Highway Cost Allocation Study

2007-2009 Biennium

Prepared for
Oregon Department of Administrative Services,
Office of Economic Analysis

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Summary of Major Findings

The 2007 Oregon Highway Cost Allocation Study finds that:

- Light vehicles (those weighing 10,000 pounds or less) paying full fees should pay 65.9 percent of state highway user revenues, and heavy vehicles (those weighing over 10,000 pounds) paying full fees should contribute 34.1 percent during the 2007-09 biennium.

- For the 2007-09 biennium and under existing, current law tax rates, it is projected full-fee-paying light vehicles will contribute 65.4 percent of state highway user revenues and full-fee-paying heavy vehicles, as a group, will contribute 34.6 percent.

- The calculated equity ratios for full-fee-paying vehicles, defined as the ratio of projected payments to responsibilities for the vehicles in each class, are 0.9933 for light vehicles and 1.0129 for heavy vehicles as a group. This means that, under existing tax rates and fees, light vehicles are projected to underpay their responsibility by 0.7 percent. Heavy vehicles, as a group, are projected to overpay their responsibility by 1.3 percent during the next biennium.

- The equity ratios for the individual heavy vehicle weight classes show some classes are projected to overpay and some to underpay their responsibility during the 2007-09 biennium. Chapter 7 of this report offers alternative fee schedules that would minimize this cross-subsidization of some heavy vehicle weight classes by others.

- The reduced rates paid by certain types of vehicles, principally publicly owned and farm vehicles, mean these vehicles are paying lower per-mile charges than comparable vehicles subject to full fees. The difference between what these vehicles are projected to pay and what they would pay if subject to full fees represents a cost that is borne by all other highway users.

2007-09 Oregon Highway Cost Allocation Study

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Chapter 1

Introduction and Background

COST RESPONSIBILITY IS THE PRINCIPLE that those who use the public roads should pay for them and, more specifically, that users should pay in proportion to the road costs for which they are responsible. Cost responsibility requires each category of highway users to contribute to highway revenues in proportion to the costs they impose on the highway system. Cost allocation is the process of apportioning the cost of highway work to the vehicles that impose those costs, and is therefore necessary for the implementation of the cost responsibility policy of the State of Oregon.

For over 60 years, Oregon has based the financing of its highways on the principle of cost responsibility. This tradition has served Oregon well over the years by ensuring that the State's highway taxes and fees are levied in a fair and equitable manner. Periodic studies have been conducted to determine the "fair share" that each class of road users should pay for the maintenance, operation, and improvement of the State's highways, roads, and streets. Prior to the present study, 14 such studies had been completed; the first in 1937, the most recent in 2005.

Oregon voters ratified the principle of cost responsibility in the November 1999 special election by voting to add the following language to Article IX, Section 3a (3) of the Oregon Constitution:

"Revenues . . . that are generated by taxes or excises imposed by the state shall be generated in a manner that ensures that the share of revenues paid for the use of light vehicles, including cars, and the share of revenues paid for the use of heavy vehicles, including trucks, is fair and proportionate to the costs incurred for the highway system because of each class of vehicle. The Legislative Assembly shall provide for a biennial review and, if necessary, adjustment, of revenue sources to ensure fairness and proportionality."

Purpose of Study

The purpose of this 2007 Oregon Highway Cost Allocation Study (HCAS) is to

(1) determine the fair share that each class of road users should pay for the maintenance, operation and improvement of Oregon's highways, roads and streets, and

(2) recommend adjustments, if necessary, to existing tax rates and fees to bring about a closer match between payments and responsibilities for each vehicle class.

Past Oregon Highway Cost Allocation Studies

Oregon, more than any other state, has a long history of conducting highway cost allocation or responsibility studies and basing its system of road user taxation on the results of these studies. Studies were completed in 1937, 1947, 1963, 1974, 1980, 1984, 1986, 1990, 1992, 1994, 1999, 2001, 2003, and 2005. As noted above, the Oregon Constitution now requires a study be conducted biennially and highway user tax rates be adjusted, if necessary, to ensure fairness and proportionality between light and heavy vehicles.

Prior to 1999, Oregon used the terminology "cost responsibility studies," while the federal government and most other states called their studies "cost allocation studies." Oregon has now adopted the more conventional terminology, although the two terms are essentially equivalent and used interchangeably in this report.[1]

In all prior studies, highway users and other interested parties have been given the opportunity to offer their input in an open and objective process. During the 1986 Study, for example, three large public meetings were held to provide information on the study and solicit the input of all user groups.

As part of the 1994 study process, a Policy Advisory Committee was formed to address several cost responsibility issues that arose during the 1993 legislative session. This committee consisted of 12 members including a representative of AAA Oregon and five representatives of the trucking industry. The committee held six meetings devoted to understanding and recommending policies for the 1994 Study as well as future Oregon studies.

In 1996, the Oregon Department of Transportation (ODOT) formed the Cost Responsibility Blue Ribbon Committee to evaluate the principles and methods of the Oregon cost responsibility studies and, if warranted, recommend improvements to the existing methodology. This eleven-member committee was chaired by the then Chairman of the Oregon Transportation Commission and included representatives of the trucking industry, AAA Oregon, local governments, academia, and Oregon business interests. The committee held a total of seven meetings and reached agreement on a number of recommendations for future studies. Since the trucking industry, in some cases, did not agree with the full committee recommendations, it was given the opportunity and elected to file a Minority Report that was included in the committee report.

All studies prior to 1999 were conducted by ODOT staff. In February 1998, the ODOT and Oregon Department of Administrative Services (DAS) Directors reached agreement to transfer responsibility for the study from ODOT to DAS. The 1999, 2001, and 2005 studies, as well as the current study, were conducted by consultants to the DAS Office of Economic Analysis. ODOT's role in these studies was to provide technical assistance and most of the data and other required information. In the 2003 study, ODOT conducted the study using the model developed for the 2001 study.

The Oregon studies prior to 1999 relied on an internal technical advisory committee to provide the expertise and some of the many data elements required for the studies. As noted, highway users and other interested parties were also provided the opportunity to offer their input as the studies were being conducted. For the 1999 and subsequent studies, DAS formed a Study Review Team (SRT) to provide overall direction for the studies. The SRT's role has been to provide policy guidance and advisory input on all study methods and issues.

The SRT for the 2001 Study consisted of ten members and the SRT for the 2003 study had eight members, as have subsequent studies. The composition of the SRT has changed from study to study, but all have included motorist, trucking industry and Oregon business representatives, academics, and state officials. All SRTs have been chaired by the State Economist. ODOT did not have

[1] It should be noted that to be precise, neither term is technically correct. Since all state studies, including Oregon's, have to this point allocated expenditures rather than actual costs imposed, they are really "expenditure allocation" studies.

a representative on the 1999 SRT but was represented on the SRTs subsequent studies.

Other Highway Cost Allocation Studies

Although Oregon has the longest history of conducting highway cost allocation studies, a number of other states also have conducted such studies. The majority of those have been completed over the past two decades. During the 60 years up through 1998, 32 states performed a total of 71 cost allocation studies. Since the late 1970s, some 30 states have conducted such studies.

The interest of other states in undertaking these studies has, in many cases, been sparked by the completion of similar studies by the federal government. Several states undertook studies following the release of the 1982 Federal HCAS. With the release of the 1997 Federal HCAS and the Federal Highway Administration's (FHWA) interest in helping states do their own studies, there has again been a renewed interest among the states. Upon completion of the 1997 Federal Study, FHWA formed a state representatives' Steering Committee to assist the states in adopting the research and methods employed in that study.

A 1996 Oregon Legislative Revenue Office report concluded most of the differences in study results among states can be explained by differences in the types of expenditures that are allocated.[2] Oregon, for example, includes no state police expenditures in its studies because, since 1980, state police do not receive Highway Fund monies. California, on the other hand, includes large Highway Patrol expenditures in its studies. Since policing expenditures are typically viewed as a common responsibility of all highway users and are assigned to all vehicle classes on the basis of each class's relative travel, they are predominantly the responsibility of automobiles and other light vehicles. Therefore, it is not surprising the California studies find a higher light and lower heavy vehicle responsibility share than the Oregon studies.

A review of state studies conducted in connection with the 1997 Federal Study found those studies attempting to clearly allocate costs between light and heavy vehicle classes have commonly found heavy vehicles to be responsible for 30 to 40 percent of total highway expenditures. The past several Oregon studies have produced results in this range. Both the 1982 and 1997 Federal HCASs found trucks and other heavy vehicles to be responsible for 41 percent of federal highway expenditures.[3]

Oregon Road User Taxation

Oregon's constitutionally dedicated State Highway Fund derives most of its revenue from three major highway user taxes: vehicle registration fees, motor vehicle fuel taxes (primarily the gasoline tax), and motor carrier fees (primarily the weight-mile tax). The basis of each of these taxes is governed by the concept of cost responsibility. This three-tiered structure is used to collect a fair share of revenue from each highway user class.

Road user taxes were initially levied against motor vehicles to cover the cost of registration. A one-time fee of $3 was instituted in 1905. Since this proved to be a productive source of revenue, the State soon

[2] "Oregon Cost Responsibility Studies Compared to Other States," Legislative Revenue Office Research Report #4-96, September 10, 1996.

[3] It should be noted, however, that the results of the federal studies are not directly comparable to those of state studies. The reasons are that highway maintenance is largely a state funded activity and so not included in the federal studies, and the heavy vehicle responsibility share is generally lower for most maintenance activities than for construction, particularly major rehabilitation projects. Therefore, the responsibility for federal expenditures will typically be more weighted toward heavy vehicles than is the case for state expenditures.

annualized the fee and began to increase the rates and used the proceeds to finance highways.

The registration fee is considered payment for the fixed or non-use related costs of providing a highway system. These costs include minimal maintenance of facilities and equipment along with certain administrative functions necessary to keep the system accessible. Since these costs account for a small portion of total highway costs, registration fees in Oregon have traditionally been low (for both cars and trucks) in comparison to the corresponding fees in most other states. From 1990 to 2003, the registration fee for automobiles and other vehicles weighing 8,000 pounds or less was $30 biennially. It currently is $54 biennially.

The second tier in the Oregon system is the fuel tax. In 1919, Oregon became the first state in the nation to enact a fuel tax on gasoline. It was regarded as a "true" road user tax since those who used the roads more paid more. The fuel tax came to be viewed as the most appropriate means of collecting the travel-related share of costs for which cars and other light vehicles are responsible.

The state fuel tax was extended to diesel and other fuels in 1943. Since that time, the tax on diesel and other fuels, referred to as a "use fuel" tax, has been at the same rate per gallon as the tax on gasoline. Oregon's fuel tax rate is $0.24 per gallon. It was last increased in 1993.

The third tier in the Oregon highway finance system is the weight-mile tax. Oregon's first third-structure tax was put into effect in 1925 in the form of a ton-mile tax. It was used to cover the responsibility of the growing number of trucks and other heavy vehicles appearing on the public roadways at that time.

Oregon's first weight-mile tax was enacted in 1947 and implemented in 1948. The tax applies to all commercial motor vehicles with declared gross weights in excess of 26,000 pounds. It is based on the declared weight of the vehicle and the distance it travels in Oregon. The weight-mile tax is a use tax that takes the place of the fuel tax on heavy vehicles. Vehicles subject to the weight-mile tax are not subject to the state fuel tax.

The Oregon weight-mile tax system consists of a set of schedules and alternate flat fee rates. There are separate schedules for vehicles with declared weights of 26,001 to 80,000 pounds and those over 80,000 pounds. Additionally, log, sand and gravel, and wood chip haulers have the option to pay flat monthly fees in lieu of the mileage tax.

Since 1990, carriers hauling divisible-load commodities at gross weights between 80,001 and 105,500 pounds pay a weight-mile tax (statutory Table "B") based on the vehicle's declared weight and number of axles. There are separate schedules for five, six, seven, eight, and nine or more axle vehicles with each schedule graduated by declared weight. The rates are structured so that, at any declared weight, carriers can qualify for a lower per-mile rate by utilizing additional axles.

Also since 1990, carriers hauling non-divisible loads at gross weights in excess of 98,000 pounds under special, single-trip permits pay a per-mile road use assessment fee. Non-divisible (or "heavy haul") permits are issued for the transportation of very heavy loads that cannot be broken apart such as construction equipment, bridge beams, and electrical transformers.

The road use assessment fees are expressed in terms of permit gross weight and number of axles and are currently based on a charge of 5.7 cents per equivalent single axle load (ESAL[4]) mile of travel. As with the Table "B" rates, carriers are assessed a lower per-mile charge the greater the number of axles used at any given gross weight. The road use assessment fee takes the place of the weight-mile tax for the loaded, front-haul

[4] An ESAL is equivalent to a single axle carrying 18,000 lbs. (80kN).

portion of non-divisible load trips. With rare exceptions, empty back haul miles continue to be subject to the weight-mile tax and taxed at the vehicle's regular declared weight.

In the years since 1947, the weight-mile rates have been adjusted 13 times based on the results of updated cost responsibility studies. The most recent revision occurred on September 1, 2000 when the rates were reduced across-the-board by approximately 12.3 percent to reflect the results of the 1999 Study. The rates were also reduced by 6.2 percent on January 1, 1996 based on the results of the 1994 Study. The last time the rates were increased was January 1, 1992, when they were increased to maintain equivalency with the fuel tax increases enacted by the 1991 Legislature.

The 1999 Oregon Legislature repealed the weight-mile tax and replaced it with a 29 cent per gallon diesel fuel tax and substantially higher heavy truck registration fees. This measure, House Bill 2082, was subsequently referred to the voters and defeated in the May 2000 primary election.

After the May 2000 vote, the trucking industry challenged the Oregon tax in the courts. The primary focus of the legal action was the feature that allows haulers of logs, sand and gravel, and wood chips to pay alternate flat fees in lieu of the mileage tax. The industry argued these fees are, from a practical standpoint, available only to Oregon intrastate motor carriers, and this provision of the Oregon system therefore unfairly discriminates against non-Oregon based interstate firms. In February 2002, the Third District Circuit Court ruled in favor of the State in the lawsuit. The ruling was reversed in the Court of Appeals in 2003, and was unreversed. The Oregon Supreme Court affirmed the original Circuit Court decision in December 2005.

Organization of this Report

This volume of the 2007 Study provides an overview of the study issues, methodology, and results as well as recommendations for future studies. There are a number of exhibits throughout this report to illustrate specific data. Please note that amounts shown are rounded and may not total exactly.

This chapter has provided an introductory discussion of the purpose, scope, and process of the 2007 Study as well as a brief background discussion of the history of Oregon highway cost allocation studies, studies by the federal government and other states, and the evolution of Oregon road user taxation.

Chapter 2 briefly summarizes the basic structure and parameters of the 2007 Study including the analysis periods, road (highway) systems, vehicle classes, revenues attributed, and expenditures allocated to the vehicle classes.

Chapter 3 presents the general methodology and approach used for the study. It includes a description of the special analyses conducted for the study and discussion of the major methodological and procedural changes from previous Oregon studies.

Chapter 4 summarizes the data and forecasts used in the study, and compares them to the data and forecasts used in recent studies.

Chapter 5 presents the study expenditure allocation and revenue attribution procedures and results, and compares the methods and results to those of previous Oregon studies.

Chapter 6 brings together the expenditure allocation and revenue attribution results from the previous chapter to develop ratios of projected payments to cost responsibilities for light vehicles and the detailed heavy vehicle weight classes. It also compares these ratios to those from the prior two Oregon studies.

Chapter 7 contains recommendations for changes in existing tax rates and fees to bring about a closer match between revenues contributed and cost responsibilities for each vehicle class.

The Appendices to this report include:

A. Glossary of terms;
B. A set of Issue Papers developed for this study;
C. The agenda and minutes of each of the SRT meetings;
D. Model description and detailed documentation of the model.

Chapter 2

Basic Structure and Parameters of Study

THE UNDERLYING APPROACH AND METHODS used in this study are, with a few significant exceptions, similar to those used in the last four Oregon studies. The analytic framework and basic parameters of the 2007 Study are briefly summarized below.

Study Approach and General Methodology

This study uses the cost-occasioned approach, employing incremental, design-based allocation methodology for bridges and the National Pavement Cost Model (NAPCOM) for pavement costs. This is the same general approach as was used in previous Oregon studies and virtually all studies conducted by the federal government and other states.

Analysis Periods

Base Year: Calendar Year 2005, the most recent full year for which data was available when the study was undertaken (2006).

Forecast Year: Calendar Year 2008, the middle 12 months of the 24-month study period.

Study Period: The 2007-09 State Fiscal Biennium, or July 1, 2007 to June 30, 2009.

The expenditures allocated are those projected for the 2007-09 biennium using ODOT's Cash Flow Forecast model. All traffic data used in the study were first developed from data for the 2005 base year, and then projected forward to the 2008 forecast year using weight-class-specific growth rates.

Road (Highway) Systems

This study uses the Federal Highway Administration's classification system for highway functional classes. Every public road in Oregon is assigned to one of 12 functional classes:

1. Rural Interstate
2. Rural Other Principal Arterial
3. Rural Minor Arterial
4. Rural Major Collector
5. Rural Minor Collector
6. Rural Local
7. Urban Interstate
8. Urban Other Freeway
9. Urban Other Principal Arterial
10. Urban Minor Arterial
11. Urban Collector
12. Urban Local

Each roadway segment also is assigned to one of four ownership categories: state, county, city, or federal. Note that US Highways and Interstates are owned by the State; federal ownership consists mostly of Forest Service and Bureau of Land Management roads.

In addition to the 12 federal functional classes, we developed three additional categories of our own to facilitate the allocation of costs for projects on multiple functional classes or where the functional class was not known. Those additional categories are: all roads, all state-owned roads, and all locally-owned roads.

Vehicle Classes

Light, or basic, vehicles include all vehicles up to 10,000 pounds gross weight, consistent with Oregon law and registration fee schedules. In previous studies, light vehicles were defined as all vehicles up to 8,000 pounds.

Vehicles weighing over 10,000 pounds are divided into 2,000-pound vehicle classes. All vehicles over 200,000 pounds are in the top weight class. Those over 80,000 pounds are further divided into subclasses based on the number of axles on the vehicle. The five subclasses are five, six, seven, eight, and nine or more axles.

Vehicles over 26,000 pounds are assigned to weight classes based on their declared weight, which may be different from their registered gross weight. For example, a given tractor may operate with different configurations (number and type of trailers) at different times, and may have different declared weights for different configurations.

For modeling purposes, each weight class under 80,000 pounds is assigned a distribution of numbers of axles, and each combination of weight class and number of axles is assigned a distribution of operating weights. For vehicles over 26,000 pounds, these distributions are obtained from Special Weighings data supplied by ODOT.[1]

For reporting purposes, the expenditure allocation and revenue attribution results reported in Chapters 5 and 6 are presented in terms of the following nine summary-level vehicle weight groups:

1 to 10,000 pounds
10,001 to 26,000 pounds
26,001 to 46,000 pounds
46,001 to 54,000 pounds
54,001 to 78,000 pounds
78,001 to 80,000 pounds
80,001 to 104,000 pounds
104,001 to 105,500 pounds
105,501 pounds and up

The only variation in these groupings from those used in the 2001, 2003, and 2005 Oregon studies is an increase in the upper weight limit for the lightest weight class to 10,000 pounds (from 8,000 pounds). One- to 8,000-pound vehicles account for 92.2 percent of vehicle miles traveled in Oregon; one- to 10,000-pound vehicles account for 92.5 percent. They were selected on the basis of the characteristics of the vehicles in each group, logical divisions in the tax structure, and the number of vehicles and miles in each group. Operators of vehicles in the 10,001 to 26,000 pound group, for example, pay the state fuel tax and higher registration fees rather than the weight-mile tax. Additionally, a large majority of these vehicles are two-axle, single-unit trucks or buses used in local commercial delivery operations or passenger transport. Thus, they have relatively similar characteristics with respect to their cost responsibility and tax payments, and it is therefore logical to combine them for reporting purposes.

Similarly, it makes sense to combine the individual weight classes above 105,500 pounds because these vehicles are: (a) operated under special, single-trip, non-divisible load permits, (b) operated with multiple axles and legally allowed higher axle weights than regular commercial trucks, (c) subject to the road use assessment fee rather than the weight-mile tax for their loaded front haul miles, and (d) typically used for short-mileage hauls (e.g., transporting heavy equipment from one construction site to another) and so account for a very small proportion of total truck miles in the state.

[1] During a special weighing, every truck passing the weigh station is weighed and the weight recorded, even if the truck is empty.

The weight classes of 78,001 to 80,000 and 104,001 to 105,500 pounds are by far the largest two truck classes by miles of travel. These two classes alone account for a majority of the total commercial truck miles in Oregon. Because of the dominant role of these two classes in terms of miles of travel, cost responsibilities, and revenue contributions, it is logical they be kept as separate groups.

Expenditures Allocated

State Expenditures

All State expenditures of highway user fee revenues are allocated, as are all State expenditures of federal highway funds (e.g., matching funds). Federal funds are included because they are interchangeable with State user fee revenues. Any differences in the way they are spent are arbitrary and subject to change.

State expenditures of bond revenues are included because the bonds are repaid from State user fees. Such expenditures are, however, reduced to the amount that will be repaid in the study period before allocation. The remaining expenditures will be included in future studies using the allocation to vehicle classes applied in this study, consistent with the approach taken in the 2005 study. Thus, expenditures of bond revenues in the last study will be included in this and the next eight studies. Allocated expenditures of bond revenues in the 2003 study also are included in this study, and will be included in the next seven studies.

Local Government Expenditures

The study allocates all expenditures by local governments of State highway user fees and of federal highway funds. Federal funds are included because, again, they are interchangeable with State user fee revenues.

Some local-government own-source revenues are allocated because they are interchangeable with State highway user fees. The study excludes local-government own-source revenues reported as coming from locally-issued bonds, property taxes (including local improvement districts), systems development charges, and traffic impact fees. These revenue sources generally must be spent on certain projects or certain types of projects, and are not considered interchangeable with State highway user fees.

In studies prior to 2003, only the expenditures of State highway user fee revenues were allocated. This approach failed to account for the interchangeability of funds from other sources, and required local governments to estimate how State funds were spent because their accounting systems do not track expenditures by funding source.

In the 2003 study, all expenditures by local governments were allocated. The 2005 study refined the approach taken in the 2003 study by excluding certain categories of own-source revenue that generally are not interchangeable.

Expenditure Categories

The four major expenditure categories are:

- **Modernization (new construction or reconstruction).** Examples include adding lanes and straightening curves. Modernization generally adds to the capacity of a roadway either directly or by improving the throughput of a facility. A replacement bridge with more lanes than the bridge it replaces is considered modernization.
- **Preservation (rehabilitation).** Most preservation projects involve repaving existing roads. Preservation projects extend the useful life of a facility, but generally do not add to its capacity. A replacement bridge that does not add capacity is considered preservation.

- **Maintenance and Operations.** Examples of maintenance include pothole patching, pavement striping, snow and ice removal, and maintaining bridges. Examples of operations include traffic signals and signage.
- **Administration, Collection, Planning and Other Costs (everything else).**

Within each of these major categories, expenditures are further broken down into a number of individual work types. Maintenance and Operations, for example, includes 16 individual work types. A separate allocation is performed for the expenditures in each individual work type. Chapter 3 contains a full listing of these work categories and the allocators used for each.

Revenues Attributed

The revenues attributed to vehicles are based on forecast collections for the 2007-09 biennium by major state revenue source under the existing tax structure and current-law tax rates (i.e., current registration and title fees, 24 cent per gallon fuel tax rate, current weight-mile tax, flat fee, and road use assessment fee rates).

Because non-State funding sources are included among the expenditures allocated, the dollar amount of revenues allocated is considerably smaller than the dollar amount of expenditures allocated. This difference in absolute size does not, however, affect the calculation of equity ratios, which is a ratio of ratios (a vehicle class's share of attributed revenues divided by its share of allocated expenditures.

Chapter 3

General Methodology and Study Approach

THIS CHAPTER PRESENTS THE GENERAL METHODOLOGY and approach used in the 2007 Oregon Highway Cost Allocation Study.

Cost-Occasioned Approach

All Oregon highway cost allocation studies, as well as the studies conducted by the federal government and most other states, use what is called the "cost-occasioned approach". The basic premise of this approach is that each class of road user should pay for the system of roads in proportion to the costs associated with road use by that class. The equity of a road tax system may then be judged by how well shares of payments by different classes of road users match their shares of costs resulting from their use of the road system.

The principal alternative to the cost-occasioned approach is the benefits approach, in which an attempt is made to identify and measure the benefits received by both users and nonusers of the system. The benefits approach begins with the recognition that the purpose of a highway system is to provide benefits, both directly to highway users and indirectly to the rest of society. Basing user fees on the value of benefits received, rather than the costs imposed, would promote both fairness (people pay in proportion to the value they receive) and efficiency (agencies would have less incentive to build facilities where the costs exceed the benefits). The benefits approach has two major drawbacks: benefits are not directly measurable, and the benefits associated with traveling a mile on a given road can vary greatly between identical-appearing vehicles or individuals, and for the same vehicle or person at different times.

A long-running debate about the proper balance of cost responsibility and tax burden between highway users and non-users continues at both the state and federal levels, fueled over the years by numerous studies. Arguments that support charging nonusers for highways are based on the societal benefits attributable to the highway system, including increased mobility, safety, and economic development. There are, however, some serious conceptual problems in quantifying benefits and deciding which accrue to users and which accrue to nonusers. In many cases, highway improvements benefit individuals or businesses simultaneously as both users and nonusers. Additionally, the more readily-understood economic impacts of highway improvements often reflect a transfer of user benefits to nonusers—the clearest example being reduced shipping costs, which are passed to businesses and consumers in the form of lower product prices.

Because of these problems, and because of the inherent advantages of user fees in promoting an economically efficient allocation of scarce resources, the federal government and most states conducting cost allocation studies now rely on a cost-occasioned approach to determine responsibility for highways. Oregon studies continue to use a cost-occasioned approach.

Incremental Method

Within the cost occasioned approach, different methods may be used to allocate costs or expenditures to the various vehicle classes. Virtually every recent study, including Oregon's, has used some version of what is referred to as the incremental method. This method divides selected aspects of highway costs into increments, allocating the costs of successive increments to only those vehicles needing the higher cost increment. The design considered adequate for light vehicles only is viewed as a common responsibility of all highway users and shared by all vehicle classes. Each group of successively larger and heavier vehicles also shares in the incremental costs they occasion.

In Oregon, the incremental method is used directly in the allocation of bridge costs. The first increment for a new bridge, for example, identifies the cost of building the bridge to support its own weight, withstand other non-load-related stresses (e.g., stream flow, high winds and potential seismic forces), and carry light vehicle traffic only.[1] This cost is a common responsibility of all vehicles and assigned to all classes on the basis of each class's share of total vehicle miles traveled (VMT). The second increment identifies the additional cost of building the bridge to accommodate trucks and other heavy vehicles weighing up to 50,000 pounds. This cost is assigned to all vehicles with gross weights exceeding 10,000 pounds on the basis of the relative VMT of each class over 10,000 pounds. Similarly, the additional cost of the third increment is assigned to all vehicles with gross weights over 50,000 pounds, and the cost of the fourth and final increment to vehicles having gross weights over 80,000 pounds.

National Pavement Cost Model (NAPCOM)

In the past, highway cost allocation studies typically used an incremental methodology to allocate pavement costs as well. Increased depth and strength of pavement surface and base is required to support increases in the number, and particularly weight, of the vehicles anticipated to use the pavement during its design life.

For the 1997 federal study, Roger Mingo adapted the National Pavement Cost Model (NAPCOM) for use in highway cost allocation. The model still has two increments: non-load-related costs and load-related costs, but the load-related costs are allocated using results from detailed engineering models of several different pavement degradation mechanisms that take into account the effects of climate, traffic levels, mix of vehicle types, and the interactions between different mechanisms. Mingo adapted the pavement model to use Oregon's special weighings data[2] and to use 2,000-pound increments of declared vehicle weight for data input and results reporting. The allocation of costs in the second increment uses the detailed results of the Oregon-specific pavement cost model, which provides allocation factors by weight class

[1] The factors influencing the design requirements, and therefore costs of bridges, are sometimes expressed by the terms "dead load," "live load," and "total load." Bridges need to be designed to support their own weight and the other non-load-related forces such as stream flow, wind, and seismic forces (the dead load) plus the traffic loadings anticipated to be applied to the bridge (the live load). The total design load is the sum of the dead and live loads. Although the precise relationships differ by the type and location of bridge under consideration, as a general rule the longer the span length, the greater the relative importance of the non-load-related factors in determining the total cost of the bridge.

[2] Special weighings record the weight of every truck passing the scale, even if empty.—. Weights are reported for each axle grouping, along with the number of axles in the group.—. This data replaces the more-generalized assumed distributions of operating weight and vehicle configurations used in the national model.

and number of axles for each combination of functional class and pavement type (flexible or rigid).

The Choice of Appropriate Cost Allocators

Some quantifiable measure, or allocator, must be used to distribute each category of cost, or each increment within a category where the incremental approach is used, to the individual vehicle classes. For many costs, there are logical relationships that suggest a particular allocator as most appropriate.

Wear-related costs are the easiest to allocate. Wear-related costs are a direct, empirically-established consequence of use by vehicles. The amount of wear a vehicle imposes per mile of travel generally relates closely to measurable attributes of the vehicle. Two approaches may be used for choosing allocators for wear-related costs.

Results from a detailed model that predicts costs imposed by individual vehicles may be used to develop allocation factors that produce the same attribution of costs as the model. That is how pavement costs are handled in this study.

If a detailed model for attributing wear-related costs does not exist, one may choose allocation factors that one expects to vary in proportion to the wear imposed per unit of use by the vehicles in each category. For example, striping costs are allocated according to axle-miles of travel because it is expected that stripes wear in proportion to the number of axles that pass over them.

Capital costs do not vary with the amount of actual use that occurs on new facility once built. Conceptually, the decision to add capacity is an investment decision that the user benefits of the enhancement exceed its costs. This, in turn, is usually related to congestion levels on existing facilities, as relief of this congestion is the primary basis for additional user benefits. Hence, the share of efficient fees (which measure the contribution of a vehicle class to existing congestion), whether or not they are actually charged, is the appropriate allocator for capital costs expended to relieve that congestion; in this way, those vehicles responsible for the current congestion “problem” are appropriately charged for its “solution”.

For structures, and, to a lesser extent, roadways, the cost of constructing a facility with a given capacity will vary with the maximum weight and size of vehicle expected to use it. Part of the difference in construction cost, however, may be offset by increased useful life of a sturdier facility. If one attributes capital costs based on differences in the size or strength of the structure required to accommodate different types of vehicle, then the incremental approach may be used. The incremental approach, by itself, does not account for the capacity demand that drove the decision to build the facility. The incremental approach may be modified to take into account the expected effects of structure design on useful life, as was done in the allocation of bridge costs in recent Oregon studies.

All other approaches to capital-cost allocation are theoretically arbitrary and thus inherently second best. However, other approaches may be selected because of their convenience, despite the lack of a compelling underlying logic. One such second-best approach to allocating capacity-enhancing capital costs was used in the two most recent Oregon studies. The non-wear-related portion of capital costs were allocated in proportion to passenger-car-equivalent vehicle-miles traveled during the peak hour (peak PCE-VMT), which varies in proportion to each vehicle’s contribution to congestion on existing facilities, but does not take into account the relationship between volume and capacity on existing facilities. The approach also assumes that the value of time is equal across all vehicle types, trip types, and vehicle occupancies.

If the benefits resulting from a given expenditure vary with vehicle use, the cost may be allocated in proportion to the level of benefit. For example, if the occupants of every vehicle passing a safety improvement benefit from reduced risk of death or injury, the cost could be attributed on the basis of occupant-miles traveled or, if occupancy is assumed to be the same across all vehicles, vehicle-miles traveled. Other costs may not vary at all with vehicle use, but must still be allocated to vehicles. If one attributes costs that do not vary with use, any allocator that seems “fair” may be chosen. In these cases, there is no single right allocator to use.

In general, an allocator that varies more closely with costs imposed should be selected over one that varies less closely. The degree of correlation may be measurable given sufficient data, but the necessary data usually do not exist, so one must calculate the expected relationship based on engineering and economic theory. A strong statistical correlation does not necessarily indicate a good allocator, as there is no reason to believe that an accidental correlation will persist. An allocator must also vary with measurable (and measured) attributes of vehicles, such as miles traveled, weight, length, number of axles, or some combination of those.

Allocators Used in This Study

As noted above, there are a number of cost allocators available for use in a cost allocation study. Allocators may be applied on either a per-vehicle or a per-vehicle-mile-traveled basis. Because it is generally vehicle use, rather than the existence of vehicles, that imposes costs on the highway system, all costs in the current Oregon study are allocated using some type of weighted vehicle-miles traveled (VMT).

Unweighted VMT are the most general measure of system use and are considered a fair way to assign many types of common costs, i.e., costs considered to be the joint responsibility of all highway users. VMT represent a reasonable and accepted measure to assign costs among the members of a subgroup (e.g., the individual vehicle classes within a cost increment), especially when members of the subgroup have similar characteristics or when an investment is made to provide a safer highway facility. Unweighted VMT are used for many traffic-oriented services, such as the provision of lighting, signs and traffic signals, since these services are generally related to traffic volumes.

Weighting VMT with an appropriate vector of zeros and ones will produce an allocator that restricts allocation to corresponding subset of weight classes. Such allocators are used to implement the incremental approach for bridge costs and for other costs allocated on VMT for a subset of all vehicles. One example is the allocation of Motor Carrier Transportation Division administrative costs only to vehicles over 26,000 pounds.

Other VMT weighting factors may also be used to allocate certain costs more appropriately. VMT can be weighted to account for the effective roadway space occupied by various types of vehicles relative to a standard passenger car. This is accomplished by using passenger-car equivalence (PCE) factors to weight VMT, producing PCE-VMT. Because trucks are larger and heavier than cars and require greater acceleration and braking distances, they occupy more effective roadway space and therefore have higher PCE factors. A variety of PCE factors were developed for the 1997 federal study, including different factors for different functional classes and different levels of traffic congestion, as well as uphill factors for steep grades. The uphill factors are used in this study to allocate the costs of climbing lanes.

Congested (or peak period) PCE-VMT is peak-period VMT weighted by the PCE factors for congested traffic conditions. It is used in this study for the common cost portion of projects undertaken to add capacity to the highway system.

VMT can also be weighted to reflect the amount of pavement wear imposed by vehicles of various weights and axle configurations. The factors used for this weighting are produced from the results of the pavement model described above.

Exhibit 3-1 shows the allocators applied to each expenditure category in this study.

Work Type	Worktype Description	Allocator 1	Share 1	Allocator 2	Share 2
1	Prelimary and Construction Engineering (and etc.)	Congested PCE	51.8%	Other Construction	48.2%
2	Right of Way (and Utilities)	Congested PCE	52.1%	Other Construction	47.9%
3	Grading and Drainage	Congested PCE	100.0%		0.0%
4	New Pavements-Rigid	Congested PCE	6.9%	Rigid Pave	93.1%
5	New Pavements-Flexible	Congested PCE	3.3%	Flex Pave	96.7%
6	New Shoulders-Rigid	Congested PCE	100.0%		0.0%
7	New Shoulders-Flexible	Congested PCE	100.0%		0.0%
8	Pavement and Shoulder Reconstruction-Rigid	Congested PCE	26.9%	Rigid Pave	73.1%
9	Pavement and Shoulder Reconstruction-Flexible	Congested PCE	23.3%	Flex Pave	76.7%
10	Pavement and Shoulder Rehab-Rigid	All VMT	26.9%	Rigid Pave	73.1%
11	Pavement and Shoulder Rehab-Flexible	All VMT	23.3%	Flex Pave	76.7%
12	Pavement and Shoulder Rehab-Other	All VMT	100.0%		0.0%
13	New Structures	None-Bridge Split	100.0%		0.0%
14	Replacement Structures	None-Bridge Split	100.0%		0.0%
15	Structures Rehabilitation	None-Bridge Split	100.0%		0.0%
16	Climbing Lanes	Uphill PCE	100.0%		0.0%
17	Truck Weight/Inspection Facilities	Over 26 VMT	100.0%		0.0%
18	Truck Escape Ramps	Over 26 VMT	100.0%		0.0%
19	Interchanges	None-Bridge Split	100.0%		0.0%
20	Roadside Improvements	All VMT	100.0%		0.0%
21	Safety Improvements	Congested PCE	100.0%		0.0%
22	Traffic Service Improvements	Congested PCE	100.0%		0.0%
23	Other Construction (modernization)	Other Construction	100.0%		0.0%
24	Other Construction (preservation)	All VMT	100.0%		0.0%
25	Surface and Shoulder Maintenance-Rigid	All VMT	26.9%	Rigid Pave	73.1%
26	Surface and Shoulder Mainenance-Flexible	All VMT	23.3%	Flex Pave	76.7%
27	Surface and Shoulder Maintenance-Other	All AMT	100.0%		0.0%
28	Drainage Facilities Maintenance	All VMT	100.0%		0.0%
29	Structures Maintenance	All VMT	100.0%		0.0%
30	Roadside Items Maintenance	All VMT	100.0%		0.0%
31	Safety Items Maintenance	All VMT	100.0%		0.0%
32	Traffic Service Items Maintenance	Congested PCE	100.0%		0.0%
33	Pavement Striping and Marking (maintenance)	All AMT	100.0%		0.0%
34	Sanding and Snow and Ice Removal (maintenance)	All VMT	100.0%		0.0%
35	Extraordinary Maintenance	All VMT	100.0%		0.0%
36	Truck Scale Maintenance-Flexible	Over 26 VMT	100.0%		0.0%
37	Truck Scale Maintenance-Rigid	Over 26 VMT	100.0%		0.0%
38	Truck Scale Maintenance-Buildings and Grounds	Over 26 VMT	100.0%		0.0%
39	Studded Tire Damage	Basic VMT	100.0%		0.0%
40	Miscellaneous Maintenance	All VMT	100.0%		0.0%
41	Bike/Pedestrian Projects	All VMT	100.0%		0.0%
42	Railroad Safety Projects	All VMT	100.0%		0.0%
43	Transit and Rail Support Projects	Congested PCE	100.0%		0.0%

Exhibit 3-1, continued

Work Type	Worktype Description	Allocator 1	Share 1	Allocator 2	Share 2
44	Fish and Wildlife Enabling Projects	All VMT	100.0%		0.0%
45	Highway Planning	All VMT	100.0%		0.0%
46	Transportation Demand & Transportation System Management	Congested PCE	100.0%		0.0%
47	Multimodal	Congested PCE	100.0%		0.0%
48	Reserve Money, Fund Exchange, Immediate Opportunity Fund	All VMT	100.0%		0.0%
49	Seismic Retrofits on Structures	All VMT	100.0%		0.0%
50	Other Common Costs	All VMT	100.0%		0.0%
55	Other--Over 26,000 Only	Over 26 VMT	100.0%		0.0%
56	Other--Basic Only	Basic VMT	100.0%		0.0%
57	Other--Over 8,000 Only	Over 8 VMT	100.0%		0.0%
58	Other--Under 26,000 Only	Under 26 VMT	100.0%		0.0%
59	Other Administration	All VMT	100.0%		0.0%
60	Bridge --All Vehicles Share (no added capacity)	All VMT	100.0%		0.0%
61	Bridge --Over 8,000 Vehicles Share	Over 8 VMT	100.0%		0.0%
62	Bridge --Over 50,000 Vehicles Share	Over 50 VMT	100.0%		0.0%
63	Bridge --Over 80,000 Vehicles Share	Over 80 VMT	100.0%		0.0%
64	Bridge --Over 106,000 Vehicle Share	Over 106 VMT	100.0%		0.0%
65	Bridge --All Vehicles Share (added capacity)	Congested PCE	100.0%		0.0%
66	Other Bridge	Other Bridge	100.0%		0.0%
67	Interchange Modernization	None-Bridge Split	100.0%		0.0%
101	Local Gov: Prelimary and Construction Engineering (and etc.)	Congested PCE	55.9%	Other Construction	44.1%
102	Local Gov: Right of Way (and Utilities)	Congested PCE	55.9%	Other Construction	44.1%
103	Local Gov: Grading and Drainage	Congested PCE	100.0%		0.0%
104	Local Gov: New Pavements-Rigid	Congested PCE	8.6%	Rigid Pave	91.4%
105	Local Gov: New Pavements-Flexible	Congested PCE	5.8%	Flex Pave	94.2%
106	Local Gov: New Shoulders-Rigid	Congested PCE	100.0%		0.0%
107	Local Gov: New Shoulders-Flexible	Congested PCE	100.0%		0.0%
108	Local Gov: Pavement and Shoulder Reconstruction-Rigid	Congested PCE	28.6%	Rigid Pave	71.4%
109	Local Gov: Pavement and Shoulder Reconstruction-Flexible	Congested PCE	25.8%	Flex Pave	74.2%
110	Local Gov: Pavement and Shoulder Rehab-Rigid	All VMT	28.6%	Rigid Pave	71.4%
111	Local Gov: Pavement and Shoulder Rehab-Flexible	All VMT	25.8%	Flex Pave	74.2%
112	Local Gov: Pavement and Shoulder Rehab-Other	All VMT	100.0%		0.0%
113	Local Gov: New Structures	None-Bridge Split	100.0%		0.0%
114	Local Gov: Replacement Structures	None-Bridge Split	100.0%		0.0%
115	Local Gov: Structures Rehabilitation	None-Bridge Split	100.0%		0.0%
116	Climbing Lanes	Uphill PCE	100.0%		0.0%
117	Truck Weight/Inspection Facilities	Over 26 VMT	100.0%		0.0%
118	Truck Escape Ramps	Over 26 VMT	100.0%		0.0%
119	Interchanges	None-Bridge Split	100.0%		0.0%
120	Roadside Improvements	All VMT	100.0%		0.0%

Exhibit 3-1, continued

Work Type	Worktype Description	Allocator 1	Share 1	Allocator 2	Share 2
121	Local Gov: Safety Improvements	All VMT	100.0%		0.0%
122	Local Gov: Traffic Service Improvements	Congested PCE	100.0%		0.0%
123	Local Gov: Other Construction	Other Construction	100.0%		0.0%
124	Local Gov: Other Rehabilitation	All VMT	100.0%		0.0%
125	Local Gov: Surface and Shoulder-Rigid	All VMT	28.6%	Rigid Pave	71.4%
126	Local Gov: Surface and Shoulder-Flexible	All VMT	25.8%	Flex Pave	74.2%
127	Local Gov: Surface and Shoulder-Other	All AMT	100.0%		0.0%
128	Local Gov: Drainage Facilities	All VMT	100.0%		0.0%
129	Local Gov: Structures	All VMT	100.0%		0.0%
130	Local Gov: Roadside Items	All VMT	100.0%		0.0%
131	Local Gov: Safety Items	All VMT	100.0%		0.0%
132	Local Gov: Traffic Service Items	Congested PCE	100.0%		0.0%
133	Local Gov: Pavement Striping and Marking	All AMT	100.0%		0.0%
134	Local Gov: Sanding and Snow/Ice Removal	All VMT	100.0%		0.0%
135	Local Gov: Extraordinary Maintenance	All VMT	100.0%		0.0%
136	Truck Scale-Flexible	Over 26 VMT	100.0%		0.0%
137	Truck Scale-Rigid	Over 26 VMT	100.0%		0.0%
138	Truck Scale-Buildings and Grounds	Over 26 VMT	100.0%		0.0%
139	Local Gov: Studded Tire Damage	Basic VMT	100.0%		0.0%
140	Local Gov: Miscellaneous / Unspecified	All VMT	100.0%		0.0%
141	Bike/Pedestrian Projects	All VMT	100.0%		0.0%
142	Railroad Safety Projects	All VMT	100.0%		0.0%
143	Transit and Rail Support Projects	Congested PCE	100.0%		0.0%
144	Fish, Wildlife Enabling Projects	All VMT	100.0%		0.0%
145	Planning	All VMT	100.0%		0.0%
146	Transportation Demand & Transportation System Management	Congested PCE	100.0%		0.0%
147	Multimodal	Congested PCE	100.0%		0.0%
148	Reserve Money, Fund Exchange, Immediate Opportunity Fund	All VMT	100.0%		0.0%
149	Seismic Retrofits	All VMT	100.0%		0.0%
150	Local Gov: Other Admin	All VMT	100.0%		0.0%
160	Bridge --All Vehicles Share	All VMT	100.0%		0.0%
161	Bridge --Over 8,000 Vehicles Share	Over 8 VMT	100.0%		0.0%
162	Bridge --Over 50,000 Vehicles Share	Over 50 VMT	100.0%		0.0%
163	Bridge --Over 80,000 Vehicles Share	Over 80 VMT	100.0%		0.0%
164	Bridge --Over 106,000 Vehicle Share	Over 106 VMT	100.0%		0.0%
165	Bridge Modernization	None-Bridge Split	100.0%		0.0%
166	Other Bridge	Other Bridge	100.0%		0.0%
167	Interchange Modernization	None-Bridge Split	100.0%		0.0%

Costs not accounted for as a part of specific construction projects, but that are expected to vary with the overall level of construction are allocated with special factors developed during the allocation process. These factors allocate costs in proportion to the construction costs that were allocated from specific projects. Separate “other construction” factors are calculated and applied for work performed by the State and by local governments.

Prospective View

The costs or expenditures allocated in a cost allocation study can be those for a past period, those anticipated for a future period, or a combination of past and future costs. Some studies conducted by the federal government and other states have allocated both historical and planned expenditures.

The Oregon studies have traditionally used a prospective approach in which the expenditures allocated are those planned for a future period, specifically, the next fiscal biennium. Similarly, the traffic data used in the studies is that projected for a future year. This is done to allow for changes in expenditure level and traffic volumes, and so that the study results will be applicable for the period in which legislation enacted to implement the study recommendations will become effective.

There are some disadvantages associated with allocating only projected future expenditures. Specifically, it requires relying on forecasts, which are subject to greater error than historical data, and it does not address issues related to facilities with useful lives far in excess of the two-year study period.

The 1996 Cost Responsibility Blue Ribbon Committee recommended the Oregon studies continue allocating only projected future expenditures. The current Oregon study again follows that recommendation, with the exception of incorporating study-period expenditures on the repayment of bonds issued in the prior study periods, allocated in the same proportions as in the prior studies.

Exclusion of External (Social) Costs

The Oregon studies, as well as the studies conducted by most other states, have chosen to allocate direct governmental expenditures and exclude external costs associated with highway use. The proponents of a cost-based approach argue that, to be consistent, a HCAS should include all costs that result from use of the highway system. They further argue economically-efficient pricing of highways requires the inclusion of all costs, and that failure to do so encourages an over-utilization of highways. Including external costs would add to the breadth and completeness of the analysis, and could help determine appropriate user charges necessary to reflect these costs.

However, there are several disadvantages associated with including external costs. Although these costs represent real costs to society, they are decidedly more difficult to quantify and incorporate in the analysis than are direct highway costs. Inclusion of external costs therefore would increase the data requirements and complexity of the studies, and could reduce their overall accuracy.

The 1996 Blue Ribbon Committee recommended the Oregon studies continue to exclude social costs until such time as the state implements explicit user charges to capture these costs. Both the 1982 and 1997 Federal HCASs included some social costs in supplementary analyses. The 1999 Oregon Study recommended future studies include “a separate assessment of the impacts of proposed changes in highway user taxes on the total costs of highway use including all major external costs.” The 2001 and 2003 studies made this same recommendation. That recommendation was never implemented.

Expenditure Allocation

The Oregon studies allocate expenditures rather than costs. Over the long run, expenditures must cover the full direct costs being imposed on the system or the system will deteriorate. Over any shorter period, however, expenditures will exceed or fall short of the costs imposed.

Some past Oregon studies, including a special analysis in the 2001 study, attempted to estimate and allocate a full-cost budget in addition to a base (actual expenditure) level budget. The intent was to approximate costs by estimating the level of expenditures required to preserve service levels and pavement conditions at existing levels. In these studies heavy vehicles were found to be responsible for a greater share of the preservation level budget than of the base level budget. This was because the majority of unmet needs at that time involved pavement rehabilitation and maintenance, items for which heavy vehicles have the predominant responsibility.

There exist strong arguments for moving toward a full cost-based approach in highway cost allocation studies. The problem is that "true" costs are more difficult to quantify and incorporate in the analysis than are direct highway expenditures. As a practical matter, therefore, most studies, including this study, continue to focus on the allocation of expenditures rather than costs.

Treatment of Debt-Financed Expenditures and Debt Service

Oregon traditionally has relied much less on debt financing of its highway program than many other states. This has changed since the enactment of the Oregon Transportation Investment Act (OTIA) by the 2001 Legislature. The first OTIA authorized the issuance of $400 million in new debt for projects to be completed across Oregon. It provided $200 million for projects that add lane capacity or improve interchanges and $200 million for bridge and pavement rehabilitation projects. Automobile and truck title fees were increased to finance the repayment of construction bonds for the OTIA projects.

Favorable bond-rate conditions allowed the 2002 Special Legislative Session to authorize an additional $100 million in debt without needing to further increase revenues. The original OTIA projects became known as OTIA I, and the additional projects as OTIA II.

The 2003 Legislature authorized an additional $2.46 billion in new debt and increased title, registration, and other DMV fees to produce the additional revenue necessary to repay the bonds. The OTIA III money will be spent as follows:

- $1.3 billion to repair or replace 365 state bridges
- $300 million to repair or replace 141 locally-owned bridges
- $361 million for local-government maintenance and preservation
- $500 million for modernization

The issue of how to treat OTIA project expenditures and the associated debt service was discussed at some length by the study review teams for both the 2003 and 2005 studies. Debt finance introduces a disconnect between study-period revenues and expenditures in that the time period in which the revenues are received differs from the period in which the funds are expended. Care needs to be taken to avoid double counting, which would occur if both the debt-financed project expenditures and full debt service expenditures (including interest and repayment of principal) were included.

Projects funded through the OTIA bonding program are easily identifiable, as are the associated debt service expenses. The dollar amount allocated in the model is the study-period debt service expenditure, given the bond rate and amortization period, in this case 20 years. The expenditures associated with each bond-financed project are scaled down by a bond factor to one study period's worth of debt service expenditure before allocation. This method retains the necessary project detail to assign expenditure shares by vehicle class. The dollar amounts allocated to each vehicle class for bonded projects are recorded and carried forward to each of the next nine studies.

This approach has two disadvantages: the choice of which projects get bond financing can affect the results of the study, as well as the next nine studies, and the allocation of those expenditures in future studies remains based on traffic conditions expected for the first two years of the 20-year repayment period. The Study Review Team considered a number of alternative approaches and decided that the advantages of simplicity and limited data requirements for the chosen approach outweighed its disadvantages. They also noted that the failure to update the allocation in future studies was consistent with the treatment of cash-financed projects, which are completely ignored in all future studies.

Treatment of Alternative-Fee-Paying Vehicles

Under Oregon's existing highway taxation structure, some types of vehicles are exempt from certain fees or qualify to pay according to alternative-fee schedules. These types of vehicles are collectively referred to in this report as "alternative-fee-paying" vehicles. The two main types of such vehicles are publicly owned vehicles and farm trucks. Publicly owned vehicles pay a nominal registration fee, and are not subject to the weight-mile tax. Most types of publicly owned vehicles are now subject to the state fuel tax, but many diesel-powered publicly-owned vehicles are not. Operators of farm trucks pay lower annual registration fees than operators of regular commercial trucks, and most pay fuel taxes, rather than weight-mile taxes when operated on public roads.

The reduced rates paid by certain types of vehicles mean they are paying less per-mile than comparable vehicles subject to full fees. The difference between what alternative-fee-paying vehicles are projected to pay and what they would pay if subject to full fees is termed the "alternative-fee difference." The approach used in past Oregon studies is to calculate this difference for each weight class and sum these amounts. The total alternative-fee difference (subsidy amount) is then reassigned to all other, full-fee-paying vehicles on a per-VMT basis, i.e., this amount is treated as a common cost to be shared proportionately by all full-fee-paying vehicles.

The rationale for this approach is that the granting of these reduced fees represents a public policy decision, and most vehicles paying reduced fees are providing some public service that arguably should be paid for by all taxpayers in relation to their use of the system. Because the heavy vehicle share of the total alternative-fee difference is greater than their share of total statewide travel, reassigning this amount on the basis of relative vehicle miles has the effect of increasing the light vehicle responsibility share and reducing the heavy vehicle share.

Treatment of Tax Avoidance and Evasion

When vehicles subject to Oregon's fuel tax purchase fuel in another state and then drive in Oregon, they avoid the Oregon fuel tax. The reverse is also true, so if the number of miles driven in Oregon on out-of-state fuel equaled the number of miles driven outside Oregon on in-state fuel, net avoidance would be zero. Net avoidance in Oregon is significant because of the large number of people who live in Washington and work in Oregon. These people tend to buy a smaller proportion of their fuel in Oregon than the proportion of their total miles that are driven in Oregon. This net avoidance is specifically accounted for in the highway cost allocation study by assuming that 3.5 percent of VMT by fuel-tax paying vehicles do not result in fuel-tax collections for Oregon.

The International Fuel Tax Agreement sorts out the payments of state fuel taxes and the use of fuel in other states for interstate truckers. If truckers pay fuel tax in California, for example, and then use that fuel in Oregon while paying the weight-mile tax, IFTA provides a mechanism for California to reimburse them. If truckers then buy fuel in Oregon, paying no fuel tax, and drive in Washington, IFTA provides a mechanism for them to pay what they owe to Washington.

The avoidance of the weight-mile tax by vehicles that are not legally required to pay it is treated as described above, under alternative-fee paying vehicles, rather than as avoidance.

Virtually any tax is subject to some evasion. While it is generally agreed evasion of the state gasoline tax and vehicle registration fees is quite low, there is more debate concerning evasion of the weight-mile and use fuel (primarily diesel) taxes. For the purpose of this study, it was assumed that evasion of the weight-mile tax is equal to five percent of what would be collected if all that is due were paid. This is the midpoint of the 3 to 7 percent evasion rate estimated by the Oregon Weight-Mile Tax Study conducted by consultants for the Legislative Revenue Office in 1996. It also assumes that an additional 1.0 percent of the use-fuel tax on diesel (beyond the 2.5 percent avoidance) is successfully evaded.

Chapter 4

Study Data and Forecasts

FIVE MAJOR TYPES OF DATA are required to conduct a highway cost allocation study. These are:

- **Traffic data.** The miles of travel by vehicle weight and type on each of the road systems used in the study.
- **Expenditure data.** Projected expenditures on construction projects by work type category, road system, and funding source, and projected expenditures in other categories by funding source.
- **Revenue data.** Projected revenues by revenue source or tax instrument.
- **Allocation factors.** Factors used to allocate costs to individual vehicle classes, including passenger-car equivalence (PCE) factors, pavement factors, and bridge increment shares.
- **Conversion factors and distributions.** Examples include distributions used to convert VMT by declared weight class to VMT by operating weight class or to VMT by registered weight class.

The allocation factors used in this study are described in Chapter 3 and the development and use of conversion factors is described in Appendix F, Model Description and Documentation.

The remainder of this chapter presents the traffic, expenditure, and revenue data used in the 2007 Study, and compares them with the data used in the prior two Oregon studies.

Traffic Data and Forecasts

VMT by road system, by vehicle weight class and number of axles, and by vehicle tax class are important throughout the cost allocation and revenue attribution processes. VMT estimates and projections are used both in the allocation of expenditures and attribution of revenues to detailed vehicle classes. Additionally, as explained in Chapter 3, VMT weighted by factors such as PCEs or pavement factors is used to assign several of the individual expenditure categories allocated in the study.

For this study, the required traffic data was first collected for the 2005 base year, the latest year for which complete historical data was available. This data then was projected forward to calendar year 2008, the middle 12 months of the 2007-09 fiscal biennium, which is the study period.

The base year traffic data were obtained from a number of sources. These include ODOT Motor Carrier Transportation Division (MCTD) weight-mile tax information, ODOT traffic counts and traffic classification statistics, HPMS submittals, MCTD and Driver & Motor Vehicle Services vehicle registrations data, and the Special Truck Weighings previously discussed. For each road system used in the study, travel estimates are developed for light vehicles and each 2,000-pound truck weight class.

Information from state economic forecasts and from ODOT's revenue forecasting model is used to forecast projected study year traffic from the base year data. Data from the Special Truck Weighings are used to convert truck miles of travel by declared weight class to miles of travel by operating weight class and to obtain detailed information on vehicle configurations and axle counts for each weight class. HPMS data are used to spread VMT to functional classifications.

Exhibit 4-1 shows total vehicle travel in Oregon is projected to increase from 36.8 billion miles in 2005 to 38.9 billion miles in 2008. This represents an average annual growth of about 1.9 percent. Light vehicle travel is projected to increase from 34.0 billion miles in 2005 to 35.9 billion miles in 2008, which represents an average annual growth of 1.8 percent. Total heavy vehicle travel is forecast to grow from 2.76 billion miles in 2005 to 2.95 billion miles in 2008, an average annual growth of about 2.2 percent. These projections are based on, and consistent with, the projections from ODOT's revenue forecast model.

The traffic growth projections for the current study are higher than the 1999, 2001, 2003, and 2005 studies. The 1999 study, projected total state VMT would grow at an average annual rate of 1.7 percent between 1997 and 2000. The 2001 study projected 1.3 percent annual growth between 1999 and 2002. The 2003 study projected 1.1 percent annual growth between 2001 and 2004. The 2005 growth projections of 1.6 percent reflect recovery from the economic downturn in Oregon and the nation that limited growth in the early part of the decade. The current study projects a growth rate of 1.9 percent from 2005 to 2008, reflecting the upward trend in the economy.

As in recent studies, travel by heavy vehicles is expected to grow faster than travel by light vehicles. Because of this, the share of travel accounted for by light vehicles is expected to decrease from 92.5 percent to 92.4 percent between 2005 and 2008. This is one reason for the slightly higher cost responsibility share for heavy vehicles reported in this study compared to the previous study.

Exhibit 4-1 also shows the growth projected for heavy vehicle travel varies by weight group. The fastest growth is expected to continue to be in the heaviest weight classes.

Exhibit 4-1: Current and Forecasted VMT by Weight Group (Millions of Miles)

Declared Weight in Pounds			2005 VMT (estimate)	2008 VMT (forecast)	Average Annual Growth Rate
1	to	10,000	34,033	35,939	1.8%
10,001	to	26,000	554	594	2.4%
26,001	to	46,000	347	296	-5.2%
46,001	to	54,000	114	120	1.9%
54,001	to	78,000	102	110	2.7%
78,001	to	80,000	1,172	1,313	3.9%
80,001	to	104,000	233	246	1.9%
104,001	to	105,500	238	267	4.0%
105,501	and	up	2	2	4.5%
Total for All Vehicles			36,794	38,888	1.9%
Total for Vehicles Under 10,001 pounds			34,033	35,939	1.8%
% for Vehicles Under 10,001 pounds			92.5%	92.4%	
Total for Vehicles Over 10,000 pounds			2,761	2,949	2.2%
% for Vehicles Over 10,000 pounds			7.5%	7.6%	
Total for Vehicles Under 26,001 pounds			34,587	36,533	1.8%
% for Vehicles Under 26,001 pounds			94.0%	93.9%	
Total for Vehicles Over 26,000 pounds			2,207	2,354	2.2%
% for Vehicles Over 26,000 pounds			6.0%	6.1%	

Exhibit 4-2: Projected 2008 VMT by Road System (Millions of Miles)

Road System	Light Vehicles		Heavy Vehicles		Total VMT
	Miles of Travel	Percent of Total	Miles of Travel	Percent of Total	
Interstate Urban	4,578	91.5%	425	8.5%	5,003
Interstate Rural	3,902	81.0%	915	19.0%	4,818
Other State Urban	5,846	96.0%	243	4.0%	6,089
Other State Rural	6,940	90.3%	747	9.7%	7,687
Subtotal-State Roads	21,266	90.1%	2,331	9.9%	23,597
County Roads	7,863	95.2%	399	4.8%	8,261
City Streets	6,714	96.9%	213	3.1%	6,927
Subtotal-Local Roads	14,577	96.0%	612	4.0%	15,189
Subtotal-State and Local Roads	35,843	92.4%	2,943	7.6%	38,785
Federal Roads	96	94.1%	6	5.9%	102
Total-All Roads	35,939	92.4%	2,949	7.6%	38,888

Exhibit 4-2 shows the distribution of projected 2008 travel between light and heavy vehicles for different combinations of functional classification and ownership. Although light vehicles are projected to account for 92.4 percent and heavy vehicles 7.6 percent of total statewide VMT, the mix of traffic varies significantly among the different road systems. Heavy vehicles are projected to account for 19.0 percent of the travel on rural interstate highways, but only 3.1 percent of the travel on city streets. Heavy vehicles are expected to account for 9.9 percent of the overall travel on state highways and 4.0 percent of the travel on local roads.

Exhibit 4-3 illustrates, in a slightly different manner, how the relative mix of traffic varies by road system. It presents the separate distributions of projected VMT by road system for light vehicles, heavy vehicles, and all vehicles. As shown, 60.7 percent of total travel in the state is expected to be on state highways and 39.1 percent on local roads and streets. These shares, however, differ significantly for light versus heavy vehicles. Rural interstate highways, for example, are projected to handle 12.4 percent of the total travel in 2008, but 31.0 percent of the heavy vehicle travel. At the other extreme, 18.7 percent of light vehicle travel, but only 7.2 percent of heavy vehicle travel, is forecast to be on city streets. State highways are expected to handle about 59.2 percent of the total travel by light vehicles and 79.0 percent of the travel by heavy vehicles.

Exhibit 4-4 compares the VMT projections by road system used in the 1999, 2001, 2003, and 2005 studies. It shows the VMT shares on the six road systems have not changed substantially from the comparable projections made in the 2001 Study. The two systems projected to account for the largest shares of total

Exhibit 4-3: Distribution of Projected 2008 VMT by Road System

Road System	Percent of Light Vehicle Total	Percent of Heavy Vehicle Total	Percent of All Vehicle Total
Interstate Urban	12.7%	14.4%	12.9%
Interstate Rural	10.9%	31.0%	12.4%
Other State Urban	16.3%	8.2%	15.7%
Other State Rural	19.3%	25.3%	19.8%
Subtotal State Systems	59.2%	79.0%	60.7%
County Roads	21.9%	13.5%	21.2%
City Streets	18.7%	7.2%	17.8%
Subtotal Local Systems	40.6%	20.8%	39.1%
Federal Roads	0.3%	0.2%	0.3%
Total All Systems	100.0%	100.0%	100.0%

statewide travel are Other State Rural highways and County Roads. The current study projects a higher share of travel on city streets than did prior studies.

Expenditure Data

Until the 2001 study, Oregon highway cost allocation studies allocated only expenditures of Oregon highway user fees by State and local-government agencies. Because federal funds are in many cases interchangeable with State funds, and because the proportion of federal funds used for any particular project is arbitrary and subject to change between the time of the study and the time the money is spent, excluding federal funds can introduce arbitrary bias and inaccuracy into the study results. The 2001 study included the expenditure of federal funds by the State and reported their allocation both separately and in combination with State funds.

The 2003 study, for the first time ever, included all expenditures on roads and streets in the state. In addition to state-funded expenditures, expenditures (both State and local) funded from federal highway revenues and locally-generated revenues are also included. This change substantially increased the level and breadth of expenditures allocated in the 2003 study as compared to previous studies.

Following the 2005 study, the current study includes expenditures of State, federal, and local revenues, but excluded certain categories of local revenues that were determined not to be interchangeable with State user fees. Those sources were locally-issued bonds, property taxes (including local improvement districts), systems development charges, and traffic impact fees.

The expenditure data for the study were obtained from a number of sources. Data from ODOT's monthly Budget and Cash Flow Forecast were used to develop projected construction expenditures by project for the 2007-09 biennium. Projected expenditures on maintenance and other programs were obtained from ODOT Financial Services, and based on ODOT's Agency Request Budget.

Identifying those expenditures projected to be federally funded was relatively straightforward, and based on detailed information from the ODOT Cash Flow Forecast model and Project Control System. Local expenditures were projected from data obtained from the 2005 Local Roads and Streets Survey combined with information from ODOT's Agency Request Budget.

Care was taken to accurately identify the bonded (OTIA) projects and treat them as

Exhibit 4-4: Comparison of Forecast VMT Used in OR HCASs: 1999, 2001, 2003, 2005, and 2007 (billions of miles)

	1999 Study		2001 Study		2003 Study		2005 Study		2007 Study	
Road System	2000 VMT	Percent of Total	2002 VMT	Percent of Total	2004 VMT	Percent of Total	2006 VMT	Percent of Total	2008 VMT	Percent of Total
Interstate Urban	4	12%	3	11%	3	11%	4	11%	5	13%
Interstate Rural	4	13%	4	13%	4	13%	5	13%	5	12%
Other State Urban	5	13%	5	16%	5	15%	5	15%	6	16%
Other State Rural	8	22%	7	23%	7	22%	8	22%	8	20%
Subtotal-State Systems	20	60%	21	62%	21	61%	22	61%	24	61%
County Roads	9	25%	8	23%	8	26%	8	22%	8	21%
City Streets	5	15%	5	15%	4	14%	6	17%	7	18%
Subtotal-Local Systems	14	40%	13	38%	13	40%	14	39%	15	39%
Total	34	100%	34	100%	34	100%	36	100%	39	100%

note: VMT on federally-owned roads not included in totals a separate, independent funding source. It was assumed that any bridge projects that still remained in "option packages" and had not been assigned real project numbers by November of 2006 would not start construction until after the end of the 2007-09 biennium. Those projects were not included in the analysis.

Exhibit 4-5 presents the average annual expenditures projected for the 2007-09 biennium by major category (modernization, preservation, maintenance, bridge, and other) and funding source (state, federal, bond, and local). As shown, projected expenditures total $1.723 billion. This compares to annual expenditures allocated in the 1999, 2001, 2003 and 2005 studies of $691 million, $649 million, $1.491 billion, and 1.499 billion respectively.

Of the $1.723 billion total annual expenditures, $877 million (50.9 percent) are projected to be state-funded, $730 million (42.4 percent) federally-funded, and $66.4 million (3.9 percent) locally-funded. The remaining $48.7 million (2.8 percent) of allocated expenditures are the allocated portion of the $303 million per year of expended bond revenue. An additional $69.1 million per year of pre-allocated bond expenditure from the prior study is included in the allocated costs in this study.

The Local Funds column of Exhibit 4-5 includes only local expenditures from the own-source revenues that were included in this study. Local expenditures from state and federal revenues are included in the State and Federal Funds columns, respectively.

Bridge and interchange expenditures are shown separately from other modernization, preservation and maintenance expenditures.

The Other category in the exhibit encompasses expenditures for a large number of different activities. In addition to general administrative and tax collection costs for the State, counties, and cities, it includes expenditures for:

- Preliminary engineering
- Right of way acquisition and property management
- Safety-related projects, safety inspections, and rehabilitation and maintenance of existing safety improvements
- Pedestrian/bike projects
- Railroad safety projects
- Fish and wildlife enabling projects (e.g., salmon culverts)
- Transportation demand management and transportation system management projects (e.g., Traffic Operations Centers)
- Multi-modal projects
- Transportation project development and delivery
- Transportation planning, research and analysis

The exhibit shows significant differences in the funding of different expenditure categories. Preservation and bridge expenditures, in particular, have a large federal funds component. Almost 58 percent of preservation expenditures and 73 percent of bridge expenditures will be federally

Exhibit 4-5: Average Annual Expenditures by Category and Funding Source (thousands of dollars)

Major Expenditure Category	State Funds	Percent of All Sources	Federal Funds	Percent of All Sources	Local Funds	Percent of All Sources	Bond Funds	Percent of All Sources	All Funding Sources
Modernization	63,696	41.1%	80,057	51.7%	7,016	4.5%	4,028	2.6%	154,796
Preservation	48,804	36.2%	77,843	57.7%	6,525	4.8%	1,633	1.2%	134,804
Maintenance	282,238	59.9%	160,500	34.0%	26,426	5.6%	2,233	0.5%	471,396
Bridge	36,045	15.2%	171,660	72.6%	3,018	1.3%	25,808	10.9%	236,531
Other	446,606	61.6%	240,187	33.1%	23,457	3.2%	14,980	2.1%	725,230
All Expenditures	877,389	50.9%	730,246	42.4%	66,441	3.9%	48,682	2.8%	1,722,757

funded. Maintenance expenditures, on the other hand, are largely state-, and to a lesser extent, locally-funded, with a very small federal funds component. About 53 percent of the OTIA expenditures in the study period will be on State- and locally-owned bridges. An additional 31 percent of OTIA expenditures fall into the "other" category. Most of those are for engineering and right of way expenditures associated with State- and locally- owned bridges.

Exhibit 4-6: Revenue Forecasts by Tax/Fee Type (thousands of dollars) Average Annual Amounts for 2007-2009 Biennium

Tax/Fee	Forecast Revenue	Percent of Total
Fuel Tax	419,728	47.8%
Weight-Mile Tax	251,471	28.6%
Registration Fees	136,743	15.6%
Title Fees	64,665	7.4%
Other Motor Carrier Revenue	5,299	0.6%
Road Use Assessment Fees	927	0.1%
Total	878,833	100.0%

Revenue Data and Forecasts

The revenues projected for this study include receipts from taxes and fees collected by the state from highway users, i.e., revenues flowing into Oregon's dedicated State Highway Fund. Revenues from federal taxes and user fees are not estimated. Similarly, revenues generated by local governments from their own funding sources (e.g., property taxes, street assessments, system development charges, local fuel taxes, etc.) are not included. Because the expenditure of federal and local revenues are included among the expenditures to be allocated, and because a portion of the expenditure of bond revenue in the prior biennium is included, allocated expenditures exceed attributed revenues by $713 million.

The revenue data required for the study are obtained directly from ODOT's revenue forecasting model. The revenue forecast used for the present study was the October 2006 forecast; the latest available at the time the study was being conducted. The forecasts include the approximately 40 percent of State Highway Fund revenues transferred to local governments for use on local roads and streets, and all state funds used for highways including matching requirements for federal-aid highway projects.

Average annual state revenues for the 2007-09 biennium are expected to total $878.8 million. As shown in Exhibit 4-6, fuel taxes and the weight-mile tax are the two largest sources of state user-fee revenue. Revenue from the state fuel tax is projected to average $419.7 million per year (47.8 percent of total revenues) and weight-mile tax revenue is forecast to average $251.5 million (28.6 percent of total revenues). These two sources account for 76.4 percent of highway user revenues, illustrating that Oregon's system of highway finance is based heavily on taxes and fees directly related to use of the system.

Revenue from registration and title fees is anticipated to average $201.4 million annually (23 percent of total revenues), consistent with the 2005 study, but up sharply from prior studies as a result of the fee increases enacted to repay OTIA bonds. Other revenue sources bring in smaller amounts of revenue.

Exhibit 4-7 compares the forecasts of average annual total revenues used in the 1999, 2001, 2003, 2005 and 2007 studies. Total revenues forecast for the 1999, 2001, 2003, and 2005 studies were $691.1 million,

Exhibit 4-7: Comparison of Forecast Revenue (Millions of Dollars) Used in OR HCASs: 1999, 2001, 2003, 2005, and 2007

Year of Study	Average Annual Forecast Revenue
1999	691.1
2001	690.0
2003	712.8
2005	825.5
2007	878.8

$690.0 million, $712.8 million, and $825.5 respectively. The total revenues of forecast for the current study are $878.8 million, or 6.4 percent higher than in the prior study.

Caution should be used in comparing these forecasts, however, since they were made at different times for different biennia, and used somewhat different assumptions regarding the treatment of ODOT beginning and ending balances. Additionally, title fees were not identified as a revenue source in studies prior to 2003 because they did not produce net revenue.

Chapter 5

Expenditure Allocation and Revenue Attribution Results

THIS CHAPTER PRESENTS THE EXPENDITURE allocation and revenue attribution results of the 2007 Study and compares them to the results of previous Oregon studies. The following chapter reports equity ratios for each vehicle group and weight class based on the expenditure allocation and revenue attribution results.

Expenditure Allocation Results

The 2003 Study was the first to base expenditure allocation results on all highway expenditures, or those financed by federal, local, and state revenues; the 2005 Study did the same, but excluded some expenditure of local own-source revenues. This approach was considered necessary to address the impacts of the federal advance construction program on the expenditure. This change in approach means the expenditure allocation results for the 2003 study are not directly comparable to those of the earlier Oregon studies. For the 2005 study, the approach used in the 2003 study was modified to exclude the expenditure of certain local-government own-source revenues that were not considered to be interchangeable with State Highway Fund monies. The excluded categories were property taxes (including local improvement districts), bond revenues, systems development charges, and traffic impact fees. The 2007 study uses the same methodology as the 2005 study. As a result, the expenditure allocations in this study are comparable to the 2005 study, but not directly comparable to those in the 2003 study or any prior study,

The results presented in this chapter are for all—full fee and alternative fee—vehicles, but do not include the allocated expenditure of bond revenues that are carried forward from the 2003 study. For this reason, most of the results presented in this chapter will show slightly lower allocated expenditures than are shown in the exhibits in Chapter 6.

Exhibit 5-1 presents the expenditure allocation results by major expenditure category and vehicle weight group. Light (up to 10,000 pound) and heavy (over 10,000 pound) vehicles are projected to be responsible for 63 percent and 37 percent (respectively) of average annual total expenditures for the 2007-09 biennium.

As shown in the exhibit, the responsibility shares vary significantly among the major expenditure categories. Heavy vehicles, as a group, are projected to be responsible for the majority of modernization and preservation expenditures (64.8 percent and 57.4 percent, respectively). The group is responsible for significantly smaller shares of maintenance, bridge, and other expenditures (43.4 percent, 45.7 percent, and 18.5 percent, respectively); this illustrates the point made previously that the mix of expenditures allocated can have a significant impact on the overall results.

Both the State and local governments

Exhibit 5-1: Average Annual Cost Responsibility by Expenditure Category and Weight Class (thousands of dollars)

All Funding Sources

Declared Weight in Pounds			Modernization	Preservation	Maintenance	Bridge	Other	Prior Bonds	Total
1	to	10,000	54,428	58,458	265,664	128,509	590,470	31,896	1,129,424
10,001	to	26,000	3,909	2,626	9,562	13,340	14,194	3,957	47,587
26,001	to	46,000	7,137	5,292	16,394	6,690	14,035	2,054	51,601
46,001	to	54,000	3,583	2,720	8,073	3,048	5,984	1,023	24,431
54,001	to	78,000	3,721	2,829	8,143	3,161	5,557	893	24,303
78,001	to	80,000	57,223	45,667	111,762	35,406	64,531	13,900	328,489
80,001	to	104,000	11,474	9,171	22,900	21,684	13,907	7,024	86,159
104,001	to	105,500	12,641	9,848	25,704	24,485	15,726	8,173	96,578
105,501	and	up	651	487	1,427	208	302	219	3,294
	Total		154,767	137,097	469,628	236,531	724,705	69,139	1,791,866
Total for Vehicles Under 10,001 Pounds			54,428	58,458	265,664	128,509	590,470	31,896	1,129,424
% for Vehicles Under 10,001 Pounds			35.2%	42.6%	56.6%	54.3%	81.5%	46.1%	63.0%
Total for Vehicles Over 10,000 Pounds			100,339	78,638	203,964	108,022	134,235	37,243	662,442
% for Vehicles Over 10,000 Pounds			64.8%	57.4%	43.4%	45.7%	18.5%	53.9%	37.0%
Total for Vehicles Under 26,001 Pounds			58,337	61,084	275,225	141,849	604,664	35,853	1,177,011
% for Vehicles Under 26,001 Pounds			37.7%	44.6%	58.6%	60.0%	83.4%	51.9%	65.7%
Total for Vehicles Over 26,000 Pounds			96,430	76,013	194,403	94,682	120,041	33,286	614,854
% for Vehicles Over 26,000 Pounds			62.3%	55.4%	41.4%	40.0%	16.6%	48.1%	34.3%

spend funds from state user fees and from the federal government. Exhibit 5-2 shows the funds received from each revenue source and by whom they are expended. The upper part of the table shows the full expenditure of bond revenues and the lower part shows the portions of current and prior expenditures of bond revenues that are allocated to vehicles in this study. In the exhibits that follow, where allocated expenditures are broken down into state, federal, local, and bond, the categories correspond to rows in the lower part of Exhibit 5-2.

The responsibility amounts for state, federal, local, and bond expenditures are broken out separately in Exhibit 5-3. In this exhibit, the expenditure of state and federal monies by local governments are counted under the state and federal categories. The local category contains only the expenditure by local governments of their own

Exhibit 5-2: Sources and Expenditures of Funds (thousands of annual dollars)

Expenditure of Funds	State Revenues	Bond Revenues	Federal Revenues	Local Revenues	All Sources
	Source of Funds				
State Government	583,406	0	403,256	0	986,662
Local Governments	293,982	0	326,990	66,441	687,413
Expenditure of Bond Revenues	0	303,156	0	0	303,156
All Expenditures	877,388	303,156	730,246	66,441	1,977,231
Allocated State Expenditures	583,406	0	403,256	0	986,662
Allocated Local Expenditures	293,982	0	326,990	66,441	687,413
Allocated Current Bond	0	48,652	0	0	48,652
Allocated Prior Bond	0	69,139	0	0	69,139
Allocated Expenditures	877,388	117,791	730,246	66,441	1,791,866

revenues.

Light vehicles are projected to be responsible for 75.1 percent of state, 60.4 percent of federal, 56.3 percent of local, and 59.7 percent of bond expenditures. Heavy vehicles are projected to be responsible for 24.9 percent of state, 39.6 percent of federal, 43.7 percent of local, and 40.3 percent of bond expenditures. Overall, state-funded expenditures are expected to average $583.4 million annually over the 2005-2007 biennium. Comparable annual amounts for federal, local, and bond-funded expenditures are $403.3 million, $687.4 million, and $48.6 million, respectively.

The allocation results for state, federal, local and bond expenditures are further broken out by major category in Exhibits 5-4 through 5-7. For most funding sources, heavy vehicles are projected to be responsible for the majority of modernization and preservation expenditures while light

Exhibit 5-3: Expenditure Allocation Results for Weight Groups by Expenditure Type (thousands of dollars)

		Allocation to Vehicles			
Expenditure Type	Average Annual Total Expenditures Allocated	Under 10,001 Pounds	Over 10,000 Pounds	Under 26,001 Pounds	Over 26,000 Pounds
State (Highway Fund)	583,406	437,905	145,501	448,122	135,285
		75.1%	24.9%	76.8%	23.2%
Federal	403,256	243,571	159,685	256,985	146,271
		60.4%	39.6%	63.7%	36.3%
Local	687,413	387,025	300,387	405,302	282,110
		56.3%	43.7%	59.0%	41.0%
Bond	48,652	29,027	19,626	30,750	17,903
		59.7%	40.3%	63.2%	36.8%
Current	1,722,727	1,097,529	625,198	1,141,159	581,568
		63.7%	36.3%	66.2%	33.8%
Prior Bond	69,139	31,896	37,243	35,853	33,286
		46.1%	53.9%	51.9%	48.1%
Total	1,791,866	1,129,424	662,442	1,177,011	614,854
		63.0%	37.0%	65.7%	34.3%

Exhibit 5-4: Average Annual Cost Responsibility, State Highway Fund Detail (thousands of dollars)

Declared Weight in Pounds			Modernization	Preservation	Maintenance	Bridge	Other	Total
1	to	10,000	10,977	14,158	118,380	12,313	282,078	437,905
10,001	to	26,000	759	208	3,065	1,152	5,033	10,216
26,001	to	46,000	967	381	2,429	550	6,094	10,421
46,001	to	54,000	520	216	1,176	262	2,541	4,715
54,001	to	78,000	597	234	1,270	285	2,406	4,793
78,001	to	80,000	13,656	4,987	26,667	3,632	31,529	80,470
80,001	to	104,000	2,529	933	5,202	2,130	6,072	16,866
104,001	to	105,500	2,553	950	5,315	2,351	6,511	17,680
105,501	and	up	94	28	141	18	58	340
Total			32,652	22,095	163,644	22,693	342,322	583,406
Total for Vehicles Under 10,001 Pounds			10,977	14,158	118,380	12,313	282,078	437,905
% for Vehicles Under 10,001 Pounds			34%	64%	72%	54%	82%	75%
Total for Vehicles Over 10,000 Pounds			21,676	7,937	45,265	10,380	60,244	145,501
% for Vehicles Over 10,000 Pounds			66%	36%	28%	46%	18%	25%
Total for Vehicles Under 26,001 Pounds			11,736	14,366	121,444	13,465	287,111	448,122
% for Vehicles Under 26,001 Pounds			36%	65%	74%	59%	84%	77%
Total for Vehicles Over 26,000 Pounds			20,917	7,729	42,200	9,228	55,211	135,285
% for Vehicles Over 26,000 Pounds			64%	35%	26%	41%	16%	23%

Exhibit 5-5: Average Annual Cost Responsibility, Federal Detail (thousands of dollars)

Declared Weight in Pounds	Modernization	Preservation	Maintenance	Bridge	Other	Total
1 to 10,000	23,702	15,856	22,712	83,959	97,344	243,571
10,001 to 26,000	1,061	894	581	8,091	2,787	13,414
26,001 to 46,000	1,125	1,316	447	3,891	1,731	8,510
46,001 to 54,000	561	719	213	1,838	803	4,134
54,001 to 78,000	631	813	227	1,986	850	4,507
78,001 to 80,000	13,070	18,722	4,466	24,203	13,952	74,413
80,001 to 104,000	2,576	3,666	870	15,389	3,442	25,943
104,001 to 105,500	2,717	3,623	908	17,314	3,781	28,342
105,501and up	86	119	22	140	54	421
Total	45,527	45,729	30,446	156,810	124,744	403,256
Total for Vehicles Under 10,001 Pounds	23,702	15,856	22,712	83,959	97,344	243,571
% for Vehicles Under 10,001 Pounds	52.1%	34.7%	74.6%	53.5%	78.0%	60.4%
Total for Vehicles Over 10,000 Pounds	21,826	29,873	7,734	72,851	27,400	159,685
% for Vehicles Over 10,000 Pounds	47.9%	65.3%	25.4%	46.5%	22.0%	39.6%
Total for Vehicles Under 26,001 Pounds	24,763	16,750	23,293	92,050	100,131	256,985
% for Vehicles Under 26,001 Pounds	54.4%	36.6%	76.5%	58.7%	80.3%	63.7%
Total for Vehicles Over 26,000 Pounds	20,765	28,980	7,153	64,760	24,614	146,271
% for Vehicles Over 26,000 Pounds	45.6%	63.4%	23.5%	41.3%	19.7%	36.3%

Exhibit 5-6: Average Annual Cost Responsibility, Local Government Detail (thousands of dollars)

Declared Weight in Pounds	Modernization	Preservation	Maintenance	Bridge	Other	Total
1 to 10,000	17,640	27,899	122,560	18,271	200,656	387,025
10,001 to 26,000	1,994	1,492	5,877	2,930	5,984	18,277
26,001 to 46,000	4,926	3,540	13,500	1,709	5,939	29,614
46,001 to 54,000	2,446	1,756	6,676	681	2,511	14,070
54,001 to 78,000	2,432	1,749	6,638	588	2,162	13,569
78,001 to 80,000	29,426	21,287	80,520	3,116	16,694	151,041
80,001 to 104,000	6,146	4,442	16,809	1,644	3,779	32,819
104,001 to 105,500	7,118	5,140	19,461	2,251	4,756	38,726
105,501 and up	461	335	1,264	32	179	2,271
Total	72,589	67,640	273,306	31,219	242,659	687,413
Total for Vehicles Under 10,001 Pounds	17,640	27,899	122,560	18,271	200,656	387,025
% for Vehicles Under 10,001 Pounds	24%	41%	45%	59%	83%	56%
Total for Vehicles Over 10,000 Pounds	54,949	39,741	150,745	12,949	42,003	300,387
% for Vehicles Over 10,000 Pounds	76%	59%	55%	42%	17%	44%
Total for Vehicles Under 26,001 Pounds	19,634	29,391	128,437	21,201	206,639	405,302
% for Vehicles Under 26,001 Pounds	27%	44%	47%	68%	85%	59%
Total for Vehicles Over 26,000 Pounds	52,494	38,249	144,868	10,019	36,020	281,649
% for Vehicles Over 26,000 Pounds	72%	57%	53%	32%	15%	41%

Exhibit 5-7: Average Annual Cost Responsibility, Bond Detail (thousands of dollars)

Declared Weight in Pounds			Modern-ization	Preser-vation	Mainte-nance	Bridge	Other	Current	Prior	Total
1	to	10,000	2,110	546	2,012	13,966	10,393	29,027	31,896	60,922
10,001	to	26,000	95	32	39	1,168	390	1,723	3,957	5,680
26,001	to	46,000	119	55	18	541	270	1,002	2,054	3,057
46,001	to	54,000	56	29	8	267	129	488	1,023	1,511
54,001	to	78,000	61	32	8	302	139	541	893	1,434
78,001	to	80,000	1,072	670	109	4,457	2,357	8,664	13,900	22,565
80,001	to	104,000	224	129	20	2,521	614	3,507	7,024	10,531
104,001	to	105,500	254	135	20	2,569	679	3,657	8,173	11,830
105,501	and	up	10	5	0	18	11	43	219	262
Total			3,999	1,633	2,233	25,808	14,980	48,652	69,139	117,791
Total for Vehicles Under 10,001 Pounds			2,110	546	2,012	13,966	10,393	29,027	31,896	60,922
% for Vehicles Under 10,001 Pounds			53%	33%	90%	54%	69%	60%	46%	52%
Total for Vehicles Over 10,000 Pounds			1,889	1,087	221	11,842	4,587	19,626	37,243	56,869
% for Vehicles Over 10,000 Pounds			47%	67%	10%	46%	31%	40%	54%	48%
Total for Vehicles Under 26,001 Pounds			2,205	578	2,051	15,134	10,783	30,750	35,853	66,602
% for Vehicles Under 26,001 Pounds			55%	35%	92%	59%	72%	63%	52%	57%
Total for Vehicles Over 26,000 Pounds			1,794	1,055	182	10,675	4,197	17,903	33,286	51,189
% for Vehicles Over 26,000 Pounds			45%	65%	8%	41%	28%	37%	48%	44%

vehicles are projected to bear larger shares of maintenance, bridge, and other expenditures.

Because of restrictions on the types of expenditures for which federal-aid highway funds can be used, federal funds tend to be concentrated on construction (i.e., modernization and preservation) projects and other types of work for which heavy vehicles have the predominant responsibility. Additionally, federal funds are focused on projects on interstate and other higher-order highways where the heavy vehicle share of travel is highest. Hence, the inclusion of federally-funded expenditures in a state HCAS will almost always have the effect of reducing the light vehicle responsibility share and increasing the heavy vehicle share.

Conversely, state funds are generally more concentrated on maintenance, operations, administration and other activities for which light vehicles have the largest responsibility share. This is particularly the case at the present time with ODOT's use of the federal advance construction programming technique and aggressive strategy to "federalize" a large portion of the construction program.

The inclusion of local expenditures in a state HCAS will, by itself, typically increase the relative responsibility of light vehicles and reduce that of heavy vehicles. This is because many types of expenditures are allocated on a relative travel basis and heavy vehicles account for a comparatively small share of the total travel on local roads and streets. This factor, however, is more than offset by the fact local governments spend more of their road and street funds on activities having a comparatively high heavy vehicle responsibility component; specifically rehabilitation, repair and maintenance of pavements and bridges.

Because pavements and bridges represent two of the largest and most important expenditure areas in a highway cost allocation study, the responsibility results for these expenditures are broken out separately in Exhibits 5-8 and 5-9.

Exhibit 5-8: Comparison of Pavement Responsibility Results From 2005 and 2007 OR HCASs (thousands of annual dollars)

	2005 Study			2007 Study		
Expenditure Work Type	Expenditures Allocated	Light Vehicle Responsibility	Heavy Vehicle Responsibility	Expenditures Allocated	Light Vehicle Responsibility	Heavy Vehicle Responsibility
New Pavements	92,940	20,595	72,345	90,849	20,616	70,233
	6.2%	22.2%	77.8%	5.3%	22.7%	77.3%
Pavement and Shoulder Reconstruction	19,746	5,778	13,968	38,162	14,131	24,031
	1.3%	29.3%	70.7%	2.2%	37.0%	63.0%
Pavement and Shoulder Rehabilitation	147,504	53,521	93,983	125,484	46,902	78,582
	9.8%	36.3%	63.7%	7.3%	37.4%	62.6%
Pavement Maintenance	222,505	88,811	133,695	304,009	118,980	185,029
	14.8%	39.9%	60.1%	17.6%	39.1%	60.9%
Other Pavement Expenditures	14,682	14,466	216	11,698	11,411	286
	1.0%	1.0%	0.0%	0.7%	97.6%	2.4%
Total Pavement Expenditures	482,695	168,705	313,991	570,202	212,041	358,161
	32.2%	35.0%	65.1%	33.1%	37.2%	62.8%

Exhibit 5-8 shows that pavement expenditures allocated in the 2007 Study total $570.2 million, 118 percent of the pavement expenditure allocated in the 2005 Study.

The responsibility shares for particular types of pavement work are roughly the same between the two studies. Both

Exhibit 5-9: Comparison of Bridge and Interchange Responsibility Results from 2005 and 2007 OR HCASs (thousands of dollars)

	2005 Study			2007 Study		
Expenditure Work Type	Expenditures Allocated	Light Vehicle Responsibility	Heavy Vehicle Responsibility	Expenditures Allocated	Light Vehicle Responsibility	Heavy Vehicle Responsibility
Bridge and Interchange	363,405	191,647	171,758	235,244	127,341	107,903
	24.2%	52.7%	47.3%	13.7%	54.1%	45.9%
Bridge Maintenance	31,103	28,311	2,792	22,934	20,705	2,229
	2.1%	91.0%	9.0%	1.3%	90.3%	9.7%
Total Bridge and Interchange Expenditures	394,508	219,958	174,550	258,178	148,046	110,132
	26.3%	55.8%	44.2%	15.0%	57.3%	42.7%

studies found heavy vehicles responsible for relatively larger shares of new pavement, pavement reconstruction, and pavement rehabilitation expenditures and slightly smaller shares of maintenance expenditures. For this exhibit, other pavement expenditures include those for climbing lanes, pavement striping and marking, maintenance of truck scale pavements, and studded tire damage repair.

Exhibit 5-10: Average Annual Cost Responsibility by Weight Group with Prior Allocated Expenditures (thousands of dollars)

Declared Weight in Pounds			Total Without Prior Allocated Expenditures	Prior Allocated Expenditures	Total With Prior Allocated Expenditures
1	to	8,000	1,097,529	31,896	1,129,424
8,001	to	26,000	43,630	3,957	47,587
26,001	to	46,000	49,547	2,054	51,601
46,001	to	54,000	23,408	1,023	24,431
54,001	to	78,000	23,409	893	24,303
78,001	to	80,000	314,589	13,900	328,489
80,001	to	104,000	79,135	7,024	86,159
104,001	to	105,500	88,405	8,173	96,578
105,501	and	up	3,075	219	3,294
		Total	1,722,727	69,139	1,791,866

Exhibit 5-9 compares the bridge plus interchange expenditure amounts and responsibility results in the 2005 and present studies. Bridge-related expenditures were lower as a share of total expenditures in the current study (15.0 percent) than in the 2005 Study (26.4 percent), which was considerably higher than in the 2001 study.

The heavy vehicle responsibility share for total bridge plus interchange expenditures in the present study is 42.7 percent, as compared to 44.2 percent in the 2005 Study. This reflects differences in the mix of bridge types, as well as a different treatment of bridge projects that are funded, but for which the bridges to be worked on have not yet been selected. In this study, we created a new work type, "other bridge", and allocated it in proportion to the allocation results for work on known bridges.

Exhibit 5-10 shows the amounts of allocated expenditures of bond revenues that were carried forward from the 2005 study. These represent amounts that were spent in the 2005-07 biennium and that will be repaid during the 2007-09 biennium. The 2009 study will include the same allocated expenditures from the 2003 and 2005 studies as well as allocated bond expenditures from the current study.

For illustrative purposes, Exhibit 5-11 compares the expenditure allocation results (with prior allocated costs) for the present study with those of the previous study. As shown, the shares are nearly identical: the all-vehicle responsibility shares in the 2005 Study were 64.3 percent for light vehicles and 35.7 percent for heavy vehicles; the 2007 Study shares are 63.0 percent for light vehicles and

Exhibit 5-11: Cost Responsibility Distributions by Weight Group: Comparison Between 2005 and 2007 OR HCASs

Declared Weight in Pounds			2005 Study	2007 Study	Change in Percentage
1	to	10,000	64.3%	63.0%	-1.3%
10,001	and	up	35.7%	37.0%	1.3%
10,001	to	26,000	3.0%	2.7%	-0.3%
26,001	to	46,000	3.1%	2.9%	-0.2%
46,001	to	54,000	1.3%	1.4%	0.0%
54,001	to	78,000	1.1%	1.4%	0.3%
78,001	to	80,000	17.8%	18.3%	0.5%
80,001	to	104,000	4.2%	4.8%	0.6%
104,001	to	105,500	5.0%	5.4%	0.4%
105,501	and	up	0.2%	0.2%	-0.0%
			100.0%	100.0%	

37.0 percent for heavy vehicles.

Revenue Attribution Results

The attribution of revenues to the various vehicle types and weight classes is an important element of a highway cost allocation study. Once accomplished, the shares of projected payments are compared to the shares of cost responsibility for each class to determine whether each class is paying more or less than its fair share under the existing tax structure and rates. Where significant imbalances are detected, recommendations for changes in tax rates are made to bring payments back into balance with cost responsibilities.

As noted in Chapter 4, most of the required revenue data for the study, including control totals for forecasted revenues by tax instrument (i.e., fuel, registration, weight-mile, etc.), are obtained from ODOT's revenue forecasting model. Every effort is made to ensure the data used in the HCAS are consistent with the most recent revenue forecast available at the time the study is being conducted. Some information required for the HCAS, however, is not available from the revenue forecasting model and so must be estimated from other sources. The revenue model, for example, does not project fuel tax payments by detailed, 2,000-pound weight class. Therefore, estimated fuel efficiencies by vehicle type and weight group must be used together with control totals from the revenue model to attribute projected fuel tax payments to the detailed vehicle classes.

The revenue attribution results are summarized in Exhibit 5-12. For the next biennium, under existing tax rates, it is forecast light vehicles will contribute 64.5 percent of State Highway Fund revenues and heavy vehicles will contribute 35.5 percent. The 35.5 percent projected payment share for heavy vehicles is less than the overall responsibility share of 37.0 percent for these vehicles reported in Section 5.1. However, these results need to be adjusted to reflect the impacts of tax exemptions and reduced rates granted to

Exhibit 5-12: Average Annual User-Fee Revenue by Tax Instrument and Weight Class (thousands of dollars)

Declared Weight in Pounds			Fuel Tax	Registration and Title Fees	Weight-Mile Tax	Other Motor Carrier	Flat Fee	RUAF	Total
1	to	10,000	405,870	160,198	0	0	0	0	566,068
10,001	to	26,000	11,369	12,480	0	0	0	0	23,849
26,001	to	46,000	1,951	1,761	5,152	275	5	0	9,143
46,001	to	54,000	159	1,264	5,996	256	80	0	7,755
54,001	to	78,000	65	1,337	8,061	261	65	0	9,789
78,001	to	80,000	178	16,866	158,876	3,275	6,013	0	185,209
80,001	to	104,000	50	3,356	28,454	566	4,183	17	36,608
104,001	to	105,500	86	4,046	33,553	660	1,033	16	39,378
105,501	and	up	0	100	0	6	0	894	106
		Total	419,728	201,408	240,093	5,299	11,379	927	877,906
Total for Vehicles Under 10,001 Pounds			405,870	160,198	0	0	0	0	566,068
% for Vehicles Under 10,0001 Pounds			96.7%	79.5%	0.0%	0.0%	0.0%	0.0%	64.5%
Total for Vehicles Over 10,000 Pounds			13,858	41,210	240,093	5,299	11,379	927	311,838
% for Vehicles Over 10,000 Pounds			3.3%	20.5%	100.0%	100.0%	100.0%	100.0%	35.5%
Total for Vehicles Under 26,001 Pounds			417,239	172,678	0	0	0	0	589,917
% for Vehicles Under 26,001 Pounds			99.4%	85.7%	0.0%	0.0%	0.0%	0.0%	67.2%
Total for Vehicles Over 26,000 Pounds			2,489	28,730	240,093	5,299	11,379	927	287,989
% for Vehicles Over 26,000 Pounds			0.6%	14.3%	100.0%	100.0%	100.0%	100.0%	32.8%

certain types of vehicles. As explained in the following chapter, these adjustments have a significant effect on the relative shares of attributed revenues and allocated expenditures for the various vehicle classes.

Exhibit 5-12 also illustrates how the relative payments of different vehicle weight groups vary by tax instrument. Light vehicles are projected to contribute approximately 96.7 percent of fuel tax revenues and 79.5 percent of registration and title fee revenues. Heavy vehicles, on the other hand, contribute 100 percent of weight-mile tax, flat fee, and road use assessment fee revenues. Heavy vehicles also contribute 100 percent of the "Other Motor Carrier" revenue identified in the exhibit. This category includes revenues from truck overweight/overlength permit fees, late payment penalties and interest, etc.

Exhibit 5-13: Revenue Attribution Distributions by Weight Group- Comparison Between 2005 and 2007 OR HCASs

Declared Weight in Pounds				2005 Study	2007 Study	Change in Percentage
1	to		10,000	66.2%	64.5%	-1.8%
10,001	and	up		33.8%	35.5%	1.8%
10,001	to		26,000	3.0%	2.7%	-0.3%
26,001	to		46,000	1.2%	1.0%	-0.1%
46,001	to		54,000	0.9%	0.9%	-0.0%
54,001	to		78,000	1.0%	1.1%	0.2%
78,001	to		80,000	19.3%	21.1%	1.8%
80,001	to		104,000	4.0%	4.2%	0.2%
104,001	to		105,500	4.4%	4.5%	0.1%
105,501	and		up	0.0%	0.0%	-0.0%
	Total			100.0%	100.0%	

Exhibit 5-13 compares the revenue attribution results of the present study with those of the 2005 Study. The projected share of revenues contributed by light vehicles has decreased from 66.2 percent in the 2005 Study to 64.5 percent in the present study. Conversely, the overall heavy vehicle share of projected payments has increased from 33.8 percent in the previous study to 35.5 percent in the present study.

Chapter 6

Comparison of Expenditures Allocated to Revenues Paid

THIS CHAPTER BRINGS TOGETHER THE expenditure allocation and revenue attribution results reported in Chapter 5 to compare projected responsibilities and tax payments for each vehicle class and for broader groupings of vehicles (e.g., all heavy vehicles combined). This comparison is facilitated by the calculation of equity ratios, or the ratio of the share revenues contributed by the vehicles in a class to the share of cost responsibility for vehicles in that class. An equity ratio greater than one indicates the vehicles in that class are projected to pay more than their cost-responsible share of user fees. Conversely, an equity ratio less than one indicates the vehicles in that class are projected to pay less than their cost-responsible share.

The comparison of revenue share to cost responsibility share in Oregon studies traditionally is done for full-fee-paying vehicles only. This study takes the same approach, which requires some further adjustments to the numbers presented in Chapter 5. The model separately estimates the revenue contributions from full-fee-paying and alternative-fee-paying vehicles for each tax instrument. For alternative-fee-paying vehicles, the model also estimates the fees they would pay if they were full-fee-paying vehicles. The expenditures allocated to each vehicle class are apportioned among full-fee-paying and alternative-fee-paying vehicles on the basis of the relative miles of travel of each in that class.[1]

6.1 Presentation of Equity Ratios

Exhibit 6-1 includes calculated equity ratios for the summary-level weight groups shown in earlier exhibits. Exhibit 6-3, at the end of this chapter, shows the equity ratios for each 2,000-pound weight class. It needs to be emphasized that these results are for full-fee-paying vehicles only, and exclude vehicles that pay on an alternative-fee basis.

As shown in the first table within Exhibit 6-1, projected 2008 VMT for full-fee-paying vehicles are 37.852 billion, 93.5 percent of these miles being by light vehicles and 6.5 percent by heavy vehicles. This compares to projected 2006 miles of travel by all vehicles of 38.888 billion, 92.4 percent by light vehicles and 7.6 percent by heavy vehicles. As explained in the previous chapter, alternative-fee-paying vehicles are disproportionately concentrated in the heavy vehicle classes, so excluding them will reduce the heavy vehicle share of VMT. The heavy vehicle percentage share of VMT, in other words,

[1] If, for example, 80 percent of the VMT in a weight class is by full-fee-paying vehicles and 20 percent by alternative-fee-paying vehicles, then 80 percent of the total responsibility of that class is assigned to full-fee-paying vehicles and 20 percent to alternative-fee-paying vehicles. This division is based on the reasonable assumption that two vehicles that are identical, except one is subject to full fees and the other alternative fees, have exactly the same per-mile cost responsibility.

will always be lower if only full-fee-paying vehicles are considered than if all vehicles are considered.

The projected total responsibility of full-fee-paying vehicles is $1,695.6 million, with responsibility shares of 65.5 percent for light vehicles and 34.5 percent for heavy vehicles. This compares to the projected total responsibility for all vehicles of $1,791.9 million. The difference between these two amounts is the projected responsibility of alternative-fee-paying vehicles.

Forecasted average annual user fees paid by full-fee-paying vehicles total $855.1 million, 65.4 percent from light vehicles and 34.6 percent from heavy vehicles. The difference between this total and the $878.8 million total for all vehicles represents projected revenues from alternative-fee-paying vehicles.

The total of the Allocated Alternative-Fee Difference column represents the average annual difference between what alternative-fee-paying vehicles are projected to pay and what they would pay if subject to full fees. This total is $20.2 million annually for the next biennium under existing tax rates.[2] Following the approach of previous studies, this amount is reassigned to the full-fee-paying vehicle classes based on the relative VMT of each of these classes.

Because the current study includes expenditures of funds from federal and local revenue sources, the allocated expenditures for full-fee-paying vehicles are over twice the attributed State revenues for these vehicles. This does not present a problem in calculating the equity ratios themselves, but does raise an issue as to how and at what stage the alternative-fee difference adjustment should be made.[3] In this study, the allocated alternative-fee difference is added to allocated costs for full-fee-paying vehicles before calculating the share of costs in the denominator of the equity ratio.

The equity ratios are calculated four different ways to illustrate the effects of considering only full-fee-paying vehicle costs and revenues and of adding the allocated alternative-fee difference. The bottom table in Exhibit 6-1 presents both the unadjusted and alternative-fee difference-adjusted equity ratios for all vehicles and for full-fee-paying vehicles. The adjusted ratios in the final column are the more important, however, since it is these results that form the basis for the determination whether rates should be adjusted.

This study finds overall equity ratios of .9933 for light vehicles and 1.0129 for heavy vehicles as a group. This means that, for the 2007-09 biennium, under the existing tax structure and rates, light and heavy vehicles are each expected to pay almost exactly their fair shares.

Exhibit 6-1 also shows the overall equity ratios for vehicles under and over 26,000 pounds, as well as for the summary-level weight groups shown in earlier exhibits. Vehicles with weights between 10,001 pounds and 26,000 pounds are projected to overpay their responsibility by 25.6 percent. This is almost entirely a result of the adjustments for full-fee-paying vehicles in

[2] These amounts represent the underpayment by alternative-fee-paying vehicles relative to what they would pay on a full-fee basis – the difference, for example, between revenues from publicly owned vehicles under the existing tax structure versus revenues from these vehicles if they were all subject to the state fuel tax or weight-mile tax and full registration fees. The amounts, however, do not necessarily represent an underpayment relative to the cost responsibility of these vehicles. Some flat-fee vehicles, for instance, pay more under the alternative fee structure than they would under the weight-mile tax, while others pay less.

[3] The calculation of equity ratios in the model is accomplished by comparing ratios of revenues attributed to ratios of expenditures allocated. For each vehicle class, the ratio of the revenues attributed to this class to the total revenues attributed to all classes is first calculated. This ratio is then divided by the ratio of the expenditures allocated to this class to the total expenditures allocated to all classes. Thus, the calculation of the equity ratios does not require scaling of either the attributed revenues or allocated expenditures when the two are not equal.

Exhibit 6-1: Comparison of Average Annual Cost Responsibility and User Fees Paid by Full-Fee-Paying Vehicles by Declared Weight Class (Thousands)

			Annual VMT			Percent of Annual VMT		
Declared Weight			All	Full-Fee	Alternative Fee	All	Full-Fee	Alternative Fee
1	to	10,000	35,939,195,994	35,377,747,586	561,448,407	92.4%	93.5%	54.2%
10,001	and	up	2,948,500,329	2,474,201,306	474,299,023	7.6%	6.5%	45.8%
10,001	to	26,000	594,092,156	418,141,662	175,950,495	1.5%	1.1%	17.0%
26,001	and	up	2,354,408,173	2,056,059,645	298,348,528	6.1%	5.4%	28.8%
26,001	to	105,500	2,352,182,564	2,053,834,036	298,348,528	6.1%	5.4%	28.8%
26,001	to	80,000	1,838,986,093	1,578,152,142	260,833,951	4.7%	4.2%	25.2%
26,001	to	46,000	295,891,290	106,591,789	189,299,501	0.8%	0.3%	18.3%
46,001	to	54,000	120,041,706	99,307,097	20,734,609	0.3%	0.3%	2.0%
54,001	to	78,000	109,987,304	101,446,120	8,541,184	0.3%	0.3%	0.8%
78,001	to	80,000	1,313,065,793	1,270,807,136	42,258,657	3.4%	3.4%	4.1%
80,001	to	105,500	513,196,471	475,681,894	37,514,578	1.3%	1.3%	3.6%
80,001	to	104,000	246,044,128	219,584,291	26,459,837	0.6%	0.6%	2.6%
104,001	to	105,500	267,152,343	256,097,602	11,054,741	0.7%	0.7%	1.1%
105,501	and	up	2,225,609	2,225,609	0	0.0%	0.0%	0.0%
Total			38,887,696,323	37,851,948,893	1,035,747,430	100.0%	100.0%	100.0%

			Annual Cost Responsibility					Percent of Cost Responsibility				
Declared Weight			State	Federal	Local	Total	Full-Fee	State	Federal	Local	Total	Full-Fee
1	to	10,000	498,827,725	243,571,404	387,025,143	1,129,424,271	1,111,073,518	71.1%	60.4%	56.3%	63.0%	65.5%
10,001	and	up	202,369,442	159,684,586	300,387,411	662,441,439	584,654,752	28.9%	39.6%	43.7%	37.0%	34.5%
10,001	to	26,000	15,896,389	13,413,936	18,277,175	47,587,500	32,794,673	2.3%	3.3%	2.7%	2.7%	1.9%
26,001	and	up	186,473,053	146,270,649	282,110,236	614,853,939	551,860,080	26.6%	36.3%	41.0%	34.3%	32.5%
26,001	to	105,500	185,871,410	145,849,656	279,839,002	611,560,068	548,585,679	26.5%	36.2%	40.7%	34.1%	32.4%
26,001	to	80,000	128,964,953	91,564,663	208,293,808	428,823,423	379,346,397	18.4%	22.7%	30.3%	23.9%	22.4%
26,001	to	46,000	13,477,676	8,509,914	29,613,640	51,601,229	18,822,868	1.9%	2.1%	4.3%	2.9%	1.1%
46,001	to	54,000	6,225,974	4,134,377	14,070,202	24,430,553	20,221,427	0.9%	1.0%	2.1%	1.4%	1.2%
54,001	to	78,000	6,227,033	4,507,028	13,568,669	24,302,730	22,385,016	0.9%	1.1%	2.0%	1.4%	1.3%
78,001	to	80,000	103,034,271	74,413,343	151,041,298	328,488,911	317,917,087	14.7%	18.5%	22.0%	18.3%	18.7%
80,001	to	105,500	56,906,457	54,284,993	71,545,194	182,736,645	169,239,281	8.1%	13.5%	10.4%	10.2%	10.0%
80,001	to	104,000	27,396,581	25,943,183	32,818,993	86,158,756	76,702,614	3.9%	6.4%	4.8%	4.8%	4.5%
104,001	to	105,500	29,509,876	28,341,810	38,726,202	96,577,888	92,536,667	4.2%	7.0%	5.6%	5.4%	5.5%
105,501	and	up	601,643	420,993	2,271,234	3,293,871	3,274,401	0.1%	0.1%	0.3%	0.2%	0.2%
Total			701,197,167	403,255,989	687,412,553	1,791,865,710	1,695,728,270	100.0%	100.0%	100.0%	100.0%	100.0%

continued

Exhibit 6-1 (continued)

Declared Weight			Annual User Fees: All	Full-Fee	Alternative-Fee Difference	Allocated Alternative-Fee Difference	Percent of User Fees: All	Full-Fee	Alternative-Fee Difference	Allocated Alternative-Fee Difference
1	to	10,000	566,071,220	559,307,525	2,112,571	18,915,219	64.4%	65.4%	10.4%	93.5%
10,001	and	up	312,761,553	295,754,741	18,125,515	1,322,867	35.6%	34.6%	89.6%	6.5%
10,001	to	26,000	23,846,211	20,658,394	6,112,194	223,565	2.7%	2.4%	30.2%	1.1%
26,001	and	up	288,915,342	275,096,347	12,013,320	1,099,302	32.9%	32.2%	59.4%	5.4%
26,001	to	105,500	287,915,350	274,096,355	12,013,320	1,098,112	32.8%	32.1%	59.4%	5.4%
26,001	to	80,000	211,896,523	203,513,207	11,946,451	843,782	24.1%	23.8%	59.0%	4.2%
26,001	to	46,000	9,142,774	7,041,615	9,892,647	56,991	1.0%	0.8%	48.9%	0.3%
46,001	to	54,000	7,755,389	7,726,552	1,592,512	53,096	0.9%	0.9%	7.9%	0.3%
54,001	to	78,000	9,789,228	9,769,743	743,591	54,240	1.1%	1.1%	3.7%	0.3%
78,001	to	80,000	185,209,132	178,975,296	-282,299	679,455	21.1%	20.9%	-1.4%	3.4%
80,001	to	105,500	76,018,827	70,583,149	66,870	254,330	8.7%	8.3%	0.3%	1.3%
80,001	to	104,000	36,625,400	32,259,652	-517,442	117,404	4.2%	3.8%	-2.6%	0.6%
104,001	to	105,500	39,393,428	38,323,497	584,311	136,926	4.5%	4.5%	2.9%	0.7%
105,501	and	up	999,992	999,992	0	1,190	0.1%	0.1%	0.0%	0.0%
Total			878,832,773	855,062,266	20,238,086	20,238,086	100.0%	100.0%	100.0%	100.0%

Declared Weight	Share of Full-Fee Revenues	Share of Full-Fee Costs	Share of Full-Fee Costs + Allocated Difference	Full-Fee Equity Ratio	Difference-Adjusted Full-Fee Equity Ratio
1 to 10,000	65.4%	65.5%	65.9%	0.9983	0.9933
10,001 and up	34.6%	34.5%	34.1%	1.0032	1.0129
10,001 to 26,000	2.4%	1.9%	1.9%	1.2494	1.2557
26,001 and up	32.2%	32.5%	32.2%	0.9886	0.9984
26,001 to 105,500	32.1%	32.4%	32.0%	0.9909	1.0007
26,001 to 80,000	23.8%	22.4%	22.2%	1.0639	1.0742
26,001 to 46,000	0.8%	1.1%	1.1%	0.7419	0.7485
46,001 to 54,000	0.9%	1.2%	1.2%	0.7578	0.7648
54,001 to 78,000	1.1%	1.3%	1.3%	0.8655	0.8737
78,001 to 80,000	20.9%	18.7%	18.6%	1.1164	1.1274
80,001 to 105,500	8.3%	10.0%	9.9%	0.8271	0.8357
80,001 to 104,000	3.8%	4.5%	4.5%	0.8341	0.8427
104,001 to 105,500	4.5%	5.5%	5.4%	0.8213	0.8299
105,501 and up	0.1%	0.2%	0.2%	0.6057	0.6127
Total	100.0%	100.0%	100.0%	1.0000	1.0000

the equity-ratio calculation, as all vehicles in this group pay close to their fair share.

Vehicles with declared weights between 26,001 and 78,000 pounds underpay their fair share and those between 78,001 and 80,000 pounds overpay by 12.7 percent. Vehicles in the 78,001-80,000 pound class alone account for 51.3 percent of the VMT by full-fee-paying heavy vehicles, and 61.8 percent of the VMT by over 26,000-pound vehicles. These vehicles also account for 54.4 percent of the cost responsibility and 60.5 percent of the user fees paid by full-fee-paying heavy vehicles. The reason for the large difference in the equity ratio between this group and the groups above and below it is that most truckers who are capable of operating at 80,000 pounds and do not know in advance how much their loads will weigh, declare at 80,000 pounds. As a result, the average operating weights of vehicles declared at 80,000 pounds are a substantially lower fraction of their declared weight than for other declared weight classes, and the wear-related costs they impose per mile are correspondingly lower.

Vehicles between 80,001 and 105,500 pounds (Schedule B vehicles) pay 16.4 percent less than their fair share. Those in the 104,001 to 105,500 range pay 17.0 percent less than their fair share.

Vehicles over 105,500 pounds all pay the Road Use Assessment Fee, as do some vehicles between 96,001 and 105,500 pounds. Those over 105,500 pounds underpay their fair share by 38.7 percent. This study and the 2005 study report smaller underpayments for these vehicles than did the 2001 and 2003 studies primarily because the model was changed for the 2005 study to attribute portions of vehicle registration fees to these vehicles. Since no vehicle can register above 105,500 pounds, no registration fees were attributed to these vehicles in earlier studies.

6.2 Comparison with 1999, 2001, 2003 and 2005 Oregon Studies

The overall light and heavy vehicle equity ratios found by this study are slightly different from those determined by the prior three Oregon studies. The alternative-fee difference adjusted equity ratios found by the 1999 Study were 0.97 for light vehicles

Exhibit 6-2: Comparison of Equity Ratios from the 1999, 2001, 2003, 2005 and 2007 Oregon Highway Cost Allocation Studies

Declared Weight			Alternative-Fee Difference Adjusted Equity Ratios for Full-Fee-Paying Vehicles				
			1999	2001	2003	2005	2007
1	to	10,000	0.9700	1.0027	0.9921	1.0032	0.9933
10,001	and	up	1.0500	0.9952	1.0158	0.9936	1.0129
10,001	to	26,000	1.0000	0.9440	1.3803	1.1846	1.2557
26,001	and	up		0.9996	0.9870	0.9789	0.9984
26,001	to	105,500				0.9812	1.0007
26,001	to	80,000				1.0189	1.0742
26,001	to	46,000		0.9596	1.0091	0.7401	0.7485
46,001	to	54,000		0.8517	1.1727	0.7537	0.7648
54,001	to	78,000		0.9291	1.2561	0.8965	0.8737
78,001	to	80,000		1.0603	1.0931	1.0610	1.1274
80,001	to	105,500				0.8880	0.8357
80,001	to	104,000		0.9479	0.7430	0.9034	0.8427
104,001	to	105,500		0.8712	0.7576	0.8759	0.8299
105,501	and	up	1.3500	0.4727	0.2678	0.6395	0.6127
Total			1.0000	1.0000	1.0000	1.0000	1.0000

Exhibit 6-3: Detailed Comparison of Average Annual Cost Responsibility and User Fees Paid by Full-Fee-Paying Vehicles by Declared Weight Class (Thousands)

		Annual VMT		Annual Cost Responsibility		Annual User Fees		Alternative-Fee Difference		Equity Ratio	
Weight Class	Axles	All	Full-Fee	All	Full-Fee	All	Full-Fee	Alternative-Fee Difference	Allocated Alternative-Fee Difference	Plain	Alternative-Fee Adjusted
1	0	35,939,195,994	35,377,747,586	1,129,424,271	1,111,780,208	566,068,261	559,304,609	2,112,568	18,915,528	1.0226	0.9933
10,001	0	109,231,992	83,912,230	6,887,882	5,291,285	3,762,758	3,272,534	497,234	44,866	1.1138	1.2307
12,001	0	67,389,587	41,308,898	4,624,982	2,835,051	2,058,120	1,682,002	685,827	22,087	0.9073	1.1814
14,001	0	123,160,684	100,956,472	9,133,690	7,487,009	5,069,624	4,613,236	558,240	53,979	1.1317	1.2277
16,001	0	61,821,160	50,839,925	4,803,675	3,950,402	2,726,798	2,520,112	337,648	27,183	1.1574	1.2715
18,001	0	59,687,847	46,019,393	4,694,850	3,619,734	2,793,213	2,498,888	447,882	24,605	1.2131	1.3761
20,001	0	22,989,419	12,349,322	2,110,420	1,133,663	910,278	720,207	430,455	6,603	0.8794	1.2675
22,001	0	32,901,479	16,108,021	3,265,633	1,598,800	1,357,625	1,013,774	713,061	8,613	0.8476	1.2657
24,001	0	116,909,988	66,647,400	12,066,369	6,878,729	5,170,753	4,339,940	2,442,182	35,635	0.8737	1.2596
26,001	0	25,586,568	4,134,787	3,589,021	579,986	743,196	224,315	644,890	2,211	0.4222	0.7732
28,001	0	26,970,249	6,688,881	3,829,972	949,870	796,206	383,438	749,856	3,576	0.4239	0.8071
30,001	0	52,121,601	13,566,576	8,374,134	2,179,678	1,555,234	755,466	1,347,201	7,254	0.3787	0.6933
32,001	0	37,284,455	25,205,869	6,217,298	4,203,156	1,513,229	1,503,256	710,383	13,477	0.4963	0.7154
34,001	0	15,262,150	5,239,074	2,974,009	1,020,895	361,756	350,856	660,337	2,801	0.2480	0.6878
36,001	0	6,206,877	2,370,329	1,608,418	614,235	171,263	162,482	254,209	1,267	0.2171	0.5298
38,001	0	27,372,073	3,882,586	4,777,162	677,616	313,682	311,136	1,879,813	2,076	0.1339	0.9187
40,001	0	8,313,251	4,171,338	1,453,369	729,257	320,112	293,942	265,699	2,230	0.4491	0.8064
42,001	0	46,858,114	3,302,849	9,311,916	656,361	482,113	212,529	2,533,069	1,766	0.1056	0.6481
44,001	0	49,915,953	38,029,501	9,465,930	7,211,814	2,885,983	2,844,195	847,190	20,333	0.6216	0.7892
46,001	0	28,492,215	24,848,723	5,789,860	5,049,471	1,900,306	1,861,354	233,973	13,286	0.6692	0.7378
48,001	0	33,978,426	26,730,974	6,829,371	5,372,696	2,106,895	2,049,825	498,691	14,292	0.6290	0.7636
50,001	0	18,421,993	16,529,948	3,853,878	3,458,062	1,267,387	1,280,461	159,637	8,838	0.6705	0.7412
52,001	0	39,149,073	31,197,451	7,957,445	6,341,197	2,480,801	2,534,912	700,210	16,680	0.6357	0.8001
54,001	0	42,710,977	37,534,064	9,550,990	8,393,333	3,160,362	3,138,363	410,862	20,069	0.6747	0.7486
56,001	0	10,416,316	9,397,803	2,672,104	2,410,825	793,928	804,633	97,909	5,025	0.6058	0.6684
58,001	0	9,242,948	8,165,970	1,954,706	1,726,946	719,637	725,710	101,784	4,366	0.7506	0.8412
60,001	0	2,466,537	2,230,455	534,970	483,766	200,832	204,420	25,225	1,193	0.7654	0.8459

		Annual VMT		Annual Cost Responsibility		Annual User Fees		Alternative-Fee Difference		Equity Ratio	
Weight Class	Axles	All	Full-Fee	All	Full-Fee	All	Full-Fee	Alternative-Fee Difference	Allocated Alternative-Fee Difference	Plain	Alternative-Fee Adjusted
62,001	0	3,176,511	3,142,002	737,063	729,056	298,577	298,770	3,475	1,680	0.8259	0.8205
64,001	0	15,477,027	15,425,215	3,413,689	3,402,261	1,528,180	1,528,992	5,947	8,247	0.9127	0.8997
66,001	0	4,087,513	3,910,763	901,314	862,340	417,302	416,324	17,838	2,091	0.9440	0.9665
68,001	0	7,406,381	7,340,504	1,646,709	1,632,062	826,257	826,826	7,989	3,925	1.0231	1.0143
70,001	0	5,547,573	5,283,894	1,028,492	979,607	625,023	630,365	36,799	2,825	1.2391	1.2877
72,001	0	2,021,692	1,843,272	346,133	315,586	236,588	235,918	22,166	986	1.3936	1.4956
74,001	0	5,742,945	5,696,173	1,054,349	1,045,762	748,931	749,487	6,710	3,046	1.4483	1.4341
76,001	0	1,690,884	1,476,006	462,210	403,472	233,611	209,935	6,887	789	1.0305	1.0422
78,001	0	1,313,065,793	1,270,807,136	328,488,911	317,917,087	185,209,132	178,975,296	-282,299	679,466	1.1496	1.1274
80,001	5	5,368,107	3,400,610	1,919,791	1,216,157	808,213	492,256	-31,152	1,818	0.8584	0.8111
80,001	6	192,951	122,231	75,792	48,013	24,625	14,405	-1,886	65	0.6624	0.6013
80,001	7	30,437	19,282	10,248	6,492	7,024	3,636	-1,285	10	1.3974	1.1221
80,001	8	25,707	16,285	13,493	8,547	2,026	1,293	15	9	0.3061	0.3032
80,001	9	25,212	15,972	10,941	6,931	1,891	1,207	14	9	0.3524	0.3490
82,001	5	10,455,277	9,873,442	3,921,780	3,703,533	1,553,530	1,475,001	8,392	5,279	0.8077	0.7981
82,001	6	606,771	573,005	218,380	206,228	92,730	85,361	-2,338	306	0.8658	0.8294
82,001	7	91,751	86,646	31,749	29,982	11,207	10,640	60	46	0.7197	0.7111
82,001	8	57,460	54,262	18,632	17,596	6,694	6,355	36	29	0.7325	0.7236
82,001	9	15,240	14,392	6,174	5,830	1,689	1,604	9	8	0.5579	0.5513
84,001	5	17,318,909	14,513,765	7,901,043	6,621,311	2,670,331	2,195,777	-50,167	7,760	0.6891	0.6647
84,001	6	4,672,938	3,916,062	1,734,765	1,453,785	782,538	580,893	-89,373	2,094	0.9197	0.8007
84,001	7	252,641	211,721	88,673	74,311	34,064	28,675	153	113	0.7833	0.7732
84,001	8	95,713	80,211	34,220	28,677	10,600	8,779	-123	43	0.6316	0.6135
84,001	9	13,080	10,961	5,837	4,892	1,315	1,112	12	6	0.4594	0.4556
86,001	5	2,334,007	1,656,435	1,122,913	796,927	393,172	261,995	-24,007	886	0.7139	0.6590
86,001	6	23,204,944	16,468,456	7,880,745	5,592,933	3,471,286	2,328,922	-189,708	8,805	0.8981	0.8343
86,001	7	578,988	410,905	182,803	129,734	80,993	56,727	-1,063	220	0.9034	0.8760
86,001	8	491,320	348,688	152,604	108,303	47,223	32,839	-951	186	0.6309	0.6075
86,001	9	17,644	12,522	10,935	7,760	1,526	1,089	7	7	0.2846	0.2812
88,001	5	877,379	746,759	431,551	367,304	140,907	122,227	2,699	399	0.6657	0.6671
88,001	6	33,767,692	28,740,509	11,373,785	9,680,506	5,000,605	4,178,542	-91,168	15,367	0.8964	0.8649

Weight Class	Axles	Annual VMT		Annual Cost Responsibility		Annual User Fees		Alternative-Fee Difference		Equity Ratio	
		All	Full-Fee	All	Full-Fee	All	Full-Fee	Alternative-Fee Difference	Allocated Alternative-Fee Difference	Plain	Alternative-Fee Adjusted
88,001	7	1,451,570	1,235,467	430,876	366,729	211,894	173,029	-8,600	661	1.0027	0.9452
88,001	8	198,060	168,574	63,036	53,651	38,047	25,027	-8,642	90	1.2307	0.9346
88,001	9	37,598	32,000	8,863	7,543	3,942	3,414	69	17	0.9069	0.9061
90,001	5	111,890	105,173	61,504	57,812	24,275	22,220	-636	56	0.8047	0.7706
90,001	6	8,233,806	7,739,518	2,976,714	2,798,018	1,246,763	1,166,073	-6,218	4,138	0.8540	0.8351
90,001	7	944,721	888,008	334,413	314,337	122,414	116,252	1,262	475	0.7464	0.7411
90,001	8	30,677	28,835	8,774	8,247	4,923	4,578	-53	15	1.1441	1.1119
90,001	9	7,531	7,079	2,592	2,437	886	841	9	4	0.6966	0.6917
92,001	5	113,677	96,003	53,271	44,989	19,387	18,654	2,702	51	0.7420	0.8312
92,001	6	2,389,171	2,017,726	916,594	774,092	370,389	323,867	13,099	1,079	0.8239	0.8385
92,001	7	978,640	826,491	343,178	289,824	116,144	106,599	10,079	442	0.6900	0.7370
92,001	8	20,684	17,469	6,307	5,326	2,336	2,148	208	9	0.7552	0.8079
92,001	9	2,606	2,201	1,019	860	280	257	25	1	0.5595	0.5991
94,001	5	307,653	286,244	184,349	171,520	53,390	50,574	967	153	0.5905	0.5912
94,001	6	2,571,313	2,392,375	1,112,042	1,034,655	572,204	498,057	-36,895	1,279	1.0491	0.9648
94,001	7	27,111,349	25,224,667	8,534,617	7,940,692	3,690,096	3,476,766	46,715	13,487	0.8816	0.8772
94,001	8	935,130	870,054	282,821	263,139	126,212	116,073	-1,458	465	0.9099	0.8837
94,001	9	16,609	15,453	6,930	6,447	1,982	1,879	37	8	0.5833	0.5842
96,001	5	3,181,200	3,073,842	1,458,346	1,409,130	615,427	596,917	2,338	1,644	0.8604	0.8491
96,001	6	2,888,209	2,790,738	1,093,350	1,056,452	485,253	462,128	-6,984	1,492	0.9049	0.8766
96,001	7	31,795,407	30,722,384	10,004,092	9,666,477	4,574,866	4,403,131	-17,950	16,426	0.9324	0.9126
96,001	8	838,782	810,475	265,273	256,321	123,510	112,820	-6,750	433	0.9493	0.8818
96,001	9	39,360	38,032	12,912	12,476	-15,778	-15,217	29	20	-2.4915	-2.4437
98,001	5	0	0	165		0	0	0	0		
98,001	6	432,629	384,634	197,723	175,789	65,296	58,479	480	206	0.6733	0.6668
98,001	7	12,319,242	10,952,589	3,921,063	3,486,074	1,828,573	1,612,540	-14,821	5,856	0.9508	0.9267
98,001	8	759,395	675,150	244,588	217,454	99,645	89,643	1,184	361	0.8307	0.8259
98,001	9	3,819	3,396	1,552	1,380	9,220	5,523	-3,008	2	12.1122	8.0212
100,001	5	0	0	408		0	0	0	0		
100,001	6	0	0	3,483		0	0	0	0		
100,001	7	12,405,772	11,991,563	4,149,750	4,011,196	1,888,385	1,812,318	-13,466	6,412	0.9278	0.9053
100,001	8	6,448,558	6,233,251	1,903,373	1,839,822	883,477	854,765	813	3,333	0.9464	0.9307

Weight Class	Axles	Annual VMT: All	Annual VMT: Full-Fee	Annual Cost Responsibility: All	Annual Cost Responsibility: Full-Fee	Annual User Fees: All	Annual User Fees: Full-Fee	Alternative-Fee Difference: Alternative-Fee Difference	Alternative-Fee Difference: Allocated Alternative-Fee Difference	Equity Ratio: Plain	Equity Ratio: Alternative-Fee Adjusted
100,001	9	4,798	4,638	1,989	1,923	616	596	1	3	0.6317	0.6216
102,001	5	0	0	76		0	0	0	0		
102,001	6	0	0	1,195		0	0	0	0		
102,001	7	16,940,131	16,757,129	6,189,650	6,122,784	2,600,144	2,566,581	-5,534	8,960	0.8565	0.8400
102,001	8	12,028,130	11,898,192	4,233,803	4,188,065	1,716,767	1,703,542	5,379	6,362	0.8268	0.8151
102,001	9	1,844	1,824	1,215	1,201	247	245	1	1	0.4148	0.4090
104,001	5	0	0	20,149		0	0	0	0		
104,001	6	0	0	26,623		-35	0	0	0		
104,001	7	59,833,737	57,357,822	24,154,306	23,154,803	9,191,634	9,030,259	228,426	30,668	0.7759	0.7816
104,001	8	205,170,064	196,680,145	71,413,627	68,458,537	29,950,115	29,049,203	353,030	105,160	0.8551	0.8503
104,001	9	2,148,542	2,059,636	963,184	923,328	251,714	244,035	2,855	1,101	0.5328	0.5298
106,001	5	0	0	181		0	0	0	0		
106,001	6	0	0	143		0	0	0	0		
106,001	7	23,149	23,149	19,103	19,103	5,500	5,500	0	12	0.5870	0.5774
106,001	8	39,683	39,683	23,646	23,646	6,650	6,650	0	21	0.5734	0.5639
106,001	9	3,307	3,307	1,480	1,480	488	488	0	2	0.6726	0.6612
108,001	6	0	0	3,514		0	0	0	0		
108,001	7	40,048	40,048	27,070	27,070	10,315	10,315	0	21	0.7770	0.7641
108,001	8	72,586	72,586	37,365	37,365	12,890	12,890	0	39	0.7034	0.6916
108,001	9	12,515	12,515	5,008	5,008	1,847	1,847	0	7	0.7520	0.7392
110,001	6	0	0	1,911		0	0	0	0		
110,001	7	19,389	19,389	12,281	12,281	5,188	5,188	0	10	0.8613	0.8470
110,001	8	38,110	38,110	18,566	18,566	7,149	7,149	0	20	0.7850	0.7718
110,001	9	9,360	9,360	3,568	3,568	1,475	1,475	0	5	0.8428	0.8284
112,001	6	0	0	2,248		0	0	0	0		
112,001	7	15,338	15,338	14,867	14,867	4,257	4,257	0	8	0.5839	0.5744
112,001	8	32,445	32,445	22,510	22,510	6,410	6,410	0	17	0.5807	0.5711
112,001	9	11,208	11,208	5,711	5,711	1,878	1,878	0	6	0.6705	0.6593
114,001	7	25,223	25,223	16,292	16,292	7,254	7,254	0	14	0.9078	0.8928
114,001	8	59,220	59,220	41,307	41,307	13,477	13,477	0	32	0.6652	0.6543
114,001	9	25,223	25,223	12,944	12,944	4,227	4,227	0	14	0.6658	0.6547
116,001	7	8,405	8,405	6,479	6,479	2,585	2,585	0	5	0.8136	0.8003

Weight Class	Axles	Annual VMT All	Annual VMT Full-Fee	Annual Cost Responsibility All	Annual Cost Responsibility Full-Fee	Annual User Fees All	Annual User Fees Full-Fee	Alternative-Fee Difference: Alternative-Fee Difference	Alternative-Fee Difference: Allocated Alternative-Fee Difference	Equity Ratio Plain	Equity Ratio Alternative-Fee Adjusted
116,001	8	21,854	21,854	17,728	17,728	5,192	5,192	0	12	0.5971	0.5873
116,001	9	11,767	11,767	6,954	6,954	2,090	2,090	0	6	0.6126	0.6025
118,001	5	0	0	1,869		0	0	0	0		
118,001	6	0	0	2,094		0	0	0	0		
118,001	7	22,095	22,095	17,526	17,526	7,459	7,459	0	12	0.8677	0.8535
118,001	8	66,284	66,284	26,273	26,273	17,073	17,073	0	35	1.3249	1.3023
118,001	9	41,590	41,590	18,652	18,652	7,801	7,801	0	22	0.8528	0.8384
120,001	7	7,471	7,471	4,794	4,794	2,671	2,671	0	4	1.1362	1.1174
120,001	8	26,681	26,681	16,672	16,672	7,139	7,139	0	14	0.8731	0.8586
120,001	9	19,210	19,210	9,077	9,077	3,796	3,796	0	10	0.8526	0.8382
122,001	7	5,093	5,093	3,243	3,243	1,923	1,923	0	3	1.2092	1.1892
122,001	8	22,225	22,225	12,933	12,933	6,391	6,391	0	12	1.0076	0.9908
122,001	9	18,984	18,984	8,371	8,371	4,320	4,320	0	10	1.0523	1.0345
124,001	7	7,532	7,532	7,588	7,588	2,995	2,995	0	4	0.8047	0.7916
124,001	8	44,251	44,251	39,306	39,306	13,168	13,168	0	24	0.6831	0.6719
124,001	9	42,368	42,368	27,056	27,056	10,066	10,066	0	23	0.7585	0.7460
126,001	7	3,204	3,204	4,521	4,521	1,338	1,338	0	2	0.6033	0.5936
126,001	8	28,832	28,832	34,628	34,628	8,868	8,868	0	15	0.5222	0.5137
126,001	9	32,035	32,035	26,890	26,890	7,931	7,931	0	17	0.6014	0.5915
128,001	7	2,346	2,346	8,070	8,070	1,074	1,074	0	1	0.2712	0.2669
128,001	8	51,614	51,614	62,086	62,086	17,424	17,424	0	28	0.5722	0.5629
128,001	9	63,344	63,344	53,281	53,281	16,316	16,316	0	34	0.6244	0.6142
130,001	7	0	0	769		0	0	0	0		
130,001	8	21,717	21,717	15,170	15,170	7,766	7,766	0	12	1.0437	1.0265
130,001	9	28,788	28,788	14,816	14,816	7,703	7,703	0	15	1.0601	1.0423
132,001	8	16,946	16,946	12,398	12,398	6,229	6,229	0	9	1.0243	1.0075
132,001	9	27,648	27,648	22,051	22,051	7,398	7,398	0	15	0.6840	0.6728
134,001	6	0	0	946		0	0	0	0		
134,001	8	20,892	20,892	18,457	18,457	8,097	8,097	0	11	0.8945	0.8799
134,001	9	40,554	40,554	39,918	39,918	11,663	11,663	0	22	0.5957	0.5860
136,001	8	6,178	6,178	11,017	11,017	2,518	2,518	0	3	0.4660	0.4585

Weight Class	Axles	Annual VMT All	Annual VMT Full-Fee	Annual Cost Responsibility All	Annual Cost Responsibility Full-Fee	Annual User Fees All	Annual User Fees Full-Fee	Alternative-Fee Difference: Alternative-Fee Difference	Alternative-Fee Difference: Allocated Alternative-Fee Difference	Equity Ratio: Plain	Equity Ratio: Alternative-Fee Adjusted
136,001	9	14,415	14,415	16,163	16,163	4,290	4,290	0	8	0.5411	0.5324
138,001	8	18,746	18,746	15,220	15,220	8,015	8,015	0	10	1.0738	1.0562
138,001	9	56,238	56,238	47,839	47,839	17,298	17,298	0	30	0.7372	0.7252
140,001	7	0	0	929		0	0	0	0		
140,001	8	5,243	5,243	5,579	5,579	2,451	2,451	0	3	0.8958	0.8813
140,001	9	19,722	19,722	14,987	14,987	6,263	6,263	0	11	0.8521	0.8381
142,001	8	2,673	2,673	5,851	5,851	1,330	1,330	0	1	0.4634	0.4560
142,001	9	13,048	13,048	17,219	17,219	4,535	4,535	0	7	0.5370	0.5284
144,001	8	6,939	6,939	6,881	6,881	3,592	3,592	0	4	1.0641	1.0468
144,001	9	50,886	50,886	34,076	34,076	18,196	18,196	0	27	1.0887	1.0707
146,001	8	3,277	3,277	6,675	6,675	1,729	1,729	0	2	0.5280	0.5196
146,001	9	37,683	37,683	31,149	31,149	13,851	13,851	0	20	0.9067	0.8918
148,001	8	2,804	2,804	5,718	5,718	1,619	1,619	0	2	0.5774	0.5681
148,001	9	67,284	67,284	50,107	50,107	25,405	25,405	0	36	1.0338	1.0168
150,001	8	0	0	465		0	0	0	0		
152,001	8	0	0	931		0	0	0	0		
154,001	8	0	0	1,480		0	0	0	0		
156,001	8	0	0	624		0	0	0	0		
158,001	8	0	0	0		0	0	0	0		
160,001	8	0	0	354		0	0	0	0		
162,001	8	0	0	1,012		0	0	0	0		
150,001	9	33,208	33,208	29,751	29,751	13,203	13,203	0	18	0.9048	0.8901
152,001	9	16,423	16,423	28,857	28,857	6,694	6,694	0	9	0.4729	0.4654
154,001	9	45,552	45,552	76,484	76,484	19,477	19,477	0	24	0.5192	0.5109
156,001	9	18,742	18,742	36,497	36,497	8,951	8,951	0	10	0.5000	0.4920
158,001	9	72,193	72,193	88,665	88,665	35,922	35,922	0	39	0.8260	0.8127
160,001	9	17,352	17,352	14,265	14,265	8,981	8,981	0	9	1.2837	1.2627
162,001	9	39,942	39,942	51,582	51,582	21,472	21,472	0	21	0.8487	0.8350
164,001	9	44,073	44,073	111,508	111,508	25,456	25,456	0	24	0.4655	0.4580
166,001	9	11,865	11,865	32,297	32,297	7,209	7,209	0	6	0.4551	0.4478
168,001	9	47,730	47,730	133,002	133,002	30,431	30,431	0	26	0.4665	0.4591

Weight Class	Axles	Annual VMT		Annual Cost Responsibility		Annual User Fees		Alternative-Fee Difference		Equity Ratio	
		All	Full-Fee	All	Full-Fee	All	Full-Fee	Alternative-Fee Difference	Allocated Alternative-Fee Difference	Plain	Alternative-Fee Adjusted
170,001	9	15,127	15,127	46,059	46,059	9,947	9,947	0	8	0.4403	0.4333
172,001	9	30,630	30,630	92,120	92,120	21,673	21,673	0	16	0.4797	0.4721
174,001	9	44,745	44,745	79,771	79,771	32,556	32,556	0	24	0.8321	0.8188
176,001	9	17,572	17,572	59,460	59,460	13,312	13,312	0	9	0.4565	0.4492
178,001	9	37,941	37,941	74,532	74,532	30,641	30,641	0	20	0.8382	0.8248
180,001	9	11,572	11,572	42,441	42,441	9,693	9,693	0	6	0.4656	0.4582
182,001	9	21,867	21,867	46,790	46,790	18,971	18,971	0	12	0.8267	0.8135
184,001	9	42,076	42,076	170,515	170,515	38,608	38,608	0	23	0.4617	0.4543
186,001	9	13,472	13,472	56,126	56,126	12,631	12,631	0	7	0.4589	0.4516
188,001	9	28,099	28,099	65,569	65,569	27,469	27,469	0	15	0.8542	0.8405
190,001	9	10,778	10,778	49,226	49,226	11,075	11,075	0	6	0.4587	0.4515
192,001	9	17,757	17,757	81,384	81,384	18,957	18,957	0	10	0.4749	0.4674
194,001	9	20,458	20,458	53,136	53,136	22,454	22,454	0	11	0.8616	0.8479
196,001	9	12,658	12,658	63,312	63,312	14,526	14,526	0	7	0.4678	0.4604
198,001	9	17,285	17,285	89,944	89,944	20,354	20,354	0	9	0.4614	0.4541
200,001	9	100,824	100,824	535,973	535,973	122,761	122,761	0	54	0.4670	0.4596
		38,887,696,323	37,851,948,893	1,791,865,710	1,696,434,960	878,832,773	855,061,648	20,238,417	20,238,417		

and 1.05 for heavy vehicles as a group, indicating a projected underpayment of 3 percent by light vehicles and overpayment of 5 percent by heavy vehicles. The analysis period for the 1999 Study was the 1999-01 biennium. On the basis of these results, the 1999 Legislature enacted an across-the-board 12.3 percent reduction in the weight-mile tax rates.[4] This reduction became effective September 1, 2000.

The 2001 Study found adjusted equity ratios of 1.003 for light vehicles and 0.995 for heavy vehicles as a group. This indicated a situation of near-perfect equity for the 2001-03 biennium analysis period, i.e., a 0.3 percent projected overpayment by full-fee-paying light vehicles and 0.5 percent projected underpayment by heavy vehicles. As a consequence, no adjustment in tax rates was deemed necessary by the Legislature to satisfy the constitutional requirement of “fairness and proportionality” between light and heavy vehicles.

The 2003 study found adjusted equity ratios of 0.9921 for light vehicles and 1.0158 for heavy vehicles, even closer to perfect equity than the 2001 study. The 2003 legislature did not change rates as a result of the 2003 study, but did increase registration and other fees in anticipation of the debt-service requirements of OTIA III. Those fee increases were designed to preserve light/heavy equity given the nature of the projects they would fund and the results of this study indicate they succeeded.

The 2005 study found adjusted equity ratios of 1.0032 for light vehicles and .9936 for heavy vehicles. This indicated near-perfect equity for the 2005-2007 biennium analysis period: a 0.32 percent projected over payment by full-fee paying light vehicles and a 0.64 percent underpayment by full-fee paying heavy vehicles.

All four prior studies, as well as this study, have projected an overpayment by vehicles in the 78,001-80,000 pound class, and underpayment by vehicles weighing more than 80,000 pounds.

[4] The overall results of the 1999 Study were implemented by a proportionate reduction in all the weight-mile tax rates. The Legislature, however, did not implement the detailed recommendations of either the 1999 or 2001 studies.

Chapter 7

Recommendations for Changes in Tax Rates

Because light and heavy vehicles pay equitable shares of highway costs in Oregon, there is no constitutional requirement to change user-fee rates for the 2007-2009 biennium. This report does not recommend any change that would affect the distribution of revenue burdens between light and heavy vehicles. Should rates be adjusted for other reasons, such as to fund additional highway projects, the proportional burdens on light and heavy vehicles should be maintained.

Within the various classes of heavy vehicles, there are inequities that the Legislature could choose to address through changes to the rate structure. In this chapter, we offer alternative rate schedules that, if implemented, would bring about substantially greater equity within heavy vehicle classes without noticeably changing the total amount of revenue collected from heavy vehicles.

The inequities within heavy vehicle classes may be generalized as follows:

- vehicles weighing over 80,000 pounds are paying less than their fair share,
- vehicles with a declared weight of 78,000 to 80,000 pounds (which account for 55 percent of all vehicle miles by vehicles over 26,000 pounds and 41 percent of all heavy vehicle miles) are paying more than their fair share,
- vehicles weighing more than 26,000 pounds, but less than 78,000 pounds, are paying less than their fair share, with inequity decreasing as weights increase, and
- vehicles between 10,000 and 26,000 pounds paying more than their fair share.

To achieve equity within heavy vehicle classes, several rate schedules would need to be changed. These include the registration fees paid by 10,001-26,000 pound commercial vehicles, the Table A and Table B weight-mile tax rates; the optional flat fee rates for haulers of logs, sand and gravel, and wood chips; and the Road Use Assessment Fee applicable to vehicles operated under single-trip, non-divisible load permits at gross weights over 98,000 pounds.

Registration Fees for 10,001-26,000 Pound Commercial Vehicles

Commercial vehicles registered at gross weights of 10,001 to 26,000 pounds pay the state fuel tax and relatively higher registration fees in place of the weight-mile tax. The existing annual registration fees for these vehicles range from $192 for vehicles registered at 10,001-12,000 pounds to $375 for vehicles registered at 24,001-26,000 pounds. In contrast, a vehicle weighing 26,001 pounds would pay $184 per year for registration, along with the weight-mile tax.

To achieve better equity within heavy vehicles, the registration fees for vehicles between 10,001 and 26,000 pounds could be decreased by 33 percent, as shown in Exhibit 7-1.

It should be noted that the lack of data about actual miles traveled and fleet-average fuel consumption per mile for vehicles in this range of weights makes our estimates of equity for this weight group less reliable than for other weight groups.

Exhibit 7-1: Annual Registration Fees

Registered Weight			Current Rate	Alternative Rate
10,001	to	12,000	$192	$128
12,001	to	14,000	$215	$143
14,001	to	16,000	$238	$159
16,001	to	18,000	$261	$174
18,001	to	20,000	$291	$194
20,001	to	22,000	$314	$209
22,001	to	24,000	$345	$230
24,001	to	26,000	$375	$250

Weight-Mile Tax Table A and Table B Rates

Commercial vehicles operated at declared weights of 26,001 to 105,500 pounds are subject to the weight-mile tax for their Oregon miles of travel. Operators of vehicles with declared weights of 26,001-80,000 pounds pay the statutory Table A rates. Vehicles operated under special annual permits at declared weights of 80,001-105,500 pounds are subject to the statutory Table B rates.[1]

Exhibit 7-2: Weight-Mile Tax Table A

Declared Weight			Current Rate	Alternative Rate	Difference	Percent Difference
26,001	to	28,000	$0.0400	$0.0640	$0.0240	60.00%
28,001	to	30,000	$0.0424	$0.0660	$0.0236	55.57%
30,001	to	32,000	$0.0443	$0.0679	$0.0236	53.33%
32,001	to	34,000	$0.0463	$0.0699	$0.0236	50.94%
34,001	to	36,000	$0.0481	$0.0718	$0.0237	49.37%
36,001	to	38,000	$0.0506	$0.0738	$0.0232	45.87%
38,001	to	40,000	$0.0525	$0.0758	$0.0233	44.32%
40,001	to	42,000	$0.0544	$0.0777	$0.0233	42.89%
42,001	to	44,000	$0.0564	$0.0797	$0.0233	41.30%
44,001	to	46,000	$0.0583	$0.0817	$0.0234	40.06%
46,001	to	48,000	$0.0602	$0.0836	$0.0234	38.90%
48,001	to	50,000	$0.0622	$0.0856	$0.0234	37.58%
50,001	to	52,000	$0.0645	$0.0875	$0.0230	35.72%
52,001	to	54,000	$0.0669	$0.0895	$0.0226	33.78%
54,001	to	56,000	$0.0694	$0.0915	$0.0221	31.79%
56,001	to	58,000	$0.0723	$0.0934	$0.0211	29.22%
58,001	to	60,000	$0.0756	$0.0954	$0.0198	26.17%
60,001	to	62,000	$0.0795	$0.0973	$0.0178	22.45%
62,001	to	64,000	$0.0839	$0.0993	$0.0154	18.36%
64,001	to	66,000	$0.0887	$0.1013	$0.0126	14.17%
66,001	to	68,000	$0.0950	$0.1032	$0.0082	8.66%
68,001	to	70,000	$0.1017	$0.1052	$0.0035	3.43%
70,001	to	72,000	$0.1084	$0.1072	-$0.0012	-1.15%
72,001	to	74,000	$0.1146	$0.1091	-$0.0055	-4.79%
74,001	to	76,000	$0.1205	$0.1111	-$0.0094	-7.82%
76,001	to	78,000	$0.1263	$0.1130	-$0.0133	-10.50%
78,001	to	80,000	$0.1316	$0.1150	-$0.0166	-12.61%

Table A rates are specified for each 2,000-pound declared gross weight increment. The existing rates range from 4.00 cents per mile for vehicles declared at 26,001-28,000 pounds to 13.16 cents per mile for vehicles declared at 78,001-80,000 pounds.

To achieve better equity within heavy vehicle classes, Table A rates could be changed to range from 6.40 cents per mile to 11.50 cents per mile as shown in Exhibit 7-2. These rates are higher than existing rates for lower weights and lower than existing rates for the highest weights and would result in a 7.9 percent reduction in revenue collected from vehicles paying Table A rates.

Table B rates are specified for combinations of 2,000-pound increment and number of axles. The rates are structured so that, at any given declared weight, carriers can qualify for a lower rate by utilizing additional axles. At a declared weight of 98,000 pounds, for example, the per-mile rate for a five-axle vehicle is 18.51 cents

[1] Under the Oregon weight-mile tax system, a power unit (tractor) can have multiple declared weights, depending on the configuration in which it is being operated (i.e., the number of trailers/semi-trailers the truck or tractor is pulling). Hence, during any given reporting period, a portion of a vehicle's miles may be reported under Table A and a portion under Table B.

Exhibit 7-3: Weight-Mile Tax Table B

Declared Weight			Axles	Current Rate	Alternative Rate	Difference	Percent Difference
80,001	to	82,000	5	$0.1359	$0.1648	$0.0289	21.26%
80,001	to	82,000	6	$0.1243	$0.1507	$0.0264	21.26%
80,001	to	82,000	7	$0.1162	$0.1409	$0.0247	21.26%
80,001	to	82,000	8	$0.1104	$0.1339	$0.0235	21.26%
80,001	to	82,000	9	$0.1041	$0.1262	$0.0221	21.26%
82,001	to	84,000	5	$0.1403	$0.1701	$0.0298	21.26%
82,001	to	84,000	6	$0.1263	$0.1531	$0.0268	21.26%
82,001	to	84,000	7	$0.1181	$0.1432	$0.0251	21.26%
82,001	to	84,000	8	$0.1118	$0.1356	$0.0238	21.26%
82,001	to	84,000	9	$0.1055	$0.1279	$0.0224	21.26%
84,001	to	86,000	5	$0.1445	$0.1752	$0.0307	21.26%
84,001	to	86,000	6	$0.1292	$0.1567	$0.0275	21.26%
84,001	to	86,000	7	$0.1200	$0.1455	$0.0255	21.26%
84,001	to	86,000	8	$0.1132	$0.1373	$0.0241	21.26%
84,001	to	86,000	9	$0.1070	$0.1297	$0.0227	21.26%
86,001	to	88,000	5	$0.1494	$0.1812	$0.0318	21.26%
86,001	to	88,000	6	$0.1320	$0.1601	$0.0281	21.26%
86,001	to	88,000	7	$0.1219	$0.1478	$0.0259	21.26%
86,001	to	88,000	8	$0.1152	$0.1397	$0.0245	21.26%
86,001	to	88,000	9	$0.1084	$0.1314	$0.0230	21.26%
88,001	to	90,000	5	$0.1552	$0.1882	$0.0330	21.26%
88,001	to	90,000	6	$0.1354	$0.1642	$0.0288	21.26%
88,001	to	90,000	7	$0.1239	$0.1502	$0.0263	21.26%
88,001	to	90,000	8	$0.1171	$0.1420	$0.0249	21.26%
88,001	to	90,000	9	$0.1104	$0.1339	$0.0235	21.26%
90,001	to	92,000	5	$0.1619	$0.1963	$0.0344	21.26%
90,001	to	92,000	6	$0.1393	$0.1689	$0.0296	21.26%
90,001	to	92,000	7	$0.1257	$0.1524	$0.0267	21.26%
90,001	to	92,000	8	$0.1190	$0.1443	$0.0253	21.26%
90,001	to	92,000	9	$0.1123	$0.1362	$0.0239	21.26%
92,001	to	94,000	5	$0.1692	$0.2052	$0.0360	21.26%
92,001	to	94,000	6	$0.1431	$0.1735	$0.0304	21.26%
92,001	to	94,000	7	$0.1277	$0.1548	$0.0271	21.26%
92,001	to	94,000	8	$0.1209	$0.1466	$0.0257	21.26%
92,001	to	94,000	9	$0.1138	$0.1380	$0.0242	21.26%
94,001	to	96,000	5	$0.1769	$0.2145	$0.0376	21.26%
94,001	to	96,000	6	$0.1475	$0.1789	$0.0314	21.26%
94,001	to	96,000	7	$0.1301	$0.1578	$0.0277	21.26%
94,001	to	96,000	8	$0.1229	$0.1490	$0.0261	21.26%
94,001	to	96,000	9	$0.1156	$0.1402	$0.0246	21.26%
96,001	to	98,000	5	$0.1851	$0.2244	$0.0393	21.26%
96,001	to	98,000	6	$0.1528	$0.1853	$0.0325	21.26%
96,001	to	98,000	7	$0.1330	$0.1613	$0.0283	21.26%
96,001	to	98,000	8	$0.1249	$0.1515	$0.0266	21.26%

and the rate for a six-axle vehicle is 15.28 cents. Thus, by adding an axle, a carrier can reduce his or her tax liability by over three cents per mile. Current Table B rates range from 10.41 cents per mile for a nine-axle vehicle declared at 82,000 pounds to 18.51 cents per mile for a five-axle vehicle declared at 98,000 pounds. Vehicles declared at over 98,000 pounds must have six or more axles, and vehicles declared at over 100,000 pounds must have seven or more axles.

To achieve better equity within heavy vehicles, Table B rates could be increased by 21.25 percent as shown in Exhibit 7-3.

Optional Flat Fee Rates

Under existing law, carriers hauling qualifying commodities — logs, sand and gravel, and wood chips — have the option of paying monthly flat fees in lieu of the weight-mile tax. There are separate flat fee rates applicable to each of the three different commodity groups. Each rate is set so that carriers paying it should, on average, pay the same amount as they would on a mileage basis.

The existing statutory flat fee rate for carriers transporting logs is $6.10 per 100 pounds of declared combined weight. The comparable rates for carriers transporting wood chips and sand and gravel are $24.62 and $6.05, respectively. These are annual rates that typically are paid in monthly installments. The monthly flat fee applicable to a log truck declared at 80,000 pounds, for example, is $407 (i.e., $6.10 x 800 = $4,880/12 months = $407). This amount must be paid each month the vehicle remains on a flat fee basis, regardless of the number of miles traveled during the month.

Exhibit 7-3: Weight-Mile Tax Table B, continued

Declared Weight			Axles	Current Rate	Alternative Rate	Difference	Percent Difference
96,001	to	98,000	9	$0.1176	$0.1426	$0.0250	21.26%
98,001	to	100,000	5				
98,001	to	100,000	6	$0.1585	$0.1922	$0.0337	21.26%
98,001	to	100,000	7	$0.1359	$0.1648	$0.0289	21.26%
98,001	to	100,000	8	$0.1272	$0.1542	$0.0270	21.26%
98,001	to	100,000	9	$0.1195	$0.1449	$0.0254	21.26%
100,001	to	102,000	5				
100,001	to	102,000	6				
100,001	to	102,000	7	$0.1388	$0.1683	$0.0295	21.26%
100,001	to	102,000	8	$0.1301	$0.1578	$0.0277	21.26%
100,001	to	102,000	9	$0.1215	$0.1473	$0.0258	21.26%
102,001	to	104,000	5				
102,001	to	104,000	6				
102,001	to	104,000	7	$0.1417	$0.1718	$0.0301	21.26%
102,001	to	104,000	8	$0.1330	$0.1613	$0.0283	21.26%
102,001	to	104,000	9	$0.1239	$0.1502	$0.0263	21.26%
104,001	to	106,000	5				

The flat fee rates are required to be reviewed biennially and appropriate adjustments in these rates presented to each regular legislative session. This review is accomplished through the biennial flat fee studies, the latest of which was completed in August 2006. That study compared flat fee revenues in 2005 to what those vehicles would have paid in weight-mile tax in 2005. On January 1, 2004, both flat-fee rates and weight-mile rates were increased as a result of the OTIA III legislation. The study found that wood chip haulers reporting on a flat fee basis paid more than they would have on a mileage basis in 2001, while flat fee log and sand and gravel haulers paid less than they would have on a mileage basis.

We applied 2004 flat-fee rates and weight-mile rates to the 2005 data and found that current flat-fee rates for wood-chip haulers result in overpayment and current flat-fee rates for log haulers and for sand and gravel haulers result in underpayment relative to the weight-mile taxes those haulers would otherwise pay. When paying the weight-mile tax, log haulers are allowed to use a lower declared weight when their trailer is empty and stowed above the tractor unit. We assumed that 55 percent of log-truck miles are with an empty, decked trailer.

Exhibit 7-4 shows the flat fee rates necessary to implement the flat fee study results in combination with the overall light and heavy vehicle HCAS results. These rates represent an increase in the statutory rate for log trucks and for sand and gravel trucks, and a reduction in the statutory rates for wood chip trucks. The flat-fee rates presented here were recalculated to match the alternative weight-mile tax rates presented above, using 2005 flat-fee mileage data. Those rates would result in 28 percent higher revenues from flat-fee paying vehicles than under current law.

Exhibit 7-4: Flat Fee

Rate per 100 lbs. per Year	Logs	Sand & Gravel	Wood Chips
Current flat-fee rate	$6.10	$6.05	$24.62
Rate to match current weight-mile tax	$6.50	$8.15	$19.05
Rate to match alternative weight-mile tax	$7.69	$9.11	$21.47

Road Use Assessment Fee Rates

Since 1990, carriers operating vehicles under single-trip, non-divisible load permits at gross weights above 98,000 pounds pay the Road Use Assessment Fee. The Road Use Assessment Fee takes the place of the weight-mile tax for the loaded portion of non-divisible load hauls. With rare exceptions, the empty back haul portion of these trips is subject to the weight-mile tax and taxed at the vehicle's regular declared weight.

The existing statutory Road Use Assessment Fee rate is 5.7 cents per equivalent single-axle load (ESAL) mile of travel. The fees carriers actually pay are contained in a table of per-mile rates expressed in terms of permit gross weight and number of axles. Because of its size, that table is not reproduced in this report. Per-mile rates for loads over 200,000 pounds are calculated from the actual weight on each axle. As with the Table B rates, carriers are charged a lower per-mile fee for the use of additional axles at any given gross weight. This reflects the fact that spreading any given total load over additional axles reduces the amount of pavement damage imposed by that load.

The equity ratio results presented in Chapter 6 suggest the weight classes above 105,500 pounds are significantly underpaying their responsibility. To increase equity within heavy vehicles, Road Use Assessment Fee rates could be increased to 9.1 cents per ESAL-mile. Doing so would increase revenues from the Road Use Assessment Fee by 60 percent.

Glossary of Highway Cost Allocation Terms

List Of Acronyms

AAA	American Automobile Association
AASHTO	American Association of State Highway and Transportation Officials
ADT	Average Daily Traffic
ADTT	Average Daily Truck Traffic
AMT	Axle Miles of Travel
BMS	Bridge Management System
BOR	Bridge Options Report
CAFE	Corporate average fuel economy
CRC	Conventionally Reinforced Concrete
DAS	Department of Administrative Services
DL	Dead Load
DMV	Department of Motor Vehicles
ESAL	Equivalent Single Axle Load
FHWA	Federal Highway Administration
FO	Functionally Obsolete
HCAS	Highway Cost Allocation Study
HPMS	Highway Performance Monitoring System
LEF	Load Equivalence Factor
LL	Live Load
MCTD	Motor Carrier Transportation Division
NAPCOM	National Pavement Cost Model
NCHRP	National Cooperative Highway Research Program
NHS	National Highway System
OHCAS	Oregon Highway Cost Allocation Study
OTIA	Oregon Transportation Investment Act
PCE	Passenger Car Equivalent
SD	Structurally Deficient
SRT	Study Review Team
STIP	Statewide Transportation Improvement Program
TRB	Transportation Research Board
VMT	Vehicle Miles Of Travel

Alternative fee A fee charged to some vehicles in place of the usual fee (e.g., a lower registration fee for publicly-owned vehicles)

Arterial A road or highway used primarily for through traffic.

Attributable Costs Costs that are a function of vehicle size, weight, or other operating characteristics and therefore can be attributed to vehicle classes based on those characteristics.

Average Daily Traffic (ADT) The average number of vehicles passing a given point or using a given highway per day.

Average Daily Truck Traffic (ADTT) The average number of trucks passing a given point or using a given highway per day.

Axle Miles of Travel (AMT) Vehicle miles of travel multiplied by number of axles. Since trucks, on average, have roughly twice as many axles as cars (i.e., four versus two), their share of the total axle miles of travel on any given highway system will be about double their share of the vehicle miles of travel on that system.

Axle Weight or Axle Load The gross load carried by an axle. In Oregon, 20,000 pounds is the legal maximum for a single axle and 34,000 pounds is the legal maximum for a tandem (double) axle.

Beltway A controlled-access arterial encircling an urban area.

Benefits Things that make people better off, or the value of such things.

Bridge Management System (BMS) A set of procedures, and software and databases to implement those procedures, to inventory bridges, track their condition, and plan maintenance and reconstruction activities

Collector A road that connects local roads with arterial roads.

Common Costs Expenditures that are independent of vehicle size, weight, or other operating characteristics and so cannot be attributed to any specific class of vehicles. These expenditures must therefore be treated as a common responsibility of all vehicle classes and are most typically assigned to all classes on the basis of a relative measure of use such as vehicle miles of travel.

Conventionally Reinforced Concrete Concrete cast with steel reinforcing bars inside

Corridor Based Strategy Planning Road and bridge improvements taking into account their relationships to each other as parts of a corridor through which traffic moves.

Cost Allocation The analytical process of determining the cost responsibility of highway system users.

Cost Occasioned Approach An approach that determines responsibility for highway expenditures/costs based on the costs occasioned or caused by each vehicle class. Such an approach is not based solely on relative use, nor does it attempt to quantify the benefits received by different classes of road users.

Cost Responsibility The principle that those who use the public roads should pay for them and, more specifically, that payments from road users should be in proportion to the road costs for which they are responsible. The proportionate share of highway costs legitimately assignable to a given vehicle type user group.

Cost-Based Approach An approach in which the dollars allocated to the vehicle classes are measures of the costs imposed during the study period, rather than expenditures made during the study period. The difference between the cost-based and expenditure-based approaches is most evident when considering large investments in long-lived structures and when deferred maintenance moves the expenditures associated with one period's use into another period.

Cross-Subsidization A condition where some vehicles are overpaying and others are underpaying relative to their respective responsibilities.

Dead Load The load on a bridge when it is empty

Debt Financing Funding current activities by issuing debt to be repaid in the future

Debt Service Funds used for the repayment of previously incurred debt (both principal and interest.)

Deck The roadway or surface of a bridge.

Declared Weight In Oregon, vehicles choose a declared weight and pay the weight-mile tax based on that weight. They may not exceed that weight while operating without obtaining a special trip permit. For tractor-trailer combinations, a single tractor may have multiple declared weights; one for each configuration it expects to be a part of.

Depreciation The amount of decrease in value of a physical asset due to ageing in a time period

Efficiency The degree to which potential benefits are realized for a given expenditure

Efficient Pricing Setting prices for the use of highway facilities so that each vehicle pays the costs it imposes at the time and place it is traveling. Efficient pricing promotes the most efficient use of existing facilities and generates the right amount of revenue to build the most efficient system and perform the optimal amount of maintenance

Equity Generally interpreted as the state of being just, impartial, or fair. Horizontal equity refers to the fair treatment of individuals with similar circumstances. Vertical equity refers to the fair treatment of individual in different circumstances.

Equity Ratio The ratio of the share of revenues paid by a highway user group to the share of costs imposed by that group.

Equivalent Single Axle Load (ESAL) The pavement stress imposed by a single axle with an 18,000-pound axle load. ESAL-Miles are equivalent single-axle loads times miles traveled. Research has concluded that the relationship between axle weight and ESALs is an approximate third or fourth-power exponential relationship; ESALs therefore rise rapidly with increases in axle weight.

Excise Tax A tax levied on the production or sale of a specific item such as gasoline, diesel fuel, or vehicles.

Expenditure The amount of money spent in a time period.

External Cost A cost imposed on individuals who do not use the facility

Federal Highway Funds Funds collected from federal highway user fees and distributed to states by the Federal Highway Administration for spending on transportation projects by state and local governments.

Functional Classification The classification of roads according to their general use, character, or relative importance. Definitions are provided by the Federal Highway Administration for Rural Interstate, Rural Other Principal Arterial, Rural Minor Arterial, Rural Major Collector, Rural Minor Collector, Rural Local, Urban Interstate, Urban Other Expressway, Urban Other Principal Arterial, Urban Minor Arterial, Urban Collector, and Urban Local.

Functionally Obsolete (FO) A bridge that no longer meets minimum standards, but may continue to operate with load restrictions.

Fungibility The relative ability to use funds from different sources for the same purposes. Funds from some sources carry restrictions on how they may be spent; to the extent that those funds free up unrestricted funds that would otherwise be spent that way, they may be considered fungible with the unrestricted funds.

Gross Vehicle Weight The maximum loaded weight for a vehicle.

Heavy Vehicle Vehicles All vehicles weighing more than the upper limit in the definition of a light (basic) vehicle (see light vehicle). Includes trucks, buses, and other vehicles weighing 10,001 pounds or more.

Highway Cost Allocation Study (HCAS) A study that estimates and compares the costs imposed and the revenues paid by different classes of vehicles over some time period.

Highway Performance Monitoring System (HPMS) The Federal Highway Administration collects and reports data about a sample of road segments in every state in a common format.

Highway User A person responsible for the operation of a motor vehicle in use on highways, roads, and streets. In the case of passenger vehicles, the users are the people in the vehicles. In the case of goods-transporting trucks, the user is the entity transporting the goods.

Incremental Cost The additional costs associated with building a facility to handle an additional, heavier (or larger) class of vehicle.

Incremental Method A method of assigning responsibility for highway costs by comparing the costs of constructing and maintaining facilities for the lightest class of vehicles only and for each increment of larger and heavier vehicles. Under this method, vehicles share the incremental cost of a facility designed to accommodate that class as well as the cost of each lower increment.

Light (or Basic) Vehicles The lightest vehicle class, usually including passenger cars. In Oregon, the current definition of Light Vehicles includes vehicles up to 10,000 pounds, which account for over 90 percent of the total vehicle miles of travel on Oregon roads.

Live Load The additional load on a structure by traffic (beyond the load imposed by holding itself up).

Load-Related Costs Costs that vary with the load imposed by traffic on a facility.

Marginal Cost The increase in total cost that results from producing one additional unit of output. With respect to highway use, the marginal cost is the increase in total highway costs that results from one additional vehicle trip. Economic efficiency is achieved when the price charged to the user is equal to the marginal cost.

National Highway System (NHS) A set of highways throughout the United States that have been designated as National Highways by the federal government. The Federal Highway Administration sets design and maintenance standards and provides funding for national highways, but the highways are owned by the states.

National Pavement Cost Model (NAPCOM) A model of pavement costs that incorporates the wear-and-tear costs imposed by vehicle traffic of different weights and configurations as well as deterioration from age and environmental factors, taking into account the soil type, road base depth, pavement material, pavement thickness, and climate zone.

Non-Divisible Load Non-divisible loads are large pieces of equipment or materials that cannot be feasibly divided into smaller individual shipments. All states issue special permits for non-divisible loads that would otherwise violate state and federal gross vehicle weight, axle weight, and bridge formula limits.

Operating Weight The actual weight of a vehicle on at a particular time

Overhead Costs Costs that vary in proportion to the overall level of construction and maintenance activities but are not directly associated with specific projects.

Passenger Car Equivalent (PCE) A measure of road space effectively occupied by a vehicle of a given type under given terrain, vehicle mix, road type, and congestion conditions. The reference unit is the standard passenger car operating under the conditions on the road category in question.

Registered Weight The weight that determines the registration fee paid by a single-unit truck or a tractor. For a tractor, it is typically the highest of that vehicle's declared weights.

Revenue Attribution The process of associating revenue amounts with the classes of vehicles that produce the revenues.

Right of Way The strip of land, property, or interest therein, over which a highway or roadway is built.

Road Use Assessment Fee In Oregon, vehicles carrying non-divisible loads over 96,000 pounds on special permit pay a fee based on the number of ESAL-miles for the trip (see Equivalent Single-Axle Load).

Seismic Retrofit Work on an existing structure intended to increase its resistance to earthquakes.

Social (or Indirect) Costs Costs that highway users impose on other users or on non-users. Costs typically included in this category are those associated with noise, air and water pollution, traffic congestion, and injury and property damage due to traffic accidents.

Span A section of a bridge

State Highway System Roads under the jurisdiction of the Oregon Department of Transportation

Statewide Transportation Improvement Program (STIP) Each state, following guidelines in federal law, produces and regularly updates a list of intended future transportation improvements

Structurally Deficient (SD) A structure that fails to meet the desired level of structural integrity. Weight limits often are placed on structurally-deficient bridges.

Studded Tire A tire with metal studs imbedded in its tread for better traction on icy roads.

Tax Avoidance The legal avoidance of a tax or fee

Tax Evasion The illegal failure to pay a tax or fee

Truck A general term denoting a motor vehicle designed for transportation of goods. The term includes single-unit trucks and truck combinations.

User Charge A fee, tax, or charge that is imposed on facility users as a condition of usage..

User Revenues Highway revenues raised through the imposition of user charges or fees.

Value Pricing Prices set in proportion to the benefits received, rather than the cost of production.

Vehicle Class Any grouping of vehicles having similar characteristics for cost allocation, taxation, or other purposes. The number of vehicle classes used in a cost responsibility (allocation) study will depend on the needs, purpose, and resources of the study. Since the Oregon weight-mile tax rates are graduated in 2,000-pound increments, the Oregon studies have traditionally divided heavy vehicles into 2,000-pound gross weight classes. Light (basic) vehicles are considered as one class in the Oregon studies. Potential distinguishing characteristics include weight, size, number of axles, type of fuel, time of operation, and place of operation.

Vehicle Miles of Travel (VMT) The sum over vehicles of the number of miles each vehicle travels within a time period.

Vehicle Registration Fees Fees charged for being allowed to operate a vehicle on public roads.

Weight-mile Tax In Oregon, commercial vehicles over 26,000 pounds pay a user fee based on the number of miles traveled on public roads within Oregon. The per-mile rate is based on the declared weight of the vehicle, and for vehicles weighing over 80,000 pounds, the number of axles. Vehicles paying the weight-mile tax are exempt from the use-fuel (diesel) tax.

Oregon Highway Cost Allocation Study 2007/2008 Biennium

Issue Papers

Issue Paper 1:

Costs or Expenditures

Carl Batten and Andrew Dyke, ECONorthwest

Introduction

Oregon's constitution mandates that the Legislature provide for biennial review of expenditures on Oregon's highway system and the revenue streams that fund the expenditures. The constitution requires the State to ensure that the shares of revenues paid by light and heavy vehicles are fair and proportionate to the costs each class incurs. Oregon's Highway Cost Allocation Study (HCAS) serves to meet this mandate, ultimately estimating equity ratios to determine whether current taxes and fees raise revenue so as to pass constitutional muster. If necessary, the calculated equity ratios can suggest modifications that would improve the equity of the tax and fee structure across vehicle classes.

The name of the study itself is, however, somewhat misleading. The HCAS is really a prospective expenditure allocation study, rather than a true cost allocation study. The current approach allocates budgeted, or prospective, highway expenditures to vehicle classes largely according to the forecast highway use of each new or improved facility by each vehicle class. A true cost allocation study would, on the other hand, estimate the share of actual costs each vehicle class imposes on the existing highway system during the study period. Because the costs imposed by users and budgeted expenditures need not necessarily match, the two allocation approaches will generally produce different equity ratios, particularly over short time horizons. The difference between the approaches may diminish over longer periods of time, as maintaining highway capacity requires that expenditures that compensate for the costs actually imposed by users. However, the temporal pattern of costs and expenditures will still differ.

Part of the issue of whether the study should allocate planned expenditures or attribute costs imposed, therefore, is tied up in the meaning of "incurred". The relevant dictionary definition for incur is "to become liable for". Are users liable for costs they impose if no corresponding expenditure is made and the highway system is allowed to deteriorate? Are users liable for all expenditures the State makes, even if the expenditure is not useful? We will leave those questions to lawyers and focus on two other questions:

- Is there a meaningful difference, in either magnitude or distribution, between expenditures made and costs imposed?
- If there is a difference, should policymakers care about costs imposed?

In practical terms, the tax and fee adjustments suggested by an expenditure allocation study will differ from those suggested by a cost allocation approach to the extent that the calculated equity ratios differ. A seemingly equitable fee structure that is based on expenditure allocation may appear quite inequitable when viewed from the perspective of a true cost allocation study, especially over the short term. In addition, cost allocation is more appealing from a theoretical perspective, as the equity ratios derived from this approach are based on costs likely to be imposed by each class of user, rather than on the calculated responsibility for currently budgeted projects.

Regardless of the theoretical appeal of cost allocation, however, Oregon is in good company methodologically. Federal, and most state, highway cost allocation studies use some variation of expenditure allocation.

Differences between costs and expenditures

Budgeted expenditures may differ in magnitude from costs imposed, either by category or overall. If, for example, highway authorities deferred repairing roads damaged by studded tire use, the costs imposed on some road segments would exceed expenditures on those segments. As another example, the Oregon Transportation Investment Acts fund a large number of bridge repair, replacement, and enhancement projects. This will result in several biennia of expenditures on bridges that far exceed the costs imposed through use. In general, if the overall magnitude of costs and expenditures is different but the differences are proportionally the same across all expenditure categories, there will be no effect on equity ratios, but this is unlikely to occur in practice.

Expenditures for preservation and maintenance are often different in magnitude from the costs imposed. If they are lower, the system will deteriorate, and if the degraded system is later brought back to standard, they will be higher in the later time period. Since heavier vehicles are allocated a relatively larger proportion of preservation expenditures, underspending on preservation will reduce heavy vehicles' allocated expenditures and increase their equity ratios relative to ratios calculated using properly attributed costs. The reverse would happen if subsequent spending compensated for the earlier underspending.

Unless the financing term for expenditures on a capital facility (new roads, new lanes, new bridges, replacement bridges, etc.) is the same as its useful life, allocated expenditures on such capital will exceed the properly attributed cost early in the facility's life and then fall to zero. If the facility is not financed over time, all of the expenditures will be allocated during the time period when construction takes place and none will be allocated during the time periods when the facility is used. Furthermore, since the allocation of capital expenditures typically differs from the allocation of other expenditures, those weight classes with relatively higher allocations of capital expenditures will appear to pay a larger share of their cost responsibility in the years in which the investment occurs and a smaller share in later years, relative to the shares implied by a proper attribution of costs.

Oregon's 2001 HCAS describes other differences that can result from the alternative approaches to allocation. An appendix to that report presented an allocation of a cost-based preservation budget designed to approximate the level of expenditures required to preserve the existing highway system and compared it to an allocation based on the traditional expenditure based allocation. The analysis allocated a greater share of cost responsibility to heavy vehicles under the preservation budget than under the planned budget. The discrepancy resulted from a planned budget that left significant preservation needs unmet.

Resolving these issues requires studies using the prospective spending approach to make arbitrary decisions about expenditure responsibility. This is because the times at which construction occurs, expenditures are made, and revenues are received will not align either temporally or across vehicle classes. This contrasts with true cost allocation, which allows a comparison of revenues paid to costs contemporaneously imposed, although costs may not align with specific budgeted expenditures.

The long run and the short run

Differences between allocated expenditures and properly attributed costs are likely to be much larger in any particular study period than over a long time period. In the case of capital construction projects funded entirely with current revenue, for example, the inequities in early study periods will be at least partially offset by inequities in the opposite direction in other study periods. The same holds true for deferred maintenance expenditures.

If patterns of road use did not change over time, one could expect that the shares of revenue paid by a given user class over many years would match reasonably well the shares of costs imposed over those years, although a user's grandchildren may be paying for the costs he imposed. Because patterns of road use can change significantly over time, however, there is no reason to expect this kind of intertemporal balancing to occur automatically. The problem becomes more acute the more the cost responsibility shares and traffic patterns change over time.

Practical considerations

Data availability also drives the choice of method. For example, identifying the expenditures to be allocated by the prospective spending method requires only a budget of planned or projected expenditures over the course of the study period. The prospective spending approach does not require any detailed knowledge about actual costs imposed. On the other hand, a true cost attribution approach requires estimates for the marginal costs imposed by different vehicle classes for all relevant cost categories. Many of those costs are unknown and unknowable, at least in the short run with currently available data.

The efficient fee-based allocation method described in more detail in an issue paper in the 2005 HCAS offers a practical "second-best" method for approximating the proper attribution of costs. The efficient fee method estimates a fee schedule that incorporates both the user's contribution to the need for new facilities (i.e., congestion costs) and the wear and tear costs imposed by current use. It then determines the amount that would be paid by each user class if that schedule were applied to projected use. Each class's share of cost responsibility is its share of the fees that would be paid. Applying the efficient fee method requires, at a minimum, knowledge of the place and time of road use and the value of time for different classes of users. Since both usage patterns and values of time vary greatly within weight classes, a much more detailed set of user classes must be defined, modeled and then aggregated to weight classes. Though more daunting than the data-collection needs of the expenditure allocation approach, adequate data exists to implement an efficient fee approach that would bring HCAS more into line with the principal that users should pay in proportion to costs they impose.

Does it matter?

Under expenditure allocation, the cost responsibility assigned to each user class does not necessarily bear any resemblance to the costs imposed by users in that class during the study period. Furthermore, expenditure allocation approaches as commonly practiced often requires essentially arbitrary methodological choices about the allocation of certain types of expenditure, whereas properly implemented cost attribution methods do not. The HCAS, for example, allocates certain maintenance expenditures on the basis of system-wide VMT by vehicle class because the expenditures are not budgeted by project. This allocation does not necessarily reflect the responsibility of each vehicle class for creating the damage, however, and other allocators are also justifiable. A cost allocation approach, on the other hand, would allocate the costs imposed by vehicle class for each facility using traffic data and estimates of the damage caused by each vehicle, regardless of the level at which expenditures are budgeted. The allocation of debt service poses similar difficulties for expenditure allocation methods but not for cost allocation.

Although policy requirements and practicality often trump theoretical appeal in the choice of study method, many real-world situations can result in recommendations from prospective expenditure studies that depart significantly from the principle that road users should pay in proportion to the costs they impose on the system. Policymakers should understand the implications of choosing one method over another. Analyses similar to the alternative analysis from the 2001 HCAS described above help create this understanding.

Issue Paper 2: Allocation of Non-project Costs

Carl Batten and Andrew Dyke, ECONorthwest

Introduction

EXPENDITURES CLASSIFIED AS *NON-PROJECT COSTS* PRESENT a particular challenge for cost responsibility studies. In brief, there's no right way to allocate these costs and the choice of method will have a big impact on the final result.

Non-project costs include overhead and administrative expenditures, maintenance, expenditures on fee collection and enforcement, and other expenditures not easily tied to a particular highway facility or the vehicles that use it. Furthermore, these expenditures account for a significant share of all highway fund expenditures: non-project costs accounted for 55% of all expenditures by the State allocated in the 2005 Highway Cost Allocation Study. This issue paper discusses options for allocating non-project costs and describes the methods used in recent Oregon studies.

Some non-project costs can be associated with a limited range of vehicle classes. For example, the cost of collecting weight-mile tax is associated with trucks between 26,001 and 105,500 pounds. The allocation of those expenditures to classes outside that range is easy – it's zero. Within the range, though, the same issues apply as for other non-project costs. Other non-project costs can be associated with project costs and allocated as overhead. These are allocated in the same proportions as the associated project costs.

Unfortunately, many types of non-project costs do not vary directly with use, cannot be associated with projects, and do not reflect costs imposed by particular types of vehicle. For example, what share of ODOT copy paper expenditures should fall to each vehicle class? Any conceivable allocation method will, to a greater or lesser degree, create winners and losers on the basis of arbitrary decisions about allocation procedures. Creating an equitable allocation may be theoretically possible for some non-project costs, by determining, for example, how much time administrators spent discussing the weight mile tax versus HOV lanes. This type of accounting is unlikely to be cost effective, however, when carried out to any useful level of detail. The remainder of this paper describes the types of non-project expenditures in more detail and discusses possible allocation methods.

Table 1 lists the categories of non-project costs allocated in the 2005 HCAS, the dollar amount allocated from each category, and the percent of the total allocated expenditures that the category represents.

Table 1: Allocated Non-project Expenditures by the State in the 2005 HCAS

Category	Amount	Percent of Total Allocated
Admin.	**$570,305,318**	**30.3%**
Collections	$132,918,140	7.1%
Other	$437,387,178	23.2%
Maintenance	**$317,471,500**	**16.8%**
Overhead	**$139,734,969**	**7.4%**
Engineering	$78,022,280	4.1%
Right of Way	$61,712,689	3.3%
Total	**$1,027,511,787**	**54.5%**

Overhead Costs

Overhead costs include the expenditures associated with preliminary engineering, right of way, and construction engineering for highway projects. In the most recent study, costs allocated as overhead accounted for 7.4 percent of allocated expenditures by the State. These costs have clear associations with specific projects and have been considered project overhead in past studies.

The allocation method used in the past several studies has been to identify the proportions of each category of overhead cost associated with modernization (projects that increase capacity) and with preservation (projects that preserve current capacity) and then to allocate overhead expenditures in the same way. Those assigned to preservation are allocated in proportion to the allocation of other project costs, and those assigned to modernization are allocated in proportion to peak-period congested PCE-miles. The reason for basing the split on projects in the current list is that right of way and preliminary engineering can take place years in advance of construction and can take place for projects that are abandoned and never constructed. In other words, linking these expenditures to specific projects is not possible at the time they are allocated.

Maintenance Costs

In the most recent study, maintenance costs accounted for 16.8 percent of allocated expenditures by the State. While maintenance involves actual work on roads, maintenance expenditures are not budgeted by individual project, and there is no link to particular roads or users. There are, however, several categories of maintenance expenditure, so a different allocator can be applied to each category. In recent Oregon studies, non-project maintenance expenditures have been allocated on the basis of VMT, with the exception of traffic-service items, which is allocated using congested PCE-miles.

Administrative Costs.

As a category, administrative costs include expenditures associated with revenue collection and with "other" administrative costs. In any given period, ODOT will make certain expenditures regardless of the size of the road investment program. Others of these costs are not fixed, but still may vary independent of the scale of activity. Economic theory does not provide a pricing policy that fits nicely into the marginal cost pricing approach for fixed administrative costs because they are, by nature, not "marginalizable". Administrative expenditures comprise the largest category of non-project costs. They accounted for 55.5 percent of non-project expenditures by the State, and 30.3 percent of all expenditures by the State allocated in the 2005 HCAS.

Other administrative costs

Recent Oregon studies have allocated "other" administrative expenditures across all vehicle classes using total VMT. While this approach seems as reasonable as any, other methods could serve equally well. Furthermore, without a direct connection between use and administrative expenditure, any usage-based allocation is essentially arbitrary. There is no obvious reason why users that travel significantly more should be responsible for a significantly higher fraction of fixed administrative expense. In utility pricing, billing costs and other "fixed" costs often are charged equally to each user, regardless of usage.

A more sophisticated approach used in utility pricing is to charge for fixed costs in proportion to users' willingness to pay. This approach produces the least distortion in usage patterns from what would occur if consumers paid the marginal cost. It also results in the users who receive more benefit from each unit of use paying more per unit. Implementing this approach requires knowing quite a bit about the demand for the service by different users. It is likely that demand for highway use varies more across users within weight classes than across weight classes, so implementing it in a highway cost allocation model would require dividing each weight class into multiple subclasses based on attributes that vary with demand elasticities, calculating allocation factors for each subclass, applying them, and then aggregating the results to weight classes.

At present, the detailed data required to implement this approach do not exist, and it will not likely be a viable option for highway cost allocation in the near future.

Another alternative is to calculate vehicle class equity ratios excluding administrative costs. Total costs allocated would fall short of forecasted revenues, but this would not hinder the equity ratio calculations. This treatment is equivalent to allocating administrative costs in proportion to all other costs (as overhead on everything else), and would yield identical results.

Collection costs

Collection costs are simply the ODOT expenditures related to revenue collection from the various revenue sources. In the most recent study, collection costs accounted for 7.1 percent of all allocated expenditures by the State. The HCAS could allocate these costs in several ways:

- In proportion to the number of transactions (accounting approach)
- In proportion to revenues collected (overhead approach)
- In proportion to VMT (past HCAS approach)

In most cases, allocating in proportion to the number of transactions would come the closest to matching the costs imposed by each vehicle class. Data currently exist that identify the number of transactions for weight-mile taxes, road use assessment fees, and registration fees by vehicle class. Data do not exist on the number of transactions by weight class for fuel tax receipts because fuel taxes are paid to the State by distributors (for gasoline) or dealers (for diesel) and passed on to consumers, who could be in any weight class. Past studies have used VMT, within the range of affected weight classes, to allocate collection costs. VMT should be at least somewhat correlated with collection costs across vehicle classes.

Issue Paper 3:

Oregon Highway Cost Allocation Study Examination of Issues Related to Federal and Local Revenues and Expenditures

Mark Ford, HDR Engineering

Introduction

THE PURPOSE OF THIS PAPER IS to examine issues related to the mix of federal, state and local funding for Oregon's highways, roads and streets and their impacts on cost allocation. Specific issues raised by the study committee include:

1. To what extent are federal, state, and local funds interchangeable (fungible)? In practice, how does the attribution of funding sources on the books relate, if at all, to what would happen to funding levels for individual projects and non-project activities if the amount of funding from a particular source were to change?
2. Should the expenditure of federal and local revenues be included? If so, how, both theoretically and given current constrained practice?
3. How should local option taxes (e.g., gas tax increments) for advancing development of *State* highways be treated, if at all (an issue with Hwy 217)?

In addition to these three questions early discussions also included the question of whether federal and local revenues should be attributed. However, since there is general consensus that they should not, this issue was not pursued.

Conclusions

With regard to interchangeability of state and federal funds on the state highway system, this analysis concludes that state and federal funds can be considered fungible. There are two qualifiers, however. First, while most state program funds are interchangeable at the margin – that is for any given project or for small changes in program levels – it would not be possible to interchange funds and maintain the same distribution of expenditures if all federal funds were eliminated. Second, there is still a question about whether OTIA III revenues should be considered interchangeable with other funding sources since they are strictly dedicated to specific types of projects.

With regard to local streets and roads, all funds should not be considered completely interchangeable. There are many categories of funding used for local road systems in addition to allocations of state road-user taxes and Federal Aid Highway Funds. Some of these are interchangeable with regard to construction expenditures but should not be regarded as interchangeable between construction and maintenance. Federal-Aid Highway funds are fungible across construction expenditure classes, which include modernization, preservation, and bridges, but are not interchangeable with maintenance expenditures. This analysis proposes an allocation methodology for the treatment of local expenditures that accounts for these issues.

With regard to expenditures of local funds on state highways, this analysis finds that such expenditures should be included and proposes a method of treating the allocation of expenditures across jurisdictions to avoid double counting.

Background

The purpose of the cost allocation study is to determine the distribution of responsibility among user groups for expenditures of state highway funds. If the use of other funding sources had no impact on the use of state road user taxes, then these other funding sources could be disregarded. This, however, is not always the case. Other funds can affect use of state highway funds by paying for activities that would otherwise be funded with state highway funds. If these alternate sources are perfectly interchangeable then the allocation of state highway funds would be exactly the same as the allocation of total funding. "Fungibility" refers to the extent to which funds are interchangeable.

In planning and executing programs, funding source is often referred to as "color of money." In some cases the decision by ODOT or a local road authority to spend one "color" rather than another could be completely arbitrary. In other cases the addition or removal of funding from certain sources could significantly change the overall program or the distribution of funding between elements of the program.

The importance of this question is illustrated in Table 1. In this simple example, an agency is going to carry out three projects totaling $260, for which users will pay $140 and non-users will pay $120. The relative contribution between users and non-users is different for each project. The three columns under "% User Allocation" show the consequences of alternative assumptions regarding fungibility.

Table 1. Hypothetical Distribution of Project Funding
Impact of Fungibility Assumptions

A	B	C	D	E	F	G
	Funding			% User Allocation		
Project	Total Cost	Users	Others	Not Fungible	Fully Fungible	(2) and (3) Fungible
(1)	$80	$80	$0	57.10%	30.80%	57.20%
(2)	$80	$40	$40	28.60%	30.80%	19.00%
(3)	$100	$20	$80	14.30%	38.40%	23.80%
Total	$260	$140	$120	100.00%	100.00%	100.00%

If funds are not fungible, then the distribution of user responsibility between the projects (column E) is based strictly on user funding (column C). If funds are fully fungible (column F) then the distribution is based on the distribution of total cost (column B). Column G presents a special case in which funding is fungible between projects (2) and (3), but project (1) remains at $80 regardless of expenditures on the other projects. In this case the ratio of total user fees going to project (1) remains the same but projects (2) and (3) are scaled proportionately to the total cost of projects (2) and (3). If the cost responsibility of different user classes varies between the three projects then the basis used to allocate user funds across the three projects is a significant issue.

If all funds were perfectly fungible, then the state and local highway, roads, and streets budgets could be evaluated without regard to funding source. This would produce ratios of relative responsibility across vehicle classes that could then be applied against total state road-user revenue to determine cost responsibility. To the extent that an individual category of funds is not fungible, the category should be removed prior to the calculation of cost responsibility to avoid attributing costs to a vehicle class from which they need not be recovered. Such attribution would distort cost responsibility ratios for the remaining state user fees.

In addition to the question of fungibility across individual projects and programs, an overall question also exists about fungibility if federal or other sources were completely eliminated. While an agency budget may be blind to the “color of money” for individual non-state user fee funded programs, if all other funds were removed the entire budget might need to be rebalanced in a way that does not preserve the proportionality that formerly existed between project and programs.

This issue has practical consequences for the treatment of federal aid at the state level. Federal aid funds only construction. In addition, federal aid revenues fund relatively more modernization than do state funds. If federal funding were completely eliminated from the program then, given ODOT’s priority of maintaining and preserving roads and bridges, it is doubtful that the agency would shift enough funds from maintenance to construction to maintain proportionality between those programs. Within construction it is doubtful that state funds would be shifted from preservation to modernization to maintain the balance between those programs. Therefore, in this case the criteria for considering funds interchangeable are not met. As a practical matter, it would be impractical to assume anything other than the existing distribution of state road-user fees for cost allocation calculations.

The question of fungibility may be different for ODOT and for local agencies. While the state program consists primarily of state user fees and Federal-Aid Highway Funds, local programs also receive other local funds and other categories of federal funds that may differ in degree of fungibility. Finally, other local user fees must be considered. Are state and local programs fungible with respect to these programs or should these funds be removed from the calculation?

ANALYSIS

This paper examines the first two issues presented in the introduction from both state and local perspective. The third issue is then examined as a special case.

1. **To what extent are federal, state, and local funds interchangeable (fungible)? In practice, how does the attribution of funding sources on the books relate, if at all, to what would happen to funding levels for individual projects and non-project activities if the amount of funding from a particular source were to change?**

State Highway Program

Previous cost allocation studies have found that state and federal funding of the state highway program are completely fungible, since the state can develop its highway budget without regard to the color of the money and then mix and match revenues to create the best program. Given ODOT’s overall budget and the procedures used to develop the State Transportation Improvement Program (STIP), these assumptions generally make sense. ODOT’s 2005-07 budget contains a highway program of just over $2 billion. Approximately 24% of which is made up of Federal-Aid Highway Funds and the remainder almost entirely state road-user taxes and revenue bonds supported by road user taxes. The only portion of the program that could not be supported by federal funds in some form is the maintenance program, which accounts for $306 million. Within this framework it is relatively easy to mix and match funding. If some funding sources were reduced or increased it would still be possible to rebalance the program to approximate the original budget objectives.

There are two logical limitations to this flexibility. One is that the complete elimination of Federal-Aid Highway Funds would result in a 24% reduction in the State Highway Program and could result in a different allocation of total resources and of state user taxes. However, there are no current predictions of what this allocation would be. If the state chose to approach cost allocation on the assumption that all funding types were not interchangeable, the practical way to proceed would be to consider only state funds as they are distributed today.

A more significant issue is the large portion of funding comprised of revenue bonds and the future commitment of future state road-user fees to servicing that debt. Since the uses of the bond revenue were specified in legislation and since the future revenue required to pay off those bonds cannot be used for other purposes until the bonds are paid, it may be appropriate to separate those activities from other fungible uses and calculate the responsibility for those costs separately.

Local Programs

Local road programs differ from the State Highway Program in several important ways:

1. They are supported by a wide variety of revenue sources that include:[1]
   - Property taxes and special assessments, which are often dedicated to bond repayment;
   - General funds;
   - Local road-user fees, which can be used for any category of road expenditure;
   - A variety of other local fees;
   - Transfers between local governments;
   - Bond sales, which are used for capital construction (modernization, preservation and bridges);
   - Private contributions, which are normally for capital projects;
   - Receipts from State government, including
     - Allocation of state highway funds, which are completely fungible across all street and road uses and
     - Federal-Aid Highway Funds which are only fungible across categories of capital construction;
   - Other federal funds, including
     - Various categories of timber receipts which tend to be fully fungible across all local road and street purposes, and
     - Special programs that tend to have very specific use limitations;
   - Receipts for work performed for other jurisdictions.
2. Not all sources of local funds are available or used in all jurisdictions. For instance federal timber receipts are only available to some counties and no cities (unless shared by the county). Only a few jurisdictions have local gas taxes or vehicle registration fees. Thus, the ability of any single jurisdiction to make flexible decisions with regard to federal or other revenues is more limited than for ODOT.
3. Local funding decisions are much more limited than the state's because of the small size of most jurisdictions. Total city and county revenues, including pass-through of state road user funds totaled approximately $1 billion in 2005 but were divided among 113 jurisdictions.[2] The average local jurisdiction with a budget of $9 million will have significantly less flexibility than the state.
4. Local governments may be more financially constrained than the state. A recent analysis of county road programs by the Association of Oregon Counties showed clearly that many Oregon Counties are struggling to adequately maintain and preserve their road systems.[3] That study found a 54% shortfall in county road funding, including a 19% shortfall in operations and maintenance. The study notes that the shortfall would grow by another

[1] A complete list of sources is contained in Attachment I.

[2] Source: Summary audit reports for cities and counties

[3] Association of Oregon Counties, County Needs Study, 2006.

$90 million per year if current federal timber receipts are not reauthorized (PL 106-393). If any of the various funding sources were removed it is highly unlikely that the overall program would be rebalanced to anything closely resembling the current program.

5. With regard to use of bond funds, the existing allocation methodology already assumes that these funds are constrained to capital expenditures.
6. In some instances ODOT allows local agencies to exchange allocations of federal funds for state funds, which can be spent more flexibly. However, the exchange takes place only within the capital program with the exchanged state funds usually going to preservation projects.

With this background, it appears that funding within local street and road programs is significantly constrained by the requirements of the various funding sources and limited flexibility of many local agencies. These funds should not be regarded as fully fungible. Some of the major sources, including forest receipts, local user fees, local property taxes and other general funds are very flexible. The current distribution of expenditures may already reflect the extent to which these funds are interchangeable because of fund exchanges that substitute more flexible funds for less flexible funds and other local decisionmaking.

2. **Should the expenditure of federal and local revenues be included? If so, how, both theoretically and given current constrained practice?**

As noted in the background discussion, the objective of the allocation procedure should be to determine the cost responsibility of vehicle classes for state road-user fees based on either the actual use of those funds or the use that would result if other funds did not substitute for or otherwise influence the distribution of those funds. Given the background provided above, cost allocations for state and local expenditures and revenues should be calculated separately. Expenditures for each should be divided into three categories:

1. Fully fungible expenditures including state, federal and local funds that are interchangeable as described previously. This group of costs would be allocated according to existing procedures and then scaled to the amount of state road -user taxes involved before adding back to allocations for the second category of expenditures;
2. Partially fungible expenditures in which funds are interchangeable within a program, such as construction, but not between programs;
3. Non-fungible road user taxes, such as OTIA III bridge program funds, which are dedicated to a specific activity and not interchangeable with other funds. This group of cost would be allocated strictly to the purpose for which the funds are available and scaled to the level of state road-user taxes before adding to the first group; and
4. Non-road user taxes which are not fungible with road user funds, such as local bond revenue which is spent on projects that would otherwise not be built or federal funds which are used for projects that would simply not be considered if only state and local road-user funds were available. These funds would not be allocated at all, since they have no impact on the allocation of state road-user taxes.

State Calculations Based on "Fungibility"

Following this approach, it is recommended that revenues in the state highway program be treated as Category 1: completely fungible with respect to state road-user revenue and federal revenue. A possible exception to this recommendation would be the OTIA III State Bridge Program, which might be considered Category 3. The decision on whether to place OTIA III bridges in category 3 should be based on whether, without OTIA III funding, these bridge repairs would be made at a level of similar proportion to other expenditures. If so, then they should be considered fungible; if not, they should be considered in Category 3. Local revenues and expenditures, however, should be treated under the assumption that not all funds are interchangeable.

Local Calculations Based on "Fungibility"

With respect to local expenditures it is recommended that Category 1 allocations include expenditures made from state road-user taxes, local option taxes, local general funds except those going to debt service, and any other source that is interchangeable with state road-user taxes.

Category 2 would include user revenue-backed bonds and other categories which are interchangeable within construction programs but not across all categories of expenditures.

Category 3 would include OTIA III local bridge funds, which are paid for with revenue bonds backed by user taxes.

Category 4 would include items which can be removed from the calculation entirely:

i. Federal-Aid Highway Funds and the federal portion of the projects they fund;
ii. Local general obligation bonds, along with the capital projects they fund;
iii. Local non-user revenue dedicated to repayment of road and street bonds;
iv. OTIA III bond funds, which are dedicated to specific project types.

Resulting allocations of locally expended and state expended state road-user fees should then be added together to determine cost responsibility for the overall program.

3. How should local option taxes (e.g., gas tax increments) for advancing development of *State* highways be treated, if at all (an issue in Hwy 217)?

This question arose from the practical problem created when local agencies provided funding for advance preliminary engineering on Oregon Highway 217 using local option road use taxes. If these expenditures had been from a federal or non-road user state source they would have fit the cost allocation framework wherein they would have been regarded as fungible expenditures. However, since they were road user taxes, if the normal procedures were followed for both state and local allocations the funds might have been double counted.

On the local side, the expenditure would be considered a user tax expenditure and allocated accordingly. On the state side it would be considered an alternative fungible source. The result would be that the cost allocation impacts would be counted on both the state and local side. There are two different ways in which an expenditure of local funds on the state highway system might appear on the the books. First, it could show up as a direct expenditure of local funds. While unlikely, this is easy to account for, since it would be a local user fee expenditure on an arterial highway. Second, the expenditure could show up as a transfer of local funds to the state and a corresponding expenditure of state funds. If this is the case, the expenditure would be analyzed as a part of the state system, but the cost allocations would not be attributed back to the local sources from which they originated.

To correctly allocate both local and state user fees and avoid double counting, local user fee expenditures or transfers should both be analyzed as expenditures of local funds and attributed back to the sources from which they originated. At the state level these expenditures or transfers should be treated as reductions in expenditures in order to avoid counting them on the state side as well.

For example, in the case of Highway 217, the local funds contributed to the project should be analyzed as local expenditures on the route. In evaluating state cost allocation, the amount contributed by the local governments would be considered a reduction in cost and not analyzed.

To keep the accounting straight, the same protocol should be observed for expenditures and transfers of state funds to the local system or of local funds to other jurisdictions. Transfers should be treated as reductions in expenses to the receiving agency and as expenditures by the originating agency.

This protocol will work whether the funds involved are road user funds, federal funds or other non-fungible local sources. It will also work whether the final expenditure is on the state side where complete fungibility is assumed, or on the local side where only partial fungibility is assumed.

Finally, attributing revenue to the appropriate user group should not be affected by where the funds are finally spent.

CONCLUSIONS AND RECOMMENDATIONS

To decide the issue of whether or not to treat certain categories of state, federal and local funds as interchangeable, the cost allocation methodology must first consider whether the objective is: (1) to strictly determine the allocation of state highway user fees as they exist without regard to the influence of other funding, or (2) to determine the allocation that would most likely take place in the absence of other funding sources. The current methodology implicitly assumes the second approach. If the first approach were adopted then no funds should be considered fungible and any funds other than state road-user fees should be eliminated from the analysis.

With regard to interchangeability of state and federal funds on the state highway system, the analysis reaches the conclusion that all state and federal funds can be considered fungible based on the fact that they are interchangeable at a project level or for small program changes. However, in the unlikely event that all federal funds were removed, the conclusion would not hold. With regard to the question of whether OTIA III funds should be treated as interchangeable across the entire program, the Cost Allocation Study Steering Committee recommended treating them as interchangeable and, therefore, no change in methodology is recommended on this point.

With regard to local streets and roads, not all funds should be considered completely interchangeable. There are many more categories of funding than exist for the state system. Some of these are fungible across all categories of road expenditures. Other road use taxes are limited to specific categories of expenditures, such as construction or bridge replacement and should not be considered fully fungible. Other non-state/local user sources are not fungible and should be eliminated from the calculation. Federal-aid and property tax backed bonds fall into this category. An allocation methodology is proposed for treatment of local expenditures which takes account of this approach.

With regard to expenditures of local funds on state highways, this analysis finds that such expenditures should be treated as local expenditures and as cost reductions from the state point of view. This will properly account for expenditures in the allocation formula while avoiding double counting.

Attachment I. RECEIPTS FOR ROAD AND STREET PURPOSES
2005

ITEM	Cities	Counties	Total
A. RECEIPTS FROM LOCAL SOURCES			
1. Property Tax and Special Assessments			
a. Levies within the 6% limitation	$3,273,419	$7,718,551	$10,991,970
b. Serial levies		$0	$0
c. One year special levies	$14,463	$0	$14,463
d. Local or other special benefit area assessments (LID, EID, other area specific assessments)	$4,792,254	$11,722,321	$16,514,575
2. General Fund and Other Non-Road Fund Transfer	$46,509,013	$27,489,246	$73,998,259
3. Local Road User Fees			
a. Fuel taxes (indicate rate _______)			
Less: Collection Expense	-$34,231	-$12,433	-$46,664
Net Fuel Tax	$7,324,026	$7,578,733	$14,902,759
b. Motor Vehicle Registration fees			
4. Other Local Receipts			
a. Interest income	$4,757,226	$15,924,944	$20,682,169
b. Traffic fines	$232,336	$78,226	$310,562
c. Parking meters and fines	$14,714,865	$0	$14,714,865
d. Land sales and rentals	$2,332,241	$1,275,261	$3,607,502
e. Traffic impact fees or system development charges	$43,383,080	$11,675,606	$55,058,686
f. Permits	$2,722,600	$1,693,611	$4,416,211
g. Hotel/Motel taxes	$1,377,896	$0	$1,377,896
h. Franchise fees	$5,191,208	$104,545	$5,295,753
i. Transportation Utility Fees	$8,860,835	$7,631	$8,868,466
j. Other	$9,502,053	$6,203,171	$15,705,224
5. Receipts from Other Local Governments			
a. From Cities		$3,677,706	$3,677,706
b. From Counties	$27,649,316	$2,423,031	$30,072,347
c. Other	$17,386,916	$4,027,620	$21,414,536
6. Proceeds from Sale of Bonds and Notes			
a. Bonds (Must equal item III, B.1)	$21,379,606	$606,270	$21,985,876
b. Notes (Must equal item III, B.2)	$2,136,783	$5,045,267	$7,182,050
B. PRIVATE CONTRIBUTIONS	$18,016,113	$19,861	$18,035,974

C.	**RECEIPTS FROM STATE GOVERNMENT**			
	1. State Highway Fund Apportionment	$99,756,562	$165,914,624	$265,671,186
	2. State Forestry		$1,802,709	$1,802,709
	3. State General Fund	$65,629	$26,468	$92,097
	4. Other State Funds (Please Specify) ______	$22,705,438	$177,060,157	$199,765,595
	5. Special County Program	$143,388	$17,100,976	$17,244,364
	6. Fund Exchange Program	$1,614,428	$5,056,494	$6,670,922
D.	**RECEIPTS FROM FEDERAL GOVERNMENT**			
	1. Traffic Grants	$2,145,254	$794,824	$2,940,078
	2. Housing and Urban Development	$451,131	$0	$451,131
	3. Economic Development Administration	$20,000	$0	$20,000
	4. National Forest Reserve Revenue	$352,004	$87,710,776	$88,062,779
	5. Oregon-California Land Grant Revenue	$0	$11,954,780	$11,954,780
	6. 5% Distribution of BLM Land Sales	$0	$26,425	$26,425
	7. Mineral Leases	$0	$9,399	$9,399
	8. U.S. Taylor Grazing Apportionment	$0	$22,002	$22,002
	9. Federal Flood Control	$0	$0	$0
	10. All other Federal Fund Receipts (Please Specify) ______	$3,746,626	$9,715,145	$13,461,771
	11. Federal Receipts for Federally Declared Emergency Events:	0	$0	$0
	a. FEMA - Public Assistance	$22,280	$22,408	$44,688
	b. FHWA - Emergency Relief	$13,381	$0	$13,381
E.	**RECEIPTS FOR WORK FOR OTHER JURISDICTIONS:**			
	1. Non-road and street work	$12,599,856	$5,796,071	$18,395,927
	2. Work for other jurisdictions	$260,031	$5,445,531	$5,705,563
	TOTAL RECEIPTS	$385,452,257	$597,091,812	$982,544,069

Issue Paper 4:

Examination of Issues Related to Innovative Finance

Mark Ford, HDR Engineering

Introduction

The purpose of this paper is to examine the impacts of alternative financing mechanisms on the principles and methods of cost allocation as practiced in Oregon. In recent years a number of innovative financing practices have become commonplace across the country. Some are being used in Oregon and others, like tolls and new forms of value capture, are expected to become more common in the future. Specific questions raised by the study team include:

1. How do time-shifts in funding burdens (e.g., bonding) affect cost allocation and how should bonded expenditures be treated?
2. Should the cost of assets with long lives continue to be counted only in the year(s) in which expenditures are made?
3. How should toll revenues be treated?
4. How should privately-financed toll projects be treated?

This analysis reaches the following general conclusions:

- Changes in financing practices resulting in increased use of debt service and use of tolls represent opportunities to move cost allocation in a direction that more closely reflects marginal costs and, therefore, more efficient pricing. Required changes in cost allocation methodologies can continue to preserve the cost the fundamental cost occasioned principle that has guided Oregon policy and methodology.
- Regarding debt financing, the analysis concludes that there are at least three alternative methods of allocating debt service that would be consistent with Oregon cost allocation philosophy and method. The method that seems to represent the most accurate approach with the least increase in computational complexity is the current method, which allocates expenditures for the year the debt financed project was built into the years in which the debt service will be paid and includes interest in total costs allocated.
- Regarding treatment of long lived assets this analysis reaches the conclusion that there are alternatives for handling long lived assets that would make cost allocation more consistent with long run marginal cost and better reflect efficient pricing. For instance, by using a depreciation formula, the cost of long lived assets could be allocated to the time periods in which road users actually used them, rather than the year in which they were built. However, allocating long lived assets in a manner different from traditional cost occasioned methods introduces a new theoretical framework as well as computational issues. Accordingly, this analysis does not recommend moving forward with an alternative approach to allocation of long lived assets.
- If and when tolls are introduced they will result in a change in user fee collections that may require changes in Oregon's approach to cost allocation. However, the issue of tolls does not have

to be addressed in the 2007 Highway Cost Allocation Study since there are currently no toll roads on the Oregon Highway System.

- Regarding how to treat tolls in future cost allocation studies, this analysis identifies several alternatives for treatment of tolls within the cost occasioned framework. None of the alternatives entails significant data or computational difficulties. The choice of methodology will likely depend on two factors: (1) the legal definitions of the public road system and of road user fees; and (2) a trade off between traditional equity measures and the desire to make the cost allocation more reflective of marginal cost pricing.
- Private tolls were identified as a special category of the general tolls discussion. The degree to which they must be treated differently depends largely on legal definitions of public road system and of user fees. It may be most appropriate to treat private tolls as completely outside of the cost allocation framework required by Oregon statutes.

Background

Oregon's highway cost allocation methodology has evolved since the early studies in the 1930's. These studies have generally not dealt with the implications of innovative finance techniques, but instead generally assumed pay-as-you-go financing from road user taxes and other public revenue sources.

In recent years growing interest in innovative financing techniques raise questions about the best way to allocate costs – and in some cases, which costs should be allocated. Innovative finance techniques discussed in this paper include increased use of debt financing, mainly through bonds; increased use of public/private partnerships in which private partners have a financial stake in the projects; and increased interest in toll financing, including traditional tolls and congestion or value pricing.

Developments in innovative highway finance present interesting problems for calculation of cost allocation among road user groups. In some cases they may provide opportunity to more accurately attribute costs occasioned by different user groups. In some cases they may also provide the opportunity to more accurately reflect marginal costs of road use and thereby improve the economic efficiency as well as equity of the road user tax structure.

Oregon's cost allocation structure is based on a cost occasioned methodology. To quote the 1997 Federal Cost Allocation Study, "the underlying philosophy of the cost-occasioned approach is that each user should pay the highway costs that it creates or 'occasions.' A key question in cost allocation is what costs to consider." Traditionally, Oregon's cost allocation structure deals only with government expenditures on the state's highways, streets and roads. The introduction of public-private partnerships, toll financing and increased amounts of debt service in the highway program present new issues in terms of what costs to allocate.

Some of these new innovative techniques, including congestion tolls and value pricing of facilities, also introduce new concepts in user fees. Proponents of "efficient pricing" would point out that Oregon's highway user tax structure is in fact a pricing structure that would function better by the introduction of marginal cost pricing. This would be achieved by introducing delay costs that motorists impose on each other during congested times and by introducing social and environmental costs into the equation. While the traditional structure promotes equity, the marginal cost structure stresses economic efficiency and would allocate costs in proportion to marginal costs rather than average costs.[1]

In some ways Oregon's cost allocation structure is already moving in this direction. Costs of constructing new capacity are no longer allocated by vehicle size and weight according to incremental construction costs, but according to passenger car equivalents (PCEs) during peak hours, which is indicative of the capacity used up by each vehicle.

In addressing the issues listed in the introduction, this paper discusses the technical and theoretical problem related to each issue and lists several possible solutions.

Issue Analysis

1. **How do time-shifts in funding burdens (e.g., bonding) affect cost allocation and how should bonded expenditures be treated?**

   As the use of debt financing began to increase with the introduction of the Oregon Transportation Investment Acts (OTIA I, II and III), the 2005 Cost Allocation Study considered alternative methods of allocating debt service. The study reached the conclusion that, in theory, the cost of debt service should be allocated according to the same allocation as the construction projects it financed. However, if the study were to look back at the projects financed by the current outstanding bonds, calculations would become very difficult. As an alternative, consistent with the forward-looking approach of allocating costs for a future rather than past biennium, the current practice is to project the cost of debt financed projects forward and allocated those costs in proportion to the amount of debt service that will be paid as a result of those expenditures.

   If debt service is a relatively small portion of the budget and the projects being financed are similar to those for which current debt was incurred, the opportunity for misallocation is minor. However, the total authorized debt for the OTIA programs has now reached $2.5 billion. As the program moves from a concentration on modernization to one of bridge replacement, the potential deviation between the theoretically correct methodology and the simplifying assumptions will increase. Furthermore, since the OTIA III bonds have tapped out the state's highway revenue bond capacity, there may be no further debt financed construction for several years after the bridge program is complete. In this situation it is important to review the methodology to assure the most theoretically correct and accurate procedure..

Alternatives for allocation of debt service and treatment of debt-financed projects fall into three categories:

1. The present methodology for allocating debt service is to allocate the debt financed construction in the year the projects were built and then scale the allocations to the size of the bond payments for the present period and each future study period until the bonds are repaid. The benefit of this method is the direct relation between the cost attribution of the debt service and the original project which the debt financed. Potential drawbacks of this system include the need to include results of each cost allocation study in future studies for as long as debt is being repaid and the fact that changes in relative traffic volumes by different user groups could lead to higher or lower than anticipated allocations.

[1] For a more complete discussion of the relation between cost occasioned and marginal cost techniques see FHWA, 1997 Highway Cost Allocation Study, Chapter 5, "Highway Cost Responsibility". For a more complete discussion of marginal cost pricing as related to highway maintenance and construction, see Small, K.A. and Winston, C., "Efficient Pricing and Investment Solutions to highway infrastructure Needs", American Economic Review, Vol. 76, No. 2, May 1986. For a more complete discussion of marginal cost pricing as related to social and environmental costs, see Litman, T., Socially Optimal transport Prices and markets, Victoria Transport Policy Institute, 1998.

In addition, it is uncertain how future changes in methodology might affect these allocations.

2. A second methodology would be to recompute responsibility for debt service in each new study by looking backward at the expenditures financed by the debt. This could be done in two ways. One is by using previous cost allocation studies to determine the allocation of debt service based on the expenditures which they financed. This is the practical effect of the current methodology.

   As an alternative to the present methodology, debt financed projects could be reallocated in each new study based on traffic patterns existing at that time. This would actually be a better refection of marginal costs, since increases or decreases in traffic would result in changes in allocations and better reflect actual costs over time than does an allocation as a project is being built, which is never revisited even if assumptions about usage turn out to be inaccurate.

3. Another method that would move the cost allocation process in the direction of marginal cost pricing would be to calculate depreciation on the facilities that were financed by the current debt. This depreciation would be attributed to user groups based on rates of deterioration and rates at which capacity are used up on these facilities.

   The calculation of depreciation could be done either for the individual projects that were part of the debt package or for the highway system as a whole. In either case a value would be placed on key components of the system, such as road surfaces, drainage structures, bridge structures, bridge decks, etc. Elements would be subdivided into those that depreciate strictly with time, such as drainage structures, those that deteriorate with use, such as road surfaces and those for which capacity can be used up by traffic over the life of the facility. By this method, depreciation could be assigned to user groups and weight classes. Debt service would then be allocated by the depreciation on the debt financed facilities.

   This would move in the direction of marginal cost pricing because the resulting fee would better reflect the consequences of actual use.

   The problem with this approach is that it introduces a new theory into the cost occasioned methodology and requires an additional calculation that is not a part of the existing methodology.

2. **Should the cost of assets with long lives continue to be counted only in the year(s) in which expenditures are made?**

   This question is relevant on theoretical grounds and may become more relevant with the introduction of privately financed toll facilities. The current approach to cost allocation actually allocates expenditures rather than costs. While cost impacts form the basis of allocations, it is actually the projected budget of expenditures that is allocated. Another approach is to consider the costs created by vehicles as they use the facilities. These include surface and structural wear, maintenance, opportunity costs of fixed facilities which are then not available for other uses, and other factors. The distinction is easy to see when considering surface preservation expenditures. Surfaces deteriorate and costs accumulate with use and time. But these are only allocated in the year a preservation project is undertaken to correct deterioration. This, on average, will be years after the actual wear and tear costs were incurred. On the other hand, construction costs which are financed by current revenues are allocated as costs in the year of construction, even though costs of use and depreciation will actually take place over many years following construction. Businesses account for this by use of depreciation expenses which assign the costs of facilities to the time periods in which they took place. No such system within the present cost allocation formula currently exists.

For routine maintenance and operation cost and expenditures, both are incurred in the same budget period. A difference between budget and actual costs exists only if budgets are inadequate to cover costs resulting in deferred maintenance or more rapid deterioration.

Preservation costs are similar to routine maintenance and operation to the extent that the preservation program is fairly regular in size and adequate to maintain existing conditions. Expenditures and costs will closely correlate over time.

Capital expenditures create a more interesting situation. The current road users, whose road use taxes paid for the facility, may not be the ones to benefit from it or to contribute to its deterioration over the life of the facility. Instead future users both benefit from the facility and "use it up." Those who are using up the facility are not paying for it unless it was financed by debt or unless there is some mechanism for recovering depreciation from current users. As discussed under the debt service discussion, it would be possible to calculate depreciation and allocate these costs to the current users. Just as the depreciation allocation for debt service would be used to allocate that budget, the system depreciation allocation would be used to allocate capital construction costs.

As noted in regard to the use of depreciation for allocation of debt service, this concept introduces a new concept of cost occasioned and new issues in calculation of cost allocation.

3. **How should toll revenues be treated?**

Oregon's experience with tolls since the creation of the State Highway System has been reserved for the recovery of debt costs for the construction of bridges. The most recent state bridge constructed using tolls was the Astoria Bridge, opened in 1966. The tolls on this bridge were removed in 1993 after construction bonds were paid off.

Historically, tolls were used to finance the cost of construction, and in some cases, maintenance during the time in which bonds were being retired. However, they only reflected the average cost of construction and maintenance and did not attempt to capture marginal costs of additional users, or "value costs" reflecting users willingness to pay. In this regard they were consistent with Oregon's overall approach to cost allocation and road user fees.

By contrast, recent toll roads in the United States have considered other factors besides cost to construct and retire debt. For instance California's SR-91 includes extra lanes for which the user pays a premium toll based on traffic congestion levels. This value of service pricing is intended to limit use of the lanes so that they continue to operate at normal speeds even when other lanes are congested. This and similar experiments with "congestion pricing" are similar to marginal cost pricing in which each user would be charged for the costs they impose on all others by virtue of their presence on the facility.

While marginal cost and value of service pricing present significant theoretical and practical problems for cost allocation on a system wide basis, they are easy to accommodate on an individual toll road where access can be controlled and where modern electronic pay systems track distinctions like distance traveled and time use.

An additional feature of toll roads since the 1990's has been the participation of private participants in "build-maintain-operate" schemes in which the private contractor or franchisee not only constructs the road, but maintains and operates it at a profit. Thus, tolls can reflect not only marginal costs and value of service, but are set to earn a return for operators.

Oregon has recently signed agreements with a consortium of private investors to construct three toll roads through a public-private partnership in which all or a large share of financing comes from the private sector.[2] While the primary motive for these agreements may be financial – the state does not have the resources to construct these facilities within the desired time frame from existing revenues – they also create the possibility for innovative toll arrangements similar to other recent toll facilities across the US.

Options for Treatment of Toll Facilities in Cost Allocation Studies

The potential for tolls not directly related to construction and maintenance costs raises interesting issues for the Oregon cost allocation philosophy and methodology:

1. Should the tolls simply be ignored in the cost allocation calculation?

   The Oregon methodology considers only expenditures in setting rates. That is, the costs being allocated are those raised by state road user taxes. While calculation of these costs may consider other factors, such as federal funds, in the end the rates calculated are those necessary to recover the same revenue as currently collected through these fees. Therefore one possibility is to keep the tolls completely outside of the cost allocation in the same way that private contributions or non-user financed improvements would be outside the calculation.

   This methodology has the advantage of simplicity. In addition, if alternative routes are available for the toll facilities, users can still make the trip without paying the additional fees, presumably at the cost of a lower level of service.

   However, it also raises several theoretical problems. Are those paying the tolls being charged twice for the same travel: once for general road use and once for the toll facility? When tolls were limited to bridges, the overlap was minor. However, if major road segments were financed in this way the burden on some vehicles could be extensive. For instance an 80,000 lb truck now pays approximately 13-cents per mile in weight mile taxes. If the toll authority added another 15 to 25-cents per mile the rate could result in total mileage charges of 28 to 38-cents per mile.

2. Another possibility would be to consider the cost of the toll facilities in the cost calculations and attribute the toll revenue to the classes of vehicles paying the tolls. This approach may actually be required if it is determined that tolls are taxes according the definitions of road user taxes in the Oregon constitution.

   This approach would directly recognize the toll roads as being a

[2] For a discussion of the partnership and potential project, see http://www.oregon.gov/ODOT/HWY/OIPP/docs/OIPP-OTIGFAQ050806.pdf

part of the public highway system and tolls as being paid as a part of the road finance structure. The state may or may not get involved in the process of setting tolls, but to the extent that tolls introduced value of service or marginal cost pricing concepts, these would be internalized into the cost allocation structure.

As with the first option, the potential problems with this approach is that for individual users there could be a large discrepancy between the overall fees paid by users of the same vehicle size. If tolls are determined to be road use taxes, then constitutional requirements to maintain an equitable allocation of taxes among user groups, "in proportion to costs incurred"[3] could require additional adjustments to maintain constitutional principles.

3. A third option for treatment of tolls could result if tolls are determined to be taxes. In this case the constitution requires that the tax be levied in such a way as to maintain proportionality between user classes according to costs incurred. The difference between this approach and the second approach would be that tolls, as road use taxes, would have to be set according to cost and might not be able to promote efficiency through a marginal cost or economic efficiency theory. In this case the tolls themselves might be subject to adjustment through the cost allocation study. The problem of users paying both the general taxes and the tolls at the same time would still exist but the framework within which it would have to be resolved would be narrowed.

For tolls collected on public roads, the choice between options 1, 2 and 3,whether to keep tolls and toll facility costs outside the cost allocation structure or whether to fold them in may be decided based on the interpretation of tolls and road user fees. The Oregon Constitution restricts the use of, "Any tax or excise levied on the ownership, operation or use of motor vehicles." The same Article and Section requires that the distribution of road use taxes between light and heavy vehicles is, "fair and proportionate to the costs incurred for the highway system because of each class of vehicle."[4] If tolls are determined to be taxes then the entire structure must be folded into the cost allocation framework. If tolls are not taxes then a key consideration in whether to fold them into the overall cost allocation framework would be whether they inappropriately change the distribution of existing road use revenue.

Options for Balancing Equity between Toll Road Uses and Other Road Users

As noted above, if tolls are treated as road user taxes, some users will be paying only general road use taxes through fuel, weight-mile and registration fees, while others will be paying these taxes as well as tolls. The next three tolling options deal with alternate methods of balancing equity between those paying tolls and other road users.

4. An option to account for both highway user fees and tolls being charged on the same facility would be to compensate the operators of the toll facilities through shadow tolls reflecting the basic cost occasioned of vehicles using these facilities. The shadow tolls could then be included in the overall cost calculation. This would benefit the constructors of the facilities by creating an additional

[3] Oregon Constitution, Article IX, Section 3a

[4] Oregon Constitution, Article IX, Section 3a

cash flow while at the same time reducing the burden on users.

From a cost allocation perspective, this has the same general drawbacks as simply including the facilities in the cost calculation in the first place and attributing tolls to the various user groups. It would diminish the value of the tolls as congestion management tools and would not compensate individual users who would still be subject to both sets of fees while using the facility.

In addition, since a major motivation in financing roads through tolls is to raise money for these routes, any scheme that requires additional contribution of existing road user revenues is somewhat self-defeating.

5. Another possibility to reduce double payment of both tolls and user fees for completely private facilities would be to allow users to claim refunds for fuel and weight-mile taxes paid while using these routes in the same way as currently permitted for off system use.

   In favor of this approach is historic precedence since users can claim rebates for other off-system uses.

   However, the impact in reducing the value of marginal cost and value pricing in managing facilities would be even more severe than the option of attributing costs and revenues from these facilities to user groups. In addition, there would be considerable administrative burden created by the need to process refund claims.

   As with the shadow price scheme this practice would be self defeating for highway financing since it would reduce the already scarce funds that were at least partially responsible for the creation of toll options.

6. Finally, to the extent that the state becomes involved in setting tolls, rates could be set either to compensate users for fees already paid or to reflect cost occasioned principles of road financing. This approach would reduce the affect of tolls as an economically efficient pricing mechanism but could become a part of the cost allocation process, especially if tolls are interpreted to be road use taxes.

In summarizing options for treatment of toll facilities there are two major considerations: (1) whether to consider tolls and toll financed facilities as part of Oregon's overall road system and user fee structure or to treat tolls as a special case outside the normal cost allocation framework; and (2) to what extent, if any, users and user groups should be compensated for the fact that those paying tolls might also be paying fuel taxes and weight mile taxes as the same time. It was noted that these questions may be resolved by interpretation of the Oregon Constitution as to whether tolls constitute road user taxes.

In reviewing options for consideration of toll revenue, there were no technical issues identified with regard to computing cost allocation. In fact toll financing may make additional useful information available for cost allocation studies.

Finally, for those who would move Oregon's road use finance structure in the direction of marginal cost pricing and economic efficiency tolls may provide an opportunity to move in that direction.

4. How should privately financed toll projects be treated?

As noted above, in theory, privately financed toll facilities would be outside of the state road finance structure and privately financed toll facilities could be treated no different than private parking facilities, in which the user pays for access to the facility outside of any state revenue or expenditure. If the road were completely privately developed it could be considered "off-system" the same way a parking lot is. Users would pay fuel taxes and mileage fees while using the facility, but since it is off-system they could apply for reimbursement or credit for off-system use.

A significant advantage of private tolls, kept outside the cost allocations structure, would be the ability to introduce value pricing in which users paid for the value of service whether or not it directly relates to cost. In terms of more economically efficient road pricing this would be an advantage.

Unfortunately, this approach breaks down when face to face with practical reality. First, it is unlikely in the near future that any Oregon facilities would be completely privately financed. Therefore, the roads would not be purely off-system. Second, if users did try to claim off-system compensation while using these facilities, the administrative burden on the state could be significant.

With these two practical realities, private tolls become similar to state tolls, with the same alternatives for cost allocation treatment.

The key question for the state is whether, within its cost allocations, it wants to:

(a) Consider private tolls as completely outside of the cost allocations structure and ignore them in coast allocation studies;

(b) Consider private toll roads as a part of the overall highway system and adjust road user taxes to promote equity across the system; or

(c) Recognize toll roads as a part of the system and require users to pay fuel and weight mile taxes as well as tolls while using these roads; or

(d) Consider private toll roads as off-system and either compensate users or take account of user fees paid while using these roads in the cost allocation calculations.

Conclusions

Innovative highway finance techniques involving use of debt, public-private partnerships and tolls present no major inconsistencies or insurmountable methodological problems with Oregon's cost allocation philosophy. Instead they present the opportunity to incrementally move in the direction of more efficient road pricing through consideration of marginal costs and value of service.

Issue Paper 5:

Bridge Cost Allocation Methodology Issues

Brian Leshko, Robert W. Hunt Company

Introduction

Allocating the cost of Oregon's bridges continues to be one of the more important and complex tasks confronting the 2007 Oregon Highway Cost Allocation Study (HCAS). Approximately 500 conventionally reinforced concrete deck-girder bridges in the Oregon Department of Transportation (ODOT) inventory exhibit diagonal-tension cracks. Most of these cracked bridges were constructed in the late 1940s to early 1960s, and have exceeded their expected design life of 50 years. Since the cracks effectively decrease the structural capacity of the bridges, ODOT has posted these structures at lower loads, thus limiting heavy-truck traffic. This has had a direct impact on the trucking industry and a corresponding effect on Oregon's economy. This also affects consumers since the cost of transporting goods and materials increases when trucks are either detoured or limited to carry lighter loads. To remedy the current situation, 293 of these state highway bridges are being repaired or replaced at an estimated cost of $1.22 billion. The allocation of bridge costs will therefore be paramount in the 2007 Oregon HCAS.

As a point of reference, the National Bridge Inspection Standards defines a bridge as any structure greater than 20 feet in length spanning a roadway, railway, body of water, or depression along the ground surface. A bridge is typically constructed from one or more of the following materials: steel, concrete or timber. A conventionally reinforced concrete member is comprised of a cast-in-place concrete component with embedded reinforcing steel bars. Concrete (a mixture of cement, water, aggregates and air) resists compressive forces, whereas steel provides tensile strength. Compression can be likened to pushing together or crushing, while tension is pulling apart or stretching. By design, the steel is placed close to the tension face. By combining the two materials, the resulting reinforced concrete member can resist both compression (concrete) and tension (steel).

Diagonal cracks are indicative of shear stress in excess of the shear capacity afforded by the U-shaped steel stirrups in the girders. They are categorized as tension cracks since the shear forces are causing the member to pull apart in a manner similar to shearing a piece of paper with scissors. The concrete member is not being cut; however, the resulting internal forces align along the horizontal and vertical planes with a resultant external crack forming at 45-degees to both reference planes. Once the crack has developed, the reinforced concrete member is in a "weakened" condition, such that passage of heavy truck traffic will cause the crack to propagate in length and open in width, thus exacerbating the resulting condition.

The 1982 Federal HCAS identified three cost categories for bridges: New Bridge Construction, Bridge Replacement, and Bridge Rehabilitation. The 1997 Federal HCAS retained New Bridge Construction and Bridge Replacement, while subdividing bridge rehabilitation into Major Bridge Rehabilitation and Other Bridge Improvements to include minor bridge rehabilitation and repairs. Subsequent state studies have included a bridge maintenance category and separately reported seismic retrofitting costs from other bridge rehabilitation costs.

For the current study, the same five cost categories for bridges that were identified in the two previous Oregon HCAS will be used: New Bridge Construction, Bridge Replacement, Seismic Retrofitting, Bridge Rehabilitation (other than seismic retrofitting), and Bridge Maintenance. These categories, along with recommendations on how the costs in each category should be allocated, are discussed in this issue paper.

New Bridge Construction

New bridges are typically constructed to provide new capacity. This capacity could refer to

Average Daily Traffic (ADT) or related Average Daily Truck Traffic (ADTT). ADTT can be expressed as a percentage of ADT. The ADT and ADTT are determined from either observed traffic counts or prediction models. When the ADT and ADTT reach a high enough value, the capacity of a given bridge may be exceeded, resulting in the need for a new bridge with higher capacity. This higher capacity could be attained by constructing a new bridge with a wider deck to provide additional travel lanes, or by constructing a parallel bridge adjacent to the existing bridge to provide additional travel lanes.

The new capacity requirement could stem from a traffic study that recommends a new crossing to provide access to a new development (residential, commercial or industrial). This new bridge would be constructed based upon the new capacity requirement. The width of the structure would be determined by the projected ADT and ADTT.

A new capacity requirement, in the form of ADT and ADTT, is derived from user demand. Congestion can result in a need for new capacity and thus new bridge construction. Beltway expansion projects are an example of new bridges constructed to provide new capacity.

When a new bridge is required, design engineers must use the current AASHTO design specifications and ODOT practice manuals. The new design must support the self-weight of the superstructure (deck, railing and beams), the dead load; the weight of the design vehicle traffic loadings, the live load; plus various environmental loads (wind, earthquake, thermal, stream flow and ice pressure).

Load-related factors influence the design of bridges such that increased structural strength (thicker deck, deeper beams/girders, increased area of steel reinforcement, etc.) is required to support increased gross vehicle weight. As vehicle weight increases, vehicle width also typically increases. Wider traffic lanes and shoulders are therefore required to accommodate the larger vehicles. The subsequent wider deck necessarily leads to an overall wider structure. Practically all highway cost allocation studies for new bridges have been based on an incremental analysis of the costs of constructing bridges for different design loadings (heavier/wider vehicle weight classes).

OBEC Consulting Engineers conducted the ODOT Bridge Cost Allocation Study to determine costs apportioned to five (5) different design vehicles (truck loads) for three (3) different span arrangements. For simplicity, the designs were based upon the AASHTO Group IA load combination of dead load and live load only. The vehicle types with associated gross vehicle weights, as well as lane and shoulder widths for design are as follows:

Vehicle Type (Load)	Gross Vehicle Weight	Lane Width	Shoulder Width
Basic (4 tons)	8,000 lbs	11’	8’
Type 3 (25 tons)	50,000 lbs	12’	10’
Type 3S2 (40 tons)	80,000 lbs	12’	10’
Permit 2 (49 tons)	98,000 lbs	12’	10’
Permit 4 (114 tons)	228,000 lbs	12’	10’

The three span arrangements are as follows:

- 100’ simple span (single span from

abutment to abutment)

- 150' simple span (single span from abutment to abutment)
- 60'-90'-60' continuous spans (multiple spans over intermediate piers)

The results of the study indicate an increase in structure costs/unit area as the vehicles get heavier up to the 98,000 lbs vehicle. For single span structures, the plotted curves flatten out after the 98,000 lbs vehicle to the 228,000 lbs vehicle, suggesting not much increase in structure cost to design a single span bridge for a 228,000 lbs vehicle compared to a 98,000 lbs vehicle. For the three-span continuous bridge, there is an increase in cost per square foot as the vehicles get heavier from the 98,000 lbs vehicle to the 228,000 lbs vehicle.

The study compared the Live Load + Impact Factor (LL+I) to the Dead Load (DL) for each vehicle type and span arrangement. The impact factor accounts for the increased live loading effects of vehicle speed, vibration and momentum. I= 50/(L+125), where L is the span length, in feet. The impact factor is a function of the span length, decreasing as the span length increases. The maximum value of the impact factor (I) is 30%. The trend showed higher (LL+I)/DL ratios as vehicle weight increases, suggesting structures become more efficient as design Live Load becomes heavier.

The superstructure/substructure cost ratio for single span bridges show a slight increase as the vehicles get heavier up to the 98,000 lbs vehicle, then show a slight decrease from the 98,000 lbs vehicle to the 228,000 lbs vehicle. For the three-span bridge, there is a steady decrease in superstructure/substructure cost ratio as vehicle weights increase.

In the 1997 Federal HCAS Summary Report, an incremental approach was used to allocate new bridge construction costs to vehicles: "…costs for constructing the base facility of a new bridge are allocated to all vehicle classes in proportion to their passenger car equivalent vehicle miles traveled (PCE-VMT). Incremental costs to provide the additional strength needed to support heavier vehicles are assigned to vehicle classes on the basis of the additional strength required on account of their weight and axle spacing."

Oregon State University (OSU) is currently performing research to define a truck load model unique to Oregon. The present truck loads and configurations allowed on Oregon state highways differ from most other states in that many trucks above the national legal weight limit are allowed on Oregon highways as permit vehicles. This presents a problem since bridge design and rating are based upon national truck models, which are derived from data collected in other states and may not reflect actual Oregon loads. Using national truck models to design bridges in Oregon may introduce error in the structural analysis. "The project will use Oregon-specific weight data to define a number of truck configurations for design and load rating that accurately represent truck loading."

For the present study, it is recommended that new bridge expenditures continue to be allocated incrementally based on the Oregon bridge cost model.

Bridge Replacement

Bridges are typically replaced when functional and/or structural problems are found during a routine National Bridge Inspection Standards in-service inspection that is performed biennially for all structures in excess of 20 feet in length. In the early 2000s, ODOT bridge inspectors discovered an alarming increase in the numbers of conventionally reinforced concrete deck-girder bridges in the ODOT inventory exhibiting diagonal-tension cracks and/or in the propagation of these cracks in bridges that were previously reported.

Over 500 conventionally reinforced concrete deck-girder bridges in the ODOT inventory exhibit diagonal-tension cracks with nearly half of these structures located along the major north-south and east-west transportation corridors, Interstate 5 (I-5) and Interstate 84 (I-84), respectively. ODOT contracted with OSU to investigate the remaining capacity and life of conventionally reinforced concrete deck-girder bridges with diagonal-tension cracks. The initial findings of this research were published in the April 2004 report entitled, "Remaining Life of Reinforced Concrete Beams with Diagonal-Tension Cracks" by the Structural Engineering Group of the Department of Civil Engineering at OSU. The report is divided into two parts: Part I – A database of Oregon's conventionally reinforced concrete deck-girder bridges most prone to diagonal-tension cracks, and Part II – An analysis of a bridge with diagonal-tension cracks. The database developed in Part I focused on 442 cracked bridges constructed between 1947 and 1962.

Bridges in Crack Stage 1 have low density cracks, randomly dispersed; Crack Stage 2 indicates medium density cracks, mostly near supports; Crack Stage 3 indicates high density cracks, widely dispersed. Bridges in Crack Stages 2 and 3 are typically candidates for repair or replacement. A general trend observed from the database research showed that,

> "bridges at a higher crack stage tended to have larger girders and longer span lengths. This is likely due to the design practice at the time. When more capacity was needed and the addition of reinforcing steel was not possible due to constructability…a designer would increase the girder size to obtain more contribution from the concrete. As a result, girders of larger dimensions would have proportionally less steel reinforcement than corresponding girders of smaller dimensions. This is further compounded by a higher concrete stress for design than would be permissible today."

This explains why there are bridges with larger girders and longer spans in Crack Stage 3. Except for this isolated finding, "there were no strong or predominant trends within parameters or inter-relationships found within the database." The overall conclusion is that, "…assessment of shear-cracked CRC [conventionally reinforced concrete] deck-girder bridges in Oregon may not permit a uniform or standard approach, but will likely require assessment of individual bridges and member proportion details."

Based upon field studies and finite element analysis results of an in-service 1950's era conventionally reinforced concrete slab-girder bridge with diagonal-tension cracks, the following conclusions were reported:

- The bridge girders do not meet modern design requirements for shear. [Due to overestimation of the concrete shear strength that was allowed in the design specification in effect at the time of the design.]
- Stirrup strains were well below the fatigue limit for long life of reinforcing steel. [Metal fatigue leading to fracture of the stirrups is unlikely.]
- Cracks were observed to open in the simple span, and open and close in the continuous spans. [May have implications for epoxy injection of cracks and bond fatigue of stirrups.]
- Stirrup strains and crack displacements in the continuous spans were higher than those in the simple span. [Fewer girders and structural indeterminacy.]
- Peak strain measurements in stirrups tended to increase with increasing vehicle speed. [20% increase in strain for vehicle near posted speed compared to slow speed (5 mph).]
- Maximum calculated stress range in the steel stirrups (11.1 ksi) is less than the safe stress range (23.6 ksi)

based upon the AASHTO Standard Specification. [Below the maximum allowed; therefore, not a problem.]

- Stirrup stresses under combined Live Load + Impact and Dead Load were estimated to be above the allowable stress (20 ksi). DL contributed significantly to the stress magnitude. [A problem, since above the maximum allowed. Consider milling before overlaying the wearing surface to limit the increase in stirrup stress due to Dead Load.]
- The finite element model subjected to Live Load + Impact, Dead Load, and loads due to drying shrinkage and non-uniform temperature change predicted diagonal-tension cracking of the girders. [Analysis results estimated that an HS truck configuration corresponding to HS12 caused the initial diagonal-tension cracking near the center support. A heavier truck, HS33, generated a subsequent diagonal-tension crack next to the first crack located a distance of approximately the girder's effective depth away.][1]
- It is anticipated that the bridge would exhibit diagonal-tension cracks from actual truck loads operating on the bridge from combined effects of Live Load + Impact with Dead Load as well as temperature and drying shrinkage effects.

In order to efficiently manage the repair and replacement of the identified conventionally reinforced concrete deck-girder bridges with diagonal-tension cracks, ODOT has changed from a "worst-first" approach to a "corridor-based strategy". The impetus for this fundamental change is to keep freight moving through Oregon along I-5 and I-84. From the *OTIA III State Bridge Delivery Program Monthly Progress Report*, No. 22, July 2006, Program Data through June 30, 2006, the Design & Construction Stages 1-5 are as follows:

Stage	# of Bridges	No Work	Repair	Replace	BOR Amount	Current Budget
1	23	1	2	20	$60,729,600	$70,445,000
2	119	32	50	37	$500,207,600	$426,653,688
3	104	13	31	60	$481,884,800	$417,848,225
4	77	18	27	32	$193,948,400	$169,771,000
5	42	8	5	29	$106,800,600	$136,253,739
Total	365	72	115	178	$1,343,571,000	$1,220,971,652

The Bridge Options Report (BOR) of March 2003 identified 365 bridges at a cost of $1.34 billion. As the scopes of work were refined, 72 bridges were identified with no work recommendations, resulting in a total of 293 bridges to be repaired or replaced. The revised program cost estimate is $1,220,971,652, down from the original BOR amount of $1,343,571,000.

Because many of the existing Oregon Transportation Investment Act (OTIA) III bridges are located within the limits of existing Statewide Transportation Improvement Program (STIP) projects, these crossover projects were combined into one project for efficiency and to limit traffic impact. Thus, the "corridor-based strategy" had, in effect, replaced the "worst-first" philosophy prior to the discovery of the cracked conventionally reinforced concrete deck-girder bridges.

A functionally obsolete bridge can no longer safely or efficiently accommodate existing traffic demands because of inadequate capacity, substandard geometrics or other safety problems. Structurally deficient bridges have insufficient structural capacity or strength to safely carry the traffic. The National Bridge Inspection Standards classifies bridges as functionally obsolete

[1] The HS truck classification indicates the weight, in thousands of pounds, that a structure is rated to safely carry.

or structurally deficient on the basis of condition ratings for bridge structural elements and on the basis of appraisal ratings for the services provided by a bridge. Both scales range from zero (worst) to nine (best).[2]

As described in *Non-Regulatory Supplement OPI: HNG-33*, from the U.S. Department of Transportation, Federal Highway Administration, a bridge is structurally deficient (SD) if it has a condition rating of 4 or less for Item 58 – Deck, Item 59 – Superstructures, Item 60 – Substructures, or Item 62 – Culvert and Retaining Walls, or has an appraisal rating of 2 or less for Item 67 – Structural Condition or Item 71 – Waterway Adequacy. A bridge with an appraisal rating of 3 or less for Item 68 – Deck Geometry, Item 69 – Underclearances, or Item 72 – Approach Roadway Alignment, or an appraisal rating of 3 for Item 67 – Structural Condition or Item 71 – Waterway Adequacy, is functionally obsolete.

Oregon's inventory of structurally deficient and functionally obsolete bridges, both on and off the National Highway System (NHS), as of December 2005 is as follows:

Highway System	Structurally Deficient	Functionally Obsolete	Structurally Deficient + Functionally Obsolete	Count	%
NHS	168	298	466	1,476	31.6
Non-NHS	529	877	1,406	5,762	24.4
All Systems	697	1,175	1,872	7,238	25.9

The condition and appraisal ratings are determined by a qualified bridge inspector based upon the findings from a field inspection of the bridge. The Structure Inventory and Appraisal data is required to be reported to the Federal Highway Administration (FHWA) through the state's Bridge Management System (BMS). Oregon uses the widely accepted Pontis BMS.[3] Any bridge classified as structurally deficient is excluded from the functionally obsolete category, thus such a structure will not be classified under both categories.

From the 1997 Federal HCAS Summary Report, costs are assigned according to the types of improvements that are made. For SD bridges, costs to provide additional structural capacity should be allocated to those vehicles that require the greater strength. FO bridge improvement costs should be allocated on the basis of capacity used as indicated by passenger car equivalent-vehicle miles traveled (PCE-VMT).

For the present study, it is recommended that replacement bridge expenditures be allocated based on the cost occasioned approach.

Seismic Retrofitting of Existing Bridges

Oregon is located adjacent to the Cascadia Subduction Zone, where the Juan de Fuca Plate is moving under the North American Plate. Plate tectonics theory indicates the probability of Magnitude

[2] The condition rating scale is 9-Excellent, 8-Very Good, 7-Good, 6-Satisfactory, 5-Fair, 4-Poor, 3-Serious, 2-Critical, 1-"Imminent" Failure, 0-Failed; the appraisal rating scale is 9-Superior to present desirable criteria, 8-Equal to present desirable criteria, 7-Better than present minimum criteria, 6-Equal to present minimum criteria, 5-Somewhat better than minimum adequacy to tolerate being left in place as is, 4-Meets minimum tolerable limits to be left in place as is, 3-Basically intolerable requiring high priority of corrective action, 2-Basically intolerable requiring high priority of replacement, 1-Not used, 0-Bridge closed.

[3] The term "Pontis" is Latin referring to a "bridge". The Pontis software program was developed by Cambridge Systematics for the FHWA and is licensed through the American Association of State and Transportation Officials (AASHTO) to more than 45 U.S. state departments of transportation and other national and international agencies through AASHTOWare.

8 or 9 earthquakes (Richter scale) along the plate boundary. The relatively new information regarding seismic loading has prompted ODOT to address failure mechanisms determined from vulnerable detailing. Although Oregon's inventory of bridges has always met the basic AASHTO criteria in effect at the time of the design, current seismic requirements dictate either superstructure or substructure retrofits to address the vulnerability to a moderately severe earthquake.

From ODOT's "Assessing Oregon's Seismic Risk": "The first failure mechanism would engage when the motion from the earthquake causes the bridge's superstructure to separate from the substructure. A typical bridge designed prior to extensive seismic detailing would not have an available beam seat greater than 12 inches for seismic movement in the longitudinal direction. Additionally, the beam seat would not have shear lugs designed to resist much, if any, transverse direction seismic force." Typical Phase 1 seismic retrofit to the superstructure includes installing longitudinal cable restraints and transverse shear lugs. "…The second failure mechanism would engage when the motion from the earthquake causes the bridge's substructure to collapse from the seismic force. Similar to the superstructure design shortcomings of typical earlier bridge design, substructures (columns in particular) were not designed to resist the intense forces experienced in a seismic event." A typical Phase 2 seismic retrofit to the substructure includes installing steel casing around substandard concrete columns.

The initial Phase 1 seismic retrofit effort included 397 bridges at a total cost of $103.6 million and the initial Phase 2 seismic retrofit effort included 758 bridges at a total cost of $413.6 million. As reported in the 2003 Oregon HCAS, "Since ODOT began its seismic retrofitting program, 160 bridges have been retrofitted and 296 bridges have been replaced with new seismic designs. The backlog of remaining work, however, is large. It includes Phase I Retrofitting (tie deck onto bridge) of 375 bridges and Phase II Retrofitting (strengthen piers and footings) of 668 bridges. The estimated cost of this work is $994 million over 20 years or almost $50 million per year."

For the present study, it is recommended that seismic retrofitting expenditures be allocated separately from other bridge rehabilitation expenditures.

Bridge Rehabilitation Other Than Seismic Retrofitting

Bridge rehabilitation focuses on three major bridge components: Deck, Superstructure and Substructure. The deck provides a smooth riding surface for vehicles, is the component of the bridge to which the live load is directly applied, and transfers the live load and dead load of the deck to the superstructure through the floor system. Work activities involving the bridge deck include deck restoration/overlays, deck joint repair/replacement, and deck replacement. Deck patching and waterproofing overlays (latex concrete, bituminous with membrane, etc.) extend the life of the deck and improve rideability. Deck joints typically leak, enabling water mixed with road salt or cinders to seep through the joint onto the superstructure below. Any steel superstructure, or concrete superstructure with open cracks to the embedded reinforcing steel, would have an increased rate of corrosion with the presence of the electrolyte (water and deck runoff) to maintain the corrosion cell. Repairing, replacing or installing new expansion dams to ensure leak-proof joints will break the corrosion cell and result in a longer life for the superstructure. To remedy a structurally deficient deck, the existing deck can be replaced with a stronger deck.

The superstructure carries loads from the deck across the span and transmits the loads of the deck and superstructure to the bridge supports. Rehabilitating a superstructure typically consists of strengthening a deficient component of the floor system (stringer, floor beam, girder, diaphragm, truss member, lateral bracing, sway bracing, etc.). A structural analysis can determine the governing member for load rating the structure. By strengthening the governing member, the structure can be rated at a higher level. Typical strengthening details include restoring deteriorated reinforced concrete or prestressed concrete beam-ends, or adding steel plates/rolled sections to increase the section properties (moment of inertia). Additional methods include post-tensioning with tendons or bars. For conventionally reinforced concrete deck-girder bridges with diagonal cracks, repair techniques and materials include: pressure injecting the cracks through multiple ports along the length of the crack with epoxy (epoxy injection), external supplemental steel stirrups, internal supplemental steel stirrups, and carbon fiber-reinforced polymers bonded to supplemental external shear reinforcement on the girder faces.

The substructure transfers the loads from the superstructure to the foundation soil or rock. Substructure units typically include abutments and piers. Abutments provide support for the ends of the superstructure, whereas piers provide support for the superstructure at intermediate points along the length of the bridge. A majority of these components have been constructed of reinforced concrete. Common concrete deficiencies include cracks, delaminations and spalls.[4] Rehabilitation schemes include epoxy injection, saw cutting/jack hammering, and grouted patches, respectively. For concrete bent caps, post-tensioning techniques have been successful. Other types of substructure units are steel bents and towers. These units are typically rehabilitated using similar methods as for steel superstructure strengthening.

Bridge rehabilitation projects for system preservation may consist of any of the items discussed above, either alone or in combination. The extent of the deterioration or deficiency will dictate the overall scope of work to be performed. For steel structures, bridge protective coatings, such as painting (system replacement, overcoats, or spot/zone painting), galvanizing, or metalizing, may be warranted.

For the present study, it is recommended that bridge rehabilitation expenditures be allocated incrementally based on the cost occasioned approach.

Bridge Maintenance

Deferring maintenance on a minor problem in the base year (lower cost) may become a major problem in subsequent years (higher cost). Investing a small amount of time and money today can pay dividends tomorrow due to the higher costs in both time and money that must be expended at a later date to fix a more substantial problem. Maintenance activities include bridge component repairs due to damage (i.e. repairing a fascia girder struck by an overheight vehicle).

Bridge maintenance does not substantially improve the condition or function of the overall structure and generally is not related to vehicle characteristics. Environmental costs, related to weather, drainage, etc. should be assigned on a VMT or passenger car equivalent-VMT basis, as reported in the 2001 Oregon HCAS, Issue Paper 1. The 1997 Federal HCAS recommended that all costs associated with bridge maintenance be assigned to the base increment using VMT allocation.

It is imperative that costs be allocated for bridge maintenance, in addition to the other categories discussed above. Oregon should not concentrate on repairing and replacing the 293 cracked bridges exclusively,

[4] As defined in the *Bridge Inspector's Training Manual/90*: a crack is a break without complete separation of parts; a delamination is a subsurface separation of concrete into layers; and a spall is a circular or oval depression in concrete caused by a separation of a portion of the surface concrete, revealing a fracture parallel with or slightly inclined to the surface.

without due regard for maintaining the remaining inventory of bridges. New bridge construction and seismic retrofitting of existing bridges also need to be addressed, but not at the expense of bridge maintenance. Bridge maintenance costs should be assigned to the base increment using VMT allocation.

Research Initiatives

ODOT contracted with OSU to estimate the remaining capacity and life of conventionally reinforced concrete deck-girder bridges with diagonal-tension cracks, and to develop a reliability based assessment methodology. The results of this research were published in the October 2004 report entitled, "Assessment Methodology for Diagonally Cracked Reinforced Concrete Deck Girders" by the Structural Engineering Group of the Department of Civil Engineering at OSU.

Section 5 of the report, "Reliability Based Assessment Methodology", details the development of a reliability assessment methodology to enable ODOT staff, "to rationally establish load restrictions, prioritize bridges for replacement or repair, and identify specific segments of bridges requiring repair." Oregon-specific truck loading, determined from weigh-in-motion data, was integrated with the analysis from field and laboratory testing. A reliability index was calculated for each critical section along the girder, "by comparing the maximum operating forces in the section with the estimated capacity of the section and incorporating the inherent variability of the capacity estimate." The overall capacity of the bridge is controlled by the girder location with the smallest reliability index.

Following the calibration of the reliability index from a set of bridges, "a minimum reliability index can be selected for Oregon's conventionally reinforced concrete (CRC) deck-girder bridges that represents an acceptable level of risk." This reliability assessment methodology provides a rational method for prioritizing the repair or replacement of Oregon's deck-girder bridges.

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Issue Paper 6:

Tax Avoidance and Evasion

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Introduction

VIRTUALLY ANY TAX IS SUBJECT TO some evasion, which raises the issue of how this should be dealt with in a highway cost allocation study. The issue of how to deal with tax evasion in the Oregon HCAS was discussed by the SRT as part of the 2003 Study. It was also discussed at some length in Issue Paper 10, which is reprinted in the 2003 study as part of Volume II: Technical Results Report.[1] Tax avoidance, although legal, is somewhat related to tax evasion in terms of the methodological issues involved in estimating the extent of lost revenues and allocating them across vehicle classes. They are also discussed in this paper.The purpose of this paper is to provide an overview of tax avoidance and evasion and their treatment in Oregon cost allocation studies. The first section provides an overview of tax avoidance and evasion in Oregon relying on the discussions in previous OHCAS studies. The second section updates this information by reviewing recent and ongoing research on tax avoidance and evasion. The third section reviews alternative methodologies for handling the different categories of tax avoidance and evasion within highway cost allocation. The final section provides conclusions and recommendations.

Overview of Tax Avoidance and Evasion

Although the primary purpose of this issue paper is not to debate the level of tax evasion and avoidance, it may be useful to provide some background on this issue. In the 2005 Oregon Cost Allocation Study, two categories of tax evasion and two categories of tax avoidance were included. Each of these is summarized in Exhibit 1 (page C-38) and are discussed in the following paragraphs.

While it is generally agreed evasion of the state gasoline tax and vehicle registration fees is quite low (and assumed to be equal to zero in previous OHCAS), there is more debate concerning evasion of the weight-mile tax and use fuel (primarily diesel) tax

Many representatives of the trucking industry have long believed there is significant evasion of the Oregon weight-mile tax. This was therefore one of several issues examined in the Oregon Weight-Mile Tax Study, conducted by private consultants for the Legislative Revenue Office in 1996. The Weight-Mile Tax Study estimated evasion of the Oregon tax to be three to seven percent, with a midpoint estimate of five percent. This translated to an annual revenue loss of approximately $10 million. The study further estimated most of this evasion is due to under-reporting or non-reporting of mileage for vehicles with Oregon tax plates or permits. A small percentage of the evasion, in the range of one or two percent of total tax liability, was considered due to vehicles operating without authorization, vehicles being operated over their declared gross weight, or systematic errors not uncovered in the audit process which tend to result in net under-payment of the tax. It should

[1] 2003 Oregon Highway Cost Allocation Study, Prepared for the Oregon Department of Administrative Services, Prepared by the Oregon Department of Transportation, Transportation Development Division, Policy Section and ECONorthwest, May 2003.

Exhibit 1: Summary of Tax Avoidance and Evasion in the Oregon HCAS

Type	Rate	Methodology	Description
Evasion: Weight-mile tax	5.0%	Estimated evasion rates are applied in revenue attribution by subtracting the estimated revenue loss from projected revenues.	Underpayment due to non-reporting or underreporting of miles driven.
Evasion: Use fuel (primarily diesel) taxes	2.0%	An additional 2.0 percent of VMT by diesel fuel-tax paying vehicles do not result in tax collections for OR.	Evasion by methods such as using untaxed diesel fuel intended for off-highway use or blending in untaxed on-highway fuels such as kerosene. In addition to the 2.5 percent avoidance for diesel fuel.
Avoidance: Out of state fuel purchases versus out-of-state travel (gasoline and diesel)	2.5%	2.5 percent of VMT by fuel-tax paying vehicles do not result in fuel-tax collections for OR.	Net avoidance is significant because many people live in WA and work in OR. They buy a smaller proportion of fuel in OR than the proportion of their OR VMT.
Avoidance: Alternative-fee-paying vehicles	n.a.	The total subsidy amount is reassigned to all other, full-fee-paying vehicles on a per-VMT basis	The difference between what alternative-fee-paying vehicles are projected to pay and what they would pay if subject to full fees. This difference is calculated for each weight class and summed.

be noted many representatives of the trucking industry disputed the findings of this study and continue to believe evasion is significantly higher than the study estimated.

The Weight-Mile Tax Study was able to draw limited inferences with respect to which segments of the industry or types of trucking operations (e.g., interstate versus intrastate, long-haul versus short-haul, heavy- versus medium-weight) are most likely to evade the tax. However, the study did not reach any definitive conclusions in this regard. Therefore, even if one accepts the study's conclusions as a reasonable estimate of the overall evasion rate, it is still not possible to infer exactly which truck classes are evading the tax. It seems unlikely evasion is uniform across all types and classes of trucking operations, but there is not enough certainty to assign different evasion rates to different vehicle classes.

In the 2003 OHCAS, several SRT members raised the concern that taxes other than the weight-mile tax are also subject to evasion. Specifically, it was noted there is evidence of evasion of the Oregon use fuel tax. At the July 2002 SRT meeting, it was noted that ODOT was considering a legislative proposal dealing with use fuel tax evasion, specifically that associated with card-lock evasion operations. It was further noted the fiscal analysis estimated that this proposal would generate about $4 million in additional revenue, but that this estimate was in the process of being revised. Staff was directed to work with the ODOT Fuels Tax Group to estimate how much of this evasion was associated with light versus heavy vehicles.[2]

It was agreed the study should include an estimate of this evasion as well as that associated with the weight-mile tax. ODOT Staff was directed to develop a best estimate of use fuel tax evasion and the breakdown of this evasion between light and heavy vehicles.

According to the 2003 OHCAS, a 1995 ODOT internal audit report estimated

[2] 2003 Oregon Highway Cost Allocation Study, Volume II, Issue paper 10, Prepared for the Oregon Department of Administrative Services, Prepared by the Oregon Department of Transportation, Transportation Development Division, Policy Section and ECONorthwest, May 2003.

total use fuel tax evasion in Oregon to be $3 to $6 million annually. The SRT agreed to use the midpoint of this range, or $4.5 million, as the best available estimate of annual use fuel tax evasion. The ODOT Fuels Tax Group estimated that 35 percent (approximately $1.6 million) of this evasion was by light vehicles and 65 percent (approximately $2.9 million) by heavy vehicles, specifically those in the 8,001-26,000 pound weight classes. The SRT decided these amounts should be used in the study.

Another issue was avoidance of gasoline and diesel taxes. When vehicles that are subject to Oregon's fuel tax purchase fuel in another state and then drive in Oregon, they avoid the Oregon fuel tax. The reverse also is true, so if the number of miles driven in Oregon on out-of-state fuel equaled the number of miles driven outside Oregon on in-state fuel, net avoidance would be zero. Net avoidance in Oregon may be significant because of the large number of people who live in Washington and work in Oregon. These people tend to buy a smaller proportion of their fuel in Oregon than the proportion of their total miles driven in Oregon. This avoidance is specifically accounted for in the highway cost allocation study by assuming that 2.5 percent of VMT by fuel-tax paying vehicles do not result in fuel-tax collections for Oregon.

The avoidance of the weight-mile tax by vehicles that are not legally required to pay it is treated as part of the procedures for alternative-fee paying vehicles, rather than as avoidance. The reduced rates paid by certain types of vehicles mean they are paying less per-mile than comparable vehicles subject to full fees. The difference between what alternative-fee-paying vehicles are projected to pay and what they would pay if subject to full fees is termed the "alternative-fee difference." The approach used in past Oregon studies was to calculate this difference for each weight class and sum these amounts. The total alternative-fee difference (subsidy amount) is then reassigned to all other, full-fee-paying vehicles on a per-VMT basis, i.e., this amount is treated as a common cost to be shared proportionately by all full-fee-paying vehicles. The rationale for this approach is that the granting of these reduced fees represents a public policy decision, and most vehicles paying reduced fees are providing some public service that arguably should be paid for by all taxpayers in relation to their use of the system. Because the heavy vehicle share of the total alternative-fee difference is greater than their share of total statewide travel, reassigning this amount on the basis of relative vehicle miles has the effect of increasing the light vehicle responsibility share and reducing the heavy vehicle share.

Recent Research on Tax Avoidance and Evasion

The handling of tax evasion involves both data and methodological issues. In terms of available data, the basic conclusion is that there is not much in the way of new information, but there is at least one study under way that may shed some new light on tax evasion issues.

In terms of new data, the National Cooperative Highway Research Program (NCHRP) has an active project entitled "Identifying and Quantifying Rates of State Motor Fuel Tax Evasion."[3] The objective of this research project is to develop and demonstrate a methodology for identifying and quantifying state-level fuel tax evasion. The methodology should account for different practices among states that may lead to different rates of evasion. The results from this methodology should allow individual states to develop and evaluate potential solutions and enforcement options. Unfortunately, no preliminary

[3] Identifying and Quantifying Rates of State Motor Fuel Tax Evasion, National Cooperative Highway Research Program, Project 19-06. Effective Date: July 29, 2004, Completion Date: August 31, 2007.

products or other information from the project are currently available.[4]

A paper based on the study was submitted to the Transportation Research Board for presentation in the summer of 2005 for presentation at the 2006 TRB Annual Meeting. This paper reviewed issues that lead to the evasion problem such as the point of taxation, differences in state tax rates, and exemption and refunds. It also examined methods of reducing evasion including systems of tracking fuel, bonding and licensing requirements and enforcement. The paper reported on the findings of interviews with state fuel tax administrators and other knowledgeable parties but provided no new estimates of evasion. Oregon was mentioned in regard to implementation of a fuel tracking system. "Oregon reported that they had considered getting a system but decided it was not cost effective. This may be because Oregon does not collect much in diesel fuel taxes."[5]

In a 2002 study by some of the same authors, it was noted that at the state level, estimates of annual motor fuel excise tax evasion have varied significantly, from as low as $600 million to as high as $2 billion.[6]

Review of Alternative Methodologies

In the latest several versions of the OHCAS the estimated evasion rates were applied in the revenue attribution portion of the model. This was accomplished by subtracting the estimated revenue loss due to evasion from the revenues projected in the absence of this evasion. This procedure applies to the first three categories of avoidance and evasion listed in Exhibit 1, which include evasion of the weight-mile tax, evasion of use fuel (diesel) taxes and avoidance of gasoline and diesel taxes. This is in contrast to some of the earlier Oregon studies, where evasion of the weight-mile tax was handled by inflating the reported miles of travel of vehicles subject to the tax by the estimated evasion rate.

For the final category, avoidance by alternate-fee-paying vehicles, the total subsidy amount is reassigned to all other, full-fee-paying vehicles on a per-VMT basis.

Issue paper 10 of the 2003 study provided a detailed discussion of two alternatives to applying the estimated evasion rates in the revenue attribution portion of the model. They included:

1. Inflate reported miles by estimated evasion rate
2. Treat evasion in same way as subsidies for reduced-fee-paying vehicles.

For the second option, four sub-options were identified. These include:

1. Use allocators reflecting policy goals of subsidies.
2. Assign cost of subsidy associated with each weight class back to the full-fee-paying vehicles in each weight class.
3. Assign light and heavy vehicle subsidy amounts back to full-fee-paying light and heavy vehicles, respectively.
4. Treat cost of subsidies as overhead cost, or as common cost.

The following paragraphs describe the alternatives described in issue paper 10. The discussion is largely taken from that paper with minor edits where necessary.

Inflate reported truck miles of travel by the estimated evasion rate

If a reasonable estimate of weight-mile tax evasion is available and it is

[4] Telephone interview with Andrew Lemer, Staff member for National Cooperative Highway Research Program (NCHRP), Project 19-06, Identifying and Quantifying Rates of State Motor Fuel Tax Evasion, August 28, 2006.

[5] Issues in Estimating State Motor Fuel Tax Evasion, Anthony M. Rufolo, Patrick Balducci and Mark R Weimar, submitted for presentation at the 2006 Transportation Research Board Annual Meeting, Undated.

[6] Weimar, M.R., P.J. Balducci, J.M. Roop, M.J. Scott., and H.L. Hwang, Economic Indicators of Motor Fuel Excise Tax Collections, Prepared by Pacific Northwest National Laboratory and Oak Ridge National Laboratory for the United States Internal Revenue Service, August 2002.

assumed (a) evasion is uniform across all truck weight classes and (b) evasion predominantly takes the form of under-reporting or non-reporting of Oregon mileage, then the reported truck miles could simply be inflated by the estimated evasion rate before being used in the study. This approach has been used in some past Oregon studies.

Responsibility for most expenditures included in the study is assigned on the basis of mileage-related measures such as vehicle miles of travel (VMT), axle miles of travel (AMT), passenger car equivalent (PCE) weighted VMT, or load equivalence factor (LEF) weighted miles of travel. Some categories of expenditures, however, are assigned on a per-vehicle or other basis. Therefore, a given increase in truck VMT will generally result in a somewhat less than proportionate increase in truck responsibility. Hence, inflating the truck VMT numbers to account for evasion increases the total responsibility (and responsibility share) of trucks, but generally reduces the per-mile responsibility of trucks and therefore the recommended, cost-responsible weight-mile rates.

One problem with this approach is that it implicitly assumes we can both identify and eliminate evasion, which is not necessarily the case. Reducing the weight-mile rates would be possible only if we could eliminate evasion or at least reduce it to a point where the additional payments from carriers formerly evading the tax were large enough to allow a reduction in the rates for all carriers. If this was not possible, identifying evasion and incorporating it in the study calculations by inflating the reported truck miles would require an increase in the weight-mile rates in order to increase total payments from trucks up to their new cost responsibility target. This is because inflating the truck miles would increase their responsibility, but not the number of miles on which the tax is actually collected.

Another problem with this approach is that not all evasion of truck taxes takes the form of under-reporting of mileage. While it is reasonably certain mileage under-reporting represents the principal method of evasion, it is not known exactly what portion takes this form and what portion takes other forms. Some evasion undoubtedly takes the form of under-reporting of declared weights - *i.e.*, reporting all miles, but reporting some miles at a lower declared weight and tax rate than that at which they should have been reported. To the extent this is the case, inflating the reported miles by the total evasion rate would result in over-inflating the miles.

Treat evasion in the same way as subsidies for reduced-fee-paying vehicles

Evasion by certain taxpayers imposes a cost which must be borne by others, either lawful, non-evading taxpayers through higher taxes or society as a whole through reduced revenue and hence, service levels. It therefore can be argued that evasion is similar to a subsidy and should be treated in the same way.

There are several approaches that might be used to assign the cost of subsidies in a highway cost allocation study. One approach, recommended as a way to treat subsidies in a previous study,[7] is to use allocators reflecting the policy goals of each particular subsidy. For example, a goal of subsidizing public transit operations is to encourage transit ridership thereby freeing road capacity. Hence, an appropriate allocator for this particular subsidy might be PCE weighted VMT or congested (peak-period) PCE-VMT.

Other approaches to assign the cost of

[7] 2003 Oregon Highway Cost Allocation Study, Volume II, Issue Paper 8 (April 2002, Revised), Prepared for the Oregon Department of Administrative Services, Prepared by the Oregon Department of Transportation, Transportation Development Division, Policy Section and ECONorthwest.

subsidies focus less or not at all on the policy goal or reason for the subsidy. At one extreme, the cost of the subsidy associated with vehicles in each 2,000-pound registered or declared gross weight class could simply be assigned back to the full-fee-paying vehicles in that same weight class. This, however, would not be feasible with respect to evasion, since we do not know the exact amount of evasion associated with each individual weight class.

A possible middle approach might be to total the subsidy amounts associated with reduced-fee-paying light and heavy vehicles as a whole, and then assign these totals back to full-fee-paying light and heavy vehicles, respectively. This approach has some feasibility with respect to evasion, since we (a) know all evasion of the weight-mile tax is associated with heavy vehicles and (b) could make an estimate of registration fee and fuel tax evasion associated with light versus heavy vehicles. Again, though, this would require agreeing on reasonable estimates of the evasion associated with light and heavy vehicles as a whole.

Another approach is to treat the cost of subsidies as an overhead cost to be assigned in proportion to the cost responsibility of the full-fee-paying vehicles in each registered or declared gross weight class. This would leave the full-fee-paying vehicles' cost responsibility shares unchanged by the subsidy adjustment. This approach was proposed by the consultant team for the 1999 Oregon Study, but was not adopted by the SRT for that study. It would have some feasibility with respect to evasion, but again would require agreeing on the level of evasion to be treated as an overhead cost.

At the other extreme is the practice of past Oregon studies of treating the cost of subsidies to reduced-fee-paying vehicles as a common cost to be assigned to all vehicle classes on the basis of a relative use measure such as VMT. The argument for this approach is that the granting of these subsidies represents a public policy decision by the Legislature and therefore all vehicle classes should bear a proportionate share of this cost. It could be argued this same approach should be applied to the costs of tax evasion. At the present, evasion of truck taxes instead is handled by making the legitimate trucker pay for the tax-evading trucker through higher weight-mile rates. Having said this, though, it is difficult to argue evasion represents or results from an explicit public policy decision.

Treating the cost of evasion in the same way as the cost of subsidies to reduced-fee-paying vehicles would likely increase the light vehicle responsibility share and reduce the heavy vehicle share. One can argue it would make the treatment of evasion and subsidies more consistent. This approach has a certain level of logic, but would require assuming the level of evasion or reaching agreement on a reasonable "best estimate."

Conclusions and Recommendations

Previous examinations of this issue have concluded that there is no completely satisfactory way to deal with evasion in a highway cost allocation study. Several possible approaches have been presented, but all have drawbacks. The primary problem with all these approaches is that they first require more detailed knowledge of the level and form of evasion than is presently available, or at least agreement on reasonable best estimates. Therefore, staff did not necessarily recommend any of these options.

Given the lack of new data on evasion, this basic recommendation remains unchanged. However, it is hoped that the NCHRP study may lead to improved estimates of fuel tax evasion and that further data on evasion of the weight-mile tax will become available.

Issue Paper 7:

External (Social) Costs and Highway Cost Allocation

Mike Lawrence and Jon Skolnick, Jack Faucett Associates

Introduction

Previous Oregon Highway Cost Allocation Studies (HCAS), as well as the studies conducted by most other states, have chosen to allocate direct governmental expenditures and exclude external costs associated with highway use. The proponents of a cost-based approach argue that, to be consistent, a HCAS should include all costs that result from use of the highway system. They further argue that correct, economically efficient pricing of highways requires the inclusion of all costs, and that failure to do so encourages an over-utilization of highways. Including external costs would add to the breadth and completeness of the analysis, and could help determine appropriate user charges necessary to reflect these costs.

It is not clear, however, that the assignment of external costs is appropriately accomplished through highway cost allocation. External costs identified as related to highway use cover a wide range of cost categories. The strength of the argument for inclusion of these costs in a HCAS varies across categories. This issue paper discusses each of these commonly identified cost categories and the appropriateness of assigning these costs to classes of highway users as part of a HCAS. Included below are discussions of external costs associated with vehicle crashes, air pollution and congestion.

There are several disadvantages associated with including external costs in a highway cost allocation study. Although these costs represent real costs to society, they are decidedly more difficult to quantify and incorporate in the analysis than are direct highway costs. Inclusion of external costs therefore would increase the data requirements and complexity of the studies, and could reduce their overall accuracy. Further, the current process seeks to collect funds necessary to meet cash cost requirements to build, operate and maintain the road system. The collection of identified external costs from road users would require the selection of a fund disbursement system. As both quantifying external costs and identifying the affected parties are difficult, disbursement systems are problematic and challenge the HCAS goal of equitable cost assignment.

The 1996 Blue Ribbon Committee[1] recommended that Oregon studies continue to exclude social costs until such time as the state implements explicit user charges to capture these costs. Both the 1982 and 1997 Federal HCASs included some social costs in supplementary analyses. The 1999 Oregon Study recommended future studies include "a separate assessment of the impacts of proposed changes in highway user taxes on the total costs of highway use including all major external costs." The 2001, 2003 and 2005 studies made this same recommendation.

[1] In 1996, the Oregon Department of Transportation (ODOT) formed the Cost Responsibility Blue Ribbon Committee to evaluate the principles and methods of the Oregon cost responsibility studies and, if warranted, recommend improvements to the existing methodology. This eleven-member committee was chaired by the then Chairman of the Oregon Transportation Commission and included representatives of the trucking industry, AAA Oregon, local governments, academia, and Oregon business interests. The committee held a total of seven meetings and reached agreement on a number of recommendations for future studies. Since the trucking industry, in some cases, did not agree with the full committee recommendations, it was given the opportunity and elected to file a Minority Report that was included in the committee report.

Defining External Costs of Highways

Costs created by one party or group and imposed on other (non-consenting) parties or groups are external costs. External costs are those costs associated with an activity where the decision to undertake the activity involves only those costs borne by the undertaker and not costs (external costs) borne by others. In the case of highway travel, external costs are those costs imposed on other drivers, public agencies, or society as a whole. Common categories of external costs (also referred to as externalities) include:

- Environmental impacts including air and water pollution
- Climate Change impacts
- Energy exhaustion and foreign oil dependence
- Congestion
- Accident risks & safety costs
- Noise
- Land use impacts

In 2000, the FHWA conducted an additional analysis of external costs as an addendum to the 1997 Federal Highway Cost Allocation Study. This analysis was conducted as a result, in part, of a study by the Environmental Protection Agency on the costs and benefits of clean air. The FHWA study evaluated four categories of external cost. These categories were congestion, crash, air pollution and noise. These costs are not borne by the highway departments, but by system users and society in general. The chart below compares the marginal cost per mile estimates developed by the FHWA to marginal pavement costs contained in the 1997 Federal HCAS for selected vehicle types and road conditions.

Kip = 1000 pounds.

In the 1997 HCAS and the subsequent 2000 addendum, FHWA estimated the total highway program cost as well as the external cost borne by highway users and non-users. These data show that for the four categories of total external costs, crash cost is far and away the most costly component of these external costs, accounting for about seventy five percent of the total.

FHWA Estimated Year 2000 High, Mid-Range, and Low Estimates for Social Costs of Motor Vehicle Use ($ Millions)

	High	Mid-Range	Low
Congestion	$181,635	$61,761	$16,352
Crash Costs	$839,463	$339,886	$120,580
Air Pollution	$349,100	$40,443	$30,300
Noise	$11,446	$4,336	$1,214
Total	$1,533,344	$446,319	$170,246

Estimates of external costs are characterized by the large ranges illustrated by the table above, reflecting the high degree of uncertainty in the estimates. For example, the Texas Transportation

FHWA Estimated Year 2000 Pavement, Congestion, Crash, Air Pollution, and Noise Costs for Illustrative Vehicles Under Specific Conditions

	Cents per Mile					
Vehicle Class/Highway Class	Pavement	Congestion	Crash	Air Pollution	Noise	Total
Autos/Rural Interstate	0	0.78	0.98	1.14	0.01	2.91
Autos/Urban Interstate	0.1	7.7	1.19	1.33	0.09	10.41
40 kip 4-axle S.U. Truck/Rural Interstate	1	2.45	0.47	3.85	0.09	7.86
40 kip 4-axle S.U. Truck/Urban Interstate	3.1	24.48	0.86	4.49	1.5	34.43
60 kip 4-axle S.U. Truck/Rural Interstate	5.6	3.27	0.47	3.85	0.11	13.3
60 kip 4-axle S.U. Truck/Urban Interstate	18.1	32.64	0.86	4.49	1.68	57.77
60 kip 5-axle Comb/Rural Interstate	3.3	1.88	0.88	3.85	0.17	10.08
60 kip 5-axle Comb/Urban Interstate	10.5	18.39	1.15	4.49	2.75	37.28
80 kip 5-axle Comb/Rural Interstate	12.7	2.23	0.88	3.85	0.19	19.85
80 kip 5-axle Comb/Urban Interstate	40.9	20.06	1.15	4.49	3.04	69.64

NOTE: S.U. = Single Unit, Comb. = Combination; Air pollution costs are averages of costs of travel on all rural and urban highway classes, not just Interstate. Available data do not allow differences in air pollution costs for heavy truck classes to be distinguished.

Institute in its most recent annual congestion study estimated the cost of congestion in 2003 to be over $60 Billion. This uncertainty is particularly problematic for the assignment of responsibility and the collection of appropriate and equitable user fees.

External Cost: Accident (Crash)

The operation of motor vehicles results in vehicle crashes that cause property damage, personal injury and death. These costs are substantial, accounting for about seventy-five percent of the social cost identified in the FHWA study. Vehicle operators bear these costs in the form of operator insurance premiums and as crash costs not reimbursed by insurance. Some crash costs are internalized by actions of the highway departments through improving roadway design and the addition of added safety features and technology. These costs are part of the current cost allocation process.

Crash costs are well known, but it is not clear that actions beyond improved roadways, law enforcement and insurance requirements are necessary. Much of these costs are internalized with highway expenditures and insurance.

External Cost: Air Pollution

The operation of motor vehicles that burn fossil fuels results in engine emissions and air pollution. Air pollution is known to decrease life expectancy, lower the quality of life and have other impacts on the exposed population. These societal costs are not generally borne by the vehicle operator. The Clean Air Act and its Amendments provided government with the authority to set emissions standards for motor vehicles. To meet these standards vehicle manufactures redesigned engines and exhaust systems adding cost to the production of the vehicles. This process internalizes part of the cost of vehicle based air pollution by requiring users to pay higher vehicle prices and reducing emissions.

Modern motor vehicles still emit harmful emissions and impose societal costs, but including these air quality costs in the HCAS is problematic. These costs are uncertain and they have the unusual characteristic that, for the most part, those that cause the costs (vehicle operators) are those that bear the costs (society). The costs become external to individual groups as users are separated from non-users and disaggregated by vehicle type, time, location and other factors. In addition, the incidence of the impacts is difficult to assign. Emissions in areas with limited population may have much smaller impacts then emissions in densely populated areas. Some pollutants are harmful in localized areas while others impact entire regions.

Greenhouse gas emissions have caused more recent concern. These emissions are not regulated by the Clean Air Act, but are directly related to the amount of fossil fuel burned. Thus the CAFE standards that have mandated higher average fleet fuel efficiency by vehicle manufactures serve to internalize some of these costs. The demand for oil for motor vehicles also creates an oil security cost that is not reflected in the cost of oil. This cost includes the economic risk of oil import interruption and the balance of trade impacts on the US economy from imported oil.

External Cost: Congestion

The national transportation system suffers from excessive road congestion. Urban and suburban area drivers suffer tens of billions of dollars of cost impacts each year from wasted fuel and time stuck in congestion. Each vehicle operated during peak congested periods imposes external costs on all other vehicles by contributing to congestion. Similar to the air pollution impacts, congestion costs have the unusual condition that those who impose the costs on others bear the costs that others impose on them.

Congestion results when the number of vehicles arriving at the highway system exceeds its capacity. Traffic engineers describe the condition as breakdown.

Engineers describe the speed-flow curve as depicting what happens to highway systems when arrivals exceed capacity. Initially, as arrivals remain below the road capacity, speed is maintained but lane throughput grows. However, as the frequency of arrivals increases during rush hour, interaction between vehicles increases and the road reaches breakdown. In breakdown, speeds and throughput fall as the road can no longer carry its capacity.

The Highway Capacity Manual reports highway lane capacity as up to 2400 vehicles per hour. However, when a highway is in breakdown, the throughput falls to around 1200 vehicles per hour. These capacity values vary depending on the specific road, operations and other characteristics. Researchers at the University of California, Berkeley have studied this phenomenon by analyzing massive amounts of traffic data collected on Southern California freeways. This research empirically demonstrates that as arrivals increase, speed falls and throughput is decreased. Even after arrivals begin to diminish, recovery to full capacity is slow.[2]

Billions of dollars are invested annually in developing and maintaining highway capacity. However, with too many users trying to use the system during the same time period, as much as half this capacity is lost when it is most needed during rush hour. Traffic engineers recognize this impact of excessive arrivals and have designed traffic control measures called ramp meters. These meters monitor vehicles wishing to enter the freeway and control system arrivals to the design level, thus maintaining throughput capacity. While ramp meters offer improved flow and capacity on the freeway, problems with ramp congestion clog arterials and cause emissions hot spots.

There is a better solution, using efficient road pricing to internalize congestion costs. Priced road systems maintain flow by charging prices for road use that vary with the frequency of arrivals. Higher prices discourage some drivers and those who are willing to pay the current rate find free flow operating at the speed limit for a more rapid trip. This process leads to a great increase in effective rush hour capacity, maintaining freeway capacity of about 2400 vehicles per hour instead of the breakdown rates of about 1200 vehicle per hour. These values vary with specific road characteristics, road capacity that could be recovered through efficient pricing, range between 35 and 50 percent of potential capacity. Efficient road pricing greatly improves road conditions so that consumers can get the full value of existing capacity and greatly reduce congestion and the associated external costs.

Conclusions and Recommendations

External costs are an important consideration in evaluating the equity of the current highway transportation system. The primary responsibilities of the Oregon HCAS are 1) to document the money expenditures by ODOT and other agencies to build, operate and maintain the Oregon road system and 2) to develop fair user fee systems and rates that assign the cost to appropriate user groups. External or social costs are true costs borne by society and individuals as a result of vehicle operation. Some external costs are monetary costs, such as health expenditures, and some are non-monetary, such as lost time. External costs often require estimation procedures that produce results with large error bounds and there is difficulty in assigning costs to specific user groups.

The previous four Oregon HCAS have recognized the importance of external costs and have recommended further study. That situation has not changed for the 2007 study. External costs remain important, yet there is far too much uncertainty to include these costs in the allocation. Some external costs are identified and addressed in the highway planning process. For example,

[2] Chen, C. and Varaiya, P., "The freeway congestion paradox." *Access*, No. 20 (Spring 2002).

noise and safety costs are addressed by design modifications and sound walls. These costs are included in the allocation process as they are part of the highway budget.

Several types of highway external costs have been internalized through regulation and consumer demand. For example, the improved safety and fuel efficiency of motor vehicles have resulted from government regulation and shifting consumer preferences. Air quality considerations have also led to regulated changes in the specifications of gasoline and diesel fuel. It is not always clear that changing existing user fees is the most logical and efficient method for internalizing external costs. Changes in vehicles, fuels and driver behavior (e.g. driving habits, vehicle preferences) may be far preferable to modifications in user fees.

In those cases where social cost mitigation has occurred (such as wildlife highway crossing tunnels), these costs should be treated as enhancements and allocated by VMT or another appropriate allocator. In cases where no mitigation has occurred, the estimated non-mitigated or partially mitigated external costs should not be included in the HCAS and the SRT should encourage further study to better identify and specify these costs.

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Issue Paper 8:

Equity and Highway Cost Allocation

Mike Lawrence and Jon Skolnick, Jack Faucett Associates

Introduction

> "Concepts of equity and fairness are at the heart of tax policy. Political leaders pay homage to these ideals in virtually every sphere of lawmaking and regulation. Citizens, moreover, are keenly sensitive to arguments about fairness in almost every policy debate… No other standard reaches the lofty status of equal justice in the affairs of government or the souls of humans. While conflicts abound, they are much more likely to arise over how to apply the principle consistently, how to measure who are equals, and the extent to which compensation or special consideration should be applied to those who are different along some scale of fortune, need, or ability."[1]

The fairness of highway taxes and user fees is an issue that has received increased attention in recent years. For example, the concept of "environmental justice" assesses whether poor and minority populations, particularly in urban areas have been forced to shoulder an unfair proportion of the economic and heath burdens of motor vehicle operations and highway development. Similarly, the recent increases in the use of toll financing especially those in the form of peak user charges, have come under attack as allowing the rich a smooth ride while the poor suffer. High Occupancy Toll (HOT) lanes, which allow solo drivers to pay for the right to travel in underutilized High Occupancy Vehicle (HOV) lanes, have been unflatteringly labeled as "Lexus lanes."

Traditionally, highway cost allocation has focused on the fairness of highway user fees by vehicle class. The principal focus is on the degree to which light and heavy-duty vehicles pay their "fair" share. In fact, there are numerous dimensions along which fairness might be measured. Examples might include income class or race of users, peak versus off-peak, purpose of trip, urban-rural, or geographic zones. Moreover, highway cost allocation compares equity for the aggregate vehicle class. One might also be interested in examining whether individual users within a class are treated fairly.

Equity in Current HCAS Studies

Highway user fee payments and the highway cost responsibility of different vehicle classes are evaluated in the traditional highway cost allocation study. The equity of highway user fees are analyzed by evaluating how well user fees match cost responsibility for various groups of vehicles. Equity is measured by comparing user fees paid by vehicles in each class to highway costs attributable to each class. The ratio of revenues to costs is called an *equity ratio*.

An example of this calculation is provided in the Federal Highway Cost Allocation Study.[2] If vehicles in a particular class pay

[1] And Equal (Tax) Justice for All? C. Eugene Steuerle, Originally published in Tax Justice: The Ongoing Debate (2002, Urban Institute Press), edited by Joseph J. Thorndike and Dennis J. Ventry Jr.

[2] 1997 Federal Highway Cost Allocation Study - Final Report, (Chapter 6), Federal Highway Administration, U.S. Department of Transportation, Washington D.C., August 1997.

20 percent of total highway user revenues and are responsible for 18 percent of total highway costs, their equity ratio is 1.11 (0.20 divided by 0.18). The closer an equity ratio is to one, the more nearly user fees match cost responsibility. A ratio greater than one means that user fee payments exceed cost responsibility and that a vehicle is overpaying its cost responsibility. A ratio less than one indicates that user fees do not cover the cost responsibility of vehicles in that class and that those vehicles are underpaying their cost responsibility.

Comparing equity ratios across vehicle classes is often described in highway cost allocation studies as a measure of the "vertical equity" of the highway user fee structure.[3] Equity ratios among vehicles within the same class also can vary considerably, however, and those variations must also be considered in evaluating approaches to improve overall user fee equity. The factors that affect horizontal equity include vehicle weight, annual mileage, vehicle price, type of roads traveled on, use during peak hours, and other characteristics that affect either user fees paid by different vehicles or their cost responsibility. According to the Federal Highway Cost Allocation Study, "the most significant of these factors at the Federal level is generally weight, but differences in annual mileage and vehicle price also can affect equity ratios. Annual mileage is a more important factor at the State level where registration and other fees that are invariant with mileage represent a greater portion of total user fees than at the Federal level."[4]

Defining Equity

There is a primary distinction in economics between efficiency (maximizing net benefits) and equity (how costs and benefits are borne). Equity is the measure of fairness or justice in economics, particularly in terms of taxation and welfare economics. Society is concerned with the distributional consequences of policies because there is often a desire to avoid policies that may unfairly impact the poor or favor one region over another. Public policy often requires making choices between alternatives with multiple efficiency and equity impacts. In many cases there is a trade-off between these two objectives. In evaluating any particular public policy, the dimensions of efficiency and equity are often intertwined, but they can often be separated analytically.[5]

Within equity, vertical (the distribution of income) and horizontal (equal treatment of equals) impacts are normally distinguished. Horizontal equity is the idea that people with a similar ability to pay should pay the same or similar amounts. It is related to the concept of policy neutrality or the idea that the public systems such as taxes should not discriminate between similar things or people, or unduly distort behavior.

Vertical equity is the idea that people with a greater ability to pay should pay more. If they pay more strictly in proportion to their income, a tax is called a proportional tax; if they pay disproportionately more then the tax is progressive, and if they pay disproportionately less the tax is regressive

Horizontal Equity

Consider the case where two individuals of the same age, income, and race live next to each other. They own the same car and travel the same distances at the same times

[3] Note that this definition of vertical equity is different from that generally used in other, economic, tax and public policy studies–. The term vertical equity usually implies a comparison across income classes–. This definition is discussed in more detail in the following section of this paper.

[4] 1997 Federal Highway Cost Allocation Study - Final Report, (Chapter 6), Federal Highway Administration, U.S. Department of Transportation, Washington D.C., August 1997.

[5] This discussion is adapted from: Distributional Impacts of Congestion Pricing, Douglass B. Lee, Jr. (U. S. Department of Transportation Volpe National Transportation Systems Center Cambridge, MA) Prepared for the International Symposium on Road Pricing, November 19-22, 2003, Key Biscayne, FL.

on similar roads. However, one is a toll road and the other is not. Note that in this case, like individuals are not treated alike, thus violating the principal of horizontal equity.

Consider another case where the same two individuals pay the same amount of fuel taxes, but one drives a gas guzzler on a congested urban highway at peak hours while the other drives a fuel efficient car on an empty road during off-peak times. Note that in this case individuals who pay identical taxes receive different benefits and have different impacts on society, thus violating the principal of horizontal equity.

While we all might agree that like individuals should be treated alike and that those who place a higher burden on society should pay more, our current system of charging motorists and evaluating the fairness of user fees (highway cost allocation) cannot examine every dimension for every user. However, more sophisticated highway fee charging systems hold the promise of improving horizontal equity. There are currently systems being tested domestically and in place internationally that track vehicles using GPS. Charges are then based on vehicle characteristics, miles traveled by that vehicle on specific roads. Charges may also vary by the level of congestion or time of travel. In the meantime, the data and methodologies used in highway cost allocation are not robust enough to examine and compare each individual user, although user groups can be sub-divided along additional dimensions beyond vehicle class. Analysis of user characteristics along these dimensions can lead to user charges that improve both horizontal and vertical equity.

Income Class

Particularly when examining automobile users, policy makers may want to know how progressive or regressive both current as well as alternative highway user fees are. Do they increase or decrease with income class? Are they a higher or lower share of income for different income classes?

The rising expense of transportation has caused a variety of groups to raise the issue of the affordability of transportation for the poor. One set of groups has noted that:

> "Transportation costs in 2003 claimed 19.1 percent of all household expenditures, the second highest level in a 20-year period. Importantly, this expenditure level predates more recent hikes in gas prices, suggesting that current and future transportation costs are headed even higher. As recently as the early 1960s, when the U.S. was already turning to the automobile for a greater share of all transportation trips, yet still had more compact communities and higher levels of public transit use and walking, families spent about one out of every ten dollars for transportation, as compared to nearly one out of every five dollars in 2003. Combined, the costs of transportation and housing account for 52 percent of the average family's budget, which explains why there is growing public debate on the need for policies that address these issues in tandem. Health care, which has been the subject of much recent public debate, and food are the third and fourth highest expenses, but even when combined they are still less than transportation."[6]

The Transportation Research Board identified equity as one of the critical issues in transportation. Their report notes that:

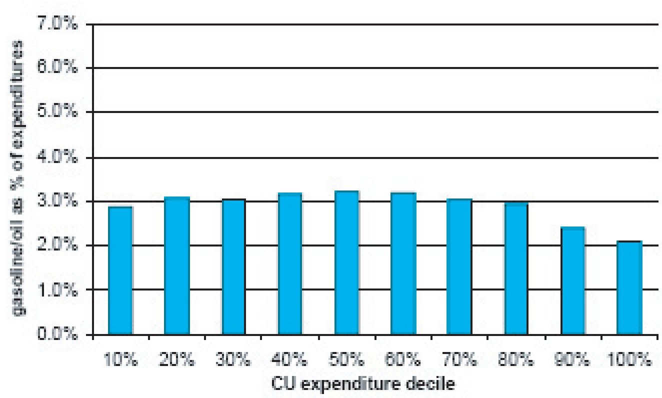
> "A passenger transportation system dominated by the automobile generates challenges for those with limited incomes or

[6] Driven To Spend: Pumping Dollars out of Our Households and Communities, Center for Neighborhood Technology and the Surface Transportation Policy Project, June 2005.

physical disabilities or for those who do not drive. The cost of transportation is growing: in the past decade, the percentage of income devoted to transportation increased by almost 9 percent, which has placed a burden on those with the lowest incomes."[7]

Some types of highway user fees are more regressive than others. Registration fees, which are often the same for all autos, are highly regressive as a share of income. Gas taxes tend to be less regressive than registration fees, as individuals in higher income groups tend to travel more. However, as travel does not rise as fast as income, even gas taxes tend to be slightly regressive as a percentage of income, especially in the highest income classes. As shown in Exhibit 1, gasoline and oil purchases represent about three percent of income for all but the two highest income deciles where they fall to approximately two percent of total expenditures. Fees based on vehicle purchase prices or property based taxes also tend to be less regressive than flat registration fees, although, like gasoline taxes, these fees also often do not rise as fast as income.

Exhibit 1: Gas and Oil Expenditures as a Share of Income by Deciles, 1999.[8]



This type of analysis, however, only considers the user charges. Equity analysis should also consider benefits to the users.[9] For example, consider a case where a large portion of highway taxes go to building a new highway in a wealthy suburban area that allows commuters to speed downtown during rush hour. Such spending would primarily benefit upper income classes, impacting the fairness of highway taxes. This specific spending pattern may result in lower income classes cross-subsidizing upper income classes.

It is theoretically possible to measure the extent to which users in different income classes pay for the highway system and receive its benefits. Vehicle owners can be divided into income classes and their contributions to revenues can be measured based on the types of vehicles they own and their travel characteristics. Expenditures for modernization, preservation, maintenance and operations can be allocated based on vehicle travel on different segments of the road system. Overhead charges for administration and planning can be allocated based on overall use of the system.

For example, a paper on the distributional impacts of congestion pricing compared gas and oil expenditures to peak highway trips by income deciles.[10] The results of the analysis are

[7] Critical Issues in Transportation, Transportation Research Board, January 2006.

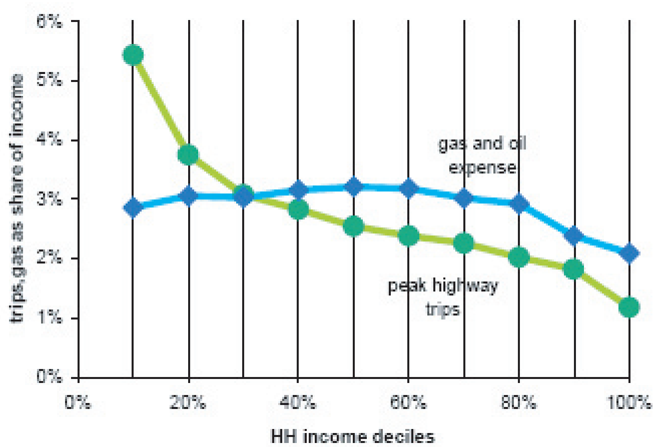
[8] This chart was taken from: Distributional Impacts of Congestion Pricing, Douglass B. Lee, Jr. (U. S. Department of Transportation Volpe National Transportation Systems Center Cambridge, MA) Prepared for the International Symposium on Road Pricing, November 19-22, 2003, Key Biscayne, FL. The original source of the data in the exhibit was the Bureau of Labor Statistics, Consumer Expenditures in 1999.

[9] For an excellent discussion of equity and its application to expenditures see: And Equal (Tax) Justice for All? C. Eugene Steuerle, Originally published in Tax Justice: The Ongoing Debate (2002, Urban Institute Press), edited by Joseph J. Thorndike and Dennis J. Ventry Jr.

[10] Distributional Impacts of Congestion Pricing, Douglass B. Lee, Jr. (U. S. Department of Transportation Volpe National Transportation Systems Center Cambridge, MA) Prepared for the International Symposium on Road Pricing, November 19-22, 2003, Key Biscayne, FL.

shown in Exhibit 2. The paper concluded that the impact of switching from gas taxes to congestion tolls would at worst be only mildly regressive. This paper, however, only examined the number of trips, not the length or direction of those trips. If individuals in higher income groups tended to have a longer journey to work and lower income groups tended to reverse commute, a finely tuned congestion pricing scheme that charged by the mile and direction of travel could easily be less regressive than fuel taxes.

Exhibit 2: Comparison of Income Shares for Peak Travel and Gasoline[11]



In general, the data requirements to compare equity by income class would be more onerous than the current data requirements for highway cost allocation. Instead of treating auto users as a single group there would be a need to subdivide these users into as many as five to ten subgroups. Data on the types of vehicles owned and fuel efficiency for those vehicles would have to be collected. Miles traveled by functional class of road or even specific road segments would have to be developed. If congestion charging schemes were to be analyzed, data on travel in peak hours under congested conditions (reflecting a lower level of service) by income class would have to be estimated.

Much of this data is available in travel models already developed for most urban areas. However, these models tend to be different for each urban area and as such the quality of the data may vary considerably across models. In addition, the Oregon statewide transportation and land use model may contain some of the necessary data. The model integrates economic, land use and transportation elements across the entire state. The model simulates land use and travel behavior mathematically using several computer programs, feeding results from one sector to the next over time. This results in a dynamic and price sensitive representation of state economic activity that simulates how businesses and households respond to change.

Many of the arguments against the more efficient congestion pricing schemes favored by economists are based on equity grounds. These popular concerns about vertical equity are often based on a weak understanding of theory and little or no empirical evidence. This is unfortunate because useful theory and a large amount

[11] The source of the data on peak highway trips by income is the 1995 National Personal Transportation Survey (NPTS). Data on the distribution of income is tabulated by deciles (i.e., ten income classes). The NPTS travel database was queried to extract households with selected characteristics with the following attributes selected:

(1) Mode = auto, SUV, van, or pickup

(2) Start Time = 6:30 to 9:30 AM and 3:30 to 7:00 PM

(3) Travel Day = weekday

(4) Place = urban, suburban, or second city (not town or rural or undetermined)

Based on these attributes, 52,000 trips are selected out of a total of 409,000 trips. The paper notes that these trips probably encompass most peak travel, but (with respect to peak pricing) erroneously include travel in the non-peak direction, do not distinguish the level of congestion, and assume vehicle occupancy is the same across income classes. The income characteristics of the household can be associated with each trip.

of data are available that could generate conclusions that would improve public decision-making.

Race

A 1994 Presidential Executive Order directed every Federal agency to make environmental justice part of its mission by identifying and addressing the effects of all programs, policies, and activities on “minority populations and low-income populations.” Environmental justice and Title VI are not new concerns. Today, because of the evolution of the transportation planning process, they are receiving greater emphasis. Effective transportation decision making depends upon understanding and properly addressing the unique needs of different socioeconomic groups. There are three fundamental environmental justice principles:

- To avoid, minimize, or mitigate disproportionately high and adverse human health and environmental effects, including social and economic effects, on minority populations and low-income populations.
- To ensure the full and fair participation by all potentially affected communities in the transportation decision-making process.
- To prevent the denial of, reduction in, or significant delay in the receipt of benefits by minority and low-income populations.

The recipients of Federal-aid have been required to certify, and the U.S. DOT must ensure, nondiscrimination under Title VI of the Civil Rights Act of 1964 and many other laws, regulations, and policies. State DOTs are at the heart of planning, design, construction, and operations and maintenance projects across all travel modes. They also allocate resources from various Federal-aid programs. State DOTs successfully integrate Title VI and environmental justice into their activities when they:

- Develop the technical capability to assess the benefits and adverse effects of transportation activities among different population groups and use that capability to develop appropriate procedures, goals, and performance measures in all aspects of their mission.
- Ensure that State Transportation Improvement Program (STIP) findings of statewide planning compliance and National Environmental Policy Act activities satisfy the letter and intent of Title VI requirements and environmental justice principles.
- Enhance their public-involvement activities to ensure the meaningful participation of minority and low-income populations.
- Work with Federal, State, local, and transit planning partners to create and enhance intermodal systems, and support projects that can improve the natural and human environments for low-income and minority communities.[12]

The Transportation Research Board’s Critical Issues in Transportation noted that:

> “Disadvantaged populations also bear the brunt of negative side effects from transportation facilities. In urban areas, the adverse health effects of vehicle emissions disproportionately affect members of ethnic, low-income households, who are more likely to reside near freeways, ports, intermodal facilities, or airports.”[13]

[12] This discussion of environmental justice is derived from the following brochure: An Overview of Transportation and Environmental Justice, Publication No. FHWA-EP-00-013, Federal Highway Administration, U.S. Department of Transportation, Washington D.C.

[13] Critical Issues in Transportation, Transportation Research Board, January 2006.

The same principles that govern environmental justice can be analyzed in a highway cost-allocation setting. Findings for automobile users can be subdivided and displayed based on race and, as discussed above, income class. Data demands for a raced-based analysis are somewhat more demanding than for income groups. Travel demand models can be analyzed for data on travel patterns for racial groups or for geographical areas with high minority populations.

Peak Versus Off-Peak

The increasing levels of congestion, especially during peak rush hour periods, has led to increased interest in congestion pricing, whereby higher tolls are placed on drivers who choose to use the system during these periods. Drivers who use roads during these periods impose congestion costs both on themselves and other drivers. Congestion costs are defined as the incremental costs that users' vehicles impose on the performance of the traffic stream in which they operate. An individual user bears their portion of this cost by being delayed. But the individual's presence in the traffic stream also imposes costs in the form of additional delay on all other users. Due to the high cost of adding additional lanes in urban areas, it is difficult to mitigate these costs. Congested travel also increases fuel use and emissions.

Highway cost allocation could potentially examine the degree to which peak and off-peak users meet their cost responsibility. User fees that do not vary with travel would be allocated based on VMT, while fuel tax revenues would be allocated based on fuel efficiencies for different travel speeds. Expenditures that relate to capacity additions would be assigned solely to peak hour travel.

The most difficult data issues would revolve around the analysis of information on vehicle speeds and vehicle class mixes during different periods of the day. Fuel efficiencies at different speeds would also be important to the analysis.

One set of thorny issues would be defining peak and off-peak hours. Different roads have different peak hours and the length of the peak varies by road segment. On some road segments, such as roads to tourist destinations, peak hours may not be the traditional rush hours, but rather may include weekend hours such as Saturday mornings and Sunday nights.

Some of the biggest impacts of congestion include increased travel time, increased energy use and increased emissions. Many of these costs are not considered in traditional highway cost allocation. Decisions about how to handle such costs will have a great influence on the results of the analysis.

Urban Versus Rural

There is a great disparity between urban and rural roads in terms of congestion. In many urban jurisdictions additional sales and gas taxes have been imposed in order to add capacity. In many state legislatures there is a constant tug-of-war between urban and rural areas for transportation as well as funding for other programs.

Highway cost allocation could potentially examine the degree to which urban and rural users cover or fail to cover their cost responsibility. This could potentially inform the public process on where to spend scarce dollars for capacity additions.

A potential problem in the analysis is that many individuals drive in both urban and rural settings. A logical method must be developed to allocate both user fees and cost responsibilities between the two geographical areas.

In terms of data needs, VMT data is available by functional classes, which are differentiated along an urban and rural dichotomy. Data are available on the location of individual projects by type (rehabilitation, etc.) so that the costs of these projects can be allocated as urban or rural. Registrations and fuel sales are available at the county level allowing these items to be identified as urban or rural as well.

Geographic Zones

Highway cost allocation could also examine equity by geographical zones other than the urban and rural split. For example, registrations by county are currently used to distribute state funds by county. An examination of the equity of this allocation could be conducted using cost allocation tools and data.

Conducting the analysis at the county level would have similar data requirements and analytical problems as the urban-rural split. One additional problem, however, is that VMT data by functional class are not available at the county level. These data would have to be estimated, resulting in additional uncertainty in the results.

Equity and Alternative Fee Vehicles

Some motor vehicles have, as a matter of public policy, been made exempt from the payment of certain highway user fees or levied fees on an alternative, reduced schedule. Such vehicles include State or other government vehicles, public transit vehicles, school buses, and some farm vehicles.

From an equity standpoint, vehicle exemptions raise the issue of who benefits from these exemptions. If the incidence of the purported benefits of the exemptions could be established, costs related to these vehicles could be assigned to the beneficiaries of these exemptions. Hypothetically, for example, parents of school children using exempt school bus transport could be assigned costs and benefits equal to the capacity and operating cost impacts of this service on the highway system. As a practical matter, the pattern of subsidies and their incidence is extremely complex and as such assignment of these dollars to beneficiaries in the evaluation of equity may be extremely cumbersome relative to the value added.

Conclusions and Recommendations

Highway cost allocation has primarily focused on the fairness of highway user fees by vehicle class. In fact, there are numerous dimensions along which fairness might be measured. These measurements can help policymakers design policies for the use of tolling and congestion fees, design policies that serve the goals of environmental justice, allocate funds between urban and rural areas or other political jurisdictions, and design future taxation strategies that lead to greater horizontal equity.

There are a variety of dimensions along which equity can be measured. As more dimensions are considered, it becomes increasingly difficult to design a set of user fees that would result in equity across all of the dimensions. In addition, the quality of data that is available to measure equity varies greatly across the various dimensions and these differences should be considered in evaluating the importance of considering a particular dimension.

It is also less than clear what would constitute equity. While most would agree that trucks and autos should each meet their cost responsibility, it is not as clear how progressive highway user fees should be with respect to income. Is it enough that all users pay their cost responsibility or should users devote a similar proportion of their income? Plans to impose congestion tolls and convert HOV lanes to HOT lanes are often thwarted early in the process based on equity concerns. However, these are often emotional pleas that are not based on proper theory or data. Better data on the equity of alternative highway finance schemes may allow for improvements in public policy.

Given the number of possible dimensions available, the first step would be to ascertain whether members of the Study Review Team have a preference to examine results along one dimension over another. If there is a consensus as to one or two dimensions, further study should be conducted to examine the data and methodologies that would be employed.

Peer Reviewer Comments on Issue Papers and Responses from Authors

Peer Reviewers:

David J. Forkenbrock – Public Policy Center, University of Iowa
Anthony M. Rufolo – School of Urban Studies and Planning, Portland State University

Issue Paper 1: Cost Versus Expenditure

Forkenbrock: The issue paper on costs or expenditures is well conceived. Oregon has a legacy for assigning highway costs on the basis of the costs incurred by each class of vehicle. The 2007 Highway Cost Allocation Study (HCAS) is intended to meet a constitutional mandate to produce equity ratios and assess whether current taxes and fees are consistent with the mandate.

This issue paper wisely focuses on expenditure allocation to vehicle classes. This approach avoids the messy question of optimal investment levels. It makes sense to me to focus on the central question of how future expenditures – whatever level they may be – should be assigned to the respective vehicle classes. My own opinion is that trying to compare the two separate and complex issues of expenditures and costs associated with optimal investment decisions would be a mistake.

Rufolo: The paper is correct in noting the many problems with trying to actually allocate "cost" rather than expenditure. However, the paper fails to clearly identify what "cost" would be allocated under alternative systems. For example, in arguing that users should be "charged" with a fee that represents marginal cost, they state "A cost allocation approach, on the other hand, would allocate the costs imposed by vehicle class for each facility using traffic data and estimates of the damage caused by each vehicle, regardless of the level at which expenditures are budgeted." However, most of the cost during congested periods is delay of other drivers. This delay cost has no direct relationship to the cost of building and maintaining the road system, although the implication in the wording of the paper is that the cost is associated with the damage caused. It is generally accepted that if an efficient marginal cost pricing system were in place, the optimal amount of capacity would differ from what should be built for an un-priced system. Hence, the cost being allocated would not have any clear relationship to the actual cost incurred in building and maintaining the road system. Further, the use of marginal cost pricing would allow users to travel faster, thus compensating them for some of the cost associated with the charge. To use this cost to determine how much should be contributed ignores the fact that the time cost is actually paid by users. Thus, the equity of charging users for the time cost that they bear seems quite questionable.

Another perspective on the cost versus expenditure approach is that the expenditures are based on current and projected usage patterns. The expenditures will have been made whether or not the projected levels of usage are correct. Hence, one can argue that it is the projections that drive cost as much as actual future usage. Future usage may affect the need for maintenance or expansion but it cannot change what has already been spent. For example, a new road might end up being unused. The "cost" approach would say that there is no cost associated with this road while the expenditure approach acknowledges that there was a cost in building it and that cost was driven by the use projections made at the time of the expenditure on the road.

Author's response: As noted in the paper, the total cost of building and maintaining a highway system includes congestion costs imposed and experienced by users. These delay costs would, ideally, be allocated. Further, the allocation of resources to the state highway system will differ from an efficient (in an economic sense) allocation to the extent that the highway finance system fails to address these congestion costs.

The major point of the paper is to distinguish the prospective expenditure allocation approach implemented in Oregon's HCAS from a true cost allocation that would attribute all costs, including the costs of congestion and delay. While the latter approach may not strictly conform to the statutory requirements for Oregon's study, a comprehensive cost allocation nonetheless provides a useful benchmark for evaluating whether users pay in proportion to costs imposed. Implementing marginal cost tolling is not a prerequisite for true cost allocation, but would, of course, affect the outcome.

We disagree with the characterization of marginal cost pricing as "quite questionable." First, the share of the marginal congestions costs borne by the marginal user is quite small, and the toll paid by this user should reflect the delay costs imposed on others. Second, an optimal marginal cost tolling system would reach equilibrium where the tolls paid by users reflect the marginal costs imposed given prevailing traffic conditions, regardless of the level of traffic that would exist absent the tolling scheme. It is true that any practical implementation would differ significantly from the theoretical optimum, and that costs imposed, revenue raised, and expenditures need not align. On the other hand, expenditure allocation ignores the actual costs imposed altogether.

Dr. Rufolo's final comment notes that future road usage may differ significantly from predictions, and that an expenditure-based allocation approach would better accommodate these differences. However, a prospective cost-based allocation would presumably rely on the same traffic forecasts as a prospective expenditure allocation. Looking forward to a future period, both cost and expenditure approaches would allocate responsibility based on the same projected road use. Once the road is built and actual use or non-use observed, studies of the period in which the road is built would differ depending on the allocation approach. The practical implication of any variation would depend on existing statutory requirements, funding mechanisms and budget processes.

Issue Paper 2: Non-project Costs

Forkenbrock: This issue paper argues for assigning overhead costs to individual projects in a proportional fashion to direct costs. The paper notes that overhead costs are "not marginalizable." I have studied willingness to pay as a theoretical means for assigning fixed costs among road users. The main problem is that there is not a functioning market and no incentive to reveal one's true willingness to pay. Lacking such a market and knowing as little as we do about demand elasticities of different road user groups, it makes sense to merely allocate overhead and other administrative costs as proportions of total VMT. The simplicity so gained is worth more than any minor refinements obtainable by struggling to learn about demand elasticities by different road uses.

Regarding the three alternatives for assigning collection costs, I definitely favor using the "overhead" approach whereby these costs are assigned as a proportion of allocated costs. In a separate study, it would make sense to compare the collection costs as percentages of revenue collected for alternative revenue sources. Revenue sources with high collection costs, all else equal, are less desirable. Collection costs are one criterion to consider when looking into new approaches such as mileage-based road user charges.

Rufolo: The allocation of non-project costs is indeed problematic. However, the simplest approach is probably the best in this case. For costs that do not have alternative allocation procedures, allocate non-project costs in proportion to cost responsibility in other areas. While overhead costs are not always directly proportional to project costs, it would seem that many overhead costs are roughly proportional to the relative size of different projects. More complex projects require more analysis, and so on. Even the example of copying costs used in the issue paper would seem to make this case. To the extent that copying relates to specific projects, more would be done for larger more complex projects than for simple ones.

I do not understand the issue with respect to collection costs. As the paper notes at the beginning, the cost of collecting the weight-mile tax should be allocated to heavy vehicles and the cost of collecting other taxes should probably be allocated as a percentage of revenue. It would seem to make more sense to allocate collection costs as a percentage of revenue collected rather than VMT. I see no clear relationship between VMT and collection costs, but there are incentives for revenue collectors to put more resources into collecting taxes and fees that generate larger amounts of revenue.

Author's response: The procedures advocated in Dr. Rufolo's comments are not entirely clear. We agree that larger, more complex projects generally require more overhead expenditures, than otherwise, but project size alone is not sufficient to allocate these expenditures across vehicle classes, particularly since some project-related expenditures cannot be associated with specific projects in the data. Preliminary engineering costs, for example, aren't tied to specific projects at the time when the costs need to be allocated, and some of the associated projects may never be built. The Oregon HCAS splits preliminary expenditures between modernization and preservation based on shares of direct project expenditures. The dollars are then allocated using allocators appropriate to those work types. This approach seems consistent with the reviewers' comments.

The paper notes that additional non-project costs could be more accurately allocated, but that doing so would require devoting more resources to accounting detail than would be warranted by the marginal gain in precision. Some copying and other administrative costs might fall into this category, but it isn't clear that allocating such costs on the basis of project size, as advocated by Dr. Rufolo, would necessarily result in an improvement over a VMT-based allocation. The fundamental problem remains that the relation between certain costs and specific projects is largely unknowable. As suggested, the simplest approach is probably best, and allocating these costs on the basis of VMT appears no worse than any other approach.

Finally, we agree with the reviewers that allocating collection costs on the basis of VMT is not ideal. The paper supports a transaction-based allocation of collection costs for two reasons. First, the number of transactions necessary to collect a particular type of revenue provides a better indication of collection costs than the size of individual transactions or the total amount of revenue raised. Second, transaction count data should be readily available in many cases. We have no evidence that collection costs vary independently with the share of revenue represented by a given source.

Dr. Forkenbrock correctly notes that implementing mileage-based user charges requires careful consideration of collection costs for the proposed system.

The paper incorporates minor revisions based on the above discussion.

Issue Paper 3: Federal and Local Issues

Forkenbrock: This issue paper addresses one of the most perplexing issues in state-level highway cost allocation—how the mix of funds from different levels of government and different programs within them should be treated. As the author notes, differences in eligibility for particular types of uses and differences in conventional applications of funding sources can be confounding when carrying out state-level highway cost allocation studies (HCAS).

In my opinion, the author has done a good job of laying out the elusive connection between funding by level of government and how the source should be treated in a HCAS. The author correctly stresses that the central issue is fungibility. I think the best approach to the matter of how various sorts of federal funds can be used is to develop a matrix of allowable uses of the funds and then attribute the costs to the vehicle classes occasioning the relevant costs. As a practical matter, the vast majority of federal funds are interchangeable with state funds, so fortunately the issue only exists at the margin.

I agree with the issue paper author that bonds with uses specified by legislative action should be separated from other funding sources in the HCAS. Having separated them, the costs that are met by these bonds can be assigned to vehicle classes that generate the costs.

The author does an excellent job of addressing the question of how the expenditure of federal and local revenues should be included. The four categories of funds are parsimonious and logical. How these categories should be treated also is handled very well. The real keys, of course, are to avoid double counting and to accurately estimate how the various vehicle classes contribute to the costs that are defrayed by the federal and local expenditures.

In the case of non-road user taxes, no credit can be given to the respective vehicle classes for defraying the relevant costs. Also, the local projects so financed really cannot be treated in the usual manner in a HCAS. Usually, that would imply that the local expenditures would be subtracted from state costs and not addressed further. The author's discussion is correct, in my opinion.

Overall, the author's analysis is conceptually on target, and it is nicely presented. When reviewing HCAS work, I try to deduce whether the underlying objective of these analyses is really being pursued, that being to assign to each vehicle class the relevant costs across the spectrum of road expenditures. This issue paper lends very useful guidance in accomplishing this central purpose.

Rufolo: The question of what to include in cost allocation when funding sources are interchangeable raises serious issues for cost allocation. In general, the recommendations made in this paper seem to make as much sense as any other. I only disagree with one point. The objective of the HCAS is to properly allocate costs based on state expenditures. As such, all state expenditures, including OTIA III, should be included. The issue for fungibility is simply whether federal or local sources could substitute for state funding, so it is only the fungibility of these sources that should be considered.

Author's response: The paper did not intend to state that OTIA III funds should not be included in cost allocation – only that if some funding is regarded as fungible and other as not fungible across the entire program, that OTIA III funds should be regarded as not fungible.

While the issue of fungibility starts with the question of federal and local sources, the analysis in the paper shows that application of the principle is more complex. Different assumptions about how federal and local funds may be used and the ability of the state to shift funds to compensate for availability of federal and local funds changes the outcome of the calculation. If a large amount of state funds are dedicated to a fixed use, such as replacement of specific bridges, then the state is limited in its ability to shift funds and the program may no longer reflect the allocation that would be made of all funds were interchangeable. If there is not complimentary fungibility on the State Highway Fund side it is important to consider whether there are programs or project categories funded by road user taxes which cannot be changed with increases or decreases in other funding categories. If there is such a program it would be OTIA III, which is fixed in both the type of projects to be constructed and the revenues that support it. The paper does not reach the conclusions that OTIA III should be treated as non-fungible, but does provide a procedure to calculate allocations if it were determined to be non-fungible.

The paper was revised to clarify the issues raised by the peer reviewers and the Study Review Team.

Issue Paper 4: Innovative Finance

Forkenbrock: This issue paper explores several of the most important considerations in matching new financing approaches with the findings of highway cost allocation studies with emphasis on the Oregon case. In its introduction, the paper mentions that Oregon is moving toward marginal cost as the cost allocation principle, rather than average costs as commonly are the basis for incremental cost allocation to respective vehicle classes. The necessary balancing of theoretical marginal costs and developing allocated costs to vehicle classes is subtle and can be difficult. To be sure, marginal cost pricing becomes increasingly important when one takes into account a greater array of cost categories. Including congestion costs is one basis for placing greater emphasis on the costs occasioned by passenger car equivalents (PCEs) under peak hours. Adding other social costs, energy security, and environmental costs, there really is no good alternative to applying a marginal cost approach to cost allocation. While much can be said for doing so, it is conceptually and methodologically complex.

The issue paper is very good in its assessment of three alternatives for allocating debt service and the treatment of debt-financed projects. I find most appealing (or least unappealing) the third one whereby depreciation is calculated for debt-financed projects and assigned to user groups and weight classes. Taking this approach, a new level of complexity would be introduced into cost allocation studies. I think this complexity would be justified only if debt financing is used sufficiently to require the assignment of debt service to vehicle classes.

The treatment of toll revenues is important to a contemporary state-level highway cost allocation study. Pricing toll facilities is a central policy issue, and it needs to be treated carefully. Specifically, if facility users are asked to pay a higher toll for higher-speed travel with much less potential for any delays caused by heavy traffic, the costs these users are assessed are generally established to produce a return for operators. The cost of service in such cases is really the capital, maintenance, and administrative costs averaged over the miles accruing on the facility by vehicle class. A problem is that facility users already have paid road user charges (i.e., motor fuel taxes), so the toll amounts to an additional fee presumably for premium service. How this toll payment should be structured across vehicle classes is an interesting dilemma – intuition says that PCEs would be a logical point of departure.

If the service provided on the tolled facility is on a par with that generally provided, it certainly appears that toll revenues must be folded into the state's cost allocation framework. The issue paper correctly stresses that shadow tolls could be used to compensate operators of the toll facilities but that double payment by users is a perplexing issue. The national experience in recent years suggests that many states are becoming comfortable charging tolls simply as a means for exacting additional revenue from road users as legislatures balk at raising other user charges. It stands to reason that in such cases, the total user charges paid by each vehicle class must be balanced against the costs occasioned. I return to the point that to the extent tolled facilities offer premium service, the cost of the service provided is higher so the toll facilities should be treated as a special element of a cost allocation study.

Rufolo: Bond financing raises the issue of whether to look at the actual usage of projects financed with bond proceeds and to re-allocate costs associated with the actual usage pattern rather than the projected usage pattern. While it is possible to make the case to change to this system for all highway projects, it seems inconsistent to do it only for bond financed projects. As has been pointed out in other contexts, this creates the potential for cost responsibility to change based on what may be an arbitrary determination of which projects were financed by bonds and which by current revenues. Unless all projects are subject to this review, it would seem to be incorrect to subject select projects to it. Further, the cost allocation process is often described as forward looking in that it allocates projected expenditures. These projected expenditures are based on actual usage patterns at the time, and a case can be made that the projection is what drives the cost allocation rather than what will actually occur. As any forecaster knows, the forecast may be wrong; but decisions made on the basis of that forecast may not be easy to change. It seems that this type of interpretation is most appropriate for the cost allocation studies. If a new road is built and no one actually uses it, any cost allocation becomes meaningless. The road was built because of projections of usage and the cost was incurred on that basis. Hence, I concur that continuation of the current procedure for allocating costs on debt-financed projects is appropriate.

Toll roads seem to fall into two possible categories. If the road is developed exclusively with private funds and paid for out of toll revenue, then it would seem to be outside of the cost allocation process. In this case, both construction cost and toll revenue would be ignored. There would be the concern about vehicles paying the tolls and also fuel or weight-mile taxes. However, this is likely to be a small amount for the foreseeable future and probably would not warrant the cost of any method to offset it. The more likely case is that the toll road would have to be partly funded from state sources. It would seem that this case is similar to the issue of how to deal with federal and local funding. The state and private funds are fungible, so the entire project should be considered for cost allocation purposes. Similarly, the toll revenue would offset other state revenue sources and I would recommend that it be attributed as if it were collected by the state in calculating equity ratios.

Author's response: The paper reached the same conclusion as Dr. Rufolo with regard to allocating debt service. His comments add another reason for keeping the current methodology. Having noted this, the comment also raises another possible treatment for debt service related to bond financed projects. Dr. Rufolo states that "the process is often described as forward looking in that it allocated project expenditures" and "this [referring to an alternative methodology rejected in the original paper] creates the potential for cost responsibility to change based on the what may be considered an arbitrary determination of which projects were finance by bonds and which by current revenues." If cost allocation is based on a future program of projects, and if the method of financing is arbitrary, why not fold debt service into construction and simply treat the entire bundle of future projects the same way? This is already done with regard to use of federal highway funds and would simplify the calculation. Of course, the problem with this, as pointed out in the paper is that future debt service may be incurred for projects that are substantially different from others in the future program. Furthermore, while the decision to finance projects using debt may have been considered arbitrary, once that decision is made the obligation to pay debt service is no longer arbitrary. In summary, I agree with Dr. Rufolo's comments and conclusion that the current procedure for allocating debt costs should be continued.

The comments support the paper's conclusions for completely privately financed toll roads: the entire construction and toll collection system would be outside of the cost allocation process. As a practical matter, the cost allocation methodology would not have to deal directly with the double payment question in this case. If individual users found the double payment burdensome they could apply for refunds. If at some future time the refund process became burdensome to the state, it could be dealt with then.

When and if partially publicly funded toll roads become a reality, allocating the state expenditures will be fairly straightforward. I question, however, whether private and state funds are fungible in the same sense as federal and local funds. Federal funds are available for use across a broad range of projects, creating significant flexibility in their use. Private funds for construction of toll roads would not be available for other projects should the toll road not be built. Furthermore, a major consideration in the proposed construction of toll roads is the inability of the state to fund the project from its own resources alone. Therefore, it could not be assumed for a particular project that any state funds at all would go into it without the specific agreements surrounding the toll aspects of the project. In conclusion, the state portion of toll roads should be included in the cost allocation formula, but I would not agree that the entire project should be treated as though private funding were fungible.

In general, I agree with the conclusion that, in calculating equity ratios, toll revenue should be attributed as if it were collected by the state. In fact, as the paper points out, if tolls become defined as road user taxes then this would be the only logical way of treating them. On the other hand, special circumstances may require revisiting this assumption if congestion tolls are used and if they are not regarded as road use taxes according to the state constitution.

The final issue paper contains more detailed recommendations for tolling, based on the above discussion.

Issue Paper 5: Bridge Issues

Forkenbrock: It is widely understood that HCAS-related issues are quite different for bridges than for roads. In the simplest terms, costs imposed by vehicles on roads are largely a function of axle loads (foot print), while for bridges, costs imposed are more related to total vehicle weight that a span of the bridge must support. I am pleased to see that the issue paper does a good job of explaining the nature of bridge support deterioration.

The issue paper correctly explains the effects of load-related factors in bridge design – five truck-load designs and three span arrangements. Basing costs to the respective truck classes for new bridge construction on an incremental basis is generally regarded as the best practice. Tailoring the approach to specific conditions in Oregon – particularly allowable truck loads and configurations – is an excellent idea.

Because Oregon is among the states that allow certain configurations of longer combination vehicles (LCVs), their impact on bridge spans that are greater than the vehicles' length is an important consideration. The corridor-based strategy now used by Oregon for I-5 and I-84 is a logical opportunity to apply an incremental cost-approach to bridge investments. I concur with the issue paper in recommending this approach.

Rufolo: The paper provides a detailed list of the reasons for bridge replacement, but the reasons for the recommendations for cost allocation are not clear. In particular, several differences from the federal procedure continue that do not maintain the cost occasioned approach. For example, the common costs for bridges are allocated using VMT, but the federal procedure would be to use PCE-VMT. In previous studies, items like the extra width associated with heavy vehicles were allocated specifically to heavy vehicles. The replacement of this system with allocation based on PCE-VMT provides a more consistent allocation of the overhead costs based on capacity used. However, the use of VMT rather than PCE-VMT continues to understate the cost occasioned by heavy vehicles in common costs or the amount of bridge capacity used by heavy vehicles. It is recommended that these common costs be allocated by PCE-VMT for all bridge construction.

The paper recommends that "replacement bridge expenditures continue to be allocated incrementally based on the Oregon bridge cost model." This is different from the federal procedure used in the 1997 cost allocation study. As noted in the report, "the 1997 Federal HCAS Summary Report, costs are assigned according to the types of improvements that are made. For structurally deficient bridges, costs to provide additional structural capacity are allocated to those vehicles that require the greater strength." Hence, the federal method allocates more of the cost of replacing structurally deficient bridges to the heavy vehicles that "occasion" the need for replacement. It appears to be a violation of the cost responsibility procedure to charge light vehicles for much of the cost of replacing these bridges when they would not have to be replaced for light vehicles. Similar arguments relate to the cost responsibility for rehabilitation associated with structural deficiencies.

The recommendations for cost allocation for seismic retrofitting and maintenance appear to be reasonable and consistent with cost allocation.

Author's response: Replaced recommendations to use the "Oregon bridge cost model" with recommendations to use the "cost occasioned approach." Changed the recommendation to allocate the costs of replacing functionally obsolete bridges from a VMT basis to a PCE-VMT basis.

Issue Paper 6: Tax Evasion

Forkenbrock: The issue paper notes that evasion of the gasoline tax has become appreciably less serious than once was the case, due mostly to improved collection approaches. The diesel tax, however, remains a fairly serious problem, in part due to the long-standing difficulties of distinguishing between on-road and off-road fuel consumption. It is quite widely recognized, however, that evasion of weight-mile charges is a serious problem – three to seven percent, according to the Oregon Weight-Mile Study. Due to the absence of weight-mile charges in nearby states, evasion is certain to remain a problem for Oregon.

One approach for the Oregon HCAS would be to estimate the amount of weight-mile evasion by class of heavy vehicle and charge each class enough extra that net of evasion, each class would pay its assigned costs. As the issue paper suggests, one way to do this would be to inflate reported miles by class by the estimated evasion rate. One salutary effect would be to encourage the motor carrier industry to self-police, to the extent that is possible or realistic. It may be neither. One must recognize that a horizontal equity issue would emerge among members of particular vehicle classes. A better approach may be a multi-state mileage-based road user charge system that would essentially eliminate evasion.

Rufolo: The evasion of taxes creates a problem for cost allocation. What costs should be allocated and how should cost responsibility be determined? As issue paper number one clearly articulates, there are several items that must be addressed in dealing with this concern. The most important is the estimation of the amount of evasion, and the next most important is the implication of this for cost allocation. One item not discussed in the paper is the possibility of overpayment to Oregon to avoid taxes in other states. Oregon has relatively low registration fees for both light and heavy vehicles. Hence, Oregon is likely to receive excess revenue relative to actual usage related to evasion of taxes in other states. Specifically, people who live in Washington but work in Oregon can reduce their registration fees by registering the vehicles in Oregon and heavy vehicles that cover many states can typically reduce their overall registration costs by claiming more miles in Oregon than were actually driven here under IRP (the International Registration Program). If evasion is going to be considered in calculating cost responsibility, the potential for overpayment should also be considered and estimated.

The paper recommends continuation of previous practice regarding tax evasion, essentially to ignore it as part of the study. Given the amount of uncertainty regarding these estimates and the potential for offsetting overpayments, it makes sense to leave evasion out of the study.

The NCHRP study cited will not be likely to provide improved estimates for Oregon tax evasion in the immediate future. An important factor leading to the delay in completing the project has been the difficulty of acquiring adequate state level data to estimate evasion. The completed study will provide procedures that Oregon could use to estimate evasion for each tax; however, the data requirements may limit the ability to do so.

Author's response to David Forkenbrock: Clearly, the best solution to the problem of tax evasion in the HCAS is to eliminate it in the real world and multi-state road user charge arrangements would advance that cause. The GPS-based mileage tax now in place county-wide for trucks in Germany is an example of such a system. In lieu of such a system the HCAS cannot handle evasion well. If mileage is inflated than the tax rate will be too low to collect the necessary revenues, in total, or from that user class. If mileages are not inflated than users will share the costs of those who evade their taxes, exacerbating inequalities in horizontal equity.

Author's response to Anthony Rufolo:

1) The potential of overpayment creates similar problems as evasion does for the HCAS, although it results in what is perhaps less of a political dilemma. If more mileage is reported than is actually traveled than the tax rate will be too high and excess revenues will be collected. If mileages are deflated to account for over reporting than users will benefit from a lower tax rate. In either case it would not be expected that there would be a large amount of complaints from Oregon politicians or truckers.

2) It is unlikely that the NCHRP study will provide perfect data on evasion in Oregon. Even if complete data were available, it would not solve the fundamental problem of who should pay for evasion – the members of that vehicle class, highway users in general or the general public. However, any new data on the extent of evasion even if not directly for Oregon will help in determining how important evasion is and how it should be handled.

Issue Paper 7: External Costs

Forkenbrock: In an earlier issue paper, the authors discussed vertical equity and environmental justice, noting that many costs of highway use fall upon other members of society than users. Thus, in general, appropriate methodologies must be applied to estimate the level and incidence of external costs. Development of such methodologies is important because the external costs of highway use can be substantial.

The issue paper correctly notes that once collected, a host of often complex problems would exist with respect to dispersing the revenue. It is almost impossible to identify who experienced external costs of various sorts or how great those costs were for a given societal group. Layering this complex matter on the Oregon HCAS may prove to be destructive to it. A separate comprehensive study probably is a better approach. Fortunately, the literature is becoming more developed on the issues and estimation methods related to environmental justice in transportation.

What can be used as a point of departure in the current HCAS is to apply values from the 2000 addendum to the 1997 Federal HCAS; the values are contained in two tables in this issue paper. These values should be updated using more current figures for Oregon.

I agree with the issue paper that it may be preferable to use public policy to modify the sources of external costs to the fullest extent possible. Alternative vehicle fuels can reduce external costs related to environmental impacts and energy security, for example. Safety features in vehicles and safer road standards also have potential. Beyond these enlightened policy initiatives, efficient road pricing is a potential means for internalizing at least some major types of external costs. The issue paper presents an informed and balanced discussion of external costs.

Rufolo: The paper does a good job of describing the issues and the problems associated with external costs, and I agree with the recommendations. Vehicle users should be charged for such costs to encourage more efficient use of vehicles, but these costs are not appropriate for allocating the cost of building and maintaining the road system. Only the costs associated with actual mitigation efforts should be included in the cost allocation.

Author's response: I agree with the reviewers' comments.

Issue Paper 8: Equity

Forkenbrock: What I like most about this issue paper is that it recognizes the multifaceted nature of equity in road finance. Interestingly, quite often, vertical equity and horizontal equity are somewhat at odds in road finance. The principal equity consideration in HCAS is horizontal – vehicles that occasion greater costs should pay greater user charges. True marginal cost pricing would call for user charges to vary by vehicle weight, vehicle configuration, pavement characteristics, and traffic conditions.

Mileage-based road user charges portend the ability to substantially improve horizontal equity among road users. Vertical equity is difficult or impossible to improve through road charges. Almost without exception, policies to improve either horizontal equity or vertical equity are likely to operate counter to the other type of equity. The most promising approach is to pursue horizontal equity through user charges and vertical equity through progressive income taxes. In the words of Herbert Mohring, "The problem with the poor is that they are not under-transported, their problem is that they are poor."

The issue paper discusses the vertical equity problems of current road user charges, particularly the motor fuel tax and congestion tolls. I agree that tuning congestion tolls to give a break to reverse commuters may improve vertical equity, but there would be some degree of a problem with target efficiency. By no means are all reverse commuters lower income workers.

Environmental justice is an issue that could be addressed to a certain degree in the HCAS. If a wider array of costs is considered, the incidences of these costs can be studied and positive steps can be identified to improve equity, mainly by mitigating costs that fall disproportionately upon protected populations. I am less sanguine about improving the incidence of road user costs, per se, other than perhaps the previously mentioned reverse commuting tolls.

Rufolo: As noted in the paper there are many dimensions to the concept of equity, but the issue is even more complex than indicated. For example, we can often measure the benefits of a highway improvement in terms of reduced travel time, etc. However, many of these benefits end up capitalized into land values for property with access to the highway. Consider a simple example; two suburban communities have congested roads that are used for access to the central city. The commute times are equal and housing prices in the two communities are the same. Then additional capacity is added to the road from one of the communities and travel times are substantially reduced. Since the travel time is lower, the community becomes relatively more attractive and housing prices are bid up there and may fall in the other. In the limit, commuters are indifferent between the higher housing prices and shorter commute time in one community and the lower housing prices and longer commute time in the other. In terms of economics, the adjustments to housing prices are what are known as equalizing differences. If we simply looked at commute times, we would conclude that the people in the community with better access are better off, but due to the housing price differences they may not be. In essence, the benefits of improved commuting times accrued to the owners of the land at the time the improvement was made. The current users may receive no net benefits if they just purchased their houses.

While it is dangerous to over-generalize, it is reasonably accurate to say that many of the equity issues associated with methods of raising general revenue are less likely to be affected by equalizing differences than those associated with service level differences. Hence, the equity analyses for some items, like the regressivity of the gas tax, are not affected by equalizing differences. However, some of the other equity comparisons may be affected by equalizing differences.

One issue not addressed in the discussion of tolling is the concern over double taxation. Since most existing roads were built on a pay-as-you-go basis, road users may correctly state that they are paid for. Further, users of toll roads typically still pay fuel and other taxes. The equity concerns may therefore be somewhat more complex than simply the progressivity or regressivity of the tolls relative to income.

A final note related to studies of equity is that in public finance there is a distinction between the equity measures of a tax relative to annual income as opposed to lifetime income. In general, a person's annual income exhibits wider swings than their consumption. For example, income may be lower in retirement, but driving may remain fairly constant. One can make the case that comparisons relative to life-cycle income are more relevant for equity evaluation than the comparison based on annual income; but this adds another dimension of complexity to equity comparisons.

Author's response to David Forkenbrock:

1) Dr. Forkenbrock is correct that the principal focus in the HCAS is horizontal – treating like groups of vehicles in a similar manner. At the same time, economists are in favor of moving toward greater equity between users through marginal cost pricing as it more correctly charges individuals for there true usage. For example, in the U.K. there is currently a strong push for nationwide congestion pricing. However, policy decisions such as this are often open to criticism on the basis that they might be regressive. While the evidence that this is true is lacking, it is

quite easy to find individual circumstances where this is the case and to use these cases to political advantage.

2) In general economists argue against attempting to permute vertical equity through each individual policy or program. The argument is that this creates programs that are less than optimal in terms of efficiency. As a result it is best to pursue vertical equity through progressive income taxes. In reality, the introduction of a new program or policy that causes a large change in the incidence of taxation will be subject to criticism on those grounds.

3) I am not attempting to argue that congestion tolls should be tuned to give a break to reverse commuters, but rather that charging on the basis of the level of congestion and thus true marginal cost would often result in lower charges for reverse commuters. If reverse commuters tend to be of lower income, this might also improve vertical equity. If the HCAS were to segregate users on the basis of income, it might be a useful tool for the analysis of environmental justice.

Author's response to Anthony Rufolo:

1) Dr. Rufolo is correct in that there are almost infinite complications and dimensions to the concept of equity. In his example, transportation investments create value which may accrue to various parties depending on the particular situation. For example, the term "Value Capture" has been coined in the literature and reflects the attempt by state and local governments to capture part of the value generated by transportation and other infrastructure improvements through development taxes and local development fees.

2) Dr. Rufolo makes a very important point regarding the issue of double taxation. In the paper, the analysis was restricted to a comparison between a pure gas tax system and a pure congestion tolling system. In practice, tolls are often applied to large structures such as bridges or tunnels, but are also used on selected major roads. In the case of their application on these other major roads there is a strong argument that they amount to double taxation. This may result in a situation where two commuters from fairly similar suburbs that are equidistant from the urban core could pay quite different charges for a similar commute with similar levels of service. This would create a potential case of horizontal inequity (i.e. like individuals not treated alike).

3) In evaluating vertical equity, the denominator in the calculation could be a variety of measures including annual or lifetime income. Other possibilities include annual salary, disposable income, or total wealth. Note that there is also may be a question as to whether the appropriate measure relates to the individual or the household. Ultimately, the selection should be based on the best available data and the policy for which equity is being measured. For example, the longer the term over which an item is used the more likely that it should be compared against lifetime rather than annual income.

Consultant's response: Tolling does not imply double taxation. A comprehensive tolling system could reduce the fuel tax and weight-mile taxes to zero. Weight-related wear-and-tear charges would simply be incorporated into the tolls. In a more likely hybrid system with both tolls and existing use taxes,

If tolling were not pervasive, the tolling system could incorporate automatic fuel-tax credits. The simplest solution would be to reduce the tolls by a per-mile amount equivalent to the fuel tax (about 1.2 cents per mile). Incorporating such a credit indirectly into an electronic tolling system would work best. If credits could be applied to users' accounts in a later month, users would pay full price when driving and respond accordingly.

Meeting Minutes

2007 HCAS Study Review Team Meeting

Agenda

April 17,2006, 3:00 p.m. – 4:00 p.m.

DAS Executive Building
155 Cottage St. N.E.
TC3 Conference Room, 3rd Floor
Salem, OR 97301-3966

3:00 - 3:10	Welcome, Introductions & Opening Remarks	Tom Potiowsky
3:10 - 3:20	Guidelines for Consultant Selection	Tom Potiowsky
3:20 - 3:50	Scoring of Bids	Tom Potiowsky
3:50 - 4:00	Next Meeting and Meeting Location, Meeting Calendar	Brian Hedman

Oregon Highway Cost Allocation Study Review Team Meeting Minutes of April 17, 2006

DAS Executive Building
TC3 Conference Room, 3rd Floor

155 Cottage Street N.E.

Salem, Oregon 97301-3966

Attendees: Study Review Team Members
Tom Potiowsky, Jim Lundy, Mazen Malik, Mike Marsh, Tim Morgan, Bob Russell
Absent: Jon Oshel
Support Staff
Brian Hedman, John Merriss

Welcome, Introductions & Opening Remarks

Chairman Tom Potiowsky opened the meeting at 3:10 p.m. and welcomed the Study Review Team (SRT) members and support staff. Introductions were made. Tom indicated that he might solicit an additional SRT member.

There was a general discussion of the scope and timing of the project. Due to the delayed start the work schedule will be compressed, however completion is still expected on schedule.

There was some discussion about the implications of a shift to annual legislative sessions, however it was determined that no change in the project schedule should be undertaken at this time.

Discussion of Guidelines for Consultant Selection

Mary Mattison, procurement officer, joined the meeting at 3:30 p.m. and presented a summary of the RFP scoring process.

Scoring, Ranking and Discussion of Proposals

ECONorthwest the sole proposer. The mandatory scored items were discussed for the proposal. Each of the SRT members scored each section of the proposal on its merit. Mary tabulated the scores. The cost proposal was noted as having been equal to the budget indicated in the RFP.

ECONorthwest was selected for the project. The period for challenging the selection was waived due to the absence of any other bidders. Contracting signing was expected within two weeks.

Next Meeting Date

The next meeting was set for May 2 from 2:00-5:00 p.m. in Conference Room A. Tom adjourned the meeting at 4:00 p.m.

2007 HCAS Study Review Team Meeting

Agenda

May 2,2006, 2:00 p.m. – 4:45 p.m.

DAS Executive Building
155 Cottage St. N.E.
Conference Room A, 2nd Floor
Salem, OR 97301-3966

2:00 - 2:10 Welcome, Introductions & Opening Remarks .... Tom Potiowsky

2:10 - 2:30 Presentation of Study Work Plan and Schedule.............................. Carl Batten

2:30 - 3:00 Discussion of Methodology & Allocators .... Carl Batten

3:00 - 3:15 Summary of Major Results of 2005 Study .... John Merris

3:15 - 4:00 2005 HCAS: Lessons Learned and Unresolved Issues..................... Carl Batten
John Merriss

4:00 - 4:30 Issue Paper Work Plan .... Carl Batten

4:30 - 4:45 Next Meeting and Meeting Location, Meeting Calendar .... Brian Hedman

Oregon Highway Cost Allocation Study Review Team Meeting Minutes of May 2, 2006

DAS Executive Building
Conference Room A, 2nd Floor

155 Cottage Street N.E.

Salem, Oregon 97301-3966

Attendees: Study Review Team Members
Tom Potiowsky, Mazen Malik, Doug Anderson, Timothy Morgan, Mike Marsh
Absent: Jim Lundy, Bob Russell, Jon Oshel
Support Staff and Interested Parties
Brian Hedman, John Merriss, Ron Chastain, Craig Campbell
ECONorthwest
Carl Batten, Andrew Glick

Welcome, Introductions & Opening Remarks

Chairman Tom Potiowsky opened the meeting at 2:00 p.m. and welcomed the Study Review Team (SRT) members and support staff. Introductions were made. Tom welcomed Doug Anderson, Metro Finance Manager, to the Study Review Team.

The minutes from the April 17, 2006 meeting were approved.

Presentation of Study Work Plan and Schedule

Carl Batten discussed EcoNorthwest's work plan and schedule. He noted the following:

- The model was largely completed during the 2005 HCAS. Effort during the 2007 HCAS will focus on improving the user interface and user documentation
- Initial model runs are expected in September
- Draft report will be completed in early December
- Final report will be completed by February 2
    - There was discussion regarding the possibility of a different legislative calendar for the 2007 session, possibly adjournment early in the session to await the budget forecast in April
    - It was also noted that there is a legislative requirement to have the HCAS finalized by January 20. This will be in the form of a memo with final results.

Discussion of Methodology & Allocators

Carl distributed handouts that described how allocation factors were chosen, how the equity ratio was defined and determined and the definition of the subsidy-adjusted equity ratio.

Carl gave a brief overview of the HCAS process and the assignment of allocation factors. Issues that were discussed included:

- How subsidized vehicles are accounted for
- Whether hybrid vehicles should be separately identified
- Which revenue sources were identifiable
- How costs are identified

Summary of Major Results of 2005 Study

John Merriss distributed a handout and presented an overview of the results of the 2005 study. Overall the equity ratios were very close to 1. The light vehicle ratio was 1.003 and the heavy vehicle ratio was .994.

The Oregon Constitution describes the balance between the revenues from the different vehicle classes and their associated costs as follows:

> Revenues described in subsection (1) of this section that are generated by taxes or excises imposed by the state shall be generated in a manner that ensures that the share of revenues paid for the use of light vehicles, including cars, and the share of revenues paid for the use of heavy vehicles, including trucks, is fair and proportionate to the costs incurred for the highway system because of each class of vehicle. The Legislative Assembly shall provide for a biennial review and, if necessary, adjustment, of revenue sources to ensure fairness and proportionality. (Article IX, Section 3a(3))

John provided additional details by funding source and expenditure category.

There was some discussion about the variation of equity ratios within vehicle classes.

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2005 HCAS: Lessons Learned and Unresolved Issues

John and Carl handed out a summary of the 2005 lessons learned and lead a discussion. In particular the following categories were discussed:

- Fuel Consumption
  - Unable to determine consumption for 8,000-26,000 pound vehicles, consequently the model assumed an equity ratio of 1 for these vehicles
  - Additional research will be conducted to determine if any data is available to

better estimate their fuel consumption

- Bridge Replacements
  - Difficult to determine cause for replacement (age, heavier than expected vehicles, etc)
  - Replacements typically higher volume than original
  - Assignment of cost responsibility hinges on these assumptions
  - An issue paper will be written to explore the issue comprehensively
- Asset life and bond financing
  - The 2005 HCAS explored the issue surrounding bond financing.
  - The impacts will increase as bond financing increases
  - An issue paper will be written
- Expenditure of revenues other than state user fees
  - Federal dollars are included due to fungibility
  - Local revenues are not included since it is not possible to determine the attribution to roads, i.e. property taxes
- Studded Tires
  - Cost impact depends on the resurfacing schedule in the absence of any studded tire damage. This schedule is not known
  - This study will try to obtain better data on resurfacing schedules as well as data on studded tire sales

Issue Paper Work Plan

Carl presented a list of potential issue papers:

1) Examination of bridge issues
2) Examination of issues related to federal and local revenues and expenditures
3) Examination of general issues
4) Examination of issues related to finance
5) Examination of pavement issues, especially the cost of studded tire damage
6) Issues related to fuel consumption per mile

The SRT recommended completion of all of these issue papers with the exception of number 2. It was felt that the issues related to federal and local revenues and expenditures was resolved in the 2005 HCAS.

Next Meeting and Meeting Location

The next meeting will be held June 12 from 1:00 p.m. to 4:00 p.m. in Conference Room A, 5th Floor DAS Exec. Bldg.

Tom adjourned the meeting at 4:45 p.m.

Agenda

2007 HCAS Study Review Team Meeting
June 12, 2006

June 12, 2006, 1:00 p.m. – 3:10 p.m.

DAS Executive Building
155 Cottage St. N.E.
BAM Conference Room, 5th Floor
Salem, OR 97301-3966

1:00 - 1:10	Welcome, Introductions & Opening Remarks	Tom Potiowsky
1:10 - 1:15	Approval of minutes from May 2 meeting	Tom Potiowsky
1:15 - 1:45	Presentation on VMT and revenue forecasting	Dr. David Kavanaugh
1:45 - 2:15	HCAS Data Development	Dr. David Kavanaugh
2:15 - 2:30	Status update on data collection and issue paper development	Carl Batten
2:30 - 3:00	Issue paper presentation	Carl Batten
3:00 - 3:10	Other issues and next meeting agenda	Brian Hedman

Oregon Highway Cost Allocation Study Review Team Meeting Minutes of June 12, 2006

DAS Executive Building
BAM Conference Room, 5th Floor

155 Cottage Street N.E.

Salem, Oregon 97301-3966

Attendees: Study Review Team Members
Tom Potiowsky, Mazen Malik, Doug Anderson, Timothy Morgan, Mike Marsh (via phone), Bob Russell
Absent: Jim Lundy, Jon Oshel
Support Staff and Interested Parties
Brian Hedman, John Merriss, Ron Chastain, Dave Kavanaugh
ECONorthwest
Carl Batten, Andrew Glick

Welcome, Introductions & Opening Remarks

Chairman Tom Potiowsky opened the meeting at 1:00 p.m. and welcomed the Study Review Team (SRT) members and support staff. Introductions were made.

The minutes from the May 2, 2006 meeting were approved.

Presentation of VMT and Revenue Forecasting

Dave Kavanaugh presented the revenue forecast modeling methodology.

The model consists of:

- Motor Vehicle Fuels Module
- Weight-Mile and Heavy Vehicles Registration Module
- DMV Module
- Aviation Module (not used for HCAS)

Dr. Kavanaugh discussed each of the modules and the revenue shares of each of the categories.

Points discussed include:

- Bio-fuels are taxed if they are distributed through the wholesale channels.

- Consumption has not been significantly affected by the rising prices.
- The trucking industry has been successful passing through a fuel increase surcharge that has helped reduce the impact of rising fuel prices on consumption.
- Global Insights fuel efficiency forecast in 2003 assumed approximately 20 mpg. The 2006 forecast reflects the significant increases in large “light” vehicle sales during 2003-2005 due to manufacturer incentives. This drops actual mpg to approximately 19.5 mpg over this period. Forecast is a gradual increase in mpg. It was noted that Oregon has changed the light vehicle definition to 10,000 pounds. Availability of data for vehicles between 8,000 and 26,000 pounds is generally unavailable.
- Due to embedded stock the incremental hybrid and other fuel efficient vehicles do not impact the revenue forecast until approximately 2026.
- The models have been enhanced to better allow for legislative scenario analysis.
- Dave explained the model calibration process. Dave will provide the biennium report that compares the forecast to the actual for the current biennium.
- Overall forecast is for approximately 1 to 1.5% annual growth.
- There were no significant changes to the VMT methodology.

HCAS Data Development

Carl inquired whether the Other Highway Division and Other ODOT category’s could be broken out into finer detail, preferably by what category the spending was for rather than which agency spent the funds. Dave indicated that he would provide any available detail behind these categories.

Status Update

Carl reported that data collection has been initiated. No issues to report. Carl described a new approach to gather data regarding studded tire sales. Project is on schedule.

Carl will prepare a list of data requirements, sources and timing to assist in establishing a process to collect the data systematically.

There was interest in a having a presentation by Dave Forkenbrock and Tony Rufolo on HCAS issues.

Issue Papers

Carl presented two issue papers.

Cost Approach versus Expenditure Approach

The SRT discussed the merits of a cost based approach versus an expenditure based approach. In general a cost based approach would generate revenues that are better alligned with the costs imposed on the system however, while there has been some progress exploring potential sources for cost data, this study will continue to use the expenditure approach due to the lack of cost data. To date this approach has met the needs of the legislature.

Several edits were suggested that will be incorporated in the revised paper.

Allocation of Non-project Costs

The non-project costs include:

- Collection costs
- Overhead costs
- Maintenance costs
- Administrative costs

Administrative costs totaled $570 million in the last study. Carl will disaggregate the costs in this study and present an allocation proposal to the SRT.

Collection, overhead and maintenance costs will be allocated as indicated in the paper.

Next Meeting and Meeting Location

The next meeting will be held September 8 from 9:00 a.m. to 12:00 a.m. in the SMFS Conference Room, 1st floor DAS Exec. Bldg.

Tom adjourned the meeting at 4:00 p.m.

Agenda

2007 HCAS Study Review Team Meeting
September 8, 2006

9:00 p.m. – 12:00 p.m.

DAS Executive Building
155 Cottage St. N.E.
SFMS Conference Room, 1st Floor
Salem, OR 97301-3966

9:00 - 9:05	Welcome, Introductions & Opening Remarks	Tom Potiowsky
9:05 - 9:10	Approval of minutes from June 12 meeting	Tom Potiowsky
9:10 - 9:25	Status Update	Carl Batten
9:25 - 10:05	Issue Paper Discussion - Bridges	Carl Batten
10:05 - 10:45	Issue Paper Discussion - Equity	Carl Batten
10:45 – 10:55	Break	All
10:55 - 11:20	Issue Paper Discussion – External Costs	Carl Batten
11:20 – 11:45	Issue Paper Discussion Innovative Finance	Carl Batten
11:45 - 12:00	Other issues and next meeting agenda	Brian Hedman

Oregon Highway Cost Allocation Study Review Team Meeting Minutes of September 8, 2006

DAS Executive Building
SFMS Conference Room, 1st Floor

155 Cottage Street N.E.

Salem, Oregon 97301-3966

Attendees: Study Review Team Members
Tom Potiowsky, Mazen Malik, Doug Anderson, Timothy Morgan, Bob Russell, Jim Lundy, Jon Oshel
Absent: Mike Marsh
Support Staff and Interested Parties
Brian Hedman, John Merriss, Ron Chastain, Mark Ford, Morgan Cowling
ECONorthwest
Carl Batten, Andrew Dyke

Welcome, Introductions & Opening Remarks

Chairman Tom Potiowsky opened the meeting at 9:00 a.m. and welcomed the Study Review Team (SRT) members and support staff. Introductions were made.

The minutes from the June 12, 2006 meeting were approved.

Status Update

Carl distributed a summary of data collected so far. Most of the data has been received. Remaining data to be collected includes the VMT for vehicles on flat fees, school and transit bus VMT, and pavement factors.

Issue Paper Discussion – Innovative Financing

Mark Ford introduced a discussion on the implications of innovative financing techniques, including debt financing, public/private partnerships and toll financing. Toll financing creates a potential double payment situation. Drivers on a toll road pay for highway use through their fuel tax, weight mile tax and other vehicle taxes. They are also, then, charged for use of the toll road through the toll. The HCAS can deal with this issue in a variety of ways, including segregating the costs of the toll road and the revenues received from the tolls from the general costs and revenues in the study.

Currently, there are no toll roads affecting this study.

Carl described how debt financed projects are modeled. The debt portion of current expenditures is assigned, allocated and carried forward over the life of the associated bonds.

Jon Oshel noted that the counties have identified all of the capital and operating expenditures planned to be spent over the 2007-2011 period. He indicated that this data is available and may be used as appropriate in the modeling process. Jon agreed to provide the information to Carl and the SRT.

Issue Paper Discussion – Bridges

Carl presented the issue paper on allocation of costs associated with bridges. The costs are segregated into several categories:

New and Replacement Bridges will continue to be allocated incrementally based on the Oregon bridge cost model results. One issue that is unresolved is how to allocate the incremental cost associated with building bridges wider than the currently required number of lanes to allow for future expansion. Currently there is no way to identify this incremental cost. Carl will work with David Cox to review the list of bridges being built to higher capacity.

Seismic retrofits will continue to be allocated by VMT.

Bridge Rehabilitation will be allocated incrementally based on the Oregon bridge cost model.

Bridge Maintenance will be continue to be allocated based on VMT

Issue Paper Discussion – Equity

The current HCAS methodology measures equity across vehicle classes. There are additional aspects of equity that could be considered, including:

- ***Income class***
- ***Race***
- ***On-peak versus off-peak***
- ***Urban versus rural***
- ***Geographic zones***
- ***Alternative fee vehicles***

At this time equity consideration within the HCAS study will continue to focus on vehicle class equity.

Issue Paper Discussion – External Costs

External costs are those costs that are imposed on other drivers, public agencies or society as a whole. They include:

- Environmental impacts
- Climate change impacts

- Energy depletion and foreign oil dependence
- Congestion
- Accident and safety costs
- Noise impacts
- Land use impacts

The Federal Highway Administration conducted a study of external costs. The study concluded that accident costs constitute the largest category of external costs.

Where quantified, external costs are already included in the highway cost allocation study. Examples are the costs of sound walls and safety enhancements. These costs will be allocated based on VMT where they can be separately identified. Additionally, some costs are internalized in the system through changes in fuel specifications, motor vehicle design and driver behavior.

Next Meeting and Meeting Location

The next meeting will be held October 13 from 10:30 a.m. to 1:00 p.m. in Conference Room A, 2nd floor DAS Exec. Bldg.

Tom adjourned the meeting at 12:00 p.m.

Agenda

2007 HCAS Study Review Team Meeting
October 13, 2006

10:30 a.m. – 1:00 p.m.

DAS Executive Building
155 Cottage St. N.E.
Conference Room A, 2nd Floor
Salem, OR 97301-3966

10:30 - 10:35	Welcome, Introductions & Opening Remarks	Suzanne Brean
10:35 - 10:45	Approval of minutes from June 12 meeting	Suzanne Brean
10:45 - 11:00	Status Update	Carl Batten
11:00 – 11:30	Issue Paper Discussion – Federal/Local Revenues	Carl Batten
11:30 – 12:00	Issue Paper Discussion – Avoidance and Evasion	Carl Batten
12:00 – 12:15	Break (get lunches)	All
12:15 – 12:50	Modeling Discussion (VMT, Studded Tires, Summary of Expenditures, Revenue Projections, Work Categories)	Carl Batten
12:50 - 1:00	Other issues and next meeting agenda	Brian Hedman

Oregon Highway Cost Allocation Study Review Team Meeting Minutes of October 13, 2006

DAS Executive Building
SFMS Conference Room, 1st Floor

155 Cottage Street N.E.

Salem, Oregon 97301-3966

Attendees: Study Review Team Members
Suzanne Brean, Mazen Malik, Doug Anderson, Timothy Morgan, Bob Russell, Jim Lundy, Mike Marsh
Absent: Jon Oshel
Support Staff and Interested Parties
Brian Hedman, Ron Chastain, Craig Campbell, Rick Munford
ECONorthwest
Carl Batten, Andrew Dyke

Welcome, Introductions & Opening Remarks

Suzanne Brean opened the meeting at 10:30 a.m. and welcomed the Study Review Team (SRT) members and support staff. She indicated that Tom Potiowsky had resigned from his position with the State to resume his position at Portland State University. Introductions were made.

The minutes from the July 8, 2006 meeting were approved.

Status Update

Carl indicated that VMT data has been collected. John Merriss needs to review the growth rates in VMT compared to Dave Kavanaugh's revenue forecast. It was noted that HCAS does not adjust for evasion and includes vehicles not included in the ODOT forecast so the HCAS forecast should be approximately 5% higher than the revenue forecast.

There was additional discussion regarding the reasonableness of the growth rates in this study compared with the prior study. Carl will verify the rates.

Carl presented the expenditure forecast. Project expenditure forecast declined significantly from the June forecast to the September forecast. The decline is driven by delays in project initiation. Mike Marsh will compare to the governor's budget.

Collection costs were discussed at length. The SRT consensus was that the collection costs appeared overstated. Carl will check with Dan Porter in the ODOT Financial Services Branch regarding collection costs of DMV registrations.

All projects have been assigned to their respective categories. Bridges are still being assigned.

A question was raised regarding whether the basic revenue fee size increase from 8,000 pounds to 10,000 pounds is incorporated in the revenue forecast. Carl indicated he would verify.

Carl discussed the incorporation of local government expenditures for studded tire damage. Damage is proportional to the speed squared. Consequently, only roads with speeds higher than 45 mph are included. This is the same methodology as used in the prior study. The assumption is that local governments spend the same proportion as state government on studded tire damage repair, adjusted for the difference in speeds.

Work Categories

Carl distributed a handout that listed the work type descriptions and the assigned allocators. These will be discussed at the December 7 meeting.

Issue Paper Discussion – Tax Avoidance

ODOT's forecast is now 3.5% loss of revenues due to avoidance. This compares with 2.5% in previous studies.

There was a recommendation that the paper be revised to note that flat fee vehicles are not subsidized. Flat fees were established for administrative simplicity, not subsidization.

Issue Paper Discussion – Federal and Local Revenues

Mark Ford was not able to attend the meeting to present the paper. Carl gave a brief description. The paper recommends continuing to use the methodology of previous studies.

There were several questions about the recommendations under section 2 of the paper that were deferred to the author, in particular how the OTIA funds should be treated. Carl will check with Mark to determine his availability to attend the December meeting, either in person or by phone.

Next Meeting and Meeting Location

The next meeting will be held December 7 from 2:00 p.m. to 4:00 p.m. in Conference Room B, 2nd floor DAS Exec. Bldg.

Suzanne adjourned the meeting at 1:00 p.m.

Agenda

2007 HCAS Study Review Team Meeting
December 7, 2006

2:00 p.m. – 4:00 p.m.

DAS Executive Building
155 Cottage St. N.E.
Conference Room B, 2nd Floor
Salem, OR 97301-3966

2:00 - 2:05	Welcome, Introductions & Opening Remarks	Suzanne Brean
2:05 - 2:15	Approval of minutes from October 13 meeting	Suzanne Brean
2:15 - 2:30	Status Update	Carl Batten
2:30 – 2:45	Discussion of Allocation Factors	Carl Batten
2:45 – 3:45	Preliminary Results	Carl Batten
3:45 - 4:00	Other issues and next meeting agenda	Brian Hedman

Oregon Highway Cost Allocation Study Review Team Meeting Minutes of December 7, 2006

DAS Executive Building
Conference Room B, 2nd Floor

155 Cottage Street N.E.

Salem, Oregon 97301-3966

Attendees: Study Review Team Members
Suzanne Brean, Mazen Malik, Doug Anderson, Timothy Morgan, Bob Russell, Jim Lundy, Mike Marsh, Dae Baek, Jon Oshel
Support Staff and Interested Parties
Brian Hedman, Ron Chastain, Craig Campbell, Mark Ford, Heidi Altmaier, John Merriss
ECONorthwest
Carl Batten, Andrew Dyke

Welcome, Introductions & Opening Remarks

Suzanne Brean opened the meeting at 2:00 p.m. and welcomed the Study Review Team (SRT) members and support staff.

The minutes from the October 13, 2006 meeting were approved.

Suzanne indicated that a letter to the legislature summarizing the HCAS study and recommending any changes to the tax rates is due January 31.

Status Update

Carl distributed a project status summary and a summary of preliminary results.

Carl focused attention on the final column of the preliminary results summary (FF Subsidy-Adjusted). The preliminary results indicate a revenue/cost ratio for vehicles under 10,000 pounds of 0.96 and a ratio for vehicles over 10,000 pounds of 1.08. Carl noted that it is up to the legislature to determine whether the final ratios warrant changes to the tax and fee rates.

The ratios were somewhat further from 1.0 than in the last study. Carl indicated that these were preliminary figures and that he had not had time to fully review the results to determine the source of the differences. The group discussed potential sources of the differences. Carl will review the final results in more detail and discuss the sources of the differences at the January meeting.

Carl indicated that he would send a spreadsheet that shows this study's equity ratios compared to those of the last study.

No changes to the proposed allocators were suggested by the SRT members.

Carl noted that collection costs for drivers' license fees and other DMV revenues were not included since the revenues associated with those fees are not included. The fees are intended to just cover the costs, however currently the fees are generating a profit. The "profit" comes almost entirely from the reinstatement fees. It was decided that excluding both was proper.

Additional bridge information was used to assign bridges to their respective categories.

Bike paths and state projects on local streets were reassigned to a general class comprised of all roads since neither category has VMT.

Issue Paper Discussion – Federal and Local Revenues Fungibility

Mark Ford reviewed the federal and local revenue fungibility issue paper. Mark clarified the discussion regarding the OTIA funds. He indicated that the purpose of the discussion in the paper was to indicate that assumptions regarding the fungibility of OTIA funds affect the allocation significantly. There was also further general discussion on the fungibility of local and federal funds.

Next Meeting and Meeting Location

The next meeting will be held January 17 from 3:00 p.m. to 5:00 p.m. in the BAM conference room, 5th floor DAS Exec. Bldg.

Suzanne adjourned the meeting at 4:00 p.m.

Agenda

2007 HCAS Study Review Team Meeting
January 17, 2007

3:00 p.m. – 5:00 p.m.

DAS Executive Building
155 Cottage St. N.E.
BAM Conference Room, 5th Floor
Salem, OR 97301-3966

3:00 - 3:05	Welcome, Introductions & Opening Remarks	Suzanne Brean
3:05 - 3:15	Approval of Minutes from October 13 Meeting	Suzanne Brean
3:15 - 3:30	Issue Paper Reviewer Comments	Carl Batten
3:30 – 4:45	Review of Draft Report	Carl Batten
4:45 – 5:00	Other Issues and Next Steps	Brian Hedman

Oregon Highway Cost Allocation Study Review Team Meeting Minutes of January 17, 2006

DAS Executive Building
BAM Conference Room, 5th Floor

155 Cottage Street N.E.

Salem, Oregon 97301-3966

Attendees: Study Review Team Members
Suzanne Brean, Mazen Malik, Doug Anderson (via phone), Timothy Morgan (via phone), Bob Russell, Mike Marsh, Dae Baek, Jon Oshel
Absent: Jim Lundy
Support Staff and Interested Parties
Brian Hedman, Ron Chastain, Craig Campbell, John Merriss
ECONorthwest
Carl Batten (via phone), Andrew Dyke (via phone)

Welcome, Introductions & Opening Remarks

Suzanne Brean opened the meeting at 3:00 p.m. and welcomed the Study Review Team (SRT) members and support staff. Due to snow and ice several parties participated via phone.

The minutes from the December 7, 2006 meeting were approved.

Issue Paper Reviewer Comments

To expedite the review process all issue paper reviews were accepted jointly. Changes to the underlying papers were incorporated as indicated in the authors' responses to the peer review.

Only the basic increment for replaced bridges that have increased capacity was allocated by PCE-VMT rather than VMT. However, the bridge issue paper recommended that the basic increment for all replaced bridges be allocated by PCE-VMT rather than VMT. The change was not incorporated in order to be consistent with prior studies. The issue was flagged to be discussed again during the 2009 study.

It was suggested that the minutes and transcripts of the prior studies' bridge discussions be reviewed and Bert Hartman be consulted to determine if there was a specific finding to use VMT historically. [Post-meeting note: no specific discussion of this issue was found in the minutes and transcripts. Bert Hartmann supports the current practice].

Draft Report

Grammatical edits will be sent separately to Carl.

Carl indicated changes that had occurred since the December draft:

- $109 million in construction expenditures allocation basis was changed from "other" to "other bridge" based on conversations with ODOT staff. This was determined to be future, but not yet identified bridge expenditures. The "other bridge" allocator was created based on direct bridge expenditures.
- New pavement factors were not incorporated. New factors were created by Roger Mingo, however he was not able to calculate factors for certain weight and functional classes. Because the factors that he was able to create were consistent with the last study the factors were not updated. It was noted that the underlying data source (HPMS) is becoming more sparse and less able to support the development of the pavement factors.
- The titling on Table 5-2 will be changed to reflect that the table is for expenditures rather than funding source. An additional table will be added to transition between Tables 4-5 and 5-2.

A question was raised as to whether the costs associated with alternative fee vehicles should be funded out of highway user funds or from other funds. It was indicated that current law specifies the current funding methodology. The report will be edited to indicate that the alternate fee vehicles "are" funded by other vehicles rather than "must be" funded by other vehicles.

Additional language will be added to the discussion of external costs to clarify their exclusion from consideration.

It was noted that there are more pavement projects relative to bridge projects in the current OTIA bond financing.

The alternate fee subsidy increased from $13 million in the 2005 study to $20 million in the 2007 study due to increased school bus miles and an increase in the number of diesel powered buses.

A general discussion was held regarding whether the report warranted changes in tax/fee structures and rates. Due to the imprecision inherent in the study, the SRT recommends that only significant differences in equity ratios would warrant changes.

It was noted that the equity ratios also vary study by study and may tend to balance out over time. If trends are noted, changes may be warranted.

The SRT indicated that the study is intended to be independent and that the consultant should make whatever recommendations are believed to be warranted.

The SRT commended the consultant for a job well done.

Next Steps

Summary of findings and chapters 1-6 will be prepared by January 24. Chapter 7, recommended rates, will be completed the following week.

EcoNorthwest will present the findings before the Legislative Transportation and Revenue committees.

The model will be provided to Mazen, ODOT and DAS to allow for scenario analysis in order to respond to legislative requests. EcoNorthwest will be available to assist in the preparation of the scenarios.

The report will be finalized and a letter sent to the Legislature by January 31.

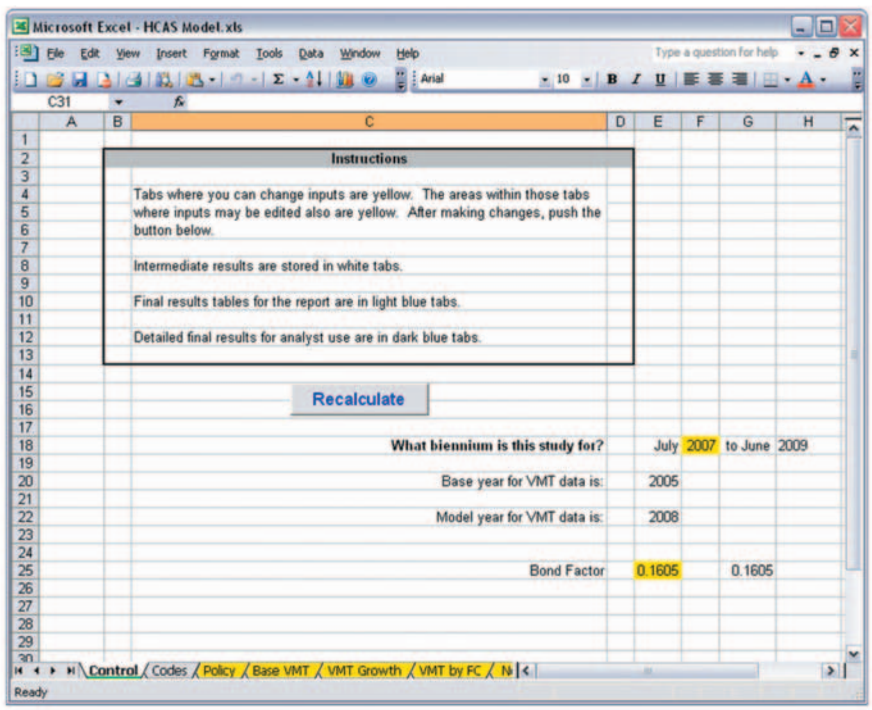
Suzanne adjourned the meeting at 4:30 p.m.

Appendix D

HCAS Model User's Guide

The Highway Cost Allocation Study (HCAS) model for the 2007-2009 biennium uses an Excel workbook as its user interface; the user can change data inputs and/or study parameters in the workbook's yellow-highlighted cells. The program returns model results to the workbook as well: white cells contain intermediate model results, light blue cells contain final results, and darker blue cells contain more detailed, analyst-oriented results.

To run the model, the user edits model data and parameters as needed and presses a "recalculate" button to execute a series of cost allocation functions. The instructions provided below are best followed in the order given, but users can skip steps where no modifications are needed. The user can also modify several additional (text file) inputs if desired (see *Additional Details*, below), but the current specifications should prove adequate for most studies.



SET THE STUDY PERIOD AND BOND FACTOR

Control tab

In the *Control* tab, enter the first year for the study (the latter year in the biennium updates automatically) and the bond factor to be applied (the share of payments on bonds issued for this biennium to be paid in this biennium.)

Note: the program already accounts for this biennium's payments on bonds issued in prior biennia. For a new model run, the program stores a similar (prior-allocated bond) data series that carries forward for the next model run.

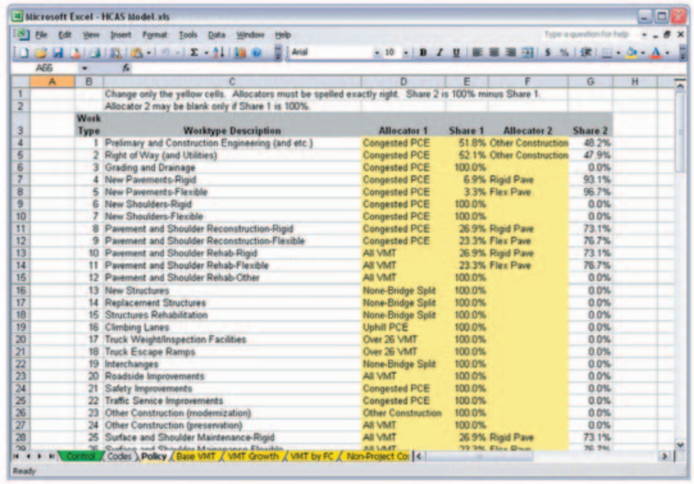
ENTER COST ALLOCATORS

Policy tab

In the *Policy* tab, enter an allocator or allocators to be used for each worktype.

Available allocators are listed to the right of the main table. Note that all allocators must be entered exactly as shown (spaces, spelling, etc.) for the model to function properly; *the user should copy and paste allocator names to avoid errors.*

Note also that the model automatically calculates the percentage for a second allocator as 100% minus the percentage for the first allocator. Do **not** change this; the allocator percentages must add to exactly 100%.



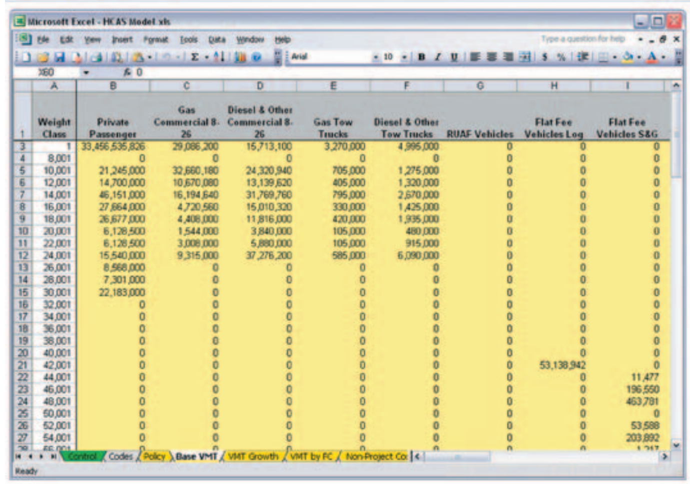
Change only the yellow cells. Allocators must be spelled exactly right. Share 2 is 100% minus Share 1.
Allocator 2 may be blank only if Share 1 is 100%.

Work Type	Worktype Description	Allocator 1	Share 1	Allocator 2	Share 2
1	Prelimary and Construction Engineering (and etc.)	Congested PCE	51.8%	Other Construction	48.2%
2	Right of Way (and Utilities)	Congested PCE	52.1%	Other Construction	47.9%
3	Grading and Drainage	Congested PCE	100.0%		0.0%
4	New Pavements-Rigid	Congested PCE	6.9%	Rigid Pave	93.1%
5	New Pavements-Flexible	Congested PCE	3.3%	Flex Pave	96.7%
6	New Shoulders-Rigid	Congested PCE	100.0%		0.0%
7	New Shoulders-Flexible	Congested PCE	100.0%		0.0%
8	Pavement and Shoulder Reconstruction-Rigid	Congested PCE	26.9%	Rigid Pave	73.1%
9	Pavement and Shoulder Reconstruction-Flexible	Congested PCE	23.3%	Flex Pave	76.7%
10	Pavement and Shoulder Rehab-Rigid	All VMT	26.9%	Rigid Pave	73.1%
11	Pavement and Shoulder Rehab-Flexible	All VMT	23.3%	Flex Pave	76.7%
12	Pavement and Shoulder Rehab-Other	All VMT	100.0%		0.0%
13	New Structures	None-Bridge Split	100.0%		0.0%
14	Replacement Structures	None-Bridge Split	100.0%		0.0%
15	Structures Rehabilitation	None-Bridge Split	100.0%		0.0%
16	Climbing Lanes	Uphill PCE	100.0%		0.0%
17	Truck Weight/Inspection Facilities	Over 26 VMT	100.0%		0.0%
18	Truck Escape Ramps	Over 26 VMT	100.0%		0.0%
19	Interchanges	None-Bridge Split	100.0%		0.0%
20	Roadside Improvements	All VMT	100.0%		0.0%
21	Safety Improvements	Congested PCE	100.0%		0.0%
22	Traffic Service Improvements	Congested PCE	100.0%		0.0%
23	Other Construction (modernization)	Other Construction	100.0%		0.0%
24	Other Construction (preservation)	All VMT	100.0%		0.0%
25	Surface and Shoulder Maintenance-Rigid	All VMT	26.9%	Rigid Pave	73.1%

ENTER BASE YEAR VMT AND VMT GROWTH RATES

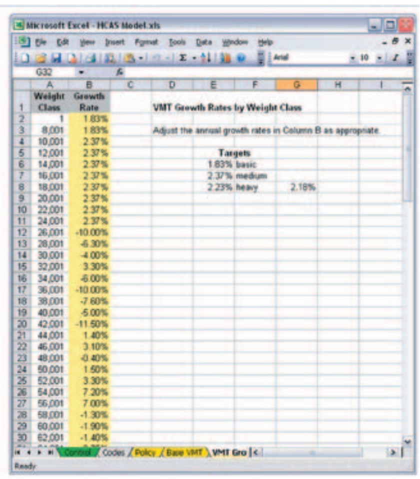
Base VMT tab

Paste base-year VMT values by weight class and vehicle tax class into the yellow portion of the *Base VMT* tab.



Weight Class	Private Passenger	Gas Commercial 8-26	Diesel & Other Commercial 8-26	Gas Tow Trucks	Diesel & Other Tow Trucks	RUAF Vehicles	Flat Fee Vehicles Log	Flat Fee Vehicles S&G
1	33,456,535,826	29,086,200	15,713,100	3,270,000	4,995,000	0	0	0
8,001	0	0	0	0	0	0	0	0
10,001	21,245,000	32,660,180	24,320,940	705,000	1,275,000	0	0	0
12,001	14,700,000	10,670,080	13,139,620	405,000	1,320,000	0	0	0
14,001	46,151,000	16,194,640	31,769,760	795,000	2,670,000	0	0	0
16,001	27,664,000	4,720,560	15,010,320	330,000	1,425,000	0	0	0
18,001	26,677,000	4,408,000	11,816,000	420,000	1,935,000	0	0	0
20,001	6,128,500	1,544,000	3,840,000	105,000	480,000	0	0	0
22,001	6,128,500	3,008,000	5,880,000	105,000	915,000	0	0	0
24,001	15,540,000	9,315,000	37,276,200	585,000	6,090,000	0	0	0
26,001	8,568,000	0	0	0	0	0	0	0
28,001	7,301,000	0	0	0	0	0	0	0
30,001	22,183,000	0	0	0	0	0	0	0
32,001	0	0	0	0	0	0	0	0
34,001	0	0	0	0	0	0	0	0
36,001	0	0	0	0	0	0	0	0
38,001	0	0	0	0	0	0	0	0
40,001	0	0	0	0	0	0	0	0
42,001	0	0	0	0	0	0	53,138,942	0
44,001	0	0	0	0	0	0	0	11,477
46,001	0	0	0	0	0	0	0	196,550
48,001	0	0	0	0	0	0	0	463,781
50,001	0	0	0	0	0	0	0	0
52,001	0	0	0	0	0	0	0	53,588
54,001	0	0	0	0	0	0	0	203,892

VMT Growth tab



VMT Growth Rates by Weight Class

Adjust the annual growth rates in Column B as appropriate.

Targets
1.83% basic
2.37% medium
2.23% heavy 2.18%

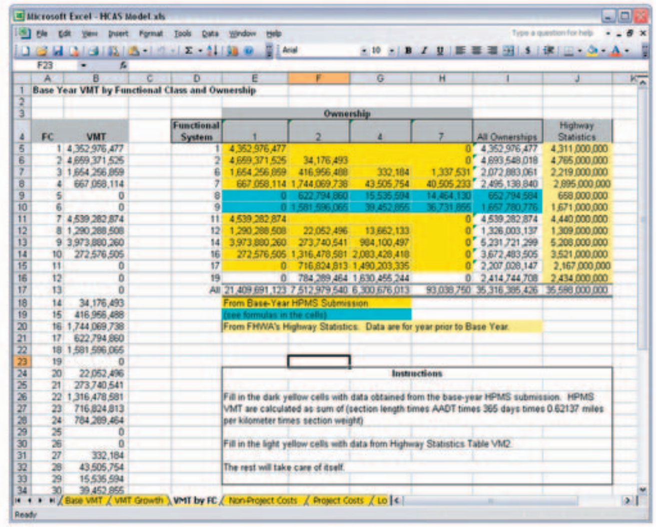
Weight Class	Growth Rate
1	1.83%
8,001	1.83%
10,001	2.37%
12,001	2.37%
14,001	2.37%
16,001	2.37%
18,001	2.37%
20,001	2.37%
22,001	2.37%
24,001	2.37%
26,001	-10.00%
28,001	-6.30%
30,001	-4.00%
32,001	3.30%
34,001	-6.00%
36,001	-10.00%
38,001	-7.60%
40,001	-5.00%
42,001	-11.50%
44,001	1.40%
46,001	3.10%
48,001	-0.40%
50,001	1.50%
52,001	3.30%
54,001	7.20%
56,001	7.00%
58,001	-1.30%
60,001	-1.90%
62,001	-1.40%

Adjust the annual growth rates in column B (*VMT Growth* tab) as needed, and the program will grow base VMT up to the model year and store results in the *Model VMT* tab.

The program will also use base-year VMT to develop VMT by vehicle weight and functional class for the *VMT Master*.

GENERATE BASE-YEAR VMT BY FUNCTIONAL CLASS AND OWNERSHIP

VMT by FC tab



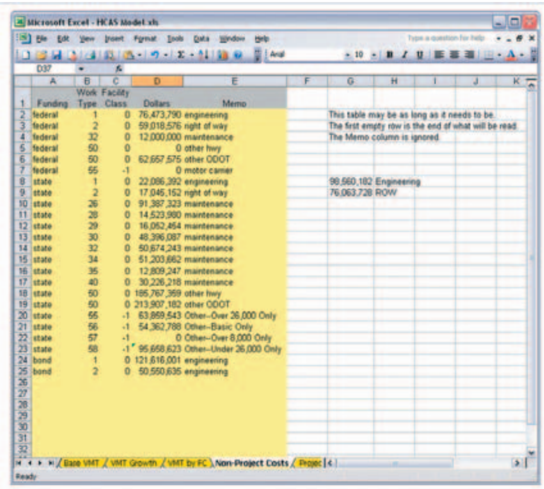
Enter VMT data from the most current HPMS submission (dark yellow cells) and the FHWA's highway statistics (light yellow cells) in the *VMT by FC* tab.

The HPMS submission does not contain reliable VMT data for rural minor collectors and rural local roads (federal functional classes 8 and 9), so the program constructs these values using proportions from the existing data.

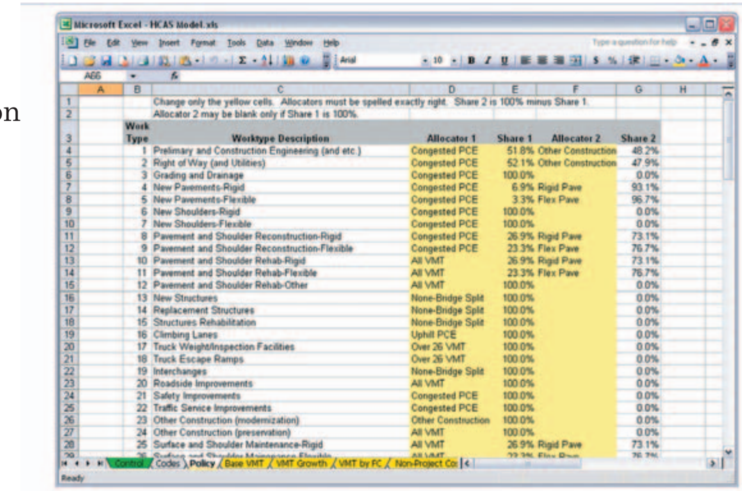
The program generates a table of VMT by functional class and ownership (*see "Available Facility Class Codes" on the Codes tab*) at the left edge of the worksheet. The program will use functional class totals from this step (with weight class totals from the previous step) to fit Seed Data (see *Additional Details*, below) and create a VMT Master table for cost allocation.

ENTER COSTS TO ALLOCATE

Non-Project Costs tab



Paste non-project expenditures for the model biennium into the yellow portion of the *Non-Project Costs* tab.



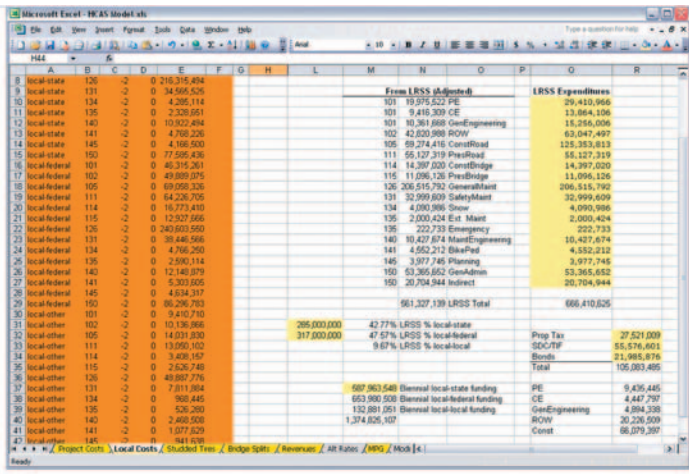
Project Costs tab

Paste project expenditures for the model biennium into the yellow portion of the *Project Costs* tab.

Local Costs tab

The Local Costs tab is set up to calculate local costs from the base year's LRSS data, along with some additional percentages and control totals, but you can override that procedure by directly entering data into the light orange table on the left.

To use LRSS data, enter the totals by expenditure category over all local governments in the light yellow cells in Column Q.



Enter the totals over all local governments by excluded revenue category in the light yellow cells in Column R.

Enter the total state- and federally-funded LRSS expenditures in the light yellow cells in Column L.

Enter the total State Highway Fund apportionment to cities and counties for the upcoming biennium in light yellow cell M37. The spreadsheet will automatically generate the proper entries in the light orange cells, which are the expenditures to allocate.

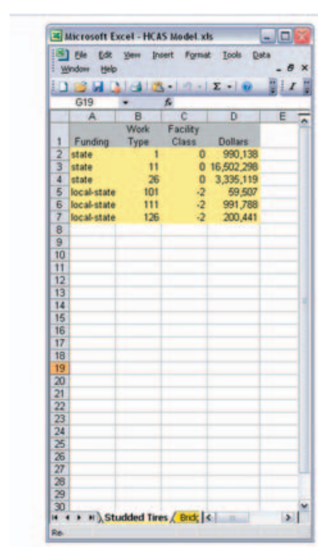
As the instructions indicate, the program stops reading at the first empty row and ignores the contents of the "Memo" column.

For worktype definitions, see the *Codes* tab.

(Note: This is a two-year model; do not use annual expenditures.)

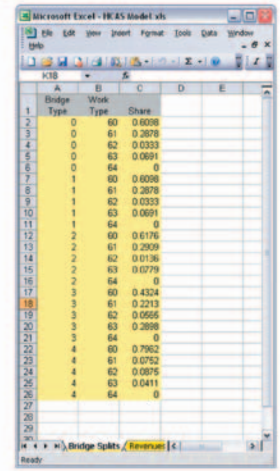
ENTER STUDDED TIRE COSTS

Studded Tires tab



Paste expenditures attributable to studded tire damage into the yellow portion of the *Studded Tires* tab. The program will use these amounts as follows:

For each combination of worktype and funding source identified, the program calculates the portion of total expenditures that are studded-tired related. The program then subtracts the calculated portion of costs from every project identified in the worktype/funding source combination and adds the studded tire costs to worktype 39 (State expenditures) or 139 (local-government expenditures.)



ENTER BRIDGE SPLITS

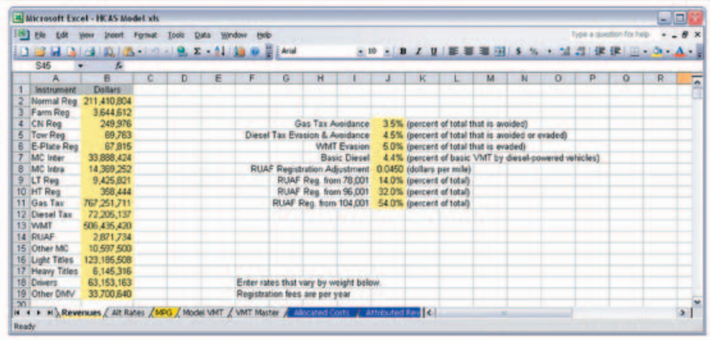
Bridge Splits tab

The existing bridge splits are based on the 2002 OBEC Bridge Cost Allocation Study and do not need to be modified unless better data become available. If better data are available, follow the instructions below to modify the existing splits.

Paste worktype shares for each of the five bridge types into the yellow portion of the Bridge Splits tab, and the program will distribute costs for bridge and interchange projects (worktypes 13, 14, 15, and 19) accordingly.

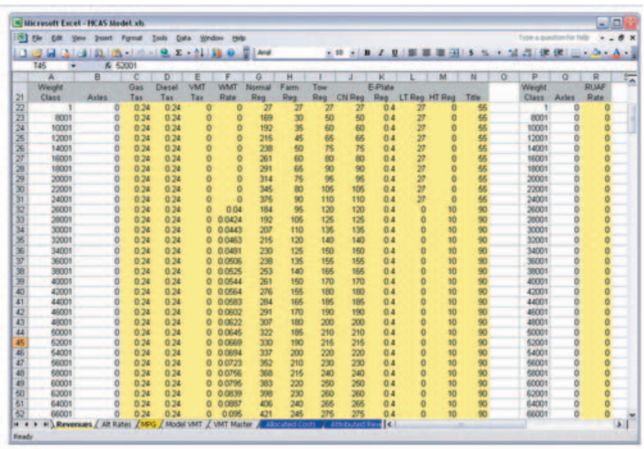
ENTER RATES AND REVENUE CONTROL TOTALS

Revenues tab

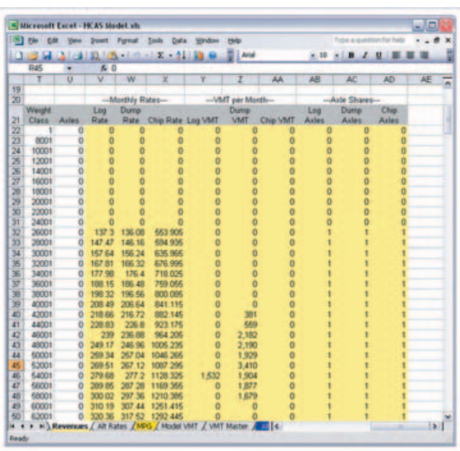


Paste revenue control totals for all instruments in the upper-left yellow portion (B2:B17) of the *Revenues* tab.

Paste avoidance/evasion rates, the share of basic VMT that is diesel-powered, and the information necessary to attribute registration revenues to Road Use Assessment Fee miles into the yellow cells to the right.



Paste current-law rates by weight class in the yellow areas further down the Revenue tab.



Revenue control totals and the rates that are entered on this tab must be consistent, so the user should review the rate assumptions used to develop the revenue control totals.

(OPTIONAL) ENTER ALTERNATIVE RATES

Alt Revenues tab

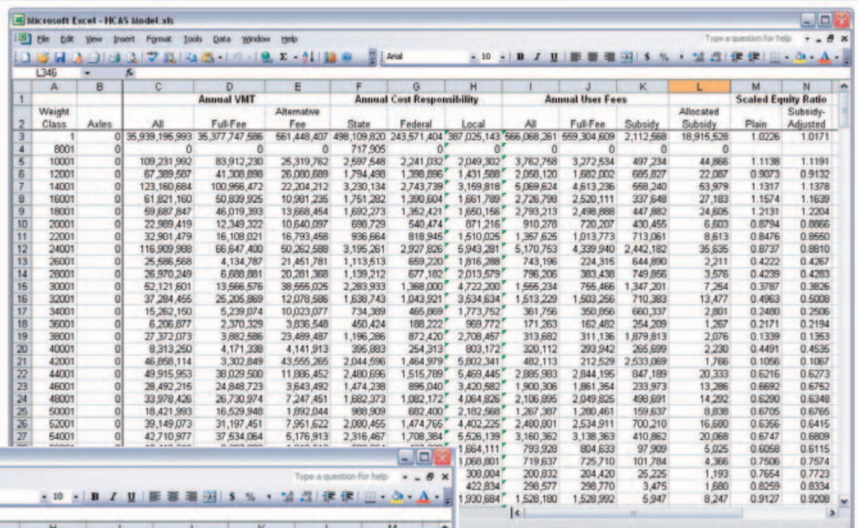
The user can estimate the effects of different rates by entering them in the *Alt Revenues* tab and pressing the "Recalculate" button. After the model is calibrated to the rates and control totals in the *Revenues* tab, the program evaluates the effect of the modified rates and reports the two analyses separately. (The model assumes that VMT will not change in response to changes in rates.)

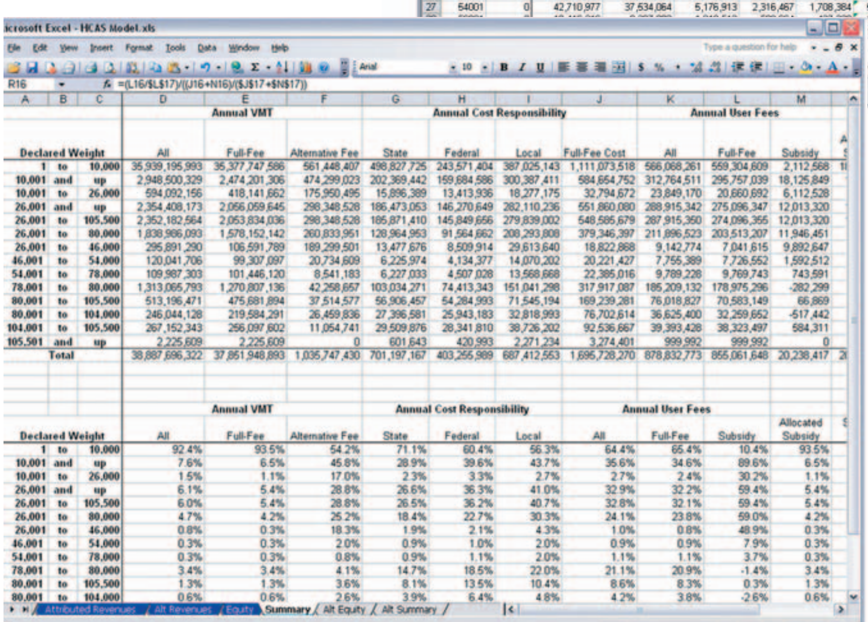
To fill the alternative rates schedules with the rates entered in the *Revenues* tab, press the button above the input area.

When all Changes are Made, Press the "Recalculate" button

Once input data have been entered, the program can allocate costs and attribute revenues. To allocate costs, the program will apply the allocation rules described in the *Policy* tab to expenditures in each combination of worktype and funding source using the appropriate VMT and allocation factors.

To attribute revenues, the program applies rates for each instrument to the appropriate class of vehicles and accounts for avoidance and evasion. The program also calculates subsidy amounts for each weight class (the difference between what vehicles would have paid if they all paid "normal" rates and what they actually paid) as well as VMT by full-fee-paying vehicles.





VIEW RESULTS

Recalculation takes a few seconds. Once recalculation is complete, the user can view results in the *Allocated Costs, Attributed Revenues, Equity,* and *Summary* tabs. The *Equity* tab contains results and equity ratios for each weight class, and the *Summary* tab reports the same information for groups of weight classes.

The *Alt Equity* and *Alt Summary* tabs are the same as the *Equity* and *Summary* tabs but report results under the alternative rates specified in the *Alt Revenues* tab.

Additional Details

MODEL INPUTS AND OUTPUTS

In addition to the data included in the Excel workbook, the model operates using a set of data files (inputs) in .txt format. These files include:

adjustedMPG, a set of MPG values (by weight class) adjusted to account for the wide variation in VMT for 8-26,000 lb. vehicles.

AxleShares, a set of proportions that divide each weight class into 7, 8, and 9-axle groups.

BasicSharePeak, the share of peak-period VMT for each functional class attributable to basic vehicles.

Bonds200X-200X, a set of files containing bonded costs to allocate. (Note: the model uses two such files, one containing prior-allocated bond costs from the previous biennium and one containing bond costs for the current biennium.)

DeclaredOperating, a distribution of operating weights for each declared weight and the share of vehicles within each operating weight.

DeclaredRegistered, a distribution of registered weights for each declared weight and the share of vehicles within each registered weight.

PaveFactors, responsibility shares for flexible and rigid pavement costs by weight class and number of axles.

PCEFactors, passenger-car equivalents (by weight class and number of axles) on regular, uphill, and congested roadways.

SeedData, VMT by weight class, functional class, ownership, and number of axles. (This file essentially contains proportions that guide the model as it fits data for the VMT master table.)

SimpleFactors, vectors of ones and zeros that help the model select the appropriate VMT for cost allocation. (Take, for example, a cost allocated on Over 106,000 lb. VMT. The model will isolate the proper VMT records by applying a simple factor [in this case, a vector containing zeros for all weight classes except those above 106,000 lbs.] to the VMT master.)

The user can view these files in Excel (right click on the file icon and open with Excel) and modify the data as necessary.

The model produces a set of output files (also in .txt) format that describe the completed cost allocation. (Again, these files can be viewed in Excel.) Output files include:

allocatedCosts_bond, bond-funded state costs (for the current biennium) distributed by worktype, weight class, and number of axles.

allocatedCosts_federal, federally-funded state costs distributed by worktype, weight class, and number of axles.

allocatedCosts_state, state-funded state costs distributed by worktype, weight class, and number of axles.

allocatedCosts_local-federal, federally-funded, local-government costs distributed by worktype, weight class, and number of axles.

allocatedCosts_local-state, state-funded, local-government costs distributed by worktype, weight class, and number of axles.

allocatedCosts_local-other, locally-funded, local-government costs distributed by worktype, weight class, and number of axles.

Using the model: How do I…?

Change an Allocator. In the *Policy* tab, modify the share for a given allocator (enter a new percentage and any second share will calculate automatically) or change the allocator itself. (Recall that cutting and pasting allocator names from the “Available Allocators” list will help avoid transcription errors, and allocator percentages must add to 100%.) Once the desired changes have been made, press the “Recalculate” button in the *Control* tab and see the *Summary* tab for the effect of the change.

Change VMT or the VMT growth rate. Enter new VMT (by weight class and vehicle type) into the yellow portion of the *Base VMT* tab and press “Recalculate.” (Or, enter new VMT growth rates into the yellow portion of the *VMT Growth* tab and press “Recalculate.”)

Change Expenditures. Enter new expenditures (project, non-project, and/or local) into the yellow sections of the appropriate tabs and press “Recalculate.” (The model ignores entries in the memo column and stops reading data at the first empty row, so be sure eliminate spaces between entries.)

Change Revenue Control Totals. Enter new revenue control totals (by instrument) in column B of the *Revenues* tab. Check to make sure that the rates entered below the revenue totals are consistent with the control totals and press “Recalculate.” Only use the *Revenues* tab to change current-law revenue control totals. **Do not use the *Revenues* tab to test alternative rates.**

Test Alternative Rates. Modify the desired rate in the lower portion of the *Revenues* tab and press recalculate; see the *Alt Detail* and *Alt Summary* tabs for the effect of the change (compare to the *Detail* and *Summary* tabs).

2007 HCAS Model Documentation

The full source code for the 2007 Oregon Highway Cost Allocation Model is included with the model. The model is contained within a class that can be run by Excel and each of the class methods within it can be called from within Excel. This document provides a written description of what each of the class methods does and how it does it.

Class methods for getting data into the model

The class methods described in this section serve to get data into the HCAS Model. Data that are not expected to change within a study are read in from tab-delimited text files. Data and assumptions that an analyst is more likely to want to change are transferred from the Excel workbook that runs the model.

Other class methods, described in later sections, make use of the data and return results to Excel. Some also write additional, more-detailed data to tab-delimited text files.

The ***readData*** method imports the following data sets (text files) from disk:

SeedData. Used to populate a preliminary VMT Master table (VMTdata) for iterative proportional fitting (see Section 2.) Any seed values (except zeros) could be used to generate fitted results, but this particular set already contains data that reflect the relative proportions of different vehicle types on different functional classes, and so will produce a distribution that not only adds up to the correct totals for each weight class and each combination of functional class and ownership, but also reflects the fact that some functional classes carry higher proportions of heavy vehicles than others.

AxleShares. The shares of vehicles with each number of axles (5-9) by weight class. These data are developed from Special Weighings data.

SimpleFactors. A vector of factors to be multiplied by VMT for simple allocators (different weight groupings of VMT.) These factors are mostly zeros and ones, reflecting the definition of the allocator. For example, the Under26 factor is one for all weight classes up to 26,000 pounds and zero for all weight classes over 26,000 pounds.

PaveFactors. Cost responsibility factors (by weight class, functional class, and number of axles) for wear and tear of flexible and rigid pavement projects. These factors are produced by the NAPHCAS-OR model (the Oregon version of the National Pavement Cost Model for Highway Cost Allocation developed by Roger Mingo).

PCEFactors. Passenger car equivalents (by weight class, functional class, and number of axles) for vehicles on regular, uphill, and congested roadways. These factors represent the amount of roadway capacity a single vehicle of a particular weight class takes up as a proportion of the capacity consumed by a basic vehicle. These factors were developed from a study conducted as a part of the 1997 federal highway cost allocation study.

DeclaredOperating. Shares of vehicles in each declared weight class operating at each operating weight class. These data were developed from the Special Weighings data.

BasicSharePeak. The Basic share of peak-hour VMT for each functional class. These data were developed from automatic traffic recorder data.

VMT calculations

The following class methods capture data from Excel (user inputs) for the VMT calculations. Excel calls these methods to give data to the model before calls the ***makeVMTMaster*** method.

setGrowthRates. Captures VMT growth rates by weight class. These assumptions are specified by the analyst.

setVMTByFC. Captures base-year VMT by functional class and ownership. These data are developed from the State's HPMS submission and FWHA Highway Statistics reports.

setBaseVMT. Captures base-year VMT by weight class and tax class. These data typically are developed from a variety of sources including the ODOT Revenue Forecast, DMV registrations data, and Motor Carrier registrations, weight-mile tax, and road-use assessment fee data.

setEvasion. Captures evasion and avoidance rates. These assumptions are specified by the analyst.

COST ALLOCATION CALCULATIONS

The following class methods capture data from Excel (user inputs) for the cost allocation calculations. Excel calls these methods to give data to the model before calls the ***allocateCosts*** method.

setPath. Captures allocation rules to be applied to each expenditure category (work type). These assumptions are specified by the analyst.

setNonProjectCosts. Captures non-project costs to be allocated (by funding source, worktype, and functional class.) These assumptions typically are derived from the Agency Request Budget.

setProjectCosts. Captures project costs to be allocated (by funding source, worktype, functional class, and bridge type.) These assumptions typically are derived from the ODOT Cash Flow Model and Project Control System.

setLocalCosts. Captures local government costs to be allocated (by funding source, worktype, functional class, and bridge type.) These assumptions typically are derived from Local Roads and Streets Survey reports and the Agency Request Budget.

setStuddedTire. Captures studded tire costs to be allocated (by funding source, worktype, and functional class.) These assumptions are supplied by the analyst.

setBridgeFactors. Captures cost shares used to distribute bridge expenditures in worktypes 60-79. (Bridge and interchange costs are reclassified from worktypes 14, 15, and 19.) The default values for these assumptions were developed from the 2002 OBEC Bridge Cost Allocation Study.

setBondFactor. Captures the bond factor. This assumption is specified by the analyst. It represents the biennial repayment amount as a proportion of the principal amount.

setBiennium. Captures the starting year of the model biennium. Specified by the analyst.

REVENUE ATTRIBUTION CALCULATIONS

The following class methods capture data from Excel (user inputs) for the revenue attribution calculations. Excel calls these methods to give data to the model before calls the ***attributeRevenues*** method.

setRevenueTotals. Captures revenue control totals. These assumptions typically are derived from the Agency Request Budget and must be consistent with current-law rates and the VMT data and assumptions specified elsewhere.

setRates. Captures rates and fees for each revenue instrument (fuel and weight mile tax, registration and title, road use assessment, and motor carrier) by weight class. These assumptions are specified by the analyst based on current law and must match the assumptions used to develop the revenue control totals.

setRUAFRates. Captures current-law road-use assessment fee rates by weight class.

setFFRates. Captures current-law monthly flat-fee rates, average monthly miles, and axle distribution by weight class (dump trucks, log trucks, chip.)

setMPG. Captures initial MPG assumptions by weight class. The default values for these assumptions were derived from a regression analysis of *Vehicle Inventory and Use Statistics (*VIUS) data.

VMT Analysis

The ***makeVMTMaster*** class method returns VMT by functional class and ownership by weight class and number of axles for the model year. It uses VMT by weight class and number of axles (VCTotals, obtained from the Base VMT tab of the workbook), VMT by functional class and ownership (FCTotals, obtained from the VMTbyFC tab of the workbook), and the VMT seed data to create a VMT Master table.

Using iterative proportional fitting, the program repeatedly scales the seed data until each row sums to its corresponding VC total and each column sums to its corresponding FC total. The program stops fitting data once the sum of squared errors for the fitted values falls below a specified threshold.

Methods within *makeVMTMaster*

The following methods are defined and used within the ***makeVMTMaster*** class method:

findFCSums. Sums VMTData by functional class and ownership across weight classes and numbers of axles.

findVCSums. Sums VMTData by weight class and number of axles across functional class and ownership.

scaleToFC. Multiplies each value in VMTData by the ratio of its FCTotal control total to its current FCSum.

scaleToVC. Multiplies each value in the VMTData by the ratio of its VCTotal control total to its current VCSum.

findSSE. Calculates the sum of squared errors for the FCSums. (The SSE for VCSums will equal zero because the scaling process for VCSums runs after scaling for FCSums.)

How makeVMTMaster works

VMTMaster is a matrix of vehicle-miles traveled (VMT) by vehicle classes and by road classes. Vehicle classes are combinations of 2,000-pound weight increments and numbers of axles. Road classes are combinations of functional classes (defined by the Federal Highway Administration) and ownership.

We start with base-year VMT by declared weight class by weight class to develop the row totals. Vehicles weighing 80,000 pounds and under are not classified by axles (axles=0). Base-year VMT by weight-mile tax vehicles between 80,000 and 105,500 pounds are available by numbers of axles because the tax rate varies with the number of axles. Other vehicles in this range (e.g., farm, publicly-owned, or Road Use Assessment Fee) are assumed to have the same distribution of miles by number of axles within each weight class as weight-mile tax vehicles.

Base-year VMT by Road Use Assessment Fee Vehicles weighing more than 105,500 pounds are distributed among numbers of axles according to the proportions specified in the **axleShares** data file. A hash named VCTotals, keyed by weight class and number of axles, is built to contain the row totals for the VMT Master matrix.

The column totals are copied from vmtByFC, which is supplied by Excel. They are then scaled to ensure that they add up to exactly the same total as the row totals.

The individual cells of the VMT Master matrix are initialized with the proportions from the **seedData** data file. The columns initially sum to one.

The iterative proportional fitting follows the following steps:

1. Scale each row so that it adds up to its row control total
2. sum each column
3. Scale each column so that it adds up to its column control total
4. Sum each row
5. Find the sum of squared differences between row totals and row control totals and compare to the threshold value
6. If the sum of squared errors is less than the threshold, stop. Otherwise, do it again.

Once iterative proportional fitting is complete, the growth rates for each vehicle class are applied to the fitted VMT data to bring it to the study year (the middle 12 months of the study biennium).

Three additional, summary facility classes are then added to the matrix. FC0 is all State-owned roads. FC-1 is all roads. FC-2 is all locally-owned roads.

VMTMaster is written to disk and portions (FC-2 to FC0, and all combinations of State ownership and functional class) are returned to Excel.

The ***makeVMTByVehicles*** class method multiplies VMT values in BaseVMT by the appropriate growth rates to produce vmtByVehicles, which contains study-year VMT by weight class and tax class.

Cost Allocation

The ***allocateCosts*** class method performs the following processes:

- Combine local costs data into project costs data.
- Do bridge splits on project costs. For projects in worktypes 13, 14, 15, 19, 113, 114, 115, and 119 (bridge and interchange projects), the bridge type for each project is identified and the project's cost is split into multiple worktypes (60-79) using the bridge factors appropriate to the bridge type. Costs in worktypes 13, 14, 15, 19, 113, 114, 115, and 119 are deleted from projectCosts and the split costs in worktypes 60-79 are inserted into projectCosts.
- Separate bond projects and apply the bond factor. Projects where the funding source is "bond" are identified, their costs are multiplied by the bond factor, and they are moved to bondCosts.
- Do studded tire adjustment. For each worktype and corresponding dollar amount in studdedTire, the dollar amount is moved from projects in that worktype to worktype 39 (or 139 for state-funded studded tire damage repair on locally-owned roads). The costs are removed from each project in proportion to that project's share of total costs within the worktype.
- Set up allocation vector data structure and build allocation vectors. There are allocation vectors for each combination of allocator, functional class, and ownership. Within each allocation vector, there is an element for each combination of weight class and number of axles.

  Allocation vectors are built by starting with the vector of allocation factors appropriate to the allocator. The allocation factors are proportional to costs imposed per vehicle.

Each allocation factor is then multiplied by the VMT in that combination of weight class and number of axles for the combination of functional class and ownership for which the allocation vector is being prepared. The VMT multiplied by the allocation factors for Congested PCE are adjusted using the peakShares factors so that they represent VMT during the peak hour for that functional class.

The allocation vectors are then scaled so that the elements of each vector sum to one. The resulting allocation vectors then may be multiplied by a project cost and the result will be a vector of allocated costs with one dollar amount for each combination of weight class and number of axles, that sum to the original amount to be allocated.

- Apply allocation vectors to project costs to allocate (except for other construction costs) as described above to generate allocated project costs.
- Make Other Construction allocator. Once project costs other than "other construction" have been allocated, a special allocation vector is built to allocate "other construction" costs in proportion to all previously-allocated project costs.
- Apply Other Construction allocator to "other construction" costs.
- Apply allocators to non-project costs.
- Apply allocation vectors to bonded costs to allocate. Applies the allocators to bondstoAllocate.
- Store allocated bonded costs. Creates a text file of allocated bond costs (allocatedBonds) for use in future studies. (Future model runs will use this file to obtain prior allocated bond costs.)
- Get prior allocated bonds from files. Captures current payments due on bonds issued for projects in previous biennia (priorBonds.)
- Add current and prior allocated bonded costs to allocatedCosts.
- Prepare a matrix of allocated costs and send it back to Excel.

Revenue Attribution

The ***attributeRevenue*** class method performs the following processes:

- Attribute Road Use Assessment Fee revenue. RUAF revenues are attributed to weight classes by multiplying their forecasted VMT in each combination of weight class and number of axles by the appropriate RUAF rate. The resulting revenues are doubled to make them biennial.
- Attribute Weight-Mile Tax revenue. WMT revenues are attributed to weight classes by multiplying their forecasted VMT in each combination of weight class and number of axles by the appropriate WMT rate. The resulting revenues are doubled to make them biennial. Further adjustments are made to account for WMT evasion. The forecasted VMT are adjusted upward to account for evasion, so the reverse adjustment must be applied to the revenue attribution.
- For all non-RUAF vehicles over 26,000 lbs, "as-if" WMT revenues are calculated. These are used to determine the subsidy amount that alternative-fee-paying vehicles over 26,000 lbs receive by subtracting what they actually pay from what they would pay in WMT.
- Attribute flat-fee revenue. For each flat-fee vehicle type, for each combination of weight

class and number of axles, divide the forecast VMT by the average VMT per month for that type and weight, and multiply the resulting number of vehicle-months by the appropriate monthly flat-fee rate. The resulting revenues are doubled to make them biennial. For flat-fee log trucks, the forecast VMT must be adjusted prior to attribution. The VMT for empty miles with the trailer stored above the tractor are forecast at a lower weight—the weight at which such a vehicle would pay WMT. Forecast flat-fee miles above 50,000 lbs are increased and those under 50,000 lbs are set to zero.

- Attribute registration revenues. Budgeted total DMV registration, Motor Carrier Apportioned, Motor Carrier Non-Apportioned, and title fee revenues are attributed to vehicle classes using fee-weighted VMT. VMT for vehicles over 26,000 lbs are adjusted using the declared-to-registered factors. VMT by tax class and weight class are multiplied by the registration fee that applies to that combination and the resulting amounts are scaled so that they add up to the total expected registration fee revenue. For vehicles over 26,000 lbs, registration fee revenues by registered weight are converted back to revenues by declared weight class using the same declared-to-registered factors. A further adjustment is made to give RUAF vehicles credit for the registration fees they pay.

  This method eliminates the need for forecasting vehicle counts and automatically accounts for the substantial registration revenues that are produced by fees other than the regular registration fee (e.g., temporary registrations, duplicates, etc.). "As-if" registration fees are estimated for alternative-fee-paying vehicles and the associated subsidy amount is calculated by subtracting what they do pay from what they would pay if they paid the normal registration fee.

- Attribute title fee revenue. Title fees are attributed using the same method as registration fees. This method eliminates the need for forecasting the number of titles to be issued.

- Attribute fuel tax revenues. Gasoline and diesel fuel tax revenues are attributed separately because the model allows for different tax rates and different evasion/avoidance assumptions. VMT by fuel type and weight class for fuel-tax paying vehicles are assembled and adjusted for evasion/avoidance. A preliminary attribution is made by dividing the adjusted VMT in each combination of weight class and fuel type by the assumed miles per gallon for that weight class from the mpg data set and multiplying the resulting number of gallons by the per-gallon rate for that fuel type. The attribution to vehicles between 8,001 and 26,000 lbs is then adjusted to bring those weight classes, as a group to equity (before considering subsidies). The attribution to basic vehicles (those 8,000 lbs and under) is adjusted to make the total revenues attributed add up to the forecast revenues from the budget. The implied miles per gallon after adjustment for each weight class is calculated and sent back to Excel where it may be examined for reasonableness. The reasons for using this approach are detailed in Issue Paper 6.

- Attribute other motor carrier revenue. Forecast other motor carrier revenue is attributed to vehicle weight classes on the basis of all RUAF and WMT VMT.

- Determine subsidy amount for each weight class. These are calculated for each tax class by subtracting what they do pay in each revenue category from what they would pay if they paid the "regular" tax or fee. Subsidy amounts may be negative, especially for certain flat-fee vehicles.

- Prepare a matrix of attributed revenues and subsidy amounts and send it back to Excel.