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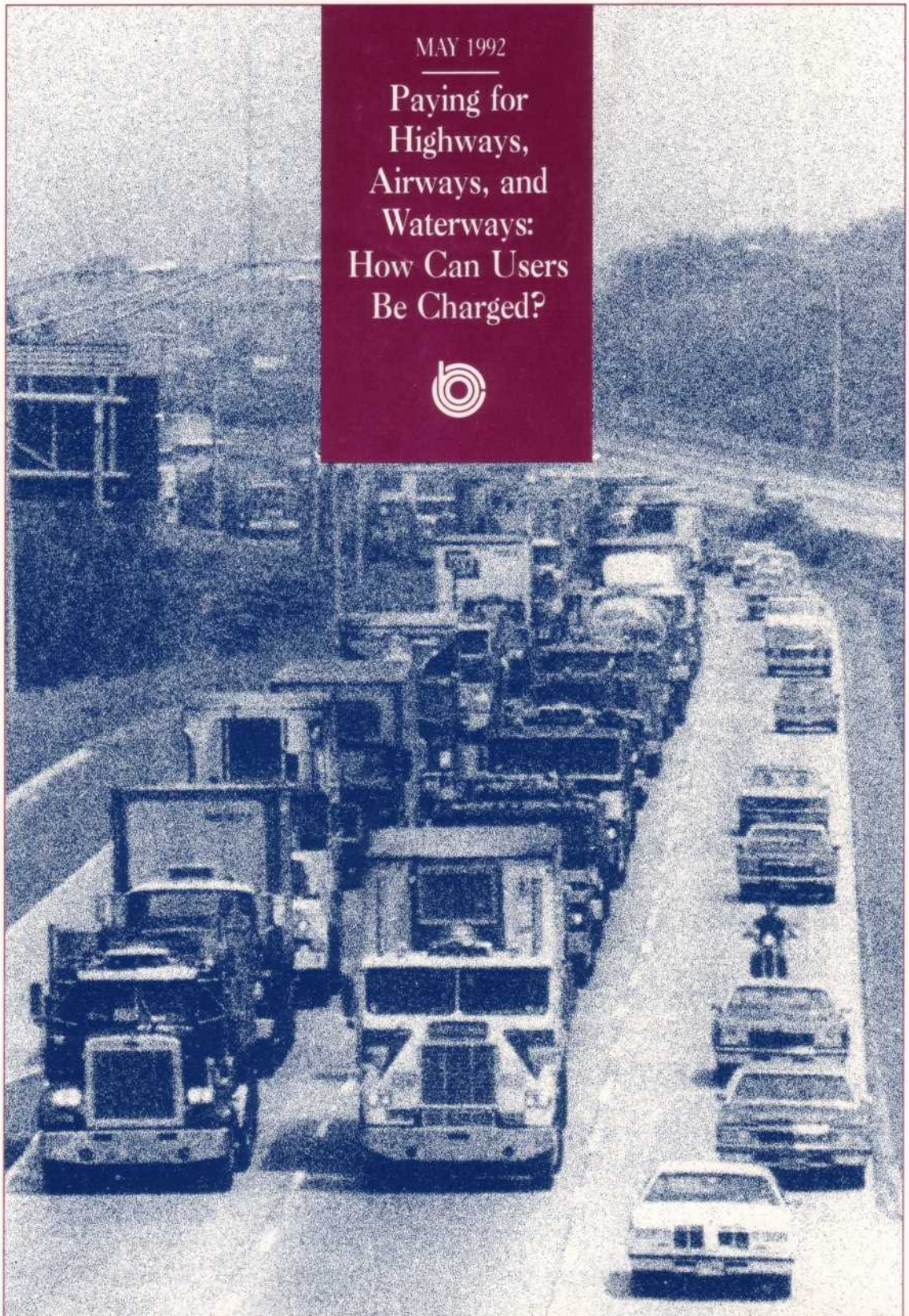
Paying for Highways, Airways, and Waterways: How Can Users Be Charged?



PAYING FOR HIGHWAYS, AIRWAYS, AND WATERWAYS: HOW CAN USERS BE CHARGED?

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NOTES

Unless otherwise indicated, all years referred to in this study are fiscal years.

Numbers in the text and tables of this study may not add to totals because of rounding.

Cover photo: A convoy of 18-wheel tractor-trailers on Interstate 91 in Connecticut in 1979. (UPI/BETTMANN)

Preface

The combination of budgetary pressures at all levels of government and increasing demands on transportation facilities has generated increased interest in directly charging users of highways, airways, and waterways. In response to a request from the Senate Committee on the Budget, this study examines the advantages and disadvantages of alternative user fee structures, including existing taxes. In keeping with the Congressional Budget Office's (CBO's) mandate to provide nonpartisan analysis, no recommendations are made.

Elizabeth Pinkston and Rajagopalan Kannan of CBO's Natural Resources and Commerce Division wrote the study under the supervision of Jan Paul Acton and Elliot Schwartz. Robert Arnold, Maureen Griffin, Theresa Gullo, Marjorie Miller, Linda Radey, Pearl Richardson, and Mitchell Rosenfeld of CBO offered insightful comments and criticism. The authors wish to thank George Antle, Dan Badger, John Fischer, Richard Golaszewski, Stefan Hoffer, Thomas Hopkins, Jeff Hornbeck, Jack Lane, Douglass Lee, James March, Daniel Taylor, William Vickrey, Jack Wells, and Clifford Winston for their helpful comments.

Sherwood D. Kohn edited the manuscript. Chris Spoor provided editorial assistance. Gwen Coleman produced numerous drafts of the study. Kathryn Quattrone prepared the report for publication.

Robert D. Reischauer
Director

May 1992

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Summary

The methods of financing highways, airways, and waterways influence both the amount of revenue that can be raised and the efficient allocation of resources. The concept of revenue adequacy--whether revenues cover costs--is important to the cash-strapped federal government, but it also has implications for efficient allocation of resources in the long run. If the costs of an investment project cannot be recovered from those who use it, the project's feasibility comes into question. But an investment that benefits society is worth making, even though it may not be possible to charge users for it. This often characterizes goods and services provided by the federal government, and it underlies the rationale for government rather than private activity in certain sectors. Revenue adequacy can provide information about the demand by users for public investments, but it alone cannot be the criterion upon which investment decisions are made.

Economic efficiency is the second criterion by which financing mechanisms are evaluated. The standard definition of allocative efficiency is used here: does the price--the value consumers place on the product or service at the margin--equal the marginal cost--that is, the value of resources used in producing the last unit? If the price is less than the marginal cost, consumers tend to overuse the resource; if the price exceeds the marginal cost, they use it too little.

The objectives of revenue adequacy and economic efficiency sometimes conflict. Economic theory offers some ways of minimizing the trade-offs, and these are included in the discussions of alternative pricing mechanisms.

This study concludes that existing federal taxes produce enough revenue to cover current spending on the nation's system of highways. But the present highway tax structure is not as efficient as it could be. Some users--such as 13-ton single-unit trucks with three axles--pay taxes that exceed their marginal cost, while others--such as 40-ton tractor semitrailers with five axles--pay less than their marginal cost. An alternative approach that would include charging users according to the pavement damage and congestion they cause could cover costs and lead to greater economic efficiency.

Existing federal taxes do not meet the criterion of revenue adequacy for airways--the air traffic control system. As prescribed by law, aviation tax revenues cover all investment spending by the Federal Aviation Administration (FAA), but only part of the operating costs. Taxes paid by commercial air carriers appear to cover their costs, while those of general aviation fall short. Aviation taxes are not particularly efficient either, since they do not closely correlate with the costs of services provided by the FAA. Marginal-cost pricing of air traffic control services

probably could not raise enough revenues to cover costs. When combined with congestion charges, however, it might meet the criterion of revenue adequacy. This study examines ways of mitigating the trade-off between cost recovery and efficiency.

Existing fuel taxes raise less than 10 percent of spending by the Army Corps of Engineers for navigation purposes on inland waterways. On a systemwide basis, fuel taxes appear roughly equal to marginal costs, although a lack of data hinders a detailed analysis of costs. If the federal government could determine marginal costs with confidence and charge users accordingly, revenues would probably be about the same as now, falling far short of covering all costs. In relation to the amount of traffic they bear, some segments of the waterway system cost much more to operate than others. This finding suggests that users of low-cost waterways subsidize those of high-cost waterways. Many tow operators use both low-cost and high-cost waterways, however, thus complicating assessment of the amount of cross-subsidy.

Chapter One

Introduction

In recent years, the combination of budgetary pressures at all levels of government and increasing demands on transportation facilities has generated increased interest in directly charging users of public infrastructure. As a result, alternative ways of setting prices for the use of highways, airways, and waterways, and the advantages and disadvantages of different approaches, are of vital concern.

One key characteristic of the transportation infrastructure is that investments are costly, but once made can accommodate individual users at relatively low marginal costs (up to the point where congestion becomes important, after which the marginal cost rises steeply). Once a highway has been built or a waterway dredged, the cost of accommodating an additional automobile or barge tow is usually quite small. Thus, if users were charged a price equal to the marginal cost--the rule prescribed by economic theory to achieve efficiency in allocating resources--there would not be enough revenue to cover the total cost of the investment.

The dilemma is how to balance objectives of efficiency and revenue when they seem to conflict. Economic theory suggests pricing structures that allow revenues to be raised while preserving most of the economic efficiency derived from marginal-cost pricing. This chapter provides an introduction to the economic principles underlying these schemes.

Federal Financing of the Transportation Infrastructure

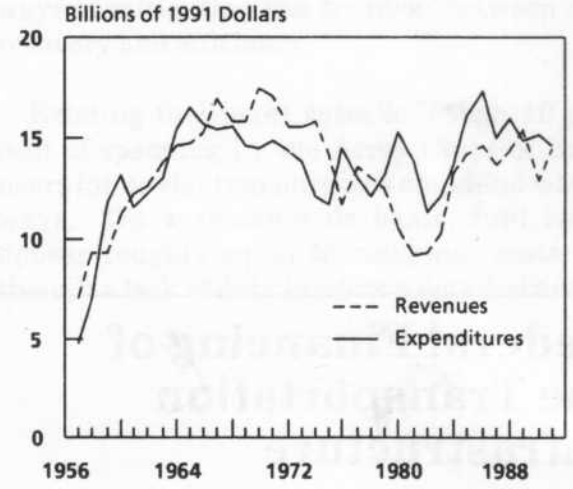
The federal government finances the construction and maintenance of highways, airways, and waterways through a mixture of general revenue funds and excise taxes levied on users. Over the past five years, federal outlays, in 1991 dollars, on these parts of the transportation infrastructure totaled $108 billion.[1] Revenues from excise taxes amounted to $91 billion. General revenues financed the balance of $17 billion. These total figures, however, do not show how much of the costs are recovered in each mode.

Figures 1, 2, and 3 show how trust fund revenues have correlated with expenditures since the formation of the highway, aviation, and inland waterway trust funds.[2] The high-

1. Outlays in a given year also include construction contracts signed in previous years for which money is now being spent. Thus, revenues collected in a year need not correspond exactly with the amount spent on users in that year. Over five years, however, the difference is likely to be smaller than in a given year.

2. As discussed in Chapters 2, 3, and 4, the laws governing the trust funds specify the kinds of spending that are authorized from them. For aviation and waterways, some kinds of spending are authorized from the general fund, not from the trust funds. The figures presented here simply compare spending with revenues from taxes related to use.

Figure 1.
Federal Highway Expenditures and Trust Fund Revenues, 1957-1991



SOURCES: Congressional Budget Office and "Historical Tables" of the *Budget of the United States Government: Fiscal Year 1992*. GNP deflator from the *Economic Report of the President, February 1991*.

NOTE: Figure 1 shows only revenues that go to the highway account of the Highway Trust Fund.

way trust fund began earmarking taxes for spending on roads in 1957, the aviation trust fund started in 1971, and the inland waterways trust fund began in 1980.

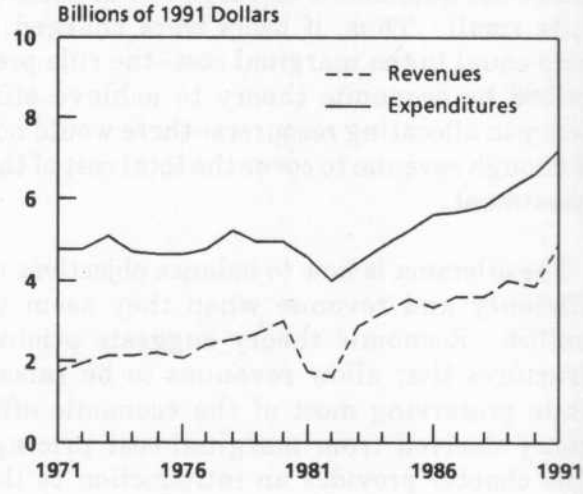
Highway tax revenues have been dependent on the state of the economy--falling, for example, during the recession of the early 1980s (see Figure 1). Spending on highways has fluctuated over the years because of a combination of economic conditions, changes in the scope of the highway program, and changes in the limits on obligations that could be incurred.

Aviation excise tax revenues, of which passenger ticket tax revenues formed the major part, dipped during 1981 and 1982 (see Figure 2). The reasons were a change in the ticket tax rate from 8 percent to 5 percent and the 1981-1982 recession.[3] Aviation expenditures remained at roughly the same level until 1986 (with a small drop in 1981 and 1982 because of the air traffic controllers' strike and its aftermath). Since then, spending has risen steadily, driven by the costs of developing and installing new technologies in air traffic control.

Tax revenues from traffic on inland waterways, shown in Figure 3, have remained about the same, in real terms, since the founding of the Inland Waterway Trust Fund. Spending on inland waterways declined in the early 1980s because of a hiatus for several years in the authorization of new construction projects. Spending rose after new authorization in 1986.

When expenditures are compared with trust fund revenues, federal spending on highways approximately balances federal revenues. Aviation revenues are consistently below expenditures. On a percentage basis, the inland waterway system is the most heavily subsidized of the three modes of transportation, although aviation is more heavily subsidized in absolute terms.

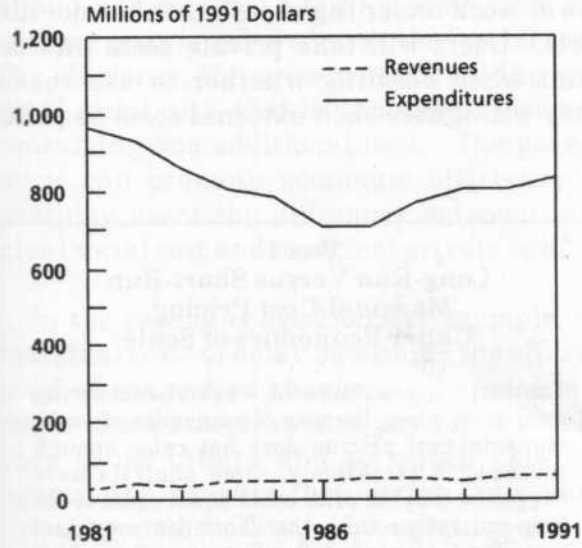
Figure 2.
Federal Aviation Expenditures and Trust Fund Revenues, 1971-1991



SOURCES: Congressional Budget Office and "Historical Tables" of the *Budget of the United States Government: Fiscal Year 1992*. GNP deflator from the *Economic Report of the President, February 1991*.

3. The dip in revenues during 1981 and 1982 was also caused by the expiration or decline of all other aviation excise taxes besides the passenger ticket tax between October 1980 and September 1982.

Figure 3.
Federal Inland Waterway Expenditures and Trust Fund Revenues, 1981-1991



SOURCES: Congressional Budget Office; Army Corps of Engineers, *1990 Inland Waterway Review* (draft); and "Historical Tables" of the *Budget of the United States Government, Fiscal Year 1991*. GNP deflator from the *Economic Report of the President, February 1991*.

Economic Efficiency and Other Goals

Economic efficiency is defined as the allocation of resources that produces the greatest satisfaction of wants within the constraints of scarce resources and technological limits. Resource allocation is considered efficient when no one can be made better off without making someone else worse off.

Cost recovery is also significant in deciding how to allocate resources, and it is especially important to deficit-ridden governments as they attempt to meet growing demands. The need to finance investment in the transportation infrastructure has led officials to seek ways of recovering a larger share of costs from users of the systems. Many previous studies have focused on cost recovery (or subsidy reduction) as the primary purpose of user fees. This study emphasizes economic efficiency and the trade-offs between efficiency and cost recovery.

Fairness is another issue. While efficiency is concerned with increasing the size of the resource pie, equity is concerned with its distribution. Changes in user taxes or user fees are likely to have different impacts on different users. It is important that the results be considered fair.

Finally, in government programs, administrative feasibility is a concern. A fee or tax system designed to increase economic efficiency may be so complex that the costs of collection and enforcement outweigh the benefits. Economic efficiency and administrative feasibility must be balanced.

The Role of Prices in Fostering Economic Efficiency

In a market economy, prices serve three key functions: they provide incentives for efficient allocation of resources, serve as a mechanism to recover the cost of production, and signal whether additional capacity is needed. If the price of a good or service is equal to the value of the resources used in producing it, resources are allocated to their most efficient use. If a good or service is provided free of charge or heavily subsidized, people tend to demand more of it and to use it more wastefully than they would if they had to pay a price that reflects its costs. The federal government can promote efficient and productive use of the goods and services it provides and controls by charging prices that reflect the cost of resources.

Designing user charges would be easier if a single fee structure could satisfy all of the objectives--namely, cost recovery, equity, and efficiency. Unfortunately, a fee structure that satisfies one or two of these objectives often violates the third. But the problem is not

surprising. It is often an important reason for government to provide the good or service. If the private sector cannot recover costs by charging users, it usually will not provide the good or service. If society judges that the benefits from the good or service are great enough to justify the expenditure, it is left to the government to provide it.

The Prescription for Efficiency: Set Price Equal to Marginal Cost

To achieve efficiency, the price of a service should equal its marginal cost--or, to be more precise, its marginal social cost in the short run. (See Box 1 for a discussion of long-run and short-run marginal costs.) The marginal cost is the value of the resources used in producing one more unit of service.

On the demand side, users compare the price of a good or service with the expected benefit of buying an additional unit. If the price is greater than the marginal benefit, users will not buy it; if the price is less than the marginal benefit, they will. When the marginal benefit equals the price and the price equals the marginal cost, resources are allocated efficiently and consumer welfare is increased to the maximum. On the one hand, if users are charged less than the marginal cost, they may be encouraged to overuse the service. On the other hand, if users are charged more than the marginal cost, they will be discouraged from using the service, even though they are willing to pay the cost of the marginal unit. Either way, resources will be used inefficiently.

Externalities and Social Costs

Some of the costs of using infrastructure are not incurred directly by the user or producer but by other members of society. These are called "external costs" or "externalities." For example, an additional automobile on a crowded highway imposes costs of delay on other motorists. Motor vehicles emit pollutants that make the air less healthy for motorists and nonmotorists alike. Aircraft noise detracts from the quality of life of people who live or work under flight paths near major airports. Users will take private costs into account when deciding whether to use roads. They will ignore such external costs as pollu-

Box 1.
Long-Run Versus Short-Run Marginal-Cost Pricing Under Economies of Scale

The text suggests several ways of recovering total costs when, because of economies of scale, marginal-cost pricing does not raise enough revenue. Alternatively, some analysts have suggested that the price could be set equal to the long-run rather than the short-run marginal cost. The long run is defined as a period in which all inputs can vary--that is, a period during which capital investments can be adjusted to an optimal level. For instance, in the long run, a highway can be built to the capacity needed to satisfy demand. Since investment can be adjusted in the long run to achieve optimal size, it follows that long-run costs can be viewed as the lowest costs that might occur in the short run for a given capacity. But capacity is not always optimal in the short run. If a shortage of capacity leads to congestion, for instance, the short-run marginal cost will exceed the long-run marginal cost. The efficient price would equal the short-run marginal cost; if the price were set equal to the long-run marginal cost, the result would be even more congestion.

Advocates of charging prices equal to long-run marginal costs imply that this approach will cover investment costs, since the cost of investment is an increment of costs. But this incremental cost applies only to the first use of the new facility. For each successive use--for example, the second and subsequent automobiles on a highway after it has opened--the marginal cost continues to be low in relation to the cost of the investment. Charging the first user of the new highway the entire cost of building it clearly is not feasible.

To get around this problem, some analysts suggest assigning increments of new investment to groups of users and charging a kind of average incremental cost divided by the number of users. But this does not yield the efficiency associated with marginal-cost pricing. The source of the problem remains the increasing returns to scale. Once the fixed capital is in place, the marginal cost of one additional user is often very small.

tion and noise, however, and thus will use more than the efficient amount.

An efficient price must reflect the private, public, and external marginal costs. The sum of these costs is referred to as the "social cost." For efficiency, the price must equal the marginal social cost--that is, the cost to society of consuming one additional unit. The government can promote economic efficiency by charging users the difference between marginal social cost and marginal private cost.

In the case of congestion, for example, the marginal costs of delay determine the efficient level of congestion charges. The goal is to make users recognize and pay for the delay they cause others and to weigh this cost against the benefits they derive from using the congested facility. If congestion charges are set too high, the additional benefits will be outweighed by the price (to the user) and usage will fall below the amount that the facility could sustain. If the charge is too little, the system will be overloaded.

Joint Costs

Although some costs are clearly associated with certain services, many costs of transportation infrastructure are joint costs. Joint costs are those incurred in simultaneously producing more than one service. For instance, a dam may aid navigation and control flooding. After subtracting any costs that are clearly attributable to navigation and those that are clearly attributable to flood control, assigning the remainder of the cost to either purpose is essentially arbitrary.

How, then, could the government charge users for joint costs? If efficiency is the goal, there should be no charge, since the marginal cost is zero. If cost recovery is the goal, the government must devise a way of allocating costs. One widely advocated approach is to allocate costs according to the benefits received by each user or class of users. The Federal Highway Administration, the Federal Aviation Administration, and the Army Corps of Engineers have developed procedures for allocating joint costs among users of highways, airways, and waterways.

Taxes, User Fees, and Marginal Costs

Users of transportation infrastructure are taxed to help finance the facilities. These levies include taxes on gasoline, diesel, and other motor fuel; trucks and equipment; airline passengers and freight; fuel used by general aviation, and fuel used by tow operators on specified inland waterways. If these taxes closely reflected the marginal costs of infrastructure use, they would serve as good proxies for prices and would encourage efficient use. But existing taxes do not generally reflect the marginal costs. They raise revenues, but they do not necessarily provide the proper signals for efficient use. This does not mean that taxes are always less efficient than user fees. Taxes can be designed to be efficient, and user fees can be inefficient in design.

Although taxes imposed on users are sometimes called user fees, a distinction should be made between taxes and user fees. Taxes may or may not be closely related to the cost of using a facility; their primary purpose is to raise revenues. User fees, however, are more closely related to the cost of using a facility. For example, tolls are generally considered user fees, while excise taxes on fuels are considered just taxes.

Cost Recovery Under Economies of Scale

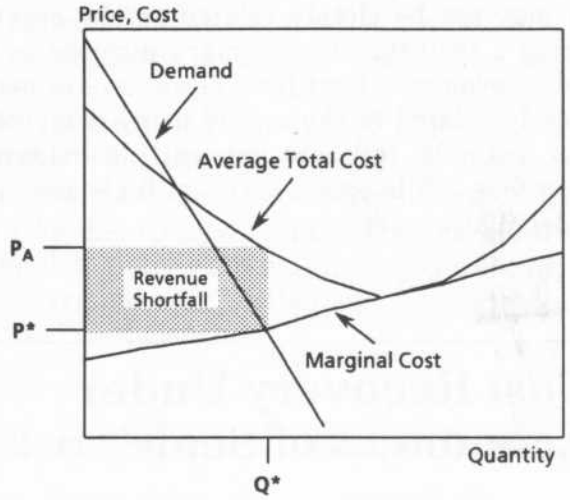
Transportation infrastructure is often characterized by economies of scale (see Box 2). Fixed costs tend to be large compared with marginal costs. The marginal cost of one additional automobile on an uncongested highway is quite small when compared with the cost of

Box 2.
Costs, Revenues, and Economies of Scale

"Economies of scale" means that the cost per unit falls as greater numbers are produced. One implication is that the marginal cost is less than the average total cost. Setting the price to be equal to marginal cost fails to cover the average total cost.

The cost structure of a firm characterized by economies of scale is illustrated in the figure below. The demand curve--which shows the quantity demanded at each price--intersects the marginal cost curve where the average total cost is greater than the marginal cost. The efficient quantity of output is shown as Q*, the quantity at which the demand (price) equals the marginal cost. But, as the figure shows, at this price and quantity, total costs (equal to quantity Q* times the average total cost of producing that quantity, shown as P_A) exceed total revenues (quantity Q* times price P*). The revenue shortfall is shown as a rectangle. The objective is to find a way of producing an efficient quantity while also covering total costs.

The Cost Structure of a Firm Characterized by Economies of Scale



SOURCE: Paul A. Samuelson and William D. Nordhaus, *Economics*, 12th ed. (New York: McGraw Hill Book Co., 1985), p. 525.

NOTE: The marginal cost curve intersects the average total cost curve at the latter's minimum point.

building and maintaining the highway. Once a waterway is dredged, the cost of one additional tow or ton-mile (the movement of one ton the distance of one mile) is small. One additional airplane in uncongested airspace imposes little cost on the air traffic control system. Because marginal costs are relatively low, charging a price equal to the marginal cost usually will not raise enough revenue to cover the total cost.

Deciding on a trade-off between efficiency and cost recovery when there are economies of scale is essentially a political choice. But there are ways of decreasing the inefficiencies of diverging from marginal-cost pricing while raising additional revenue.

General Subsidy

One way to recover costs is to charge users the marginal cost and make up any shortfall in revenues with subsidies from general government funds. This approach employs a simple pricing structure to encourage efficient use. One disadvantage is that the taxes used to raise general fund revenues may themselves distort incentives for efficiency. For example, individual income taxes--the source of 45 percent of federal receipts in 1991--may affect people's decisions about investing or dividing their time between work and leisure in ways that reduce productivity in the economy. Another disadvantage of using general revenues is that people who pay for something they do not use may perceive that financial policy as unfair.

Price Discrimination

Another approach to cost recovery is to divide users into different classes and charge them different prices. Airlines, railroads, telephone companies, electric and gas utilities, and other industries with large fixed costs practice price discrimination extensively. The idea is to charge a higher price to--and recover a greater share of costs from--users whose demand is

relatively inelastic, while charging a lower price to attract marginal customers.

Ramsey Pricing

Ramsey pricing, which calls for charging users according to their elasticities of demand (the percentage change in the quantity demanded in response to a percentage change in price) is a technique that uses price discrimination.[4] It is a "second best" pricing rule in the sense that it departs minimally from the "first best" rule of price being exactly equal to marginal cost. Ramsey pricing increases economic welfare while meeting a revenue constraint (typically that the organization break even or earn a target rate of return). It is an efficient pricing mechanism because each use is charged a price that is as close as possible to the marginal cost of supply. Users who value a commodity most (as reflected by inelastic demand) receive larger adjustments to price in order to equate needed total revenue with total cost. Ramsey pricing transfers some of the consumers' surplus to the producer--in the case of highways, airways, and waterways, the federal government. It allows total costs to be covered while meeting the efficiency criterion of setting the price equal to the cost of the marginal unit.

Ramsey pricing has some disadvantages. One is the information requirement. Estimating different users' elasticity of demand is often difficult, as is administering a system that employs different prices for different users. Another disadvantage of Ramsey pricing is that it often cannot be sustained over the long run because users who are charged higher prices seek alternatives. When railroad rates were strictly regulated, for example, the relatively high rates charged for transporting manufactured goods induced many shippers to switch to trucks.

Users with inelastic demands might complain about the inequity of paying more for a service because they have the fewest alternatives. But as long as the price paid for each unit of output exceeds the marginal cost, all users benefit; the excess of price over marginal cost contributes to overhead costs and makes it possible to continue providing the service.

Two-Part Tariffs

A two-part pricing mechanism is still another way to handle the problem of high fixed and low marginal costs.[5] Users could be charged a flat rate--a kind of admission fee allowing them access to infrastructure--to cover the fixed costs and a per-use price to reflect the marginal cost. Barge companies, for example, could be charged a fixed fee for a license entitling them to operate on the inland waterway system (or part of the system) plus a fee per use reflecting the marginal cost.

This approach preserves the incentives for efficiency of marginal-cost pricing while raising revenue to cover fixed costs. One disadvantage might be a perception of inequity arising from the fact that all users would face the same fixed fee, regardless of whether they used the service regularly or only occasionally. Another disadvantage is that some users who might be willing to pay the per-use price might not be willing or able to pay the fixed fee. A two-part tariff loses efficiency if users who are willing and able to pay the marginal cost are denied service. These disadvantages could be tempered by allowing users

4. Frank Ramsey, "A Contribution to the Theory of Taxation," *Economic Journal*, vol. 37 (March 1927), pp. 47-61. See also William J. Baumol and David F. Bradford, "Optimal Departures from Marginal Cost Pricing," *American Economic Review*, vol. 60 (June 1970), pp. 265-283; Elizabeth E. Bailey and Lawrence J. White, "Reversals in Peak and Offpeak Prices," *Bell Journal of Economics and Management Science*, vol. 5, no. 1 (Spring 1974), pp. 75-92; and Stephen Brown and David Sibley, *The Theory of Public Utility Pricing* (New York: Cambridge University Press, 1986), p. 50. The last offers a numerical example as well as a complete exposition of Ramsey pricing.

5. For an early discussion of two-part pricing, see Walter Y. Oi, "A Disneyland Dilemma: Two-Part Tariffs for a Mickey Mouse Monopoly," *Quarterly Journal of Economics*, vol. 85, no. 1 (February 1971), pp. 77-90. See also Brown and Sibley, *The Theory of Public Utility Pricing*.

If existing infrastructure services are priced, the reaction of users can provide information about their demand for new services.

to choose between paying a large entry fee and low unit price, or no entry fee but a relatively high price per use.

Average-Cost Pricing

An alternative to marginal-cost pricing as a way of raising enough revenue to cover costs is to charge users the average cost of the services.[6] By definition, this approach ensures that total costs will be covered by revenues. But some efficiency is lost, since the average-cost price exceeds the marginal cost. Users who value an additional unit of service at more than the marginal cost but less than the average cost will not be willing to pay a price as high as the average cost. Thus, they will not buy more of the service, even though they place a higher value on it than it costs to produce. The resulting output will be less than the efficient amount.

The main advantage of average-cost pricing is that it raises enough revenue to cover total costs. It also may be perceived as equitable, since all users pay the same price for a service.

6. Where there are joint products, however, average costs cannot be precisely defined.

Equity Considerations

Adopting a more efficient system of user fees would probably have distributional consequences. Some users would wind up paying more, and some less, than they do now.

Economists use several concepts of equity in assessing taxes or user fees. One is that similarly situated individuals should be treated similarly. Another is that individuals who have more money should pay higher taxes than those who have less. A third concept of equity is that people who derive benefits from a service should pay for it.

Administrative Feasibility

One of the disadvantages of alternative pricing schemes is that they are difficult to administer. There are well-developed systems for collecting and enforcing taxes on users of transportation infrastructure. New administrative mechanisms would be needed if user fees reflected marginal costs.

As discussed in the following chapters, marginal costs associated with use of infrastructure have been estimated, but additional refinements would be desirable if the estimates were to be the basis for user fees. If the Congress expressed interest in pursuing cost-based user fees, however, researchers would probably step up their efforts to determine the efficient level of fees and to develop collection and enforcement mechanisms. Increased interest by policymakers in toll roads, for instance, has stimulated development of electronic toll collection, and the concern of the states about truck weights has prompted development of mechanisms to weigh trucks while they are moving at highway speeds. Efforts of states to comply with the Clean Air Act have generated research on the costs of vehicle emissions.

At the federal level, improved cost accounting is needed to generate the data that would make efficient charging possible. The Chief Financial Officers Act of 1990 calls for improved accounting systems and procedures. Although the focus is on financial management, the law also provides for developing and reporting cost information.

Finally, more information about the demand for transportation infrastructure would illuminate the expected responses to alternative pricing arrangements. This outcome would be especially helpful for designing efficient schemes of pricing and estimating the revenue impacts. Efficient prices also would help predict how users might change their patterns of use--including possible shifts between rail and barge or trucks and rail.

Efficiency in Investment

This study focuses on using prices to create incentives for efficient use of the existing infrastructure in the short run. But prices can also play a role in making efficient investments in new infrastructure.

Benefit-Cost Analysis

Investment decisions typically are guided by benefit-cost analysis, which estimates expected benefits and costs over the life of an investment. Estimating the benefits of a public investment project can be difficult, however, especially if indicators of demand--how much users are willing and able to pay--are not available. If existing infrastructure services are priced, the reaction of users can provide information about their demand for new services. The amount users are willing to pay to alleviate congestion delays, for instance, can suggest how expanding capacity would be beneficial.

In some cases, there may be an economic rationale for not charging users the full cost of the system. If an investment provides benefits to nonusers, such as economic development or national defense capabilities, the beneficiaries of these external benefits could be charged or taxed accordingly.

Charging for Prospective Investments Versus Past Investments

In considering efficient pricing mechanisms, a distinction should be made between existing capital and future investments. Past investments can be regarded as sunk; that is, whatever resources have gone into them have already been spent. What is relevant for economic efficiency is that prospective resource allocation be cost beneficial. If the marginal cost of using a past investment is zero, economic efficiency would require that users not be charged because even a small fee might cause use to decrease when the resource cost of doing so is less than the value. That would diminish efficiency.

This leaves open the question of whether the prospect of having to pay fees for using a new investment can help shape the demand for that investment. If users expect to pay fees for an investment, they may press more vigorously for an efficient investment than if it were paid for out of general tax revenues.

The Transition from Taxes and Subsidies to Prices

Any change in user fees could impose significant costs on whole industries or individual classes of users of transportation infrastruc-

ture. The questions then arise: how great would the difficulties of transition be, and what steps could be taken to ameliorate them?

The Costs of Transition

Many of the user fees considered in this study would not greatly increase the total economic burden on users. Since highway expenditures are already in balance with highway excise taxes, user fees would only redistribute the burden of its cost among the classes of users. Similarly in aviation, the revenues from passenger ticket taxes appear to cover the costs that commercial airlines impose on the aviation system.

For some groups, however, the burden of user fees would increase substantially. If asked to cover their costs, barge operators would face much larger fees than they now pay in fuel taxes. General aviation users would also face a steep increase in their operating costs if fees were set to recover the costs they impose on the aviation system.

In addition, many private-sector investment decisions are based on the existence of public subsidies, and imposing user fees to reduce these past subsidies could create difficulties. Barge operators on the inland waterway system have come to expect the subsidies they receive. Large increases in user fees could jeopardize some of their operations and the businesses of their suppliers and customers. Similarly, trucking companies have made decisions about investments in trucks and trailers in part on the basis of the current tax structure, as well as on federal and state policies regarding truck size and weight. If fees based on axle weight and distance traveled were imposed, trucking companies would incur the costs of altering their fleets to reduce costs.

Easing Transition Problems

Gradually imposing user fees could help such users to adjust to new cost conditions. Fees phased in over a period of years could allow users to absorb new operating costs. But phasing in user fees would delay the benefits of recovering federal costs and realizing gains in economic efficiency. Such delays, however, might be worthwhile if they would ease the transition to a system that would yield the net long-term gain to the economy that user fees on transportation infrastructure would deliver.

Conclusion

The economic principles set forth in this chapter provide a framework for assessing the current set of taxes imposed on users of transportation infrastructure. As discussed in the following chapters, the existing taxes fall short on the efficiency criterion. Alternative financing mechanisms that more closely resemble marginal-cost pricing could promote greater efficiency in infrastructure use.