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New Transportation Revenue Sources for Washington State

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Final Report

Research Project GC8286, Task 38
Transportation Revenue Sources -- New/Current

NEW TRANSPORTATION REVENUE SOURCES FOR WASHINGTON STATE

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EXECUTIVE SUMMARY

Washington state's biggest capital investment is at risk. Its system of roadways, bridges, and railroad crossings is aging and deteriorating rapidly. Traffic exceeds capacity on many stretches of local and state roads. Wide-scale widening and rebuilding of bridges are needed throughout the state, and many railroad crossings need improvement. A recent Federal Highway Administration (FHWA) study rated the Seattle area traffic congestion the sixth worst in the nation.

The Road Jurisdiction Committee, which was appointed by the legislature to estimate roadway needs, has conducted a comprehensive evaluation of the roadway needs of state, county, and city governments from 1987 to 2000. Total statewide needs are projected to fall between $28.3 billion and $33.6 billion (current dollars) for the period 1987 through 2000, inclusive. However, only $13.7 billion in revenues is projected to be available to meet those needs. The statewide funding shortfall is therefore between $14.6 and $19.9 billion, expressed in current dollars.

The purpose of this study is to examine potential sources of revenue in light of the considerable shortfall projected through the year 2000. The report covers existing revenue sources and some new sources of revenue currently under consideration, but concentrates on two: road use pricing and parking taxes.

OPTIONS ALREADY UNDER CONSIDERATION FOR RAISING REVENUE

A number of innovative methods for financing transportation needs have been developed and used by state and local transportation agencies across the country. Some of these techniques have involved user charges. Others have focused on capturing some of the economic benefits resulting from transportation improvements through the use of indirect beneficiary assessments or through increased private sector involvement in public projects, e.g., joint development efforts or privately raised capital. As funding from traditional sources has

decreased, transportation agencies have found these techniques to be increasingly important in helping them meet their local transportation needs.

User charges

User charges under consideration for raising revenue include gasoline taxes and other motor vehicles taxes and licenses. Increasing the fuel tax by 1¢ per gallon would result in a revenue yield of $24 million annually for the state. A local option increase of 1¢ per gallon in King County could raise almost $8 million annually. An increase of .1 percent in the motor vehicle excise tax would yield $13 million for the state annually. A weight/distance tax could be charged for trucks and other heavy vehicles to account for the amount of damage to the roadway.

Indexing the motor fuel tax to inflation and consumption would stabilize the real buying power of the motor fuel tax, despite rising fuel prices and falling consumption. Examples of states that have adopted indexing are Ohio, Michigan, and Wisconsin.

Not all vehicles using highways are taxed. For instance, motor vehicles and trailers that transport persons or property for interstate commerce are currently exempted from state sales tax. This and other exemptions could be reviewed. Withdrawal of some exemptions would increase revenue.

Non-user charges

Non-user charges can also be levied to recoup revenue realized from increases in property value and commerce as a result of transportation investments. Some examples of such levies include negotiated investments, development impact requirements, special benefit area assessments, tax increment financing, and joint development ventures. The differences among these approaches are primarily (1) whether they are required or negotiated, (2) whether the property is already developed, and (3) where the revenue initially comes from.

Other non-user sources include marketing and merchandising approaches, debt management techniques, and other tax sources not directly related to transportation. None of these are possible for managing demand.

REVENUE SOURCES RELATED TO DEMAND MANAGEMENT

The only revenue sources that show any promise for demand management are user-based charges. In this study, two sources emerged that are not only related to highway use but that also can be related to highway use by time of day and location. Therefore, they could be used as very effective tools for controlling congestion, as well as raising revenue. These two sources are road use pricing and parking taxes.

Road use pricing

In comparison to other tax-supported financing for highways, road use pricing presents certain advantages and disadvantages. Relative to non-toll routes, toll facilities incur extra capital costs and operating expenses. Toll collection may also entail delays. However, the generally better condition of toll roads provides an offsetting benefit. Other costs of toll roads include the relatively higher costs of debt financing and the diversion of traffic that results from charging tolls. Countering these additional toll-related costs is the potential for tolls to expedite financing and road construction, to improve project selection, and to relieve traffic congestion. These financing and economic issues dominate the debate over road use pricing.

Federal policy toward road use pricing. Federal support for road use pricing has varied widely. Toll roads have existed in the U.S. since the 18th century. During the first half of the 20th century, however, little activity in toll road construction occurred. After the Second World War, the discrepancy between the growth of road traffic and the backlog in road construction built up during the war left a road network ill-suited to meet the demand. Interest was then renewed in the

financing of roads by tolls, and on their own initiative various states started to authorize and construct toll roads and turnpikes. Between 1950 and 1954, 19 states created tolling organizations or made use of their road service to construct turnpikes.

In response to a fear that turnpikes would displace the Interstate network, in the 1956 Federal-aid Highway Act Congress restricted the use of revenue from tolls to other road and tunnel projects and required the cessation of toll collection once the debts had been retired. Subsequently, sporadic legislative measures have allowed certain states to repay aid received from the federal government for the construction of connecting roads to toll roads. This legal context proved to be favorable to the growth of road tolls in the 1950s. A 1978 decision by Congress permitted the use of Interstate program funds for turnpikes, if the state concerned agreed to give access to the road once sufficient income had been collected to retire outstanding loans. Agreements to do so have been entered into by New York, Connecticut, Kansas, and other states.

In view of the inadequacy of federal funding, Congress established a pilot toll financing program in the new highway bill enacted in April 1987. The pilot program authorized by the Congress permits federal-aid financing of seven non-Interstate toll facilities. Five of the specific locations of these pilot programs are Orange County, California, and the states of Texas, Pennsylvania, Florida, and South Carolina. Under this pilot program the toll projects must be either new, non-Interstate toll highways or reconstruction to expand the capacity of existing non-Interstate toll facilities. Federal participation is limited to 35 percent of the construction or reconstruction costs, and toll facilities may receive federal participation only once for the original construction or reconstruction, except for reconstruction to expand capacity.

The objectives of road use pricing. Two of the objectives of road use pricing are to raise additional revenue and to manage congestion. The second objective

requires some explanation. When a road is congested, each additional vehicle slows down all other vehicles, and, therefore, raises the cost of other people's trips. This extra cost is one of the external costs that is usually not perceived by the road user. By requiring the user to pay the marginal cost of using the congested road, including "external" costs, a road use tax efficiently allocates resources.

Administrative issues. Toll collection can be an expensive way of raising highway revenues. As traditionally practiced in the U.S., toll collection is labor intensive, with labor costs accounting for as much as 80 percent of total collection expenses. Technological improvements as well as better management techniques have sought to trim the labor intensity of collection. For example, the use of mainline toll barriers has reduced the need for staffing each point of access and egress. The substitution of automatic machines for human toll collection has further reduced the necessary personnel. Other innovations include the collection of tolls in only one direction with a doubling of the toll rate and limits on the collection hours to avoid low volume periods.

Recent trends in technological improvements have been directed towards lowering the operational and maintenance costs. The other issue that technology has sought to address is the speed of the collection process. Systems using various technologies, including optical labels scanned by cameras, microwave systems, low frequency induction, and laser beams, are all based on the goal of identifying and automatically recording each vehicle as it crosses a toll plaza. Such "automatic vehicle identification" (AVI) systems are being developed and applied on an experimental basis in a variety of settings in the U.S. and other countries.

Toll authorities around the world have been investigating electronic road use pricing for some years. Over the period 1983 to 1985, the Hong Kong government commissioned a pilot study to examine the viability of electronic road pricing (ERP) in the territory. In the fall of 1988, the Dutch government adopted a policy to pay highway costs through road use pricing using electronic means.

User reaction. Predicting highway user responses to road use pricing is a challenging problem. Many factors are involved in forecasting the use of facilities on which tolls are charged. Some of those factors include alternative routes, trip length, trip purpose, vehicle mix, timing of toll introduction, and toll cost versus total trip cost. Estimating the elasticity of use with respect to toll requires an understanding of all these factors.

Estimated yield from road use pricing. For this study, four alternative road use pricing scenarios were investigated:

1. constructing a new highway,
2. imposing a toll on an existing facility to finance improvements,
3. imposing a "barrier" toll to relieve congestion in a specific area, and
4. imposing an "area-wide" toll for the purposes of relieving congestion and producing revenue.

The last three alternatives might require some federal payback. In each case, three different kinds of payback were analyzed: (1) all federal aid is paid back, (2) federal aid is depreciated over a 20-year period and the remaining value is paid back, and (3) as in the current federal demonstration project, 35 percent of the amount in option 2 is subsidized by the federal government.

For the purpose of this study, the first option assumed the possibility of building a new bypass around Seattle. The route would go from Auburn to the east of Lake Sammamish to just south of Everett. It would be a four-lane facility with connections to I-5 at either end. It would be approximately 50 miles long. The toll required to build the facility would vary between about 3 and 10 cents per mile, depending on the ratio between peak and off-peak charges. A typical work trip of 10 miles would cost between 45 cents and $1.30, depending on the peak to off-peak charging ratio and the amount of federal subsidy assumed.

For the second option, the imposition of a toll on the Evergreen Point Bridge was analyzed. By charging 25 cents in the peak period and 10 cents in the off-peak

on SOVs only, about $3.3 million per year could be raised and average vehicle occupancy would increase by about 10 percent.

The third option analyzed in this study was the charging of a toll on all vehicles entering the central part of Seattle, similar to the system used in Singapore. By imposing charges on all SOVs using the same assumptions as in option 2, the annual yield would be about $25 million. However, if federal payback were required on all the affected highway facilities in this option, a charge of at least $1 would be required in the peak period to realize a positive return.

Option 4 was an "area-wide" toll. In this option, all travel in King County was assumed to be tolled. An average charge of 3 cents per mile in the peak periods and 1 cent per mile in the off-peak periods would yield around $180 million per year in the county and would be equivalent to raising the gasoline tax by about 24 cents per gallon. Federal payback would require between $85 million and $130 million per year, leaving a substantial amount for transportation investment. With the assumptions used in this analysis, vehicle miles traveled would be reduced by about 2 percent. Higher levels of charges would reduce travel even more.

Parking tax

Parking is a critical element in the transportation system. Parking is not only essential for the auto traveler, but it is also a crucial variable that influences investment decisions and residential or job location decisions. It is the most sensitive variable in modal split models. Because of the importance of parking, any policy affecting its price is a sensitive political issue. Parking taxes have been adopted in many cities all over the world, and in the U.S. the following cities have had a parking tax for more than 10 years: San Francisco, Chicago, Washington, D.C., Pittsburgh, Philadelphia, and New York.

Objectives for a parking tax. Parking taxes are an alternative way of charging vehicle owners for the use of roads. To the extent that the parking tax is

passed directly on to the parker, it is like a road use tax and can be an effective method to deal with congestion.

The impact of imposing a parking tax is controversial. While virtually all studies of parking price concur that transportation choices are highly dependent on parking price, it is not clear how to impose a parking tax that will have the desired effect on mode choice and frequency of travel. A parking tax can certainly raise revenues, but unless it is passed directly to the parkers **and they perceive the additional cost**, it is unlikely to be a useful tool in demand management.

Parking involves two primary types of social costs:

1. those due to added traffic congestion and
2. foregone taxes on valuable land.

The first kind of social cost is time-dependent. That is, only those who drive to parking places during the peak hours impose these costs on others. The type of parking involved is long term, used primarily by commuters. The second kind of social cost is imposed by all parkers. Whenever a parking place doesn't generate as much tax revenue as surrounding business or retail use, those who use the parking place are imposing social costs on others. A parking tax is a way of addressing these economic issues.

A parking tax has horizontal equity if it is imposed equally on those receiving the benefits. However, if parking is provided free, or otherwise subsidized by employers, a parking tax is not paid equally. If the employer bears the cost of the parking tax, the cost is passed on either to shareholders in the form of reduced profits or to employees in the form of reduced wages and benefits. Obviously, not all shareholders or employers benefit from the parking.

If employers were allowed to give tax-exempt travel allowances to employees or parking subsidies were discouraged or disallowed by some other means, the imposition of a parking tax would be more equitable. In addition it would work more efficiently to control travel demand. However, a parking tax imposed without

any control of subsidies would still distribute the social cost of parking more equitably than it is distributed at the present.

Administration of a parking tax. There are at least three potential ways to levy a parking tax:

1. an ad valorem tax,
2. a fixed fee per space, and
3. a fee based on property value.

An ad valorem tax is the method currently used in most places that have a parking tax. Using this method allows automatic adjustments with inflation. However, this method does not allow charging for employer-owned parking lots where parking is free. The tax can be collected as part of the business and occupation tax. The amount of tax can be determined from income tax reports. No additional reporting mechanism is required.

Currently, the City of Seattle charges an annual public garage license fee of $30 per 1,000 square feet. By definition, this fee can be levied only on public garages. The charge is not a tax, but a fee to obtain a license to operate a parking facility. Increasing the fee would require an amendment to the municipal code. Extending it to all parking would require authorization by the state legislature. However, if the legislative hurdles were overcome, the administration of the fee would require no new taxing structure, at least in the City of Seattle.

Charging a fixed fee per parking space has the advantage of being easy to enforce in comparison with an ad valorem tax. It is more difficult to determine the amount of an ad valorem tax for public garages, and nearly impossible for private parking lots. However, the amount of tax should be somehow related to the value of the property in order to make the parking tax reflect the social cost of lost tax revenue. Since higher cost parking tends to be in locations where there is more traffic congestion, the use of those parking facilities tends to be related to higher social costs because of congestion.

One way to compromise between a parking tax that is constant per space and one that varies according to parking price is to charge according to property value. Since any business or institution that owns parking lots pays a property tax, the value of the parking facility can be determined from a combination of land values and the value of any structure provided for parking. The parking tax can be collected as an element of the property tax.

Estimated yield from parking tax. For this study, two options were explored for imposing a parking tax. One was to use the existing public garage fee as a basis and collect the taxes as part of the Business and Occupation tax. The other option was to collect taxes from all off-street parking places devoted to long-term parking.

The current license fee in Seattle of $30 per 1,000 square feet works out to about 1.2 cents per parking stall per day. In the first option, if that amount were raised to 25 cents per day, the annual yield would be almost $5 million in the City of Seattle. However, such a policy would encourage more employers to rent spaces for employee parking to avoid the extra charge. In order for such a plan to work, the fee (or tax, in this case) would have to apply to rented space, as well as space available to the general public. In that case, the yields would be considerably higher.

The second option was taxing of all long-term, off-street parking in King County. The analysis revealed that the parking tax could be a major source of revenue for the transportation sector, in the range of $50 million to $200 million per year. The estimate of revenue was based on the number of employees and college students in King County, their mode split, and an assumption concerning the percentage of parking places that are on-street. It was also based on an average yield per space, but realistically, the range would be on the order of from one-half to four times the average. The best way to collect such a tax would be through an additional category for property taxes.

CONCLUSIONS

This report examines two new alternative sources of transportation revenue -- road use pricing and parking taxes -- and analyzes their strengths and weaknesses. The potential problems with each of the revenue sources are identified, and their collection and enforcement costs are also discussed.

The analysis reveals that both alternatives, besides having the potential to generate revenue, are economically sound. However, any particular tax instrument may not be able to achieve all policy objectives, and optimally, a number of tax instruments should be directed at the goal that they can best achieve.

These instruments also meet the requirements of a high quality revenue systems:

1. They produce revenue in a reliable manner. Reliability involves stability, certainty, and sufficiency.

2. They have a reasonably broad base.

3. They are equitable. The minimum aspects of a fair system are that (a) it shields genuine subsistence income from taxation, (b) it is not regressive, and (c) it imposes approximately the same burden on all households earning the same income.

4. The taxes are easy to understand, raise revenue efficiently, minimize compliance costs for taxpayers, and are simple to administer. This evaluation should be interpreted in relation to other tax instruments that require complex forms, procedures, and statutes of interpretation. The costs should also be considered relative to the benefits that accrue from them.

5. The recommended taxes are accountable to the public, and the benefits resulting from the revenue financed expenditure can be observed.

Legal, political, and institutional impediments to using these revenue sources are likely to cccur. Therefore, the public must be educated before these taxes or user charges are introduced so that the public is aware of the revenue needs and the equity and efficiency trade-offs of using these instruments. The issues to be debated include who pays versus who benefits, and how the potential losers are compensated. The answers to these questions have to be publicly understood for

the public and political acceptability of any tax. The closer the connection between those who benefit from the use of the revenue source and those who provide the revenue source, generally the more easily that support can be won. Legislative changes would be required for using any of these instruments, and thus an a priori condition for their introduction is the political will of the legislators.

Clearly, any program to improve, or even maintain, the current transportation system will require new revenue. Road use pricing and parking taxes are options that will satisfy this need and, at the same time, help to manage transportation demand.

CHAPTER 1. INTRODUCTION

Washington state's biggest capital investment is at risk. Its system of roadways, bridges, and railroad crossings are aging and deteriorating rapidly. Traffic exceeds capacity on many stretches of local and state roads. Wide-scale widening and rebuilding of bridges are needed throughout the state, and many railroad crossings need improvement. A recent Federal Highway Administration (FHWA) study rated the Seattle area traffic congestion the sixth worst in the nation.

Washington's roadway system is extensive, as illustrated in Table 1. Of the total 59,000 centerline miles of roads included in the Legislative Transportation Committee's Road Jurisdiction Study, approximately 12 percent are part of the state system, 70 percent of the miles are owned by counties, and 18 percent are city streets. Another indicator of the extent of Washington's roadway system is its utilization. Road system use is measured in terms of the vehicle miles traveled, which is the sum of the average distance driven by every vehicle on state, city, and county roads. Nearly 100 million vehicle miles are driven every day on Washington's roads; 58 percent of these miles are driven on the state system, 23 percent on the county system, and 19 percent on the city system.

Table 1. Scope of Washington's Road System by Jurisdictional Level

Jurisdictional Level	Centerline Miles		Lane Miles		Vehicle Miles Traveled[1]	
	Number	Percent	Number	Percent	Number	Percent
State	6,956	12%	17,391	14%	57,056	58%
County	41,615	70%	83,748	68%	21,941	23%
City	10,375	18%	22,202	18%	18,331	19%
TOTAL	58,946	100%	123,341	100%	97,328	100%

[1] Daily vehicle miles data (expressed in 1,000s) from 1986 HPMS information

Travel and tourism has become this state's fifth largest employer. Visitor spending helped create over 72,000 jobs in 1984 and provided $814 million in wages. Most travel, about 80 percent, is done in a private car. It is therefore essential for Washington to plan and maintain an attractive and safe highway system. The state's strategic position on the Pacific Rim increases this need, for the state's highway system is important to the state's competitive edge in international trade.

PROJECTED REVENUE NEEDS

The Road Jurisdiction Committee, which was appointed by the legislature to estimate roadway needs, has conducted a comprehensive evaluation of the roadway needs of state, county, and city governments from 1987 to 2000. Total statewide needs are projected to fall between $28.3 billion and $33.6 billion (current dollars) for the period 1987 through 2000, inclusive. The first amount is based on a lower level of roadway design standards, acceptance of greater levels of congestion, and lower levels of driver convenience. The higher amount reflects a higher level of design standards, provision of wider driving lanes, wider shoulders made of more durable materials, more parking space, more durable pavement materials, and roadways designed for faster traffic to handle more vehicles per hour. The Road Jurisdiction Study did not address problems that exist on many parts of the road system because of poor horizontal alignment (bad curves) or poor vertical alignment (steep grades).

In order to compile the list of transportation needs, the study made the following assumptions:

- **No traffic growth**. The base year traffic volume was assumed to continue throughout the study period.

- **Pavement strategies**. The study assumed that once the initial pavement deficiencies were overcome (i.e., the 1987 backlog was overcome), future programs would provide resurfacing at the proper time so that future pavement deterioration would not reach the level requiring more expensive rehabilitation and reconstruction treatments.

- **Existing highway systems**. Only the system of roads, streets, bridges, and railroad grade crossings existing in the base year were included in the study's analyses.

- **Widening feasibility**. The committee determined that no constraint should be placed on widening projects. It reasoned that if widening proved not to be feasible, the needs cost estimate for widening would reflect to some degree the cost of providing an alternative facility, perhaps on a new location.

A large part of the state's needs is accounted for by an existing backlog of work, which should be performed immediately. The backlog cost of between $9.4 billion and $13.5 billion covers improvement and maintenance work needed to overcome roadway, bridge, and railroad crossing deficiencies existing in 1987 (the study's base year). Nearly 40 percent of the total study needs identified exist today.

NEW REVENUES

Revenue projections assumed no changes in statutory authorization for any jurisdictional level. Legislated tax rates (e.g., motor fuel tax, licenses, fees), distributions, debt, and revenue source authorizations were held constant over the 14-year period in the study. Conclusions drawn from the revenue projections were that actual statewide road purpose revenues stated in current dollars would grow modestly (i.e., by 10 percent) over the 14-year projection period, from about $1.035 billion in 1987 to $1.124 billion in 2000. Projected revenue growth was attributed to increased property valuations, retail price increases, and other economic and population growth trends. Actual roadway costs were expected to increase by 111 percent because of inflation over the same period, resulting in a net loss in purchasing power.

Although total needs were estimated to be between $28.4 billion and $33.6 billion over the period 1987-2000, only $13.7 billion in revenues was projected to be available to meet those needs. Therefore, the statewide funding shortfall would be between $14.6 and $19.9 billion, expressed in current dollars. One of the primary findings of the study was that the shortfall would be approximately proportional at

each jurisdictional level. State, city, and county governments would each be able to cover about 45 percent of its transportation needs with existing revenue sources.

Looking to the future, roadway revenues available to the state government were expected to decline over the 14-year period, while city and county road revenues were projected to increase modestly. These inconsistent trends were the result of a differing mix of revenues used to meet the roadway needs at each jurisdiction level. However, all revenues were predicted to decline in purchasing power because of inflation. The shortfall for the state was estimated to be $6.5 billion, $5.3 billion for counties, and $2.8 billion for cities.

STUDY OBJECTIVES AND ORGANIZATION

The purpose of this study is to examine potential sources of revenue in light of the considerable shortfall projected through the year 2000. Chapter 2 briefly covers existing revenue sources. Chapter 3 discusses several new sources of revenue that are already under consideration. Chapters 4 and 5 go into more detail on road use pricing and parking taxes.

CHAPTER 2. EXISTING SOURCES OF REVENUE

The following is a summary of the existing primary sources of revenue and their projections for each jurisdictional level that was analyzed in the Road Jurisdiction Study.

STATE ROADWAY REVENUES

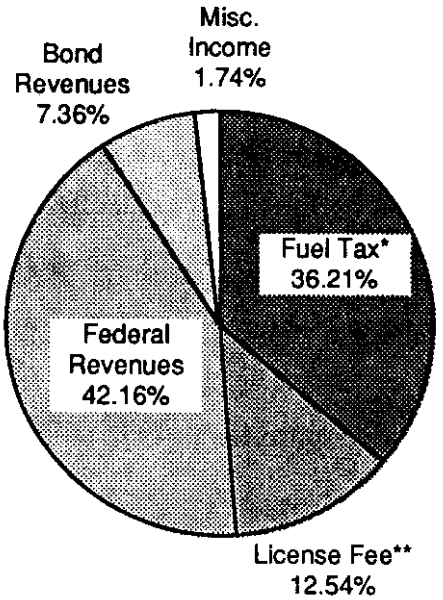
The Washington State Department of Transportation (WSDOT) funds roadways with five primary sources, as shown in Figure 1. These revenues include motor fuel tax; registration, license and fees; federal revenues; bond revenues; and miscellaneous income.

Motor fuel tax

The motor fuel tax currently is the second largest roadway revenue, but it will jump to first place (on a percentage basis) by the year 2000 with no change in legislated rates (see Figure 2). The motor fuel tax is currently assessed as a flat 18 cents per gallon, regardless of changes in fuel price. Given national and state trends of increased fuel efficiency, fewer gallons of fuel are projected to be sold even though miles driven are expected to increase. The net result is fewer overall revenue dollars produced from the motor fuel tax, assuming no changes in tax rates.

Registrations, licenses and fees

These revenues make up the second largest state source of roadway revenues. Fee rates and distributions are established by statute, and no changes were assumed over the 14-year projection period. These revenues are expected to increase in current dollar terms because of expected population and vehicle ownership increases.

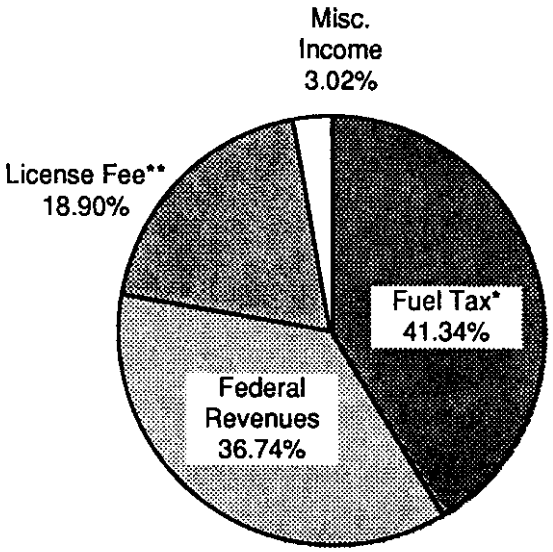


1987
TOTAL: $507,375,000

* share of Motor Fuel Tax available to highways after deductions

* share of registrations, license fees, and miscellaneous fees available for highway construction

Figure 1. Distribution of Road Purpose Revenues by Source – State Revenues



2000
TOTAL: $373,047,000

* share of Motor Fuel Tax available to highways after deductions

* share of registrations, license fees, and miscellaneous fees available for highway construction

Figure 2. Distribution of Road Purpose Revenues by Source – State Revenues

Federal revenues

Excluding Interstate completion funds, remaining federal monies are expected to decline modestly by the year 2000 (i.e., about 14 percent in current dollar terms). These estimates assume that after the current federal Surface Transportation Act expires in 1992, Washington will receive about 95 percent of federal motor fuel tax dollars paid by Washington motorists. (This compares unfavorably to Washington's current return of 170 percent for each dollar paid.) These revenues are assumed to be allocated to existing federal programs, excluding Interstate completion under historical distributions. Because of the complexities of the federal funding system, these projections could change significantly and should be revisited when future Surface Transportation Acts are enacted.

Bond revenues

Bond revenues provided more than seven percent of total state roadway revenues in 1987 but are projected to provide no revenue in 2000. All state bond issues are statutorily authorized, and these projections assume no legislative changes.

Miscellaneous income

This source accounts for one to three percent of total state road revenues. It is primarily derived from interest and investment income.

State road purpose revenues are expected to decline by 26 percent over the 14-year period in current dollars. The decline is much greater when one considers that over the same period inflation is expected to increase roadway costs 111 percent.

COUNTY ROADWAY REVENUES

Washington counties fund roads from five primary sources, as shown in Figure 3. Unlike the WSDOT revenue sources, which, under the study assumptions, are not predicted to grow over time, county roadway revenues are expected to

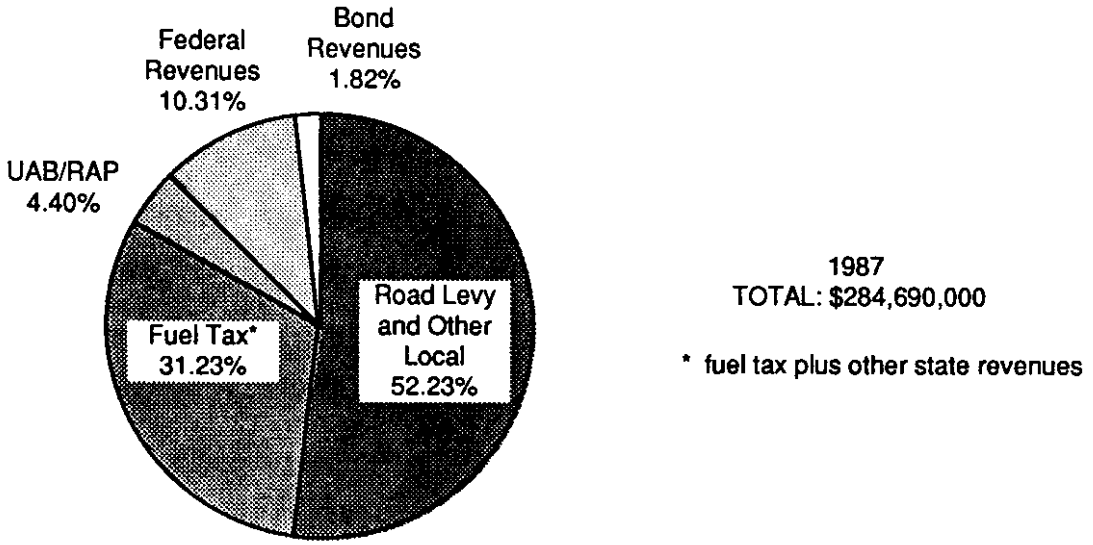


Figure 3. Distribution of Road Purpose Revenues
by Source – County Revenues

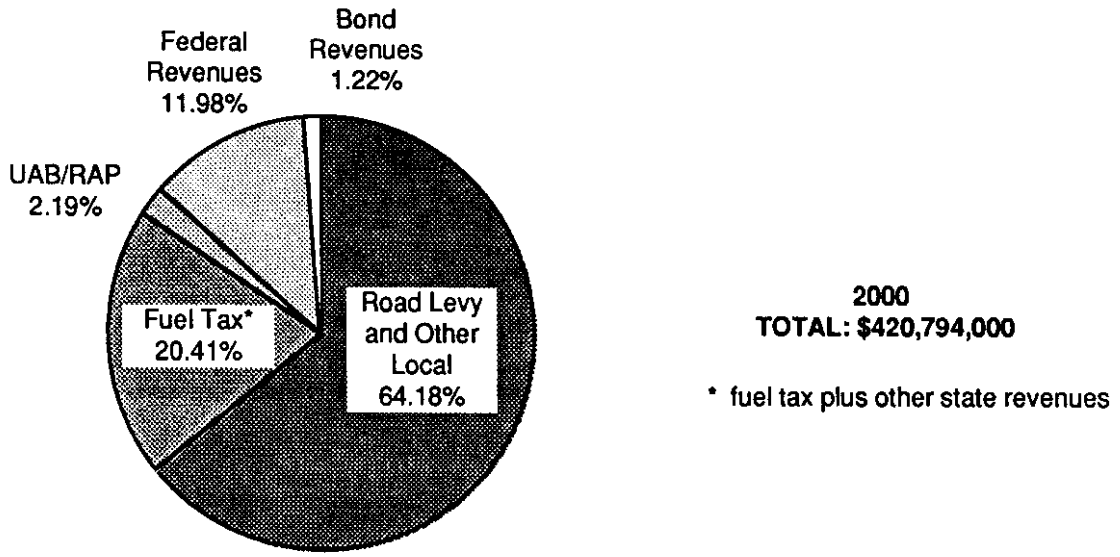


Figure 4. Distribution of Road Purpose Revenues
by Source – County Revenues

increase 48 percent over the 14-year study period in current dollars (see Figure 4). This still represents a loss in purchasing power when inflation is considered. County revenue projections assume continued funding of roads from discretionary local sources (e.g., road levy, other local income) in the same manner as in the last five years. Specific revenue sources include the road levy and other local sources; a share of motor fuel tax; federal revenues; and bond revenues.

Road levy and other local sources

The road levy is the single largest county roadway revenue source and is $2.25 per $1000 assessed value property tax. While this source can be used for current expenditures, projections assume that it will remain largely devoted to roads. This revenue source grows with increases in real property value. Other local sources include special assessments, other local taxes, and interest.

Motor fuel tax

The counties receive these revenues by formula distribution and by specific project funding from the Urban Arterial program and the County Road Administration Board's Arterial program. The rate of taxation is held constant, as are distribution formulae. As with the state, this revenue source is expected to decline in current dollar terms because of increased fuel economy.

Federal revenues

These funds are projected to increase for counties, given the assumptions of interstate completion, a 95 percent return of Washington motorist federal taxes paid, and allocation to existing programs using historical distributions. Federal funding decisions are subject to national considerations. They inherently contain risk of change and should be updated as future Transportation Acts are adopted.

Bond revenues

Unlike the state, counties can issue bonds without statutory change. Bond revenues are estimated to remain at a constant current dollar level throughout the

projection period. This estimate assumes continuation of trends from the past 10 years.

CITY ROADWAY REVENUES

Cities fund roadway needs with five primary revenue sources, as shown in Figure 5. Like county roadway revenues, city revenues are expected to grow over the 14-year projection period by 36 percent (see Figure 6). This still represents a loss in purchasing power, given inflation estimates of 111 percent over the same period. City revenue projections assume continued roadway funding from general funds, at the same priority demonstrated over the previous five years. Specific revenue sources include the general fund; motor fuel tax; federal revenues; and bond revenues.

General fund

By far the greatest roadway funding sources are non-dedicated, general government revenue sources, including property taxes, local sales taxes, other local taxes, parking meter revenues, interest, and other miscellaneous revenues. Allocation of these funds to roads is entirely discretionary on the part of local policy makers. These sources grow with inflation and are projected to make up 60 to 70 percent of total city roadway revenues.

Motor fuel tax

These revenues are expected to decline in current dollar terms over the 14-year study period.

Federal revenues

Federal revenues are projected to increase modestly over the study period. These estimates assume interstate completion, the return of 95 percent of federal motor taxes collected in Washington, continuation of existing programs, and distributions equal to historical shares. These estimates inherently hold risks of change.

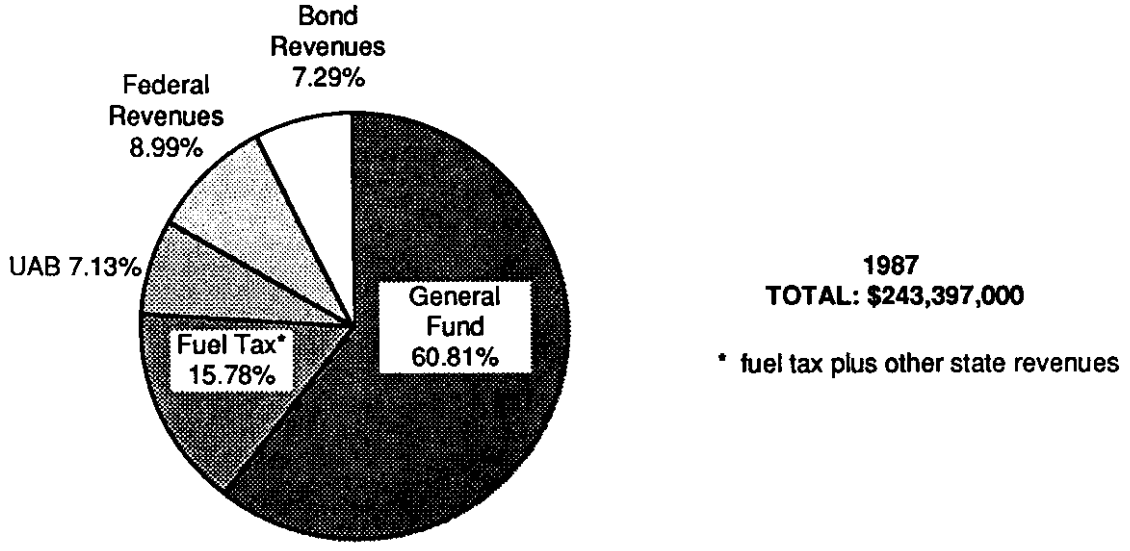


Figure 5. Distribution of Road Purpose Revenues
by Source – City Revenues

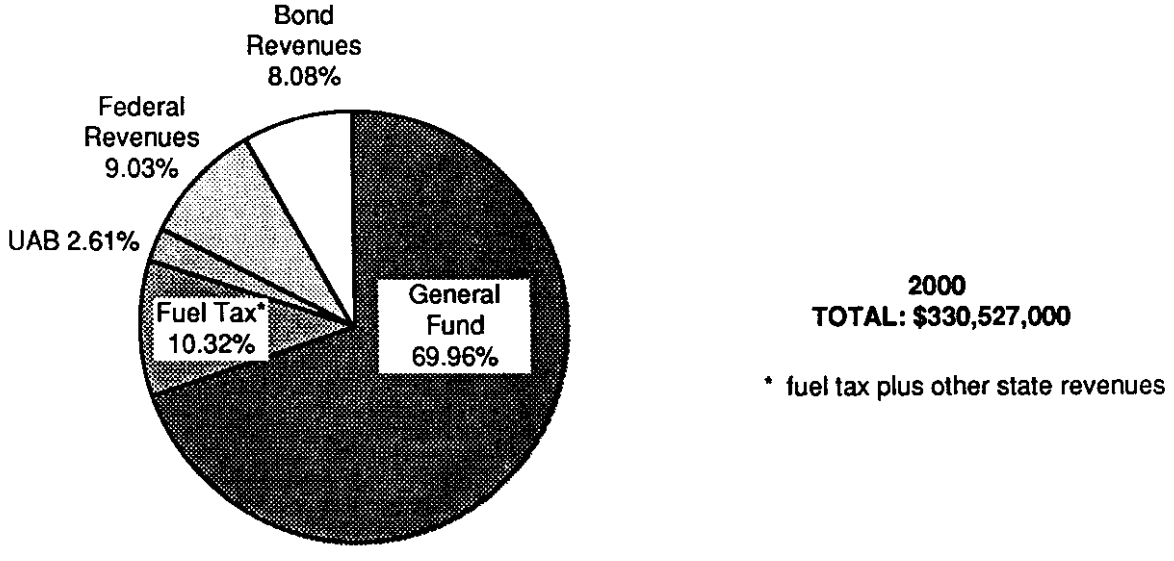


Figure 6. Distribution of Road Purpose Revenues
by Source – City Revenues

Bond revenues

Future bonds can be issued by cities for road purposes without state legislative action. Cities have demonstrated a slow but steady increase in issuing bonds for these purposes over the previous ten years, and this trend is likely to continue.

AVERAGE REVENUE PER PERSON, BY CATEGORY

In order to assess the relative impact of new revenue sources, it is important to understand the relative levels of current sources of revenue. Table 2 is a compilation of current transportation revenue sources based on figures 1 to 6. In this state, the average person pays $211 per year toward highway-related transportation expenses. Only $106 (or about half) is directly related to highway use. Fourteen dollars (or about seven percent) are related to vehicle ownership. The remainder ($90 or 43 percent) is not directly related to highway usage.

TABLE 2. SUMMARY OF TRANSPORTATION REVENUE SOURCES

Source	Annual Amounts ($1,000,000s) State	County	City	Total/person ($s/year)
Fuel tax	$184	$89	$38	$71
License fee	64	0	0	14
Federal sources	214	29	22	35 *
County road levy	0	149	0	34
City general fund	0	0	148	34
Miscellaneous	46	18	35	22
Total	$507	$285	$243	$211

*Adjusted to reflect fact that Washington currently receives 170% of its contribution from federal sources

CHAPTER 3. OPTIONS ALREADY UNDER CONSIDERATION FOR RAISING REVENUE

A number of innovative methods for financing transportation needs have been developed and used by state and local transportation agencies across the country. Some of these techniques have involved user charges. Others have focused on capturing some of the economic benefits resulting from transportation improvements through the use of indirect beneficiary assessments or through increased private sector involvement in public projects, e.g., joint development efforts or privately raised capital. As funding from traditional sources has decreased, transportation agencies have found these techniques to be increasingly important in helping them meet their local transportation needs.

Some of the options are at the state level, while others are at the local level and made possible by enabling legislation. Fuel taxes and motor vehicle excise taxes are examples of state level options, whereas local sales taxes and special benefits assessments are examples of local options. Local options have the advantages of more closely matching benefits with the financial burden and making the link between taxes and benefits more perceptible and hence more acceptable. They also allow local authorities to make their own decisions and choose options by popular vote. The state level options have the advantages of providing uniformity across the state and preventing tax export by any particular region.

Below are discussed various options, categorized by whether the user is or is not charged. User charges and non-user charges are distinguished not on the basis of whether the tax is borne by the user or the taxed entity, but on whether the tax charged individuals is proportional to their use of the facility. A user charge is similar to a direct tax because the link is direct between the tax and the payers' use of the service or good to which it is applied. For non-user charges, the link is not direct.

USER CHARGES

Raises in current taxes

This alternative has been proposed several times. Its primary advantage is that a system for collection is already in place. Increasing the fuel tax by 1¢ per gallon would result in a revenue yield of $24 million annually for the state. A local option increase of 1¢ per gallon in King County could raise about $6 million annually. However, some lesser amount would actually be realized, depending on how much additional tax was charged and what neighboring counties did.

Another potential source of additional revenue is an increase in motor vehicle excise taxes. An increase of .1 percent in the motor vehicle excise tax would yield $13 million for the state annually. Furthermore, drivers' license fees, tire taxes, and safety sticker fees also could be raised.

Indexing the motor fuel tax to inflation and consumption

This option would stabilize the real buying power of the motor fuel tax, despite rising fuel prices and falling consumption. Examples of states that have adopted indexing are Ohio, Michigan, and Wisconsin. In these states the tax is indexed to the Transportation Cost Index.

The motor fuel tax is structured as a "specific levy," which makes it susceptible to inflation and changes in fuel consumption patterns. Fuel consumption will certainly decline over the next decade because of fuel efficient vehicles. To deal with this problem of uncertain and fluctuating revenues, the state of Washington as early as 1977 introduced a variable fuel tax. This pioneering variable tax rate was the per gallon equivalent of 21.5 percent of the average net retail price of motor fuel, with a 9¢ per gallon floor and a 12¢ ceiling. Rate adjustments were made every six months, and by 1979 rising fuel prices had boosted the tax rate up to the 12¢ ceiling. However, inflation outpaced the tax rate increase, and in 1981 the legislature changed the formula and raised the ceiling to 16¢ to better meet highway construction and maintenance needs. Then fuel prices

dropped, and the tax rate froze at 12¢, increasingly too little for essential needs. In 1983, Washington had to abandon its experiment with variable fuel taxes, replacing it with a flat 16¢ per gallon tax, since increased to 18¢.

The rationale for the indexing of motor fuel taxes is to provide stability to motor fuel taxes. Stabilized fuel taxes are not indexed to the price of gasoline. Instead, fuel taxes are directly keyed to the principal transportation finance problems: declining fuel consumption and inflationary pressures on transportation service costs. Stabilized motor fuel taxes are intended to keep relatively constant the real buying power of fuel tax revenues, despite rising prices and declining fuel consumption. Fuel taxes indexed to inflation and fuel use are simple in operation. Annually the tax rates are adjusted by the same proportion that the FHWA national maintenance and operations cost index changes and by the inverse proportion of fuel consumption changes. In theory at least, the tax rates are automatically adjusted to inflation and fuel use, so that the real dollar value of the total motor fuel tax revenue is stabilized.

This system of indexing may face legislative opposition based on the conviction that the tax rates ought to be changed by specific legislative act and that it is improper for that important act to be delegated by formula to an administrative agency. Legislators may agree that they should be accountable for such major public actions as tax rate changes and that indexing fuel tax rates by formula is an inappropriate avoidance of legislative responsibility. A counter to that argument may be that implicit in the formula itself is a significant legislative policy -- that the predominant motor fuel tax resource should be stabilized in real purchasing power -- which is much more important than annual votes on a minor tax rate change. When inflation is considered, there is essentially no increase in the real dollar cost of average motorist highway user fees. Stabilized fuel taxes would not become significant real dollar costs to the average motorist when compared to the other costs of personal transportation.

Exemption changes

Presently, revenue from the fuel tax goes to the motor vehicle fund. This dedication makes it difficult to levy the fuel tax on non-highway uses/users. A change in the title of the tax would facilitate the extension of this tax to the presently exempted uses/users (i.e., farmers, loggers, and contractors). Some have proposed extending fuel tax to include all carbon-based fuels for all purposes and calling it an energy tax.

On a more modest level, certain current exemptions could be reviewed. For instance, motor vehicles and trailers that transport persons or property for interstate commerce are currently exempted from state sales tax. This exemption could be reviewed so that some of the exemptions on motor vehicles intended for specific uses might be withdrawn.

Administrative changes

Dealing with cases in which the fuel tax exemption has been misused is not easy. The penal provisions are not enforced because their exercise is not seen as worthwhile. Punishment with the highest penalty is not cost effective. Therefore, the only action taken against the violators is revocation of their exemption license. This situation is not healthy for tax compliance and encourages avoidance.

Presently, a rather long period is allowed to the distributors to deposit the tax in the treasury (until the 25th day of the succeeding month). Even though the period was changed only in 1987, in today's age of electronic transmission, a shorter period could be allowed.

Weight/distance taxes

This tax would cover both vehicle weight and distance traveled on the highway system. Practically speaking, however, the exact weight of all heavier vehicles cannot be ascertained for every mile that they operate. Motor carriers take on and discharge cargo at numerous locations. Weight/distance taxes are therefore based on approximations of weight during the time the vehicle operates within the

state. The specter of retaliatory taxation has slowed down the advocacy of weight/distance taxes. Most states participate in reciprocity agreements with other states. These grant motor carriers based within a certain state registration concessions when they operate in another state, as long as the reverse is true. Examples of states that have introduced this kind of tax are Oregon and Michigan.

NON-USER CHARGES

Charges on benefiting properties and connector fees are examples of non-user charges, in which the owners of the properties benefiting from the development of transportation are charged a tax.

Negotiated investments

A negotiated investment is an agreement between a developer and a public body through which the developer agrees to either make a needed public improvement or contribute a fixed sum towards an improvement that will benefit the development. Local governments can often utilize their zoning and building permit authority to bargain with developers so that the developers pay for the transportation-related improvements required to provide access to the new development area. Since transportation agencies have no control over zoning and land use regulations, they have to work with other government agencies to obtain the desired results.

Impact requirements

In contrast to negotiated investments by developers, impact requirements are charges or other conditions imposed upon developers to mitigate or compensate for the impact of their projects. Some good examples of the application of this technique are in California.

Special benefit assessment

This process involves levying a tax on property and/or improvements within a well defined area that benefit directly from a transportation improvement. Revenue

generated from the assessment can be used to pay for a portion of the capital improvements, or it can be used to offset operation and maintenance costs once the system has been constructed. It can be a one time assessment, or it can be applied as a reoccurring assessment over time in support of a revenue bond issue.

Benefit assessments are collected yearly as part of the overall tax bill. The annual income generated by this assessment is used to back revenue bonds and terminates once the bonds have been retired. Excess collections are used to lower subsequent year's assessments or to retire the bonds earlier than originally scheduled.

Tax increment financing

This is a technique whereby public projects are funded by increases in property tax revenues that result from increases in private sector investment near public improvements. The approach is applied in several distinct steps. First, a tax increment financing district is established in the area benefiting from the proposed public improvement project. Second, a base year of assessed property values is established. As property values in the area rise, resulting increases in property taxes are dedicated to offsetting the costs of the improvements, while the equivalent of the base line property taxes are distributed to pre-existing taxing jurisdictions.

In a sense, the assessed values of properties within the improvement area are frozen at the time the project area is created. Thereafter, taxing agencies other than the one implementing the improvement continue to receive the revenues generated by the tax rate as applied to the frozen base, while the agency responsible for implementing the improvements receives the revenues generated by the combined tax rate applied to the increase in assessed value in the defined project area. This process continues until the bond issues supporting the improvements are amortized.

JOINT VENTURE APPROACHES

This category of techniques recognizes that it is mutually advantageous for the public and the private sector to cooperate on transportation projects. There are three major techniques in this category:

a. land/air rights leasing,

b. donations for capital improvements and/or operating expenses, and

c. cost sharing.

MARKETING AND MERCHANDISING APPROACHES

Because of the large number of people who use the highways, renting or leasing advertisement space in high traffic areas can also yield revenue. Metropolitan Transit Authority in New York city raises $17,000,000, annually in this manner. Other concessions such as manned retail outlets or mechanical devices (including telephones, automatic teller machines, and vending machines) can also generate revenue through what are termed revenue percentage or sales override leases.

DEBT MANAGEMENT TECHNIQUES

Another alternative is to authorize local governments to issue bonds for raising the required financial resources. Bonds are a good source for obtaining large amounts of revenue relatively quickly. Bonds are usually appropriated for a one time capital expense to which a tax or fee can be pledged for debt service. Several mechanisms can be used to secure bonds: guaranteeing principal and interest payments from the full faith and credit of the local government's general fund revenues; issuing state supported bonds; earmarking a portion of revenues from property or sales tax or user taxes; and pledging surplus revenues from public enterprises. A local government's ability to issue bonds is affected by its financial backing and the interest rates attached to the bonds.

A number of creative alternative mechanisms of debt finance have been developed in times of high interest rates. Borrowing options such as lease options, zero coupon bonds, grant anticipation notes, participation trust certificates, and interest arbitrage have been used in many cases. These options have been guided by one of the following motivations: (1) to shift the interest rate risk from the investor to the borrower; (2) to enhance the credit worthiness of the borrowers by shifting credit-related risks to third parties; (3) to increase the types of returns available beyond regular receipts of interest income payments.

The Federal Tax Act of 1986 has clouded the legality and desirability of many of these options. Experts are therefore urging the municipalities to return to more traditional financing methods that use general obligation and revenue bonds.

OTHER SOURCES OF GENERAL REVENUE

Other sources such as sales taxes, the business and occupation taxes, tobacco tax, severance taxes, gambling taxes, and royalties could be increased and the pro rata dedicated to the transportation sector. Yet another alternative would be the dedication of lottery sale proceeds to transportation needs, as is the case in Pennsylvania. In 1985-86, transit programs received $106 million from Pennsylvania's lottery funds.

Another alternative is the payroll tax. In the state of Oregon, the local transit agencies have been authorized to impose a payroll tax to generate revenue. Since 1970 the Tri-County Metropolitan Transportation Authority has imposed a tax on employer payrolls, and since 1982 a tax on the earnings of self-employed people within the district. The state legislature allows the district to adjust the statutory ceiling of 0.6 percent. Taxes are paid quarterly by the employers within the transit districts. The state's Department of Revenue collects and administers the tax. After handling costs incurred by the state are deducted, all revenues are forwarded to the transit district.

A monthly commuter tax of $2 per worker on all employees in King County would raise about $20 million a year. This would require demarcating a road utility district by state legislation. When established, it would create a special jurisdiction governed by a council and would collect a fee similar to other utility districts for other services.

CHAPTER 4. ROAD USE PRICING

Road use pricing is an example of a direct user fee. Typically the price for using a road, bridge, tunnel, or other transportation facility is paid in the form of a toll, collected directly before or after a traveler uses the facility. However, there are alternative means to charge for the use of transportation facilities that meet the requirements of road use pricing. The terms "road use pricing" and "tolls" will be used interchangeably in this section.

Compared to tax supported financing for highways, road use pricing presents certain advantages and disadvantages. These comparative costs and benefits result from major differences in design and operation, financing methods, and pricing of road use. Relative to non-toll routes, toll facilities incur extra capital costs and operating expenses. For travelers, on-site toll collection may also entail delays, though the generally better condition of toll roads provides an offsetting benefit. Other costs of toll roads include the relatively higher costs of debt financing and the diversion of traffic that results from charging tolls. Countering these additional toll-related costs is the potential for tolls to expedite financing and road construction, to improve project selection, and to relieve traffic congestion. These financing and economic issues dominate the debate over road use pricing, with significant benefits generally required to offset the higher costs of toll facilities. From an analysis of these costs and benefits, one point emerges: traffic volume and the speed with which financing can be obtained are the major determinants of whether the benefits of road use pricing can more than compensate for the additional costs associated with collecting tolls.

BACKGROUND

Toll financing of roads in the United States predates the first federal highway program by well over 100 years. Toll roads were initially envisaged as a means of

financing the embryonic inter-regional road system. Tolls have existed in the U.S. since the opening of the Little River Turnpike in 1785. One of the earliest turnpikes was started in 1792 when Pennsylvania authorized incorporation of a company to build and operate a toll road from Lancaster to the Port of Philadelphia. The first modern toll road in the U.S. started in 1940, in almost the same location, with the opening of a 160-mile section of the Pennsylvania Turnpike. After the Second World War, the discrepancy between the growth of road traffic and the backlog in road construction built up during the war left a network ill-suited to meet the demand. Interest was then renewed in the financing of roads by tolls, and on their own initiative various states started to authorize and construct toll roads and turnpikes. Between 1950 and 1954, 19 states created tolling organizations or made use of their road service to construct turnpikes. In 1954 these states had 1,366 miles of tolled infrastructure under construction and a further 3,292 miles in the project stage.

This growth alarmed some transportation officials, who foresaw the turnpikes displacing the Interstate network and thus making the process of planning it more difficult. They also feared that the pooling of receipts from installations generating surpluses and deficits from financially weaker sections could only contribute to the extension of toll services and start a process by which toll organizations would perpetuate themselves indefinitely. Another argument against the further expansion of turnpikes was a danger of duplication and an overall growth in maintenance costs.

A Congressional Report published in 1955 indicated that 6,645 miles of Interstate were feasible to be financed from tolls and that measures would have to be taken to slow the process. It recommended integrating the turnpikes into the Interstate network if the routes were identical, if the turnpike was constructed to the same standards, and if an alternative untolled road was available. It also maintained the restriction on the use of revenues from tolls on the Interstate

network to other road or tunnel projects and the cessation of the collection of the toll once the debts were retired.

In the 1956 Federal-Aid Highway Act, the Congress adopted the recommendations of this report with the exception of the proposal to reimburse the states for the infrastructure developed without federal aid. Subsequently, sporadic legislative measures have allowed certain states to repay aid received from the federal government for the construction of connecting roads to toll roads. This legal context proved to be favorable to the growth of road tolls in the 1950s. As a result, 64 percent of the 4,658 miles of the turnpikes existing in 1975 were constructed in that decade.

A 1978 decision by Congress permitted the use of Interstate program funds for turnpikes, if the state concerned agreed to give access to the road once sufficient income had been collected to retire outstanding loans. An agreement of this type was concluded in 1982 when federal funds were granted for the improvement of the New York Thruway on the condition that the toll would be suspended when the debt was liquidated. Similar agreements have also been entered into by Connecticut, Kansas, and other states.

According to the Congressional Budget Office analysis of FHWA toll facility statistics, 72 toll roads, 157 toll bridges, and 11 toll tunnels operated in the U.S. as of 1985. Illustrative of the shift toward public sector involvement is the fact that only seven toll roads, 22 toll bridges and one toll tunnel are currently privately owned and operated. With respect to toll highway mileage, the aggregate length of toll roads, bridges, and tunnels nationwide totalled 5,176 miles, or one tenth of one percent of the approximately 3.9 million miles of roadway nationwide. Focusing on toll highway facilities broken down by highway categories, Table 3 shows that 3,702 miles, or approximately 72 percent, of the total toll mileage is on the federal-aid system, and the remaining 1,474 toll mileage is off the federal-aid system.

TABLE 3. U.S. TOLL HIGHWAY FACILITY MILEAGE BY FINANCING CATEGORY, 1985

Highway System	Toll Facility Mileage: Numbers of Miles	Toll Facility Mileage: As a Percent of Total
Federal-Aid Highway System		
Interstate	2,691	52.0
Primary	952	18.4
Secondary	27	0.5
Urban	32	0.6
Subtotal	(3,702)	(71.5)
Other Highways		
State	1,288	24.9
Local	186	3.6
Subtotal	(1,474)	(28.5)
Total	5,176	100.0

Source: Congressional Budget Office from data provide in Federal Highway Administration, *Toll Facilities in the United States* (April 1985)

Note: Mileage includes "nontoll" sections of toll facilities that may be used free of charge by local residents.

Federal government policy on tolls

The federal government has traditionally discouraged tollway construction through both policy and legislation. The policy was established by the Federal-Aid Act of 1916 and continued by the 1956 legislation creating the Interstate and Defense Highway System.

The government has created several statutory exceptions to the rule that highways constructed with federal-aid funds must be toll free. For tolls to be established on an existing highway that has previously received federal aid for construction or improvement, Congressional approval is necessary. Congressional approval may be accompanied by conditions such as payback of federal aid or a pledge to remove tolls once the capital cost has been recovered.

In general, new facilities may be constructed as toll facilities without Congressional approval, subject to enabling state legislation. Federal-aid funds apportioned to the state can be used on new facilities if they are one of the following:

a. a bridge, a tunnel, or approach;

b. a road that approaches a toll road, bridge, or tunnel and that carries traffic over and above that which moves on the connecting toll road, bridge, or tunnel;

c. an Interstate road or bridge that approaches any toll road on the Interstate system.

If federal funds are used in the construction of the new facilities, the state has to pledge that the tolls will be removed when the capital costs have been recovered.

The Surface Transportation Assistance Acts of 1978 and 1982 made toll roads that are part of the Interstate system eligible for resurfacing, rehabilitation, and reconstruction (4-R) funds. This act also stipulates that tolls must be eliminated when all outstanding debts have been paid.

Other legislation has dealt specifically with bridges and tunnels. The first bridge legislation to mention tolls was the Bridge Act of 1906, which included a uniform standard for setting tolls. A 1926 law permitted private bridge owners to make a profit while allowing public operators to collect tolls only to the point of amortization. The General Bridge act of 1946 applied more stringent regulations to Interstate toll bridges; however, intrastate toll bridges were left unregulated by that legislation. The last major legislation to deal specifically with bridge tolls was the International Bridge Act of 1972. As its name indicates, this law addressed only international bridges, and it required that toll rates be "reasonable and just."

The result of these federal legislative acts is that toll bridges operate under various requirements affecting toll collection, ranging from one that tolls be "reasonable and just" to one that tolls be eliminated once construction debts have been repaid. In addition, FHWA has the power to review the bridge tolls and must

approve the toll increases. This review procedure tends to inhibit plans for capital and safety improvements because there is always the possibility that the required toll increase will be delayed or possibly denied. Long-range and contingency planning are thus restricted and potential investors are discouraged.

In view of the inadequacy of federal funding, Congress, with the support of the Department of Transportation, the Association of State Highway and Transportation Officials, and many others, established a pilot toll financing program in the new highway bill (Public Law 100-17) enacted in April 1987. The measure represents a compromise between toll proponents, who urged federal participation in an unlimited number of toll financed highway projects, and firm opposition, primarily in the House, to federal financing of any toll projects.

The pilot program authorized by the Congress permits federal-aid financing of seven non-Interstate toll facilities. Five of the specific locations of these pilot programs are Orange County, California, and the states of Texas, Pennsylvania, Florida, and South Carolina. Under this pilot program the toll projects must be either new, non-Interstate toll highways or reconstruction to expand the capacity of existing non-Interstate toll facilities. Federal participation is limited to 35 percent of the construction or reconstruction costs, and toll facilities may receive federal participation only once for the original construction or reconstruction, except for reconstruction to expand capacity. Also, toll mileage built or reconstructed under the pilot program will not be counted toward a state's apportionment of federal highway funds. Finally, each facility under the pilot program must be publicly owned and operated, and the state highway department must agree that all toll revenues received from the toll facility will be used only on the facility itself or for the costs necessary for the proper operation, maintenance, or debt service of the toll facility. This provision in the new highway policy represents a significant departure from the traditional federal policy with respect to toll facilities, and the success of the pilot program may be instrumental in determining the role of toll financing in a

post-Interstate highway program. With the completion of the Interstate system at the end of the current five-year highway program, Congress will probably focus on enacting a national highway program to meet future needs. In view of the limits of federal funding, toll financing is likely to become a more widely used mechanism to fund highway projects in the 1990s and beyond.

Evaluation of and recommendations on the federal payback policy

On highways financed with federal funds, the federal government does not allow tolling as a rule, but exceptions are made on the condition that the federal financing is repaid. This federal aid payback policy accounts for the principal costs of converting most existing limited access federal aid highways to tolls.

The findings from the I-80 case study in Pennsylvania estimated that the necessary toll rate for automobiles ranged from $1.68 to $3.22 at each of the five barriers along the route if full payback was required. The range results from alternative assumptions about the amount of traffic diverted by tolls. With the assumption of no payback, the estimated necessary automobile toll rate would drop to a range of $0.66 to $1.77. With the assumption of an automobile traveling the full 318 mile-length of I-80 in Pennsylvania, the per mile toll rate would range from 2.7 to 5.2 cents with full payback and from 1.1 to 2.8 cents without payback. In this connection, see Figure 7, which compares toll financing with and without federal aid.

The policy requires more annual revenue to be realized from the toll facility, making prospective users pay for a benefit that has already accrued in the past to other users who paid for road use through motor fuel tax and other means. If payback is required, a more equitable system would be to relate it to the remaining value of the highway facility and not to the full cost of the original investment. The federal share is actually a sunk investment, and the proper way to treat it is to depreciate the investment for the relevant period and then determine the amount to be paid back.

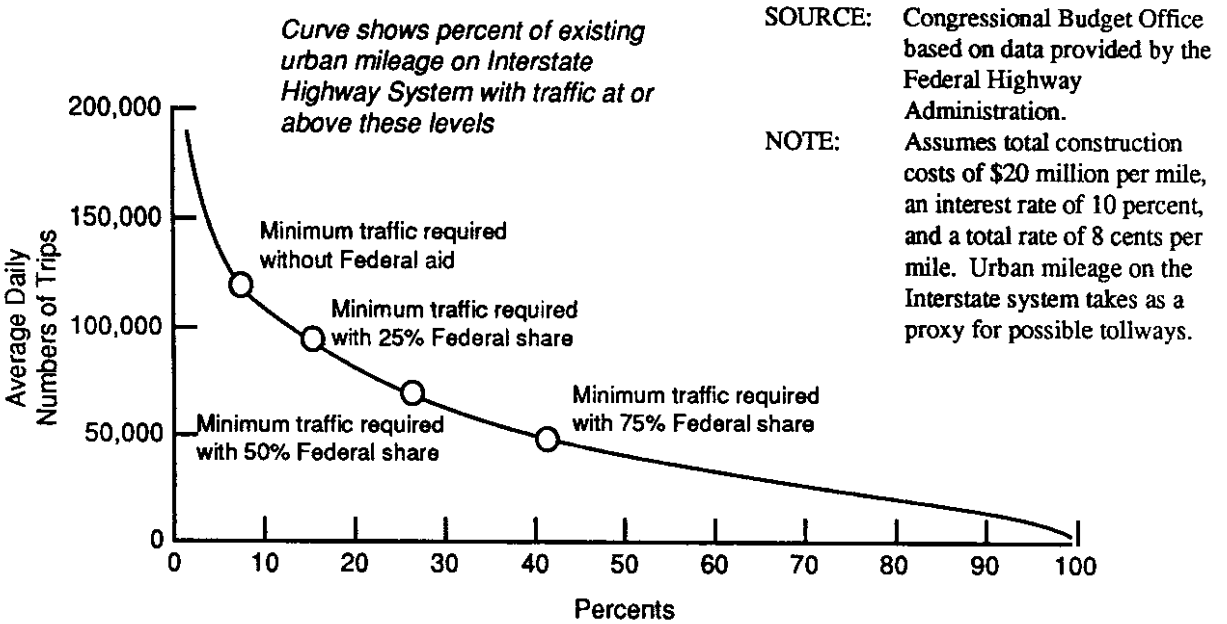
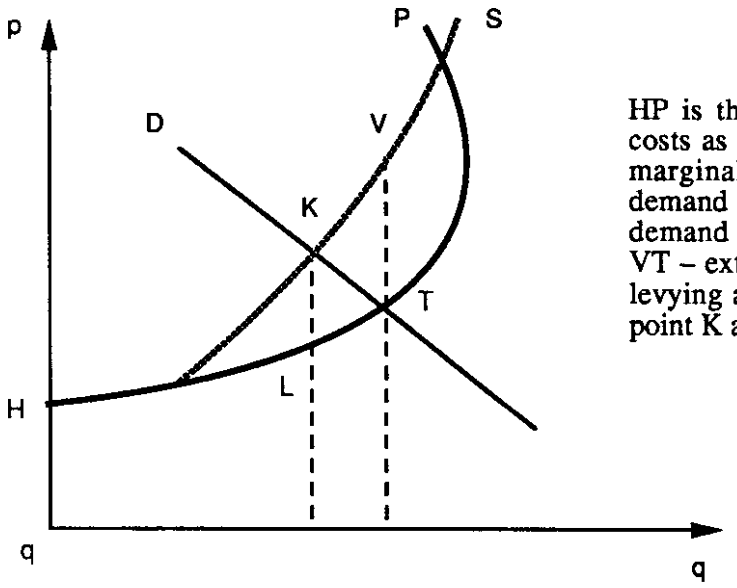


Figure 7. Feasibility of Toll Financing for Urban Roads With and Without Federal Aid



HP is the supply curve, i.e. the operating costs as perceived by the driver. HS is the marginal social cost curve. DD is the demand curve. Without tolls the effective demand would be T, at which extra costs VT – externalities – would be incurred. By levying a toll KL, demand is reduced to the point K and no externalities apply.

Figure 8. Congestion Pricing

OBJECTIVES OF ROAD USE PRICING

Two of the objectives of road use pricing are to raise additional net revenue and to manage congestion. The transportation needs of many states have exceeded their revenues, and this has been a compelling reason for the renewed interest in toll financing. Tolls can also be used as a congestion management policy instrument.

The first objective is an obvious one. The second requires some explanation. When a road is congested, each additional vehicle slows down all other vehicles, and, therefore, raises the cost of other people's trips. This extra cost is one of the external costs that is usually not perceived by the road user. Table 4 illustrates one calculation of these external costs. By requiring the user to pay the (marginal) cost of using the congested road, including "external" costs, a congestion tax aims to better allocate resources. It makes the user realize the real costs of using a congested facility. If the cost were internalized by the imposition of a congestion toll, the individual's private and social cost would be the same, and the individual's decision to use or not to use the facility would be an efficient one.

TABLE 4. COSTS IMPOSED ON OTHER USERS BY ADDITIONAL VEHICLES IN CENTRAL LONDON

Traffic Speed, in miles per hour (1)	Cost imposed by one additional vehicle-mile, in cents per mile (2)
20	10
16	22
12	52
8	120

Source: "Road Pricing: The Economic and Technical Possibilities," Her Majesty's Stationary Office, London, 1964, p. 49; conversion from English pence based on U.S. cents equivalent to one British penny.

If a toll can be set at the level that pays for the social costs, it can improve the allocation of resources. By achieving exact recovery of marginal road use cost, a toll can reduce demand to its "economic" level. In Figure 8, this is illustrated. HP is the supply curve, i.e., the operating costs as perceived by the driver. HS is the marginal social cost curve, which includes the external costs. DD is the demand curve. Without tolls, the effective demand is T, at which extra costs, VT, or externalities are incurred. By levying a toll, KL, demand is reduced to the point, K, at which no externalities apply.

This pricing mechanism allocates road use between tolled and untolled roads to ration available road space to those for whom it has the highest value. Charging tolls at a level that fully covers social costs has been called "congestion pricing."

EFFICIENCY AND EQUITY

Congestion pricing deals with two separate issues. The first is economic efficiency and the second is equity. Efficiency is being served since those who value the facility most are allowed access. Presumably, each user perceives the benefit to be at least equal to the price paid. Those who do not either shift their demand to an off-peak period or forego the use of the facility. Equity is served since those who use and benefit from the facility pay for it. Furthermore, within the user group, those who demand peak hour use and therefore are responsible for the excess off-peak capacity pay for the additional capacity since they pay more for using the facility than the off-peak user.

Toll financing in the United States goes back to the very roots of the nation. In 1776, Adam Smith had this to say about tolls:

> When the carriages which pass over a highway or bridge pay toll in proportion to their weight, they pay for the maintenance of those public works exactly in proportion to the 'tear and wear' which they occasion of them. It seems scarcely possible to determine a more equitable way of maintaining such works.

An evaluation of tolls on economic principles can be helpful to clarify the likely impact of a toll financing policy on the economy.

Equity

Tolling is equitable, since the user pays. However, it may be inequitable when only some roads are tolled (especially if substitute roads are not tolled) and even when all roads are tolled if rates exceed marginal costs. The toll collection system itself and the location of toll collection booths have an effect on equity (e.g., the rate can be a fixed amount or reflect distance traveled, can equal marginal cost or exceed it, can represent discriminatory pricing, or can be collected from all or only some users).

Whether tolling can achieve equity in the sense of income redistribution is debatable and has not been proved. Though a toll does achieve horizontal equity (by treating all vehicles in one category identically), the same cannot be said of vertical equity (since this category does not consist of people of equivalent means or equal worth). The lowest income road users may suppress trips if costs increase on both the tolled and the untolled roads. High income users may experience a net benefit even when paying the toll, if the toll road saves them time. Furthermore, since the fuel efficient vehicles are comparatively expensive, people with higher incomes may be able to cut total trip costs, even when faced with the same tolls. However, one thing is clear: people who own cars are not the poorest people in the economy, and hence the toll does not make the poorest worse off (ignoring the indirect effects of the toll on prices of consumer goods).

To determine the overall effects of a toll policy, the distributional effect of which revenues are spent is important, in addition to the incidence of the toll. The question to ask is, where is public expenditure directed: is it for more roads that will require contributions from general revenues but mainly benefit the rich, or for social programs that will also benefit the less well off?

Also important is the question of whether toll revenue surpluses, if there are any after road operation costs and loan amortization are covered, accrue to the general treasury (i.e., revenues are not, or only partly, earmarked). When not earmarked, these surplus funds can be allocated or appropriated for pursuing income redistribution objectives, alongside the toll policy. These policies can take into account people adversely affected by the tolls.

Tolls are an equitable way of distributing the tax burden since they are an example of the most direct user fee. However, although the basic policy of highway user charge is commonly accepted, there has not always been agreement about what commonly constitutes an equitable distribution of the financial burden among highway users. One of the most often accepted guidelines today is the "benefits principle," whereby users pay for roads in proportion to the benefits received. In the early '60s Mohring and Harwitz used the "benefit principle," expressed in terms of equating either benefit tax ratios or net benefits for all population classes, to analyze the equity of alternative tax systems for raising highway revenues. Their conclusion was that

> primary reliance on levies such as tolls or gasoline taxes that are directly related to the highway use would provide a more nearly equitable allocation of the highway financing burden than would reliance on the general tax revenues of the federal government.

The governing criterion that lead to this conclusion was the relative freedom of choice afforded by each tax alternative to consume highway services. This freedom was seen as critical to the potential of each tax system to equate benefits to tax ratios. The further the choice of paying for each highway service is removed from the actual consumption of each service, the greater the likelihood that an inequitable burden is placed on the individual consumer. By imposing a charge only for each use of highway service, the highway authority is giving the consumer the freedom to choose whether the direct benefits received from a given trip exceed the

direct costs, including the user charge. The greater the freedom of choice the authors argued, the higher the potential to equate benefit to tax ratios for all population classes.

Mohring and Harwitz did not express an opinion on whether tolls or gasoline taxes were more equitable on the basis of the "benefits principle." However, their freedom of choice criterion indicates that tolls levied for the rehabilitation of a given facility are more equitable than a general gasoline tax increase for the same purpose because the tolls more closely align the payments to the use of the facility. With the gasoline tax increase, payments are made by the highway users whether or not they travel on the rehabilitated facility. Consequently, these users do not have the option of making payments only if they use the facility; they pay whether they receive any benefits from the facility. On the other hand, with tolls only those who benefit from use of the toll road pay the toll. Therefore, tolls appear to offer a more complete freedom of choice and thus a greater potential for equating benefit-to-tax ratios or net benefits.

Tolls are less inequitable when compared to the motor vehicle taxes. The taxes, by raising the price of the vehicle, may take it out of the "consumption basket," whereas the toll can be avoided by motor vehicle owners if they do not equate the benefits to the price.

Efficiency

The most economic use of resources at any given time and over time requires prices to be set equal to marginal costs. In the road sector, marginal cost can be equated to the costs avoided, that is, the eventual costs not imposed on other users and on the road authority when a trip is not undertaken. The main objective of road user charge systems is to charge users the marginal social costs they impose on the road system. By doing so, the efficiency of road use is ensured, since only those users who place a value on their journey at least equal to their own costs plus the costs they impose on others will travel. Highway users for whom the utility of travel

is lower may be deterred from traveling altogether, thus freeing scarce road space for others whose travel needs are greater. This argument is subject to an important proviso: charging for the use of a particular road will not lead to the more efficient use of the road system as a whole, in general, unless other competing and complementary roads are also priced on the same principles.

Most of the existing road user charge systems do not achieve marginal cost recovery even if that were the objective because of the variability in the marginal costs and because of the limited charging means available at reasonable administrative costs. It is difficult to ascertain the cost of each vehicle on each trip. It is difficult to measure or predict even the average use that vehicles in readily distinguishable classes make of the roads; a great deal of averaging is unavoidable. Beyond that, it is difficult to devise a system of charges on vehicles, spare parts, tires, fuels, axle loads, etc., that captures the avoidable road use cost: input consumption does not necessarily vary in proportion to road costs that depend on road and traffic characteristics. Economic user charge systems try instead to recover an "average avoidable" cost for the network; this has the disadvantage of entailing cross subsidies. Contrary to common belief, high standard, heavy traffic roads normally subsidize low standard, low traffic roads; the latter are more expensive per user, given the low traffic, and yield lower revenues per mile.

There is little argument that toll financing is administratively a more expensive method of financing highway improvements than traditional user charge methods. Some of these additional expenses are direct economic costs, such as the capital and operating costs for toll collection and the costs incurred by toll facility users because of additional stops to pay tolls unless electronic methods are used to charge them. Some additional costs are indirect costs, such as the additional costs imposed on users of alternative toll-free routes by toll diverted traffic. And as previously discussed, expenses such as federal aid payback are not economic but financial costs. Therefore, these additional costs must be minimized to mitigate the

adverse impact of tolls. To the extent that these financial costs make toll rates higher than costs occasioned by toll facility use and thus divert traffic that would have used the toll facility if toll rates had been lower, toll financing involves an economic misallocation of traffic between toll and non-toll highway facilities.

ADMINISTRATION OF ROAD USE PRICING SYSTEMS

There are three traditional toll collection systems:

- closed (ticket) systems,
- open (main line barrier) systems, and
- hybrid (barrier-ramp) systems.

The closed toll collection system limits access to toll-paying motorists. Tollbooths for collection of tolls are located at each point of entry and exit, and main-line barriers span the roadway at each end of the toll route. Closed toll collection systems generally dispense tickets at an identified entry point, the tickets are surrendered at the exit point, and the toll is paid. Closed systems are well suited to bridges and tunnels, which commonly have only two access points. Typical examples of closed, ticket system toll roads are the New Jersey, Ohio, and Pennsylvania turnpikes.

The second alternative, the "open" barrier system, allows local, short distance traffic to use the facility without paying the tolls. Toll barriers are located strategically along the main line of the road, with flat rates charged to each class of user passing the barrier. Such barrier systems are usually designed to allow certain local trips to be made toll free. No tollbooths are placed on the interchange ramps. All traffic must stop at the barriers to pay the toll; however, local traffic may avoid paying the toll if there is no barrier between the drivers' entry and exit points. The percentage of trips allowed to move toll free depends on the number and location of the main-line barriers. The Connecticut Turnpike and the Bee-line Expressway in Florida are examples of barrier system toll roads. They may be designed with

mainline toll barriers and toll booths on selected high-revenue interchange ramps and yet allow toll-free passage between certain contiguous interchanges. An example of this type of design is the Garden State Parkway in New Jersey, which has three toll-free sections near the towns of Elizabeth, Yoms River, and Cape May.

The third alternative design, "the barrier-ramp" system, is a hybrid of the other two systems. It may be designed either as a closed or an open system and is often found on toll roads that pass through both rural and urban areas. If the road is designed as a closed system, toll barriers are located at interval points along the main line. In addition, most interchange ramps also contain toll booths so that no segment of the road may be used without payment of a toll. Barrier-ramp systems are generally designed to collect tolls from at least 95 percent of the traffic using a toll facility. A good example of the closed barrier ramp system is the Illinois Tollway System.

Of 22 major U.S. toll roads, 11 use closed ticket or barrier-ramp systems, eight have open barrier systems, and three use a combination of closed and open systems. Ten of the 17 interurban roads sampled have closed systems, while four out of five urban expressways use barrier systems.

Generalizing on the (financial) cost differential between barrier and closed toll collection systems requires assumptions about many variables. Most important for closed-system costs is the number of interchanges retained. The number of interchanges involves a trade-off between total costs and user accessibility, both of which vary directly with the number of interchanges. Existing non-toll, limited access highways have a higher density of interchanges and are more accessible than typical, closed system toll roads. The high density of interchanges coupled with the need for collection facilities at entry and exit points make the cost of converting existing non-toll, limited-access highways to closed system toll roads extremely expensive, both in terms of capital costs to adapt each interchange to facilitate toll collection and in terms of operating and maintaining the many toll collection points.

Costs can be decreased by closing some interchanges, but this action also reduces toll revenues and decreases toll accessibility.

Although barrier toll collection systems have potential cost advantages, they also have some disadvantages. Barriers along the main line raise the potential for accidents because motorists approaching the barrier must come to a complete stop from high speeds while concurrently jockeying for the shortest queue and searching for the required toll. Closed collection systems, where vehicle deceleration occurs primarily on the exit ramps before the toll collection area, may thus be safer than barrier systems.

Operating costs of toll collection

Toll collection can be an expensive way of raising highway revenues. As traditionally practiced in the U.S., toll collection is labor intensive, with labor costs accounting for as much as 80 percent of total collection expenses on the closed ticket systems. Technological improvements as well as better management techniques have sought to trim the labor intensity of collection. For example, the use of mainline toll barriers has reduced the need for staffing each point of access and egress. The substitution of automatic machines for human toll collection has further reduced the necessary personnel, and so has the practice on the Garden State Parkway of using senior citizens to meet peak period demands. Other innovations include collecting tolls in only one direction with a doubling of the toll rate and limiting the collection hours to avoid low volume periods.

Despite the improvements, toll collection costs remain relatively high, particularly on closed ticket systems. In 1985, Pennsylvania Turnpike Toll collection costs as a percentage of toll collection revenues were 14.8 percent. New York State Thruway and New Jersey Turnpike collection costs were 16 percent and 19 percent of total toll revenues, respectively, in 1985. These percentages also do not include toll collection area maintenance expenses, costs that are not incurred with traditional, highway user taxes.

The collection costs are lower for the traditional user taxes than for tolls. The costs for motor vehicle registration and license fee collection as a percentage of fee receipts for all U.S states was approximately 13 percent in 1984. The collection costs for motor fuel taxes averaged less than 1 percent of tax receipts in 1984. Because motor fuel service companies serve as the collection agents, motor fuel tax is an extremely efficient means of raising highway revenue. Neither registration and license fee collection costs nor motor fuel tax collection costs as a percentage of receipts has changed significantly since 1980.

In comparison with traditional highway user taxes and fees, toll collection is a costly means of raising highway revenues.

Capital costs of toll collection

Probably the most visible and frequently discussed of the additional expenses associated with toll financing are the capital and operating costs of toll collection. The capital construction costs incurred to install toll collection facilities, including tollbooths, buildings, plaza areas, collection equipment, and, if necessary, interchange reconstruction, may be relatively minor, or they may be significant enough to dictate the financial feasibility of the toll conversion project. The most important factors determining the absolute magnitude of these capital costs are the type of toll system; the number of toll collection points; the level, composition, and peaking characteristics of the traffic stream; and the size and location of the toll conversion project. As a general rule, the capital costs for toll collection, although potentially significant, can be held to less than 10 percent of total capital costs, including federal aid payback, assuming that a cost-efficient toll collection system is used.

Experience with high traffic volume toll roads in member nations of Organization for Economic Coordination and Development (O.E.C.D.) indicates that, on an average, road construction costs increase from 10 to 15 percent because of toll related facilities. Collection and other ad hoc toll road operation costs are

about equal to road maintenance costs, and collection costs absorb some 10 to 15 percent of toll revenues.

Recent developments in technology for tolling

Recent trends in technological improvements have been directed towards lowering the operational and maintenance costs, which have been growing faster than toll facility traffic or revenue. The other issue that technology has sought to address is the speed of the collection process. Systems using various technologies, including optical labels scanned by cameras, microwave systems, low frequency induction, and laser beams, are all based on the goal of identifying and automatically recording each vehicle as it crosses a toll plaza. Such "automatic vehicle identification" (AVI) systems are being developed and applied on an experimental basis in a variety of settings in the U.S. and other countries. More conventional techniques, such as special licenses, magnetic card systems, and on-vehicle meters, are also being explored.

Automatic vehicle identification systems generally require three components:

- a vehicle mounted transponder to transmit information about the vehicle,
- a road-stationed interrogator that "reads" the information from the transponder, and
- a computer to handle vehicle recognition and record trips for later billing.

To accomplish no-stop toll collection, the interrogation, verification, and billing must all occur within a few seconds -- the time it takes for a vehicle to move to the toll barrier from the electronic interrogator. To do this at a low enough cost and to be competitive with the conventional collection procedures, an AVI system has to be reliable and able to identify and bill a large number of vehicles cheaply in relation to the benefits provided. The significant problem that threatens the potential applicability of AVI to toll facilities is the cost of the transponder ($20),

which will have to be borne by the individual users. Presently, experimental testing of this technique at various facilities is taking place to evaluate this technique.

Over the period 1983 to 1985, the Hong Kong government commissioned a pilot study to examine the viability of electronic road pricing (ERP) in the territory. Dawson and Catling studied the workings of the project and concluded that ERP offers a highly efficient method of dealing with Hong Kong's intense traffic problems.

The ERP system works as follows. A small, inexpensive, solid state device termed an "electronic number plate" is attached to the underside of each vehicle. Once fitted it requires no manual intervention and is maintenance free. A series of charge zones is defined for the area covered by electronic user charges; in the Hong Kong urban area there were approximately 200 zones. At each boundary crossing, an array of loops is buried in the road surface. As a vehicle passes over those loops, its electronic number plate is energized, and its crossing is recorded. The number plate transmits a string of data at each crossing, including a unique security coded identification employed for each vehicle. In Hong Kong, tolls per zone ranged from 10¢ to $1.50 (in U.S. currency). Presumably, motorists will cross several zones during their trips, so single trip costs will be a sum of zone tolls. Tolls are calculated by means of an inexpensive microcomputer system, and at the end of a month vehicle owners are sent a statement of their road user charges in a form similar to a credit card statement. Motorists' need for privacy is maintained by making listings on the statement of charges as circumscribed and limited as the user desires. The results of this experimental system in Hong Kong were accurate and reliable. The reasons for the discontinuance of the Hong Kong experiment were more political than economic.

Toll authorities around the world have been investigating electronic road use pricing for some years. In the fall of 1988, the Dutch government adopted a policy to pay highway costs through road use pricing using electronic means. An electronic

system can reduce traffic on congested roads without penalizing drivers on congested roads and gives people free choice in the selection of their trip routes. Benefits include increased revenue collections and reduced costs, with replacement of salaried toll collectors with automatic sensors. In addition, a number of side benefits are likely, including the potential for automatic traffic data collection.

USER REACTION

Toll traffic is elastic. Elasticity may be expressed as toll sensitivity, i.e., the amount of traffic that is lost if tolls are imposed. The price elasticity of the user is crucial, since it determines the extent of diversion that can take place because of a toll and the revenue realization from a toll. Elasticity is a function of various factors such as the alternative routes that are available to take the diversion of the traffic that is possible when the toll is levied. Other factors that influence toll sensitivity include alternative routes, trip length, trip purpose, vehicle mix, timing of the toll collection, and the toll cost versus total trip cost. These factors are briefly analyzed below.

Alternative routes

The most obvious factor in toll sensitivity is the availability and condition of alternative routes. In most cases, toll facilities compete with non-toll, tax-supported routes. Patrons are willing to pay tolls to save time and/or mileage over alternative routes. Accordingly, the location, congestion levels, speed limits, traffic signals and other controls, and roadway condition of alternative routes all contribute to toll sensitivity.

Trip length

The average length and other characteristics contribute to toll sensitivity. The longer the trip, particularly if some portion of the trip is made off the toll facility, the smaller the percentage of toll trip cost represented by the total cost.

Trip purpose

The more recreational and discretionary trips in the toll facility traffic stream, the higher the probable traffic impact of a toll. Journeys to work are less discretionary, although they are sometimes offset by the commuters' keen knowledge of alternative routes, if they are available.

Vehicle mix

Trucks are theoretically less likely to divert than cars for two reasons: (1) the trips are not discretionary, and (2) the toll cost can normally be passed along to the shipper and ultimately to the consumer.

Timing of toll introduction

While it is difficult to obtain substantiated supporting data, the psychological impact associated with the timing of tolls probably has some effect on their public acceptance. At a time of increasing trip costs, the imposition of a toll may receive less of a negative reaction.

Toll cost versus total trip cost

When the potential impact of a toll is considered, the distinction between toll cost and total trip cost must be recognized. In addition to tolls, the total trip cost includes out of pocket expenses associated with miles traveled and a value for the time expended in travel. Obviously, as other costs increase, tolls become a smaller part of the total trip cost. Accordingly, traffic reduction associated with imposition of tolls is likely to be less significant in future years.

Estimating elasticity

For the toll to be fixed accurately the elasticity of demand for trips on the congested roads must be tested (and experience shows that this is not negligible). Overcharging results in underutilized roads. Toll feasibility studies have used the following formula for estimating the price elasticity of demand on the toll facility.

$$\text{Elasticity} = \frac{e^{f-1}}{e}$$

where $$f = \frac{\text{volume capacity ratio of the toll facility}}{\text{volume capacity ratio of the alternative routes}}$$

Elasticity estimates vary from -0.17 to -0.35.

POTENTIAL USES OF ROAD USE PRICING

Even though road use pricing can be a relatively costly means of collecting highway user revenue, it can be economically justified under some circumstances. One of the advantages discussed above is that it provides a means of levying congestion prices on heavily traveled urban routes. The additional costs of such toll financing may be more than offset by the ability to charge road users in accordance with the costs occasioned by their use, including the high external or social costs imposed by road use during peak travel periods. Including these social costs in the toll internalizes the social costs in the road use pricing system, thereby encouraging road users to make more efficient route or mode choices. If congestion pricing sufficiently mitigates peak hour demand, an additional benefit may occur from the postponement or avoidance of the need for additional road capacity.

Toll financing may also be justified under special financial conditions. Toll financing can be a useful and justified way of supplementing general user tax and fee revenue, particularly if the toll revenues are dedicated to building, maintaining, or improving facilities that in the absence of toll financing are not likely to be built, maintained, or improved to first class standards. For example, in the case of an existing facility, if funds from traditional revenue sources are not available to make needed improvements in a timely fashion, the level of service deteriorates, and the cost of using the deteriorating facility correspondingly increases. On the other hand, if toll financing expedites the required improvements, users may benefit from lower operating, travel time, and accident costs despite the higher highway user charges associated with tolls. The primary question then, is whether the increase in user benefits made possible by the toll financing is sufficient to justify the additional costs associated with toll collection. If benefits exceed the costs, then toll financing may

be economically acceptable within the constraints imposed by society on other means of financing.

However, this question is difficult to answer because it involves speculation about the level of service if the improvements are not made. Hypothetically, if the improvements are not made and the road is allowed to deteriorate, it may have to be closed for safety reasons. For the highway's users, the closing of the road will mean increases in travel times, accidents, and possibly operating costs as drivers divert to alternative routes with lower levels of service. In some cases fewer trips will be made. These additional user costs can be viewed as the maximum user benefits of toll financing for those travelers who would have used the road as a toll facility. If the deteriorated road is rehabilitated as a toll road, benefits accrue to users of alternative routes who would otherwise have experienced increased congestion and more rapidly deteriorating highway facilities occasioned by the diverted traffic.

A more likely scenario than the worst case is that the road is maintained at a lower level of service with a lower posted speed limit, and a minimum amount of surface maintenance is performed to maintain the integrity of the pavement. In this situation, the benefits to users of having more immediate, toll financed reconstruction of the highway would be the difference in accidents, travel time, and vehicle operating costs between a higher level of service toll road and a lower level of service non-toll road. These benefits must be measured over a period from when a reconstructed highway could be completed with conventional financing. The length of this period will in most circumstances be a governing factor in whether the benefits of toll financing exceed the additional costs.

The Congressional Budget Office (C.B.O.) recently estimated that the toll financing benefits may exceed the additional costs if a needed highway facility can be built four or more years sooner than under conventional "pay as you go" tax financing. However, if toll financing produces a facility only two or fewer years

sooner, the use of toll financing is probably not worth the additional costs. The C.B.O. indicated that the time advantage needed to make the toll financing beneficial is sensitive to the overall levels of benefits provided by the road, the prevailing bond interest rates, and the amount of traffic diversion caused by the tolls.

Tolling for general purpose revenues is more appropriate in cases of acceleration of road construction. However, clearly, not every road is suitable for tolling. A priori, tolling as a condition for private intervention or to raise general revenues can minimize distortion in resource allocation in the following situations:

a. Tolling may be beneficial when a transfer from private to public funds will increase returns in the economy, but no alternative revenue raising measure is available or politically acceptable.

b. It may be beneficial when it is applied to facilities with captive traffic, such as tunnels, or bridges, or even roads with poor substitutes. This may be generalized: tolls may be appropriate where (road) demand is inelastic, or at least, less elastic than other taxable bases, and traffic levels are enough to compensate for toll collection costs. Studies have required a revenue cost ratio of 75 percent for accepting a proposal for a toll facility, so that a financially feasible project is approved for levying a toll.

c. It may be beneficial when it is applied to existing congested facilities on which a traffic reduction or reallocation is sought. The general conclusion is that tolls may be appropriate where road supply is not fully elastic. However, tolling even where demand is inelastic is not necessarily better than other means of raising revenue. A local tax or bond may have a more acceptable distributional impact and avoid the toll collection costs. Therefore, even if these a priori conditions are satisfied, suitable instances for tolling need further analysis case by case.

d. It may be beneficial when it is applied with discriminatory pricing -- charging to the extent the market will bear short of diverting traffic on uncongested roads.

e. It may be beneficial when toll rates are not set with a view to full recovery of road construction and maintenance costs. In the case of private involvement, the answer is probably that the contract owner bears the risks and, when revenue has reached a certain level (corresponding to current cost plus interest) per unit of traffic, pays a rent to the public authorities at a rate declining with increasing traffic or simply (but not ideal) pays a tariff schedule.

f. It may be beneficial when, if a road is to be built and tolled, the following apply: (i) standard design, safety, and regulation standards,

(ii) standard economic and least cost evaluation criteria, and (iii) minimal total cost within a certain revenue constraint maintenance of a certain additional cost ceiling.

g. It may be beneficial when appropriate regulations are applied on the tolling agency to ensure that it serves the public interest.

There is great flexibility in the nature of toll road financing. It is project related and dependent on the terms and conditions of enabling legislation, bond covenants, contractual relationships, availability of alternative funding sources and/or fund pledges, and local and federal law and policy. It is an option that needs to be seen as a supplemental source of revenue, given the transportation needs.

ESTIMATED YIELD FROM ROAD USE PRICING

For this study, four alternative road use pricing scenarios were investigated:

1. constructing a new highway,
2. financing improvements on an existing facility
3. relieving congestion in a specific area with a toll "barrier," and
4. relieving congestion and producing revenues with an "area-wide" toll.

The last three alternatives may require some federal payback. In each case, three different kinds of payback were analyzed:

1. all federal aid is paid back;
2. federal aid is depreciated over a 20-year period and the remaining value is paid back; and
3. as in the current federal demonstration project, 35 percent of the amount in option 2 is subsidized by the federal government.

Option 1: New highway

For the purpose of this study, the possibility of building a new bypass around Seattle was assumed. The route would go from Auburn to the east of Lake Sammamish to just south of Everett. It would be a four-lane facility with connections to I-5 at either end. It would be approximately 50 miles long. Construction and maintenance costs were based on experience with I-405. The total cost for the project would be about $460 million in current dollars. Table 5 shows

the tolls required with four different peak/off-peak ratios and the costs for typical trips.

Assumptions used to calculate tolls included the following:

1. 1000 vehicles/lane/hour (vlh) in the peak period,
2. 500 vlh in the midday,
3. 300 vlh in the evening,
4. 100 vlh at night,
5. construction would be amortized over 25 years at 8 percent,
6. 10 percent toll administration cost,
7. work trips would occur in the peak period, and
8. through trips and recreation trips would occur in the off-peak.

TABLE 5. ANALYSIS OF TOLLS NECESSARY TO BUILD I-605

Peak/Off-Peak Ratio*	1	1.5	2	4
peak toll/mile	$0.064	$0.079	$0.091	$0.117
off-peak toll/mile	$0.064	$0.053	$0.045	$0.029
Typical Trip Costs (no federal subsidy)**	$0.70	$0.85	$1.00	$1.30
10 mi. work trip	$0.70	$0.85	$1.00	$1.30
50 mi. through trip	$3.50	$2.90	$2.50	$1.60
25 mi. recreation trip	$1.75	$1.45	$1.25	$0.80
Typical Trip Costs (35% federal subsidy)**				
10 mi. work trip	$0.45	$0.55	$0.65	$0.85
50 mi. through trip	$2.30	$1.90	$1.60	$1.05
25 mi. recreation trip	$1.15	$0.95	$0.80	$0.50

*Ratio of peak to off-peak charges. A ratio of 1 means no differential change by time of day

**A 10% administrative fee is added to cover cost of collection.

Option 2: Toll on existing facility

The Evergreen Point Bridge is the most congested facility in the state, with well over 100,000 ADT. In this option, putting a toll on the facility would have two objectives: (1) to encourage ridesharing and (2) to raise revenue to make improvements. In order to reduce traffic and encourage ridesharing, the toll would be charged only to SOVs. The following assumptions were made:

1. peak toll would be 25 cents,
2. off-peak toll would be 10 cents,
3. toll would be charged electronically, resulting in no traffic delay,
4. traffic diversion would be 13 percent and 5 percent in the peak and off-peak, respectively,
5. average occupancy would increase by 10 percent, and
6. volumes would be the same as current person volumes.

The total annual revenue would be about $3.3 million. Since no federal money was used to construct the bridge, no payback would be required. However, the fact that motorists have already paid for the construction of the bridge through tolls would mean that the revenues would have to be applied to traffic improvements in that corridor. Some possible projects might include an incident response system, more park-and-ride facilities, more bus service, and improved HOV connections to I-5.

Option 3: A "barrier" system

Several cities have explored ways to reduce traffic in CBDs. Singapore is an example of a "barrier" system. In that city, a toll is charged to SOVs crossing a line surrounding the CBD during the peak period. In Seattle, such a system would be more difficult to set up because of the numerous access points to the CBD. However, as Figure 9 shows, 12 toll collection points could effectively capture most of the traffic entering the activity center. The natural barriers of the Ship Canal and Lake Washington would facilitate such a system. The traffic entering from the south

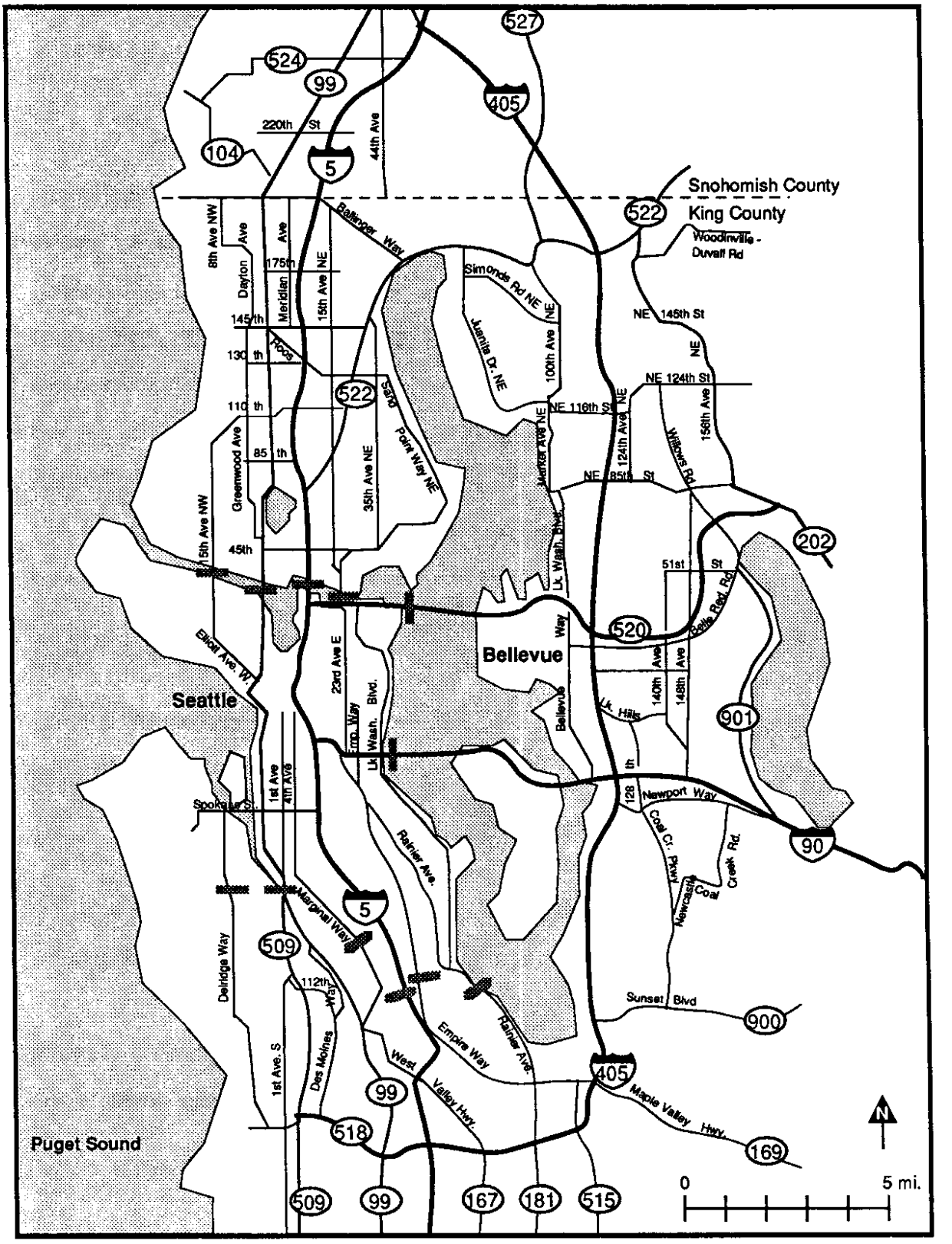


Figure 9. Location of Tolling Points for a "Barrier" System

would be somewhat more problematic. However, with electronic toll collection, it would be possible to add collection points in the south end where diversion on local streets became a significant problem.

The revenue estimate realized from such a system was based on the same assumptions used for Option 3. The total annual yield would be about $25 million.

Since many of the highways and arterials involved in the "barrier" option were paid for with federal funds, including the greatest recent expense, I-90, federal payback would be an issue. A rough estimate of the depreciated value of the federal share of the highways involved in the "barrier" option in 1995 is $1 billion. Payments of about $100 million per year over a 20-year period would be required to pay this amount off. Even if 35 percent were subsidized, the annual yield from the "barrier" system would not cover federal payback requirements. Clearly, this option would be feasible only if something like a $1 toll were charged during the peak period or if federal payback were waived.

Option 4: An "area-wide" toll

The objectives of an area-wide toll are to generate revenue and manage congestion. Such a system could be implemented in place of additional gasoline tax. If differential rates were charged by time of day, it could also serve a congestion relief function. Table 6 shows the yield with various per mile toll rates. If electronic meters were placed throughout King County to charge an average of 3 cents per mile during the peak periods and 1 cent per mile during the off-peak periods, approximately $180 million per year would be collected in the county.

The annual cost per vehicle would be about $180, or the equivalent of raising the gasoline tax by about 24 cents per gallon. The average commuter would pay less than 50 cents per day for the commute trip.

The cost to pay back the total federal investment in King County would be about $280 million per year over a 20-year period. If federal contributions were depreciated over a 20-year period, the remaining value would require $130 million

per year payments. If 35 percent of that were subsidized, the annual payment would be about $85 million, leaving almost $100 million per year for additional highway improvements.

TABLE 6. "AREA-WIDE" ROAD PRICING REVENUE YIELD ANALYSIS

Peak Toll/Mile Off-Peak Toll/Mile	1¢ 1¢	2¢ 1¢	3¢ 1¢	5¢ 2¢	8¢ 5¢
Total Annual Revenue (millions)	$98	$138	$178	$305	$567
Average Commute Cost per day ($s)	$0.18	$0.35	$0.53	$0.88	$1.41
Annual Cost/Vehicle ($s)	$99	$138	$176	$308	$576

CHAPTER 5. PARKING TAX

Parking is a necessary element in the transportation system. Parking is not only essential for the auto traveler, but it is also a crucial variable that influences investment decisions and residential or job location decisions. Parking affects movement patterns and life styles of people. It is the most sensitive variable in modal split models. Because of the importance of parking, any policy affecting its price is a sensitive political issue.

Parking taxes have been adopted in many cities all over the world, and in the U.S. the following cities have had a parking tax for more than 10 years: San Francisco, Chicago, Washington, D.C., Pittsburgh, Philadelphia, and New York. The rates of taxation vary from six percent to 25 percent of the gross receipts of the parking garage operators. A six percent tax on commercial parking in New York city yields approximately $12 million per year, and a 25 percent tax on commercial parking in San Francisco generates approximately $5.5 million annually. In the case of San Francisco, a 25 percent tax was initially introduced for revenue purposes, but it was reduced to 20 percent because of public outcry.

OBJECTIVES OF A PARKING TAX

Parking taxes are an alternative way of charging vehicle owners for the use of roads. To the extent that the parking tax is passed on to the parker, it is like a highway use tax. For example, when the tax is levied on a privately owned and operated parking garage, the tax is likely to be passed on to the users.

The parking tax has the potential for simultaneously achieving a number of other objectives. Raising the parking price has been known to achieve traffic restraint. Besides providing revenue, this tax can increase transit use and reduce automobile pollutants. The reasons for imposing a parking tax may therefore also be to deal with traffic congestion and air pollution problems.

Parking competes with the other uses of space. Parking supplants businesses that could generate taxes. During rush hour, on-street parking interferes with the use of the road by moving traffic, and parked vehicles result in travel costs to other travelers. The harm caused by low-cost parking is not the overuse of parking itself but the increased driving that it causes and the consequent congestion. Low-cost parking makes the cost of driving to work very low in comparison to using transit and encourages an inefficient choice because there is considerable divergence between socially and privately perceived cost. The employee therefore drives to work and rejects transit as an alternative. Low-cost parking may also explain the consistently disappointing inability of mass transit subsidies to lure drivers from single occupant cars. The single occupant vehicles are already enjoying a substantial subsidy, which cannot be bettered by the incentives offered by transit.

All parking (even when there is no employer subsidy) is subsidized to some extent. A parking tax can redress the inequities due to social costs and foregone revenue imposed by parkers. It can also serve to induce a shift to higher occupancy modes of travel.

IMPACTS OF A PARKING TAX

The impact of imposing a parking tax is controversial. While virtually all studies of parking price concur that transportation choices are highly dependent on parking price, it is not clear how to impose a parking tax that will have the desired effect on mode choice and frequency of travel. A parking tax can certainly raise revenues, but unless it is passed on directly to the parkers **and they perceive the additional cost,** it is unlikely to be a useful tool in demand management.

A transportation study conducted by Shoup and Pickrell in 1980 suggested a way to accomplish the goal of passing the parking tax on to the parker. Significant findings were as follows:

- driving alone is the pattern for 2/3 of the automobile commuters where parking is free, but the proportion drops by 1/5 if commercial rates are charged; and

- free parking becomes more valuable at higher income levels, thus providing even a stronger incentive for driving alone (for someone in the 28 percent income tax bracket, a free $75 a month parking space is equivalent to an annual $1,250 bonus).

This study evaluated the following four alternatives:

1. charge all drivers commercial parking rates;

2. treat free parking as taxable income;

3. offer economic incentives to carpools (e.g., free parking and cash bonuses); and

4. amend federal income tax laws to permit employers to give uniform tax-exempt travel allowances to all employees and end free parking.

Alternative 4 was recommended on the grounds of both efficiency and equity because it would give price signals more consistent with economic costs, promote better utilization of all modes, and extend the same benefits to all commuters. The last point was viewed as important because the provision of free parking to commuters was seen as inequitable to those employees who were commuting by bicycle, carpool, transit, or on foot.

A parking tax would not work as a demand management tool unless there were some way to eliminate subsidization of parking by employers. There would also be significant equity issues as discussed below.

Efficiency

A parking tax can serve the objective of economic efficiency, since it may reduce the existing divergence between the social and private cost of operating an automobile. Of course, the changes are difficult to implement efficiently by time of day that the trip was made. However, the benefits would have to at least equal the costs for an individual to incur the expense of parking, and to that extent resources would be allocated efficiently.

The two primary types of social costs include

1. those due to added traffic congestion, and
2. foregone taxes on valuable land.

The first kind of social cost is time-dependent. That is, only those who drive to parking places during the peak hours impose these costs on others. The type of parking involved is long term, used primarily by commuters. The second kind of social cost is imposed by all parkers. Whenever a parking place doesn't generate as much tax revenue as surrounding business or retail use, those who use the parking place are imposing social costs on others. A parking tax is a way of addressing these efficiency considerations.

Equity

A parking tax has horizontal equity if it is imposed equally on those receiving the benefits. However, if parking is provided free, or otherwise subsidized by employers, a parking tax is not paid equally. If the employer bears the cost of the parking tax, the cost is passed on either to company shareholders in the form of reduced profits or to employees in the form of reduced wages and benefits. Obviously, not all shareholders or employers are benefiting by the parking.

If employers are allowed to give tax-exempt travel allowances to employees or parking subsidies are discouraged or disallowed by some other means, the imposition of a parking tax is more equitable. In addition, it works more efficiently to control travel demand. However, a parking tax imposed without any control of subsidies would still distribute the social cost of parking more equitably than it is distributed at the present.

Subsidized parking also raises an issue of equity between those who drive to work and those who commute by other means. Benefits are distributed unfairly because this fringe benefit goes to employees who drive to work, and low income workers are underrepresented in this group. For example, in the Washington, D.C.,

urban area in 1970 the median annual income of transit riders was $6,200, but for auto drivers the median annual income was $9,600.

Experience in several cities has shown that 20 percent of those who drive to work alone and receive low-cost parking would form carpools or begin using public transit if they were asked to pay for the parking. This estimate reflects the results of a variety of mode choice models, comparisons of the behavior of similar commuters who park free and who pay for parking, and the results of the imposition of charges for parking that was formerly provided free. These results held true in the case of Washington, D.C., Ottawa, and the Los Angeles Civic Center.

Effects on users

Studies have found that an increase in parking prices, by way of taxes, can alter travel patterns. In particular, raising parking prices in a CBD can discourage downtown shopping and job-seeking and speed up the movement of economic activity to the suburbs. Some studies that evaluated the impact of an increase in parking rates have revealed that the demand for parking is price elastic. In Chicago a parking tax increase stimulated a drop-off in overall use of a municipal parking facility, although slightly more revenue was generated. Vehicles that entered on weekdays before 9:30 a.m. and parked all day decreased by 72 percent. Apparently most parkers increased their use of transit, rather than diverting to other parking facilities. Because of the availability of space in the midday hours and new short-term fees that remained lower than those at nearby privately owned facilities, short-term parking increased at the municipal facilities. One thing that this study makes obvious is that the alternative of transit should be well developed if a parking tax is to be politically and publicly acceptable; otherwise, there may be a strongly adverse public reaction to a parking tax.

Other studies have been interested in the effect of parking taxes on CBD sales in certain cities. One study estimated the elasticity of total demand for shopping trips to the Boston CBD in relation to parking supply to be roughly 0.6. In

other words, a 10 percent increase in parking available to shoppers (at a distance from shopping roughly equivalent to the present locations of parking) would produce roughly a six percent increase in shopping trips to the CBD. The same study estimated that the elasticity of demand in relation to parking cost is roughly 1.4. The significance of these findings is that they identify a group whose interests would be adversely affected by the introduction of a parking tax. An increase in downtown parking rates alone would imply a certain amount of diversion of business from the downtown to the suburban areas, implying a loss of business for a particular group. However, the interests of this group could be protected through the development of transit alternatives and the availability of short-term parking.

Another valid argument is that increased parking charges make hiring employees more difficult. However, much depends on how good the mass transit improvements are that accompany a parking tax. If the parking tax were imposed equally on all parking places in a region, this objection would be obviated to some extent.

ADMINISTRATION OF A PARKING TAX

There are at least three potential ways to levy a parking tax without creating a new taxing structure:

1. an ad valorem tax,
2. a fixed fee per space, and
3. a fee based on property value.

An ad valorem tax is the method currently used in most places that have a parking tax. Using this method allows automatic adjustments with inflation. However, this method does not allow charging for employer-owned parking lots where parking is free. The tax can be collected as a part of the business and occupation tax. The amount of tax can be determined from income tax reports. No additional reporting mechanism is required.

Currently, the City of Seattle charges an annual public garage license fee of $30 per 1,000 square feet. By definition, this fee can be levied only on public garages. The charge is not a tax, but a fee to obtain a license to operate a parking facility. Increasing the fee would require an amendment to the municipal code. Extending it to all parking would require authorization by the state legislature. However, if the legislative hurdles were overcome, the administration of the fee would require no new taxing structure, at least in the City of Seattle.

Charging a fixed fee per parking space has the advantage of being easy to enforce in comparison with an ad valorem tax. It is more difficult to determine the amount of an ad valorem tax for public garages, and nearly impossible for private parking lots. However, the amount of tax should be somehow related to the value of the property in order to make the parking tax reflect the social cost of lost tax revenue. Since higher cost parking tends to be in locations where there is more traffic congestion, the use of those parking facilities tends to be related to higher social costs due to congestion.

One way to compromise between a parking tax that is constant per space and one that varies according to parking price is to charge according to property value. Since any business or institution that owns parking lots pays a property tax, the value of the parking facility can be determined from a combination of land values and the value of any structure provided for parking. The parking tax can be collected as a property tax surcharge.

A parking tax should be introduced in phases over a period of time if it is to be acceptable to the people for the following reasons:

- It is not equitable to increase parking charges without a simultaneous improvement in the public transit.
- Parking lot operators may be hurt financially.
- Interests of downtown business can be hurt as downtown parking is affected initially. However, studies have shown that the consumer finally adjusts to the cost, and decreased business may only be a short-term phenomenon.

The above concerns can be ameliorated with certain transition investments. Improvements that can be instituted quickly involve an expanded and improved bus operation. Express buses, exclusive bus lanes, fringe parking, and improved bus shelters are all candidates that deserve attention. It may be advisable, from the public acceptability point of view, to utilize the initial revenues from parking taxes to finance transit improvements.

The interests of the parking lot operators can also be protected by restricting "on-street" parking (to short-term parking) in the downtown areas where parking garages are concentrated, so that the parking garages continue to get their customers and customers are not diverted. These regulations have to be enforced vigorously, which necessitates resources for the enforcing agency.

If a significant tax is introduced, the pressure for "on-street" parking would is considerable. A possible solution may be to introduce a ban on "non-residential, on-street" parking before 10 a.m. Once the rush hour begins, the delineated residential spaces may be taken quickly. All other "on-street" parking, metered and unmetered, is banned until 10 a.m., at which time the on-street facilities are available for use. If such a system is to work, vigorous enforcement of the ban must be carried out. It may be necessary to introduce the zoning parking concept to ensure that the congestion does not transfer to the neighboring areas.

A policy decision to introduce a parking tax thus requires the support of city authorities and institutions. The law makers, police force, parking authorities, and transit companies have to be aware of what is going on and recognize their role in the success of this policy decision.

ESTIMATED YIELD FROM PARKING TAX

For this study, two options were explored for imposing a parking tax. One would use the existing public garage fee as a basis and be collected as part of the

Business and Occupation tax. The other option would collect taxes from all off-street parking places devoted to long-term parking.

Option 1: Increasing the public garage license fee

A more modest proposal would use the existing license fee in Seattle of $30 per 1,000 square feet as a basis for a parking tax. One of the limitations of this method is that it would apply only to parking within the city limits. The second limitation is that it would apply only to parking available to the general public. Parking space rented by companies in public garages would not be affected. A third limitation is that it would affect short-term as well as long-term parking.

Currently, the annual yield from the license fee is about $240,000. This amount works out to an average of about 1.2 cents per parking stall per day. If this amount were increased to 25 cents per stall per day, the annual yield would be almost $5 million. At 50 cents per day, the yield would be $10 million. However, such a policy would encourage more employers to rent spaces for employee parking to avoid the extra charge. In order for such a plan to work, the fee (or tax, in this case) would have to apply to rented space, as well as space available to the general public. In that case, the yields would be considerably higher. Unfortunately, the City of Seattle does not have records of the amount of space in public garages that is not generally available to the public.

Option 2: Off-street, long-term parking tax

Table 7 estimates the revenue yield from a parking tax applied to all off-street, long-term parking in King County. This estimate reveals that the parking tax could be a major source of revenue for the transportation sector, in the range of $50 million to $200 million per year. The estimate of revenue was based on the number of employees and college students in King County, their mode split, and an assumption concerning the percentage of parking places that are on-street. The estimate was also based on an average yield per space, but realistically, the range would be on the order of from one-half to four times the average.

The yield from such a parking tax could support major transportation projects. For instance, an average charge of 60 cents per day would allow Metro Transit to provide free bus service. An average charge of 70 cents per day would be equivalent to the **total** motor fuel tax collection in the county.

Table 7. An Estimate of Revenue from Parking Taxes in King County

	People	Vehicles	Parking Places
Employment + College	987,000 [1]		
SOV (84.0%) [1]	829,080	829,080 [4]	746,172
Transit (12.7%) [1]	125,349 [2]	2,786	
Carpool (3.3%) [1]	32,571 [3]	13,028 [4]	11,725
			757,897
		TOTAL ≈	760,000

1 PSCOG
2 @ 45 persons/bus
3 @ 2.5 persons/car
4 90% are off street

Revenue Yield	$.25/day	$.50/day	$1.00/day
760,000 x 250 parking-days per year	$47.5 M	$95.0 M	$190 M

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