does not include federal tax expenditures or credit support programs. In 1982, the federal government spent an estimated $8.5 billion in tax expenditures for public works infrastructure and development (largely tax revenues foregone on tax-exempt infrastructure bonds and small issue industrial revenue bonds). New loan and loan guarantee obligations totaled about $0.6 billion and $0.3 billion, respectively.

structure "... is a national problem. And as important as it is to force the federal government to acknowledge this crisis, Massachusetts must assume a leadership role immediately and initiate its own forward looking program to address this problem, both to provoke a federal response and to protect and sustain our own economic vitality in the next decade."[46]

The governor of New Jersey has recently taken a somewhat different approach from Massachusetts, offering to borrow funds for localities through the state government. The state's bond rating is generally higher than its localities' and so, by serving as a "conduit," it can reduce local borrowing costs.

On November 8, 1983, voters in New York approved a $1.25 billion bond issue to support a wide range of road and bridge projects to perform maintenance and repairs as well as new construction. Although the projects will be undertaken in the course of the next five years, more than 20 major projects in New York City alone will start in the 15 months following passage. Immediately after the election the state had already hired 450 new design and construction workers.[47]

The New York bond issue was the largest of the $3.4 billion in long-term borrowing approved November 8, 1983. Of the 170 state and local bond proposals submitted to the voters, 122 were approved, corresponding to 89% of the issue value submitted. This approval rate is the highest for any election day since 1960, indicating that state-local governments are becoming more successful in getting voters to agree to their borrowing proposals, which predominantly sustain physical infrastructure activities. Even more recent data suggest that this trend to a higher bond approval rate is continuing. Of the 49 local bond issues that went to the polls in January 1984, 39 were approved, totalling $127 million, with a 94% approval rate for bond values. This approval rate is the highest for any January since 1956.[48]

Since January 1981, a total of 34 different states, in all parts of the country, have increased their tax on motor fuels. (*Table 3.*) In 1983 alone, 19 states increased this tax. Almost without exception, these widespread tax increases are devoted to transportation.

The NLC/USCM survey shows mayors' and city managers' priorities for physical infrastructure work. Although priorities for capital expenditures vary sharply from city to city, streets and roads was the most frequently chosen of 19 specified types of urban physical infrastructure. The next four choices were (in order) stormwater collection, wastewater treatment, sewage collection, and public buildings.

Infrastructure work can start quickly. A total of 61% of the NLC/USCM respondents stated that work on their highest-priority project could start within six months; for 38% of all respondents the work could start in under three months.

Given seven alternative choices, city officials displayed a remarkable consensus as to why the highest priority projects were chosen. "Protecting public health and safety" and "providing essential residential services" were the top two reasons. "Facilitating economic development" was third choice.[49]

A Fiscal Forecast

The Morgan Guaranty Survey has forecast bright fiscal prospects for state and local governments:

> The nation's states and localities, which in 1982 posted a combined operating deficit of $3 billion—the first red-ink year since the mid 1970s—are now moving back into surplus. The Morgan Bank's projection is for an operating surplus of $15 billion in 1983 and for an even larger surplus next year.... [See *Graph* 4.] The fiscal turnaround reflects the impact of the current economic recovery on tax collections and heroic efforts by many jurisdictions to reduce spending and raise taxes. The fiscal rejuvenation ... allows considerable room for increased construction spending by state and localities to repair the nation's decaying infrastructure.... Moreover, the improved fiscal outlook seems likely to stabilize state and local credit ratings—providing an offset to the depressing effects on the municipal securities market exerted by the recent default of the Washington Public Power

Table 3

STATES THAT HAVE INCREASED THE RATE OF MOTOR FUEL TAXATION, JANUARY 1, 1981, TO DECEMBER 31, 1983

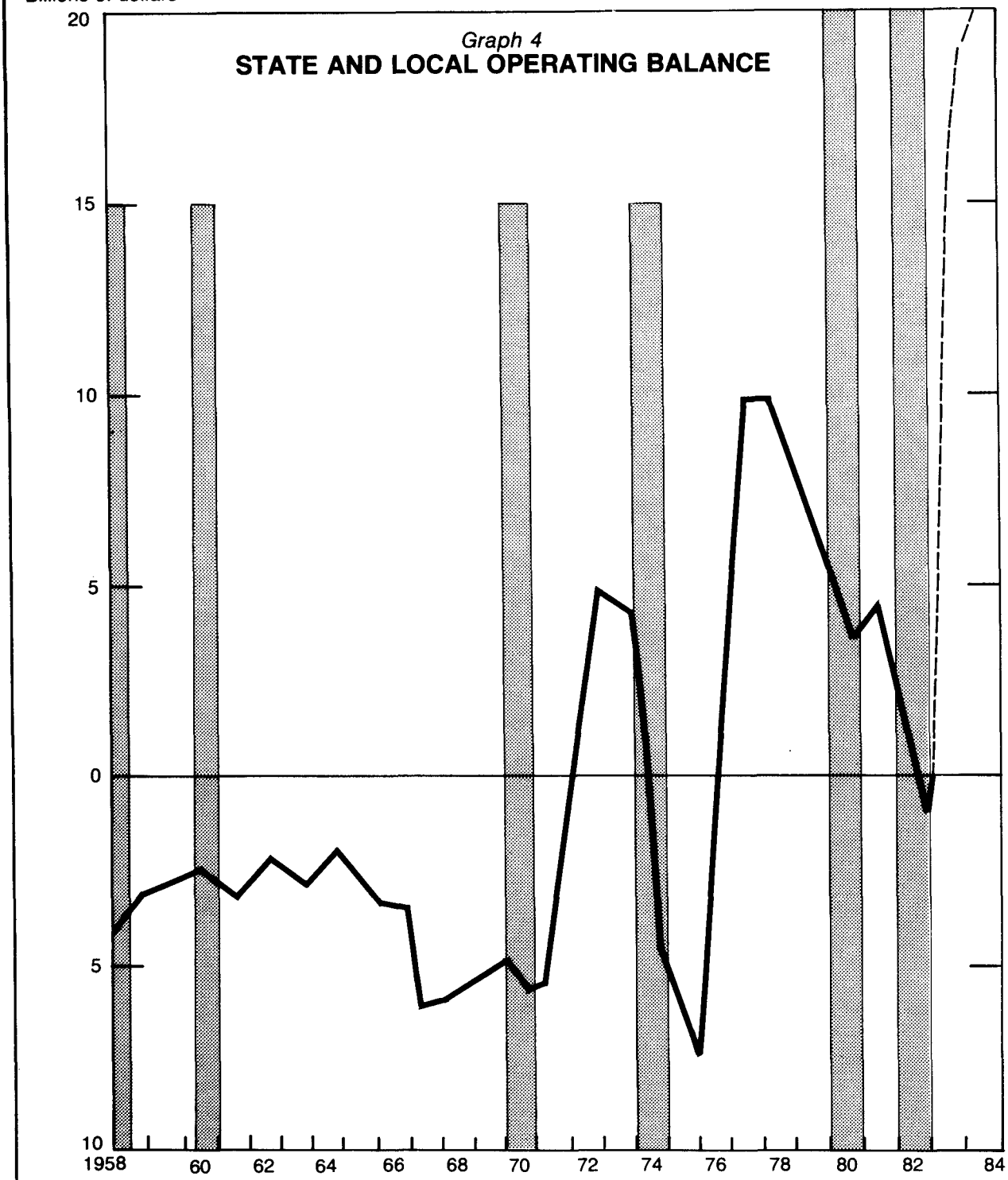
State and Region	1981	1982	1983
New England			
Connecticut			X
Maine			X
Massachusetts			X
New Hampshire	X		X
Rhode Island	X		X
Vermont	X	X	X
Mideast			
Delaware	X		
Maryland		X	
New Jersey			
New York			
Pennsylvania			X
Great Lakes			
Illinois			X
Indiana	X		
Michigan			
Ohio	X		
Wisconsin	X		X
Southeast			
Alabama			
Arkansas			
Florida			X
Georgia			
Kentucky		X	
Louisiana			
Mississippi			
North Carolina	X		
South Carolina	X		
Tennessee	X		
Virginia		X	
West Virginia			X
Plains			
Iowa	X		
Kansas			X
Minnesota	X		X
Missouri			
North Dakota			X
South Dakota	X		
Southwest			
Arizona	X	X	
New Mexico			
Oklahoma			
Texas			
Rocky Mountain			
Colorado	X		X
Idaho	X	X	X
Montana			X
Utah	X		
Wyoming			
Far West			
California	X		
Nevada	X		
Oregon	X		X
Washington	X		X
Alaska			
Hawaii			
Number of States with Increases	21	6	19

Note: In addition to rate increases, this table also includes adoptions of new taxes, temporary tax increases made permanent, and instances of switching from flat rate taxes to percentage taxes if additional revenues were gained from the changeover.

SOURCE: ACIR staff compilations based on Commerce Clearing House, *State Tax Reporter*, Chicago, various dates and National Conference of State Legislatures, *State Budget Actions in 1983*, Denver, CO, September 1983.

Graph 4

STATE AND LOCAL OPERATING BALANCE



Note: Shaded areas represent periods of recession as determined by the National Bureau of Economic Research. Estimates based on national income accounts.
SOURCE: Projection in Morgan Guaranty Trust Company, *The Morgan Guaranty Survey*, New York, October 1983, p. 8.
Operating balances are in current dollars.

> Supply System.... many jurisdictions are expected to loosen their purse strings by a modest amount in the year ahead. Construction spending, in particular, should pick up as state and local governments try to repair and rebuild their capital stock.... The recent sharp increases in public contract awards—a good indicator of future spending—strongly suggest that construction by states and localities is likely to rise well into the future.[50]

This forecast of a large "operating surplus" must be qualified, and in three ways. First of all, many governments avoided deficits during the recent recession by a variety of financial devices such as depleting "rainy day" and other reserve funds, speeding up revenue collections and delaying disbursements. These are "one shot" devices that cannot be relied upon again. Indeed, prudent fiscal management suggests that now-depleted reserves should be refilled as soon as possible, which will reduce funds available for infrastructure facilities.

Second, the Morgan forecast (like many others) is an aggregate one, pooling together the fiscal balances of all subnational governments. Such a simple summary can be misleading because one government's prospective surplus does not offset the deficit threatening another. The National Governors' Association and the National Association of State Budget Officers (NGA/NASBO) recently completed its FY 84 fiscal survey of each state government. They project an aggregate balance (for current general expenditures only) of $3.6 billion for the states at the end of that fiscal year. More than half of the aggregate surplus is accounted for by only three states: California, Minnesota and Wisconsin. Moreover, the $3.6 billion is only about 2% of the states' current expenditures, well below the 5% generally considered to be a prudent reserve.

Third, the Morgan and other forecasts are aggregated in another way, because they combine general funds and dedicated revenues, as well as funds for both capital investment and current (i.e., operating) expenses. (The NGA/NASBO figures pertains only to states' general funds for current expenses.) The Morgan forecast, for example, reflects large increases in governmental pension fund balances, which are not available for general spending purposes. It also includes increases in transportation trust funds which, of course, *are* available for many forms of infrastructure spending.

Fiscal stringency will still be the order of the day but its worst effects may be behind us, and infrastructure spending should reflect this improvement as well as, and perhaps better than, other categories of public expenditures.

No qualification need be attached, however, to the sharp increase in the value of government construction contracts that have already been let, a leading indicator of infrastructure work. The contract value for publicly owned projects jumped in March 1983 to $3.9 billion, more than half again as much as the $2.5 billion for the previous month. This increase, partially spurred by recessionary recovery, has continued. Despite the disappointing first quarter, 1983 has seen $46.1 billion in public construction contracts awarded, the highest since 1979.[51]

CONCLUSION

The widespread and often serious problems besetting public physical infrastructure are both diverse and localized. For example, some of these problems are caused by decline; others by growth. Some are matters of deferred maintenance; others, outmoded facilities.

Although some of the oldest facilities are the ones in worst condition, age alone is not a reliable indicator of infrastructure condition, much less of the priority for new investment. For this reason, and because nationally uniform "need" standards overlook differing state and local priorities, nationwide estimates of infrastructure needs can only suggest the framework for discussion, rather than fix precise budgetary choices.

Given the large number of governments with infrastructure responsibilities, the complexity of physical infrastructure systems—they are the very fabric of our communities—as well as the diversity and localized nature of the problems faced, it is unlikely that any simple national program can be relied upon predominantly. A single national program may not equally address the concerns of both urban public transit and reclamation projects in arid

regions. Similarly, a national financing program may not equally emphasize both new construction and the maintenance of the existing capital stock. Indeed, some of the current physical infrastructure difficulties are rooted (at least in part) in intergovernmental aid programs whereby Washington supports new construction and equipment, but not the maintenance of facilities now standing. Physical infrastructure problems are not only multigovernmental, many of them are truly intergovernmental in character.

Although much remains to be done, governments at all levels have begun remedying the physical infrastructure problems within their jurisdictions, according to their own circumstances and priorities. Some of the financing methods being used are innovative, such as new forms of tax-exempt borrowing and the proposed Massachusetts Development Bank, while others are traditional, such as increased gasoline taxes and increased borrowing for new construction. Repairing problems of physical infrastructure is hard work, but the job has begun.

FOOTNOTES

[1]Concentrating on financing, the report excludes important managerial considerations. For a recent annotated bibliography on this topic see Dale Thompson, *Infrastructure Sources: A Key to Current Literature for Municipal Officials and Public Managers*, Policy Working Paper No. 11, Washington, DC, National League of cities, September 1983. For a discussion of "infrastructure" definitions, see Abt Associates, *National Rural Community Facilities Assessment Study*, Cambridge, MA., 1980; and U.S. Department of Commerce, *A Study of Public Works Investment in the United States*, Washington, DC, U.S. Government Printing Office, 1980. By referring to "physical infrastructure" this report excludes job training and educational programs that are sometimes lumped with the public facilities (including school buildings) that we do examine. (The much broader definition appears in Stuart Holland, *The State as Entrepreneur*, London, Weidenfeld & Nicholson, 1972.)

[2]On the subject of demand shifts, see especially Hall Hovey, "Infrastructure," *State Policy Reports*, December 23, 1983, vol. 1, issue 24, pp. 7–8.

[3]The Alliance for State and Local Government Finance, *Public Services and Government Finance: The Taxpayers' View*, New York, Public Securities Association, February 1984, pp. 4–5.

[4]See John E. Peterson and Wesley C. Hough, *Creative Capital Financing, for State and Local Governments*, Chicago, Municipal Finance Officers Association, 1983.

[5]The Bureau of Economic Analysis (BEA) data series we use excludes the value of government owned land. The most recent estimates are unpublished; for definitions, methods, and historical data see John C. Musgrave, "Government-Owned Fixed Capital in the United States, 1925–79," *Survey of Current Business*, March 1980, pp. 33–43. Although their conclusions sometimes disagree, most recent studies use the BEA definition and data. See, e.g., Pat Choate and Susan Walter, *America in Ruins: Beyond the Public Works Pork Barrel*, Washington, DC, Council of State Planning Agencies, 1981, p. 5; George E. Peterson and Mary John Miller, *Financing Infrastructure Renewal*, Washington, DC, Urban Consortium, December 1981, p. 13; and Roger J. Vaughan, *Rebuilding America, Vol. 2: Financing Public Works in the 1980s*, Washington, DC, Council of State Planning Agencies, 1983, p. 17. Similar conclusions derive from data collected by the U.S. Census of Governments, although they do not estimate the total depreciated value of the nation's public capital plant. (See *Graph 3.*) For a discussion of Census of Governments data on infrastructure investment in FY 82, see Randy Arndt, "Infrastructure Spending Falls, as Aid to Cities Declines," *Nation's Cities Weekly*, February 20, 1984, pp. 1–11.

[6]Congressional Budget Office (CBO), *Public Works Infrastructure: Policy Consideration for the 1980s*, Washington, DC, U.S. Government Printing Office, April 1983, p. 59.

[7]*The Interstate Highway System: Issues and Options*, Washington, DC, U.S. Government Printing Office, June 1982, pp. xv-xviii, 59–68.

[8]CBO, *Public Works*, p. 6. See also Pat Choate and Susan Walter, *America in Ruins*, Washington, DC, Council of State Planning Agencies, 1981, Chapter 1.

[9]CBO, *Public Works*, pp. 6–8, 21–22, 39, 55–56.

[10]Regional and Economic Development Task Force of the Committee on the Future, *The Condition of Urban Infrastructure in the New York-New Jersey Region*, New York, NY, the Port Authority of New York and New Jersey, May 1979, p. 28, excerpted in the Appendix below.

[11]CBO, *Public Works*, pp. 19, 37, 55, 71, 87, and 103. See also CBO, *The Interstate Highway System*.

[12]George E. Peterson, Mary John Miller, Steven Godwin, and Carol Shapiro, *Guide to Benchmarks of Urban Capital Condition*, Washington, D.C., Urban Institute, June 1984. The quotation is on pp. 3–4. Another study (of nine cities) also finds that older cities in the northeast, midwest, or southeast are particularly likely to have public facilities in poor condition. See also U.S. Department of Commerce, *A Study of Public Works Investment in the United States*, Washington, DC, U.S. Government Printing Office, 1980.

[13]Nan Humphrey and Peter Wilson, *Capital Stock Condition in Twenty-Eight cities*, Washington, DC, Urban Institute, February 1980.

[14]First sentence underlined in source. National League of Cities and U.S. Conference of Mayors (NLC/USCM), *Capital Budgeting and Infrastructure in American Cities: An Initial Assessment*, Washington, DC, April 1983, p. iii.

[15]Page 5 of Hovey, *op. cit.*

[16]CBO, *Public Works*, pp. 14–31. See also General Accounting Office, *Effective Planning and Budgeting Practices Can Help Arrest the Nation's Deteriorating Public Infrastructure*, (U.S. Government Printing Office, Washington, DC, 1982); Harry P. Hatry ("Maintaining the Existing Infrastructure," Urban Institute,

Washington, DC, 1981); and U.S. Department of Commerce, *op. cit.*

[17]Environmental Protection Agency, *1982 Needs Survey: Cost Estimates for Construction of Publicly Owned Wastewater Treatment Facilities*, Washington, DC, U.S. Government Printing Office, December 1982. On the sometimes perverse consequences of federal intergovermental aid programs see generally CBO, *Public Works*, pp. 14–18 and throughout. Also, see CBO, *The Federal Government in a Federal System: Current Intergovernment Programs and Options for Change*, Washington, DC, U.S. Government Printing Office, August 1983, throughout.

[18]Pages 4–5 of Roger J. Vaughan, *Rebuilding America, Vol. 2: Financing Public Works in the 1980s* (hereafter referred to as *Financing Public Works*), Washington, DC, Council of State Planning Agencies, 1983.

[19]Choate and Walter, op. cit., pp. 15–17.

[20]George E. Peterson and Mary John Miller, *Financing Infrastructure Renewal: Policy Options*, Washington, DC, Urban Consortium, December 1981, pp. 61–62. See also George Peterson's skepticism about the role of countercyclical public works in recessionary recovery, pp. 9–12 in the Urban Institute's transcript of his testimony (February 3, 1983) before the U.S. Senate Committee on Environment and Public Works.

[21]To cite just one recent example, *Inc.* magazine conducted a survey of its readers to determine the factors influencing their future location choices. Respondents were asked to select the three most important considerations in selecting a future site. Fully 65% of them mentioned labor market factors as most important. Transportation facilities were seen as important by 58% of the respondents, who especially noted the quality and accessibility of public highways. (This 1980 survey appears at Table 36 in a special issue of *Inc.* magazine entitled "Buildings and Site Selection".)

[22]See, e.g., George A. Reigeluth and Harold Wolman, *The Determinants and Implication of Communities' Changing Competitive Advantages: A Literature Review*, Washington, DC, Urban Institute, February 1981.

[23]Choate and Walter, *op. cit.*, Ch. 2.

[24]A few details: If added infrastrucutre spending increases total government outlays without additional revenues, this causes growth in the deficit, which, some argue, may impede economic growth by "crowding out" private investment. If, alternatively, increased spending for public physical infrastructure does not add to total government spending, but effects a reallocation, then job shifting occurs, shifting demand from (say) military contractors and teachers to those employed in public infrastructure projects. Yet another kind of shifting—the time shifting of jobs—occurs with borrowing for public infrastructure. Loan proceeds are applied to hire workers now, to be repaid (presumably) through additional public revenues collected in the future, reducing the future demand for privately provided jobs.

[25]George Peterson's Senate testimony (*op. cit.*, pp. 13–14).

[26]The information about alternative financing mechanisms was compiled from a variety of sources. Unfortunately the only current compendium we have come across is rather sketchy. (James E. Hirten, James E. Freeman, and Donald C. Taylor, *An Infrastructure Planning Process for the United States*, Littleton, Co, Kellogg Corporation, September 1983, pp. A–1 to A–3.) A summary of current financing sources for urban infrastructure appears in NLC/USCM, *op. cit.*, pp. 11–17.

[27]Felix Rohatyn "America in the 1980s," (*The Economist*, September 19, 1981); "A New RFC is Proposed for Business," *New York Times*, (December 1, 1974, Section 3, p.1); "The Disaster Facing the North (*New York Review of Books*, January 22, 1981); "Reconstructing America," (*New York Review of Books*, February 5, 1981).

[28]See Choate and Walter, *op. cit.*, Chapter 6. Several bills to establish such a budget are now before Congress. Some have more "teeth" in them than others; depending on specifics, changing governmental budgetary processes might or might not increase infrastructure spending or change its characteristics.

[29]Joint Economic Committee, *Hard Choices: A Summary Report of the National Infrastructure Study*, Washington, DC, February 1984, p. 17.

[30]CBO, *Public Works*, pp. 14–18 and throughout.

[31]Joint Economic Committee, *op. cit.*, p. 18.

[32]State of Massachusetts, Office of the Governor, "The Massachusetts Development Bank" (Mass Bank), an unpublished, undated planning document.

[33]See State of New Jersey, Office of the Governor, *New Jersey Infrastructure Bank: Technical Papers*, Trenton, NJ, May 1983; and also "New Jersey's Crumbling Infrastructure," the April 1983 issue of *New Jersey Municipalities*, published by the New Jersey League of Municipalities. In the latter, especially see William G. Dressel, "The League's Position on the Infrastructure Bank," p. 10, for a critical view of the proposal.

[34]See Rodney T. Smith, *Financing Western Water*, Washington, DC, Council of State Planning Agencies, forthcoming, Chapter VII and the chapter on local borrowing in ACIR, *Local Revenue Diversification*, forthcoming.

[35]See Choate and Walter, *op. cit.*, p. 35; Vaughan, *Financing Public Works*, pp. 48–49; Robert L. Bish and Vincent Ostrom, *Understanding Urban Government: Metropolitan Reform Reconsidered*, Washington, DC, American Enterprise Institute, 1973; John C. Bollens, *Special District Government in the United States*, University of California Press, Berkeley, 1957. For a critical view see ACIR, *The Problem of Special Districts in American Government*, A–22, Washington, DC, U.S. Government Printing Office, 1964.

[36]Vaughan, *Financing Public Works*, p. 178. He then goes on (pp. 178–88) to suggest financing and administrative mechanisms to increase the state role. Roger J. Vaughan and Robert Pollard's forthcoming *Rebuilding America: Vol. 1, Planning and Managing Public Works in the 1980s* (referred to as "*Planning and Managing*"), Washington, DC, Council of State Planning Agencies, expands on this theme. Choate and Walter (op. cit., Chapter 7) talk of certain reallocations of responsibilities within the federal system that would, in general, shift them to state and local governments.

[37]Associated General Contractors, *America's Infrastructure: A Plan to Rebuild*, Washington, DC, September 1983, p. 4. "This $3.03 trillion must be viewed as a minimum figure. There are a number of significant infrastructure categories for which no needs information exists and cannot be included in the $3.03 trillion estimate. Such omissions include: rural potable water needs; parks, certain health care facilities; levees, dikes and revetments; libraries; firehouses; federal, state and local office buildings; among many others. Complete information on all such infrastructure needs would significantly increase the presently identified $3.03 trillion estimate." See also American Public Works Association, *Revenue Shortfall: The Public*

Works Challenge of the 1980's, Chicago, 1981. The second estimate is from Pat Choate, quoted in Rochelle Stanfield, "The Crumbling Public Facilities," *National Journal*, November 24, 1982, p. 2016.

[38]Vaughan, *Financing Public Works*, p. 4.

[39]Underlined in source. NLC/USCM, op. cit., p. iv.

[40]CBO, *Public works Infrastructure, op. cit.* and Joint Economic Committee, *Hard Choices, op. cit.*, p. 1.

[41]Vaughan, *Financing Public Works*, p. 3.

[42]Peterson and Miller, *op. cit.*, p. 2.

[43]John Pucher, "Who Benefits from Transit? Recent Evidence from Six Metropolitan Areas," *Transportation Research*, Vol. 17A, No. 1, January 1983. On infrastructure user charges in general, see Chapter V of Rodney T. Smith, *Financing Western Water*, Washington, DC, Council of State Planning Agencies, forthcoming.

[44]CBO, *The Interstate Highway System*, pp. 70, 73–74.

[45]*Ibid.*, p. 71 and CBO, *Public Works*, p. 8. About a fifth of the added revenues will be devoted to public transit.

[46]State of Massachusetts, *op. cit.*, p. 2.

[47]Josh Barbanel, "State Drafts Plans to Use New Road-Bond Funds," *New York Times*, November 10, 1983, p. B9 and Frank Lynn, "Cuomo Assures Voters on Plans for Using Bonds," *ibid.*, pp. A1, B8.

[48]See Louis Meli and Mark Fury, "Nation's Voters said Yes to 89% of Bond Proposals Offered on Election Day," *The Weekly Bond Buyer*, November 14, 1983, pp. 1, 53; and the same authors' article "Voters Approve $127 million, or 94%, of Bond Proposals on January Ballots," *Credit Markets*, February 6, 1984, pp. 5, 63.

[49]NLC/USCL, *op. cit.*, pp. iii, 47, 58–60.

[50]Pages 8, 10–11 in Morgan Guaranty Trust Company, "Brightening Prospects for States and Localities," the monthly *Morgan Guaranty Survey*, New York, October 1983, pp. 8–13.

[51]F.W. Dodge series from *Survey of Current Business*, (published by the Bureau of Economic Analysis, U.S. Department of Commerce), various dates.

Appendix

Excerpts From Three Detailed Infrastructure Studies

The three studies excerpted below provide an indication of how detailed examinations of public physical infrastructure are being conducted. They are good examples of carefully assessing particular infrastructure concerns and of the policy directions that may be followed. These studies were conducted by a wide range of authors and organizations and reach different conclusions. They are:

- A nationwide study of the condition of urban infrastructure, conducted by George E. Peterson and others at the Urban Institute. Part of the section on bridges is included here.
- A study of the New Jersey Department of Transportation, conducted by a public-private task force established by the governor. The section excerpted (taken from a "briefing book") emphasizes the costs of the department's operations.
- A study of infrastructure needs in the New York metropolitan region, conducted by the Port Authority of New York and New Jersey. The summary and an assessment of capital needs are used here.

GUIDE TO BENCHMARKS OF URBAN CAPITAL CONDITION*

by George E. Peterson, Mary John Miller,
Steven Godwin, and Carol Shapiro

Urban Institute Press
June 1984

A report on research supported by the Department of Housing and Urban Development, Office of Policy Development and Research

Bridges

Among cities' capital assets, bridges can present special hazards such as bridge collapse or accidents caused by narrow widths and blind approachways. The Federal Highway Administration estimates that there are more than 200,000 bridges nationwide that are deficient because of structural deterioration or inability to serve present traffic needs. Although bridges generally require large capital outlays to repair or replace, few cities keep good records of their inventory of bridges and the costs of various investment alternatives. One reason for this is the complicated jurisdictional arrangements for bridges; typically, the state, county, city and often railroads share responsibility for the upkeep of bridges. As a result, city records rarely present a full picture of bridge needs.

ASSESSING THE CONDITION OF BRIDGES

The ability of a bridge to serve traffic is related to its structural condition and the demands placed on the structure. The most frequently cited factors affecting bridge condition are the age of the bridge, maintenance levels, traffic intensity and weight (or loading factors), climate and bridge design. Although structurally sound, a bridge may also be considered inadequate if changes in traffic patterns place demands that exceed its design capacity. Often a combination of these factors contributes to bridge needs.

Although the effect of age can vary widely even for bridges in the same area, poor condition is frequently associated with older bridges. Climate also has a significant impact on the useful life of bridge structural elements and surfaces. A primary maintenance problem of bridges—the deterioration of concrete bridge decks—is directly related to the use of road salt in areas with severe winter climates. The problem is concentrated in the northeast and midwest, where extensive use of salt can cause significant damage to bridge decks in only four to six years. Environmental factors can also shorten the life span of a bridge's structural supports.

Bridge maintenance clearly contributes to bridge condition, but few cities in the sample were able to provide maintenance spending records for a series of years. Most reported that bridge spending was mixed with street spending, and in the few cases where it was reported separately the data were plainly incomparable from one city to the next because of differences in the definition of maintenance and the level of responsibility for maintenance. Because of the small number of records, no discernible trend in bridge maintenance can be inferred.

The Federal Highway Administration offers the most comprehensive source of information on bridges. The National Bridge Inspection Program, established in 1968, was intended to provide a common rating system for reporting on bridge conditions and to create a national bridge inventory. States have been required to inspect bridges every two years, starting in 1973.

BENCHMARKS

Measures of Condition

The American Association of State Highway and Transportation Officials developed performance standards for bridges that are used for the federal bridge inspection programs. Bridges are rated on a scale of 0 to 9 for two separate measures. The condition rating involves an evaluation of structural components,

*The excerpt here is drawn from pp. 15–18.

Table 8

BRIDGE NEEDS: 1980

City	Total Bridges	Percentage Structurally Deficient	Percentage Functionally Obsolescent
Albany	120	21	8
Anchorage	22	9	0
Arvada	46	13	24
Atlanta	431	7	42
Baltimore	145	10	28
Billings	16	0	6
Bloomington	6	17	0
Boston	252	26	6
Buffalo	136	55	4
Charlotte	204	12	50
Chicago	464	7	11
Cicero	6	17	17
Cincinnati	215	10	3
Cleveland	279	23	0
Dallas	1,006	7	20
Denver	233	15	22
Detroit	412	5	2
Enid	35	9	0
Eugene	62	3	3
Everett	83	2	24
Garden Grove	25	0	0
Garland	104	3	28
Green Bay	100	25	7
Greenville	21	0	0
Hampton	60	13	0
Houston	619	3	15
Independence	85	11	51
Iowa City	27	7	37
Kansas City	558	12	28
Lexington	54	6	6
Lincoln	84	6	15
Louisville	217	1	17
Meriden	80	5	15
Miami Beach	44	34	20
Milwaukee	769	27	5
Minneapolis	291	27	10
New Orleans	222	9	2
New York City	1,321	56	8
Newark	163	25	3
North Little Rock	167	4	11
Oakland	183	1	7
Ogden	31	13	6
Parma	11	18	9
Philadelphia	345	17	0
Phoenix	171	2	1
Pittsburgh	207	35	4
Pontiac	23	4	4
Portland	262	4	4
Rochester	102	51	6
St. Louis	310	9	25
San Diego	455	2	7
San Jose	190	4	3
Scranton	60	7	0
Seattle	215	7	35
Shreveport	140	44	29
Sioux Falls	68	10	4
Tucson	154	0	8
Tulsa	323	3	1
Union City	9	22	0
Washington, DC	236	21	1
Wilmington	48	10	2
Worcester	53	9	4

NOTE: Under federal bridge inspection guidelines, a scale from 0 to 9 (with 0 the lowest rating and 9 the highest rating) is used to rate specific bridge items and to develop an overall appraisal of bridge condition. A bridge is considered *structurally deficient* if—

1) the superstructure, substructure, or culvert is rated 3 or less or
2) the general appraisal or waterway adequacy ratings are 2 or less.

A bridge is considered *functionally obsolescent* if—

1) the deck geometry, underclearance, and approach roadway alignment are rated 3 or less or
2) the overall appraisal or waterway adequacy is rated 3 or less.

SOURCE: Federal bridge inventory data from 1980, provided by the Bridge Division of the Federal Highway Administration.

including the deck, superstructure and substructure. The appraisal rating evaluates the bridge in relation to the road system it is on, taking into account such factors as deck width and clearance, horizontal and vertical underclearance, safe load capacity, waterway adequcy and approach roadway alignment. These ratings are used to arrive at measures of structurally deficient and functionally obsolescent bridges. A structurally deficient bridge is a bridge that has been either restricted to light vehicles (posted) or closed because of structural inadequacy. A functionally obsolescent bridge is one whose deck geometry, approach, roadway alignment, or load-carrying capacity can no longer safely service its road system.

Table 8 shows the number of structurally deficient and functionally obsolescent bridges in each city in the sample. As might be expected, structurally deficient bridges are most common in the Northeast, and functionally obsolescent bridges are most common in the south, where growth often renders a bridge inadequate to serve traffic needs *(Table 9)*. Structurally deficient bridges are also concentrated in large and declining cities and in fiscally distressed cities. Functionally obsolescent bridges are more often found in growing cities and in cities that are either fiscally distressed or only moderately distressed. They are almost evenly distributed among large and small cities *(Table 10)*. It is important to note, however, that the data may understate the number of functionally obsolescent bridges. Once a bridge is judged structurally deficient, it is no longer considered for functional obsolescence under bridge inspection guidelines.

Bridge inventory records show that 14% of the total number of bridges in the sample cities are older than 50 years and 20% are between 25 and 50 years old. Of the bridges considered structurally deficient by the federal inspection records, 57% were located in the 15 cities with

Table 9
BRIDGE NEEDS BY REGION

Region	Average Percentage of Bridges Structurally Deficient	Average Percentage of Bridges Functionally Obsolescent
Northeast (N=12)	25.3	4.7
North Central (N=17)	15.5	12.8
South (N=18)	10.7	15.9
West (N=15)	4.9	10.0
Mean	13.5	11.4

SOURCE: Federal bridge inventory, 1980.

Table 10
BRIDGE NEEDS BY CITY CHARACTERISTICS

City Characteristics	Average Percentage of Bridges Structurally Deficient	Average Percentage of Bridges Functionally Obsolescent
Size		
Large (N=32)	15.5	11.8
Small (N=30)	11.4	11.0
Population Change, 1970 to 1980		
Growing (N=28)	9.1	13.8
Declining (N=34)	17.1	9.5
Distress		
High (N=19)	20.3	8.2
Moderate (N=19)	12.8	13.4
Not Distressed (N=24)	8.6	12.4
Mean	13.5	11.4

SOURCE: Federal bridge inventory, 1980.

Table 11

BRIDGE NEEDS BY AGE OF BRIDGE AND AVERAGE DAILY TRAFFIC

Percentage of City Bridges Older than 50 years	Number of Cities	Number of Bridges Rated Structurally Deficient
10 or Less	32	425
10.1 to 20	15	496
20.1 or More	15	1,245

Average Daily Traffic per Bridge	Number of Cities	Number of Structurally Deficient Bridges	Number of Functionally Obsolescent Bridges
10,000 Vehicles or Less	17	156	154
10,001–20,000 Vehicles	24	674	831
20,001–30,000 Vehicles	15	1,236	325
30,001 or More Vehicles	6	98	314

SOURCE: Federal bridge inventory, 1980.

20% or more of their bridges over 50 years old *(Table 11)*.

Heavily traveled bridges are more likely to be in poor condition. The average daily traffic per bridge in the cities in the sample ranged from 3,300 to 51,900 vehicles. In the sample, 62% of the deficient bridges were located in cities with average daily traffic per bridge above 20,000 vehicles. Measures of average daily traffic do not, however, reflect the weights carried by bridges. Unpredicted increases in traffic volume and live loads (the weight moving across a bridge) adversely affect bridge wearing surfaces, the bridge deck, and the structure itself. When a bridge consistently sustains vehicle loads or stress far in excess of its design capacity, bridge "fatigue" sets in and structural failure ultimately results.

The true magnitude of bridge needs in these cities can be arrived at only by calculating the cost to rehabilitate or replace deficient and obsolescent bridges, a cost that can vary widely according to the size and type of bridge and the area in which it is located. The Bridge Division at the Federal Highway Administration reports that in 1980 bridge construction unit costs per square foot ranged from $32 in Mississippi to $151 in the District of Columbia.

States frequently do not include the cost to rehabilitate or replace bridges in their inspection reports. In those cases, the Federal Highway Administration estimates a cost. In general the individual cost estimates for bringing bridges up to standard are considered unreliable measures of current need since they are often drawn from outdated engineering studies, may overstate real need, or are simply estimates. To illustrate, in the sample, the cost per square foot of bridge repairs reported ranged from $1 to $494.

In contrast with the other functional areas discussed in this paper,* for bridges there is a relatively sophisticated set of records with specific measures of condition available: the national bridge inventory. The 1980 federal bridge inventory shows two divergent patterns of bridge needs: a concentration of structurally unsound bridges in the older and fiscally stressed areas of the northeast and midwest and a large number of bridges that are inadequate to serve traffic needs in growing areas. Unfortunately, few trend data exist for comparing bridge conditions over time, since the federal inventory coverage was changed significantly during the 1970s. In time, if further changes are not mandated, the inventory should provide a realible tool for measuring changes in bridge needs.

*Roads, transit systems, sewer systems, and water systems.

STRATEGIC ISSUES AND ALTERNATIVES: TRANSPORTATION INFRASTRUCTURE

New Jersey
Department of Transportation,
September 1983

A report prepared by a team consisting of executives from New Jersey businesses, state agency officials, The Governor's Management Improvement Improvement Plan staff members and private consultants.

This report documents the efforts of a joint task force representing state government, the private sector, and outside business consultants to identify and to review the key strategic issues associated with the state's highway infrastructure as administered by the New Jersey Department of Transportation (DOT). The mission of this group, given limited time and resources, was to provide a context useful for the strategic review of these issues at the governor and cabinet officer level.

This effort arose from recognition of the fact that New Jersey's $42 billion investment in bridges and highways is in an advanced state of decay. Any rehabilitation program will be in addition to the ongoing need to complete the state's infrastructure network.

The magnitude of this fixed asset, the potential rehabilitation costs, and the need to complete the system, place transportation funding high on the list of issues which will require careful balancing against other critical needs facing the state over the next decade.

In constant dollar (inflation-free) terms, DOT's maintenance expenditures have been decreasing since 1970. Meanwhile, factors generally correlated with roadway deterioration—state population, licensed drivers and vehicle miles travelled—have been increasing. Also, state highway lane miles have been increasing at a slow, but steady, rate.

This combination of increasing lane miles and decreasing maintenance expenditures has resulted in decreased maintenance *expenditures* per lane mile. This may not accurately reflect reasonable unit maintenance *costs* per lane mile. In order to perform comparable maintenance (i.e., to the same standards as in 1970), unit maintenance costs would have to decrease as fast as maintenance expenditures, reflecting increases in productivity and/or cost effectiveness improvements. This has not been happening as will be shown in subsequent charts. The decrease in annual unit maintenance expenditures is directly related to the constraints placed on DOT's annual maintenance and operating budgets, constraints which could contribute to more extensive and costly repairs.

The problem is further worsened by the increase in real maintenance costs due to the continuing decay of the existing infrastructure.

An accepted measure of cost management effectiveness is the change in real unit costs over time. Of the over 400 individual maintenance-related activities undertaken by DOT, approximately 15 were selected for further investigation. Unit costs in appropriate terms (per ton, per square foot, per lane mile, per hour, etc.) were tracked over the recent five-year period.

The attached charts show unit cost trends for six of the selected maintenance functions, expressed in constant (inflation-adjusted) dollars. Without exception, real costs are rising. This is in contrast to other situations where constant dollar unit costs decline over time due to the "experience effect."

Unit cost increases for certain DOT maintenance activities may be due to departmental policies and local conditions. For example, the 6.3% per year increase in resurfacing costs could be the result of current policies on how much resurfacing will be done by DOT versus

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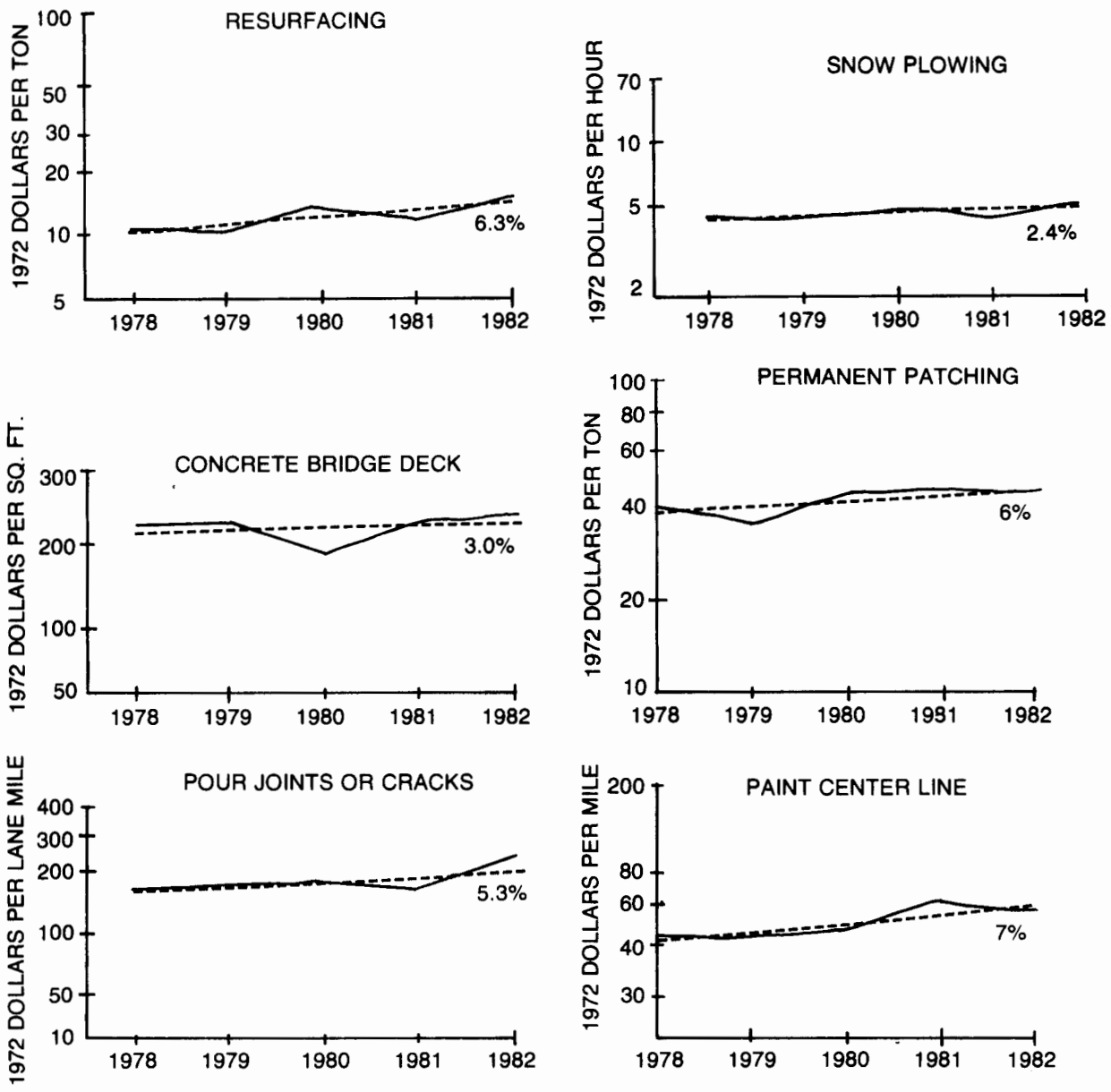
This excerpt (drawn from pages 5, and 8–11) quantifies highway maintenance expenditures and the unit costs (per lane-mile) of specific maintenance activities such as resurfacing. It shows that increases in unit maintenance costs have led to less actual maintenance being performed. The increase in unit maintenance costs is partially caused by deferred maintenance in the past. (ACIR)

contractors. The current in-house limit of 150,000 tons per year is comprised of smaller high cost jobs (maximum size 3,500 tons), whereas the larger projects are awarded to outside contractors.

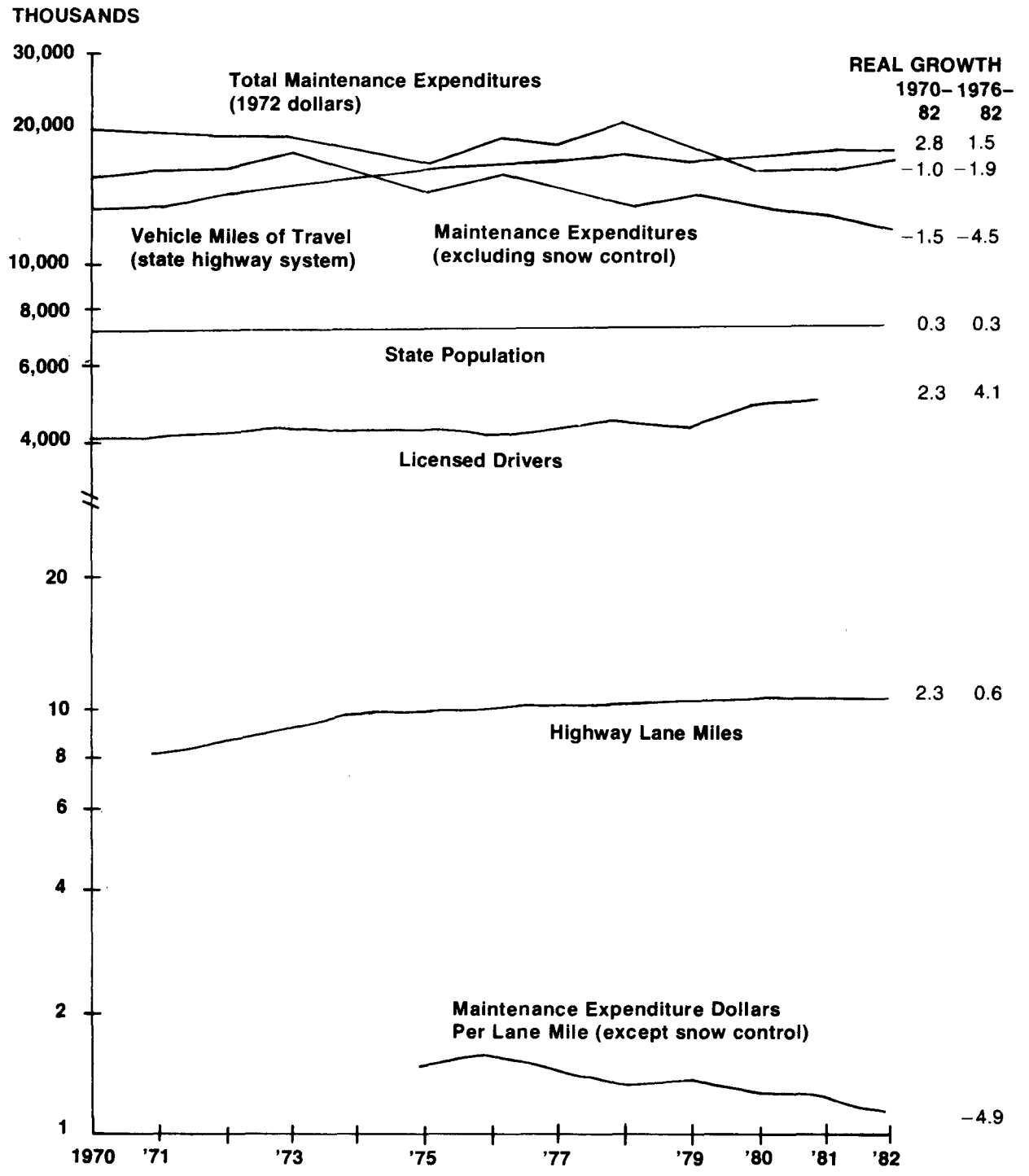
Another reason for increasing unit costs might be the advancing deterioration of the bridge and roadway systems. What might have been a true maintenance cost under ordinary circumstances may have advanced to a semi-reconstruction cost.

The effect of department policy and advancing deterioration of the transportation system should be reviewed related to increases in real unit costs. Opportunities for effective, long-term cost management and supporting financial resouces should be identified and real unit costs reduced.

NEW JERSEY DEPARTMENT OF TRANSPORTATION
UNIT COST PERFORMANCE OF SELECTED MAINTENANCE ACTIVITIES, 1978–82



NEW JERSEY DEPARTMENT OF TRANSPORTATION
COMPARATIVE TRENDS IN MAINTENANCE EXPENDITURES, 1970–82



THE CONDITION OF URBAN INFRASTRUCTURE IN THE NEW YORK-NEW JERSEY REGION: A SURVIVAL ISSUE FOR THE 1980'S*

by the Regional & Economic Development Task Force
Committee on the Future
The Port Authority of NY & NJ

May 1979

SUMMARY STATEMENT

Urban Infrastructure: The Vital Physical Support Systems

The purposes of this inquiry were to determine the nature and extent of the problems involving the deterioration of the physical infrastructure in the region's large, older cities and to recommend potential NY–NJ Port Authority roles in addressing these problems.

SUMMARY OF MAJOR FINDINGS:

1. A sound, adequate physical infrastructure (main components are: water, sewers, bridges, streets and mass transit) is vital to the continued economic health and growth of the region's urban centers. It is one of the major comparative advantages that old, larger cities have in competing for economic activity. It could also become their greatest liability, if maintenance and repair needs of these systems are not adequately met.

2. There is a growing awareness and concern for the fact that capital needs in this area are growing at a much higher rate than capital capacity. The cities realized this with the advent of the fiscal crisis and the increasing manifestation of problems caused by deferred maintenance.

3. The estimate of capital needs for several major infrastructure categories in New York, Newark, Jersey City and Elizabeth, as well as the region's roadway and mass transit systems totals nearly $40 billion over the next ten years. While this represents an order of magnitude estimate for these identified major categories, it does indicate the potential magnitude of the problem within the region.

4. The core of these problems lies in the older urban centers in the region. Other parts of the region are relatively young and/or growing and require funds for new or expanded systems rather than replacement of old systems. This situation poses a potential conflict of interest in seeking additional funding sources for infrastructure repairs.

5. Although there is a growing concern for the condition of the infrastructure, there appears to be little or no information as yet developed on the scope and magnitude of this problem. The major reason for this appears to be due to the fact that there has been no incentive for doing so. With major fiscal problems and tight capital budgets, these cities have been able to barely meet critical needs. Thus, when it comes time to prepare capital budget requests the focus tends to be on most urgent needs rather than on longer term capital replacement needs. The recent exception is New York City, which has begun addressing long-term infrastructure needs. Interestingly, the incentive for doing so was the need for long-term loan guarantees by the federal government. The city emphasized its critical capital infrastructure needs in presenting its case.

6. There is a slim hope of needs being met from local funding sources. Everyone will be looking somewhere else, the federal government, the state—at a time when the President is telling urban leaders that the next federal budget will be "very, very tight" and that urban programs will be reduced.

7. Since it is likely that the needs will continue to be greater than available resources, hard choices will have to be made as to where limited funds will be spent. Proper management of scarce capital funds will become increasingly important in maintaining the viability of the region's urban centers.

*Drawn from pp. 1–3 and 24–27.

Table I

REQUIRED VS. RECENT ACTUAL REPLACEMENT RATES FOR WATER, SEWERS AND STREETS IN NEW YORK CITY, NEWARK, JERSEY CITY, ELIZABETH

Required Replacement Rates	Recent Actual Replacement Rates			
	New York	Newark	Jersey City	Elizabeth
Water Lines (every 75 years)	250–300 Yrs.	300–400 Yrs.	400–500 Yrs.	300–400 Yrs.
Sewer Lines (every 100 years)	250–300 Yrs.	300–400 Yrs.	500–600 Yrs.	600–800 Yrs.
Streets (every 40 years)	150–200 Yrs.	300–400 Yrs.	300–400 Yrs.	400–500 Yrs.

8. If increasing funds do become available for capital improvements, the cities will find themselves with a shortage of "in-house" capability to adequately manage these funds. Since this capability cannot be developed "overnight," the cities will have to turn to outside sources, especially in technically related areas.

9. To the extent that infrastructure requirements may dominate the capital needs of the region, the ability to undertake major regional economic development capital projects will be seriously constrained.

10. There has been a nationwide decline in capital infrastructures investments; this is especially true in our region's urban centers. Infrastructure investments would provide a short-term/intermediate term economic development measure by providing needed investment and job generation in the region's inner urban core.

NATURE AND EXTENT OF NEW YORK REGION'S CAPITAL INFRASTRUCTURE

In essence, the problems facing our region's vital physical support systems are those of increasing needs to maintain, repair and rehabilitate coupled with growing fiscal problems and lack of adequate capital. The core of these problems lies within our region's larger, inner, older cities. There are several reasons for this with the most obvious being that extensive infrastructure systems are needed to support the high concentration of people and business that lies in our larger cities. Adding to this is the fact that the age of these systems affects the need for repairs and rehabilitation and the majority of the infrastructure in these cities has been in place since the turn of the century.

Also, we are well aware of the decline and fiscal plight facing our region's older cities. Our region's three largest cities have taken top honors in a recent Congressional report* on the urban needs of 45 large cities. In terms of overall economic needs Newark was ranked first, New York second and Jersey City was third. Growing budget constraints and an eroding tax base make it increasingly difficult for these cities to meet day-to-day expenses let alone capital infrastructure needs.

It is our judgment that upwards of $40 billion will be required in the next decade to meet critical maintenance, repair and construction

*"City Need and the Responsiveness of Federal Grant Programs," August 1978, Prepared by the Subcommittee on the City, Committee on Banking, Finance and Urban Affairs, House of Representatives.

Table II

REQUIRED VS. ACTUAL CAPITAL EXPENDITURES FOR WATER, SEWERS AND STREETS

(millions of dollars)

	New York	Newark	Jersey City	Elizabeth	Total Four Cities
Average Annual Capital Needs For Next Decade ($1978)	$ 800M	33M	44M	14M	891M
Average Annual Capital Expended During Past Decade (not adjusted to current dollars)	$ 90M	6M	4.4M	1M	101.4M

of the vital support systems of New York City, Newark, Jersey City and Elizabeth and the region's mass transit and roadway systems. In the major areas of water, sewers, and streets alone, these cities need to spend some $9 billion as compared to an approximate expenditure of $1 billion during the past decade. (See *Tables I, II and III*)

Table III

SELECTED EXAMPLES OF NEW YORK–NEW JERSEY REGION'S MAJOR INFRASTRUCTURE NEEDS FOR THE 1980'S

(millions of dollars)

For Water, Sewers, Streets and N.Y.C. Bridge Needs:

New York City	$ 8,100 M
Newark	330 M
Jersey City	445 M
Elizabeth	140 M
Sub-Total	$ 9,015 M
Regional Mass Transit Needs	$ 14,800 M
Regional Roadway Needs	8,300 M
Waste Water Treatment Needs	2,500 M
New York City Third Water Tunnel	2,600 M
Sub-Total	$ 28,200 M
Future Water Supply Needs (Hudson River Skimming Project)	$ 2,000 M
Identified Total For Major Categories	$ 39,215 M

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