



FISCAL RESEARCH CENTER

An Inventory of Transportation Funding Options

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ANDREW YOUNG SCHOOL
OF POLICY STUDIES

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The contents of this report reflect the views of the author who is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Georgia Department of Transportation or of the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

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An Inventory of Transportation Funding Options

I. Introduction

Current revenue sources are proving to be inadequate to fund needed transportation projects and operations. As a consequence, alternative revenue sources, such as the vehicle miles traveled (VMT) tax, sales tax, energy tax, parking tax, tolls, and others, are being used or discussed around the United States in order to provide financing for transportation (both improvements and operations). In addition, some of these revenue sources are designed to affect travel behaviors through the internalizing of travel costs. This report presents a list of alternative revenue sources that could be used to finance transportation, both at the state and local level and presents the pros and cons, advantages and disadvantages of each option.

While not the only source of revenue, fuel taxes and transit fares are two key revenue sources for transportation. The construction and maintenance of roads and bridges rely heavily on fuel taxes and the construction and operation of transit systems have been funded from fares. Both are also funded by federal grants that are funded by fuel taxes, but with fuel tax revenue lagging and with strong voter resistance to increased fuel taxes, state and local governments are searching for alternative revenue sources. In addition, rather than address the problem of congestion by continuously increasing the supply of transportation infrastructure, there is increasing interest in attempting to reduce congestion by reducing demand through pricing schemes or user charges.

There is a long list of potential revenue options for transportation. Drawing on the existing literature, we developed a list of 36 potential revenue sources for transportation. An alphabetized list is presented in section 2. These are not new options in the sense that some governments have used them or at least experimented with them. The report describes each of the alternatives, and for several options, discusses how they are used by certain jurisdictions. To evaluate the advantages and disadvantages of each alternative, a set of criteria was proposed; the criteria are presented in section 3. These criteria include: economic efficiency, equity, administrative feasibility, public acceptance, and the level and stability of the revenue. Each of the revenue options is then discussed using these criteria as a frame of reference. Section 4 discusses more traditional funding sources, section 5

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discusses pricing or tolling options, while section 6 discusses less traditional options. Section 7 contains some concluding remarks.

II. List of Revenue Options

This section presents an alphabetized list of 36 revenue options that potentially could be adopted by a state or by local governments, if they were so authorized. We also provide a very brief description of each option. The list of options was drawn mainly from Dierkers and Mattingly (2009), Sundeen and Reed (2006), and Weinstein et al. (2006). We have attempted to be as comprehensive as possible in developing the list of options. Being included on the list does not imply anything about the desirability or feasibility of the revenue option.

We focus on revenue options and not financing options. For example, bonds are a means for financing a project, but at some point the state would need to raise the revenue to pay off the bonds. Nor do we include a discussion of federal transportation funding since the state has no discretionary control over this revenue source. Public-Private Partnerships are a way to finance a project. However, since they frequently involve imposing tolls as a way to generate the revenue, we include them in our list.

- ***Advertising Revenue***

Charges for the lease of spaces to firms for advertising purposes.

- ***Alternative Fuel Tax***

This is a tax for the use of electricity, natural gas, hydrogen, and similar fuels in alternative fuel vehicles.

- ***Assessment (or Benefit or Improvement) District Tax or Fee***

In a defined area that benefits from some transportation infrastructure a property tax or fee is levied on businesses to finance the construction or operation of the transportation infrastructure.

- ***Battery Tax***

An excise tax that is imposed on batteries.

- ***Bicycle Registration Tax or Fee***

Similar to car registration or license, it is an annual or one-time fee paid to register a bicycle.

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- ***Container Charges***

Fees levied on containers used on ships and railroads.

- ***Drive-Through Service Fee***

A fee charged for the presence of drive-through service at retail establishments.

- ***Driver's License Fee***

Fees associated with obtaining or renewing a driver's license.

- ***Emissions Fees***

A fee on motorists for the amount of pollution their vehicles emit.

- ***Excise Tax on Automobile-Related Goods and Services***

A tax applied to the purchase of vehicles and vehicle parts.

- ***Fuel Excise Tax—Fixed***

This is a fixed per gallon tax on fuel.

- ***Fuel Tax—Indexed***

This is a variant of the fuel tax under which the tax rate per gallon is indexed for inflation, using a price index such as the Consumer Price Index or a construction cost index, or for fleet fuel efficiency increases.

- ***General Fund Revenue***

Some portion of a state's general revenue would be appropriated to fund transportation.

- ***Local Fuel Taxes***

These are fuel taxes that are levied by local governments for their use.

- ***Local Option Sales or Income (Payroll) Tax***

This is a local add-on to the state sales tax or a tax on payrolls paid by the employer or the earnings of employees in a given jurisdiction.

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- ***Naming Rights***

Rather than naming a section of a road, bridge, rest area, transit station, etc. to honor someone, the state would sell the right to name the facility.

- ***Parking Tax or Fee***

This is a flat fee per parking space or a percentage tax on the charge for parking.

- ***Privatization of Rest Area /Concessions***

The state would lease public rest stops and allow the lessee to install commercial facilities.

- ***Public-Private Partnerships***

This is a contractual agreement between a public agency and a private firm or consortium to collaborate on a transportation project.

- ***Road Utility Fees***

This option is a charge based on a property's access to and derived use of the road system.

- ***Safety Violation Fee***

Increased fine for drivers who are convicted of traffic safety offenses.

- ***Sales Tax on Fuel***

A tax based on the price of fuel rather than just the volume of fuel purchased.

- ***Special License Plate Fees***

These are increased fees for special license plates.

- ***Title Fee***

A fee imposed when a vehicle is purchased or the title changes hands.

- ***Tire Tax***

An excise tax on the sale of tires.

- ***Toll—Fixed***

This is a fixed, direct charge on a user for access to a highway, bridge, tunnel, etc.

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- ***Toll—Variable***

This is a toll that varies with the time of day, type or weight of vehicle, or level of congestion.

- ***Transit Fare***

Fees charged for riding a public transit vehicle.

- ***Transportation Impact Fee***

A fee that is imposed on a developer in order to fund the transportation infrastructure needed to support the development.

- ***Truck Weight-Distance Fee***

A fee based on the weight of a commercial truck and the distance traveled.

- ***Value-Based Tax on Vehicles***

A property tax applied to vehicles.

- ***Vehicle Impact Fee (Transportation Access Fee)***

A one-time charge placed on a vehicle when the vehicle is titled or registered in the state for the first time.

- ***Vehicle Mile Traveled (or Mileage) Fee***

A tax based on the number of vehicle miles traveled.

- ***Vehicle Registration Fees***

A fixed fee paid annually in association for registering a vehicle.

- ***Vehicle Rental Tax***

This is a tax that is levied on vehicle rental agreements.

- ***Vehicle Weight Fee***

A state fee based on the weight of a noncommercial vehicle.

III. General Criteria for Evaluating Revenue Options

There are general criteria that can be used to evaluate alternative revenue sources for transportation infrastructure. These criteria are: economic efficiency, equity, administrative feasibility, public acceptance, and the level and stability of the revenue.

A. Economic Efficiency

Prices are one means for rationing limited resources. Without prices, consumers would not be constrained in the amount they consume, with the result that they will consume more than is economically efficient. If the cost of producing one more unit exceeds the benefit of that unit of output, society is not being economically efficient in the use of its limited resources. In a competitive market system, prices lead to an allocation of resources to their highest and best use. This maximizes net benefits since the allocation occurs where marginal benefits equal marginal cost. In the public realm, user taxes and fees can play the role of prices. If properly set, tolls and fuel taxes signal the marginal cost of using the transportation infrastructure, and thus lead to the economically efficient use of the infrastructure.

The costs of using the transportation infrastructure include the cost of building and maintaining it, environmental damage, and congestion. When roads are congested, adding another car results in time delays for other drivers, as well as environmental damage. If drivers do not bear the congestion cost imposed on others, the result is that costs exceed the benefits, thus creating economic inefficiency from too many drivers. To the extent that tolls and taxes reflect all of these costs, the use of the transportation infrastructure will be more economically efficient.

Taxes and fees affect behavior. If taxes and fees reduce congestion or the cost of maintaining a roadway, then that would be generally thought of as a good thing. But, the taxes could lead drivers to shift purchases to other jurisdictions or simply use other roadways and increase the congestion on them. This would reduce economic efficiency.

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B. Equity

When it comes to financing public services, a distinction can be made between horizontal equity and vertical equity. Horizontal equity, or fairness, means that equals should be treated the same. Vertical equity refers to how non-equals are treated. Equity can be based on the principle of ability to pay or the benefit principle. In terms of the ability to pay principle, vertical equity means that someone with a greater ability to pay should pay more taxes or fees. While for the benefit principle it means that the tax or fee should be based on the benefit received.

Transportation has traditionally been financed by user taxes, like fuel taxes. These are benefit taxes, i.e., those who benefit more from a road, that is, use the road more or impose more cost on the system, will pay more.

C. Administrative Feasibility

Funding alternatives should be evaluated in terms of the cost of administering the revenue source relative to the revenue collected. Part of administrative feasibility ties to the compliance cost, both on the part of the user and the government.

D. Public Acceptance

While no one wants to pay taxes or be charged fees, some revenue sources are more acceptable to the public than others. If the public is strongly opposed to some revenue source, it will be difficult to get elected officials to impose it, and, if imposed, the public will strongly resist paying it, which increases the cost of collecting it.

E. Level and Stability

A revenue source should produce sufficient revenue to make it worth imposing the tax or fee. Sufficient revenue, however, should be considered relative to the types of projects being funded. A source that will be dedicated to funding bike lanes does not have to generate the same revenue as a source that will be used to build new roads. And of course, one or two revenue sources do not have to fund the entire transportation system; even revenue sources that generate relatively small revenues may contribute to the total.

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Some fees are not necessarily designed to raise revenue. For example, fees that are designed to reduce congestion may generate revenue, but the evaluation of such fees would be largely based on how well they allocate the roadway.

A revenue source that is stable and predictable is better than one that is not. While it is possible to maintain large balances that can be used in time of low revenue, stable revenues makes planning and budgeting easier.

IV. An Evaluation of Traditional Revenue Sources

In this section we provide a discussion of what some authors refer to as “traditional” or common revenue sources. Since several of the revenue sources listed above are variations of one revenue source. For example, fuel taxes indexed for inflation are still fuel taxes. Thus, we combine some of the options and discuss them together. In section 5, we discuss tolling or pricing options, while in section 6 we discuss other less traditional revenue sources.

Fuel Excise Tax

The fuel excise tax is a fixed pennies per gallon tax on gasoline and other motor fuels and is the main funding source for highways and for Federal grants for transit. The average state motor fuel excise tax in 2009 was 21.72 cents per gallon for gasoline, 22.62 cents per gallon for diesel, and 21.54 cents per gallon for ethanol (Dierkers and Mattingly, 2009). The majority of state excise taxes fall between 18 cents and 24 cents per gallon, although the complete range is from 7 to 32 cents per gallon (Dierkers and Mattingly, 2009). In 2009, state fuel excise taxes generated \$38.9 billion in revenue across the U.S., which was 27.7 percent of total transportation revenue.¹

Fuel excise taxes have been the key funding source for highways for a very long time. One of their biggest advantages is their significant revenue yield, coupled with low administrative and compliance costs. A small increase in the fuel tax generates substantial revenue. Another advantage is the direct link between the tax and the use of the revenue. Overall, in the past the excise tax has been a good proxy for a user charge since gas usage is related to the number of miles driven. However, with changes in fuel efficiency and the development of alternative fuel vehicles, this relationship has weakened and will continue to do so in the future.

One of the main disadvantages of the fuel excise tax is that it is not indexed to increases in the cost of building and maintaining transportation facilities, with the

¹ State fuel taxes as percentage of total transportation revenue was 39.8 percent for Alabama, 34.3 percent for Florida, 33.3 percent for Georgia, 22.8 percent for Louisiana, 34.1 percent for Mississippi, 43.6 percent for North Carolina, 44.1 percent for South Carolina, and 44.0 for Tennessee. Data is from *Highway Statistics*, U.S. Department of Transportation.

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exception of a few states,² and therefore the revenues do not increase automatically with some measure of inflation. With higher gas prices, voters have been unwilling to support increases in fuel taxes, so revenue in real terms has not been able to keep up with transportation financing needs. One revenue option would be to adopt legislation that would index fuel taxes for inflation. This would allow fuel tax rates to adjust quickly to cost increases rather than waiting for the legislature to act, which has been a politically acrimonious task in most states. Indexing, however, does take the approval of a tax increase out of the control of the legislature.

Another disadvantage related to revenue adequacy is that with improving fuel efficiency this source of revenue is expected to decline in real terms further in the next couple of decades. To deal with this trend, the fuel tax could be indexed for improvements in fleet fuel efficiency. This change would protect the fuel tax revenue from decreases in revenue per mile driven due to the reduced fuel used per mile driven.

In terms of economic efficiency, fuel taxes paid do relate to road usage, but do not vary much with the level of congestion, so fuel taxes are not as efficient as would be a variable tax or fee that depends on road congestion. Generally, any tax increase would be perceived as an increase in the price of gas and therefore will reduce the amount of driving. Studies of the price elasticity of gas estimate that a one percent increase in the price of gas reduces demand by 0.43 percent (Sjoquist et al., 2007). Further, fuel tax increases may influence the purchase of more efficient vehicles, carpooling, and demand for public transportation.

Finally, most taxes on consumption, either per unit or percentage excise taxes, are considered to be regressive, that is, individuals with lower incomes pay a larger share of their income in taxes. According to a study for the Colorado Department of Transportation, low income families (income less than \$20,000) pay about 0.8 percent of their income in fuel taxes, while high income families (income between \$80,000 and \$100,000) pay 0.34 percent of their income in fuel taxes in Colorado (Carter and Burgess Inc., 2007). To the extent that funding of the

² Florida, Kentucky, Maine, Nebraska, North Carolina, and West Virginia (Dierkers and Mattingly, 2009).

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transportation system should be based on the principle that those who benefit should pay, problems arise due to differences in fuel efficiency across vehicles.

Public support for tax increases is difficult to garner, as illustrated by the failure of the only two ballot initiatives (in Missouri and Washington in 2002) over the past decade for statewide fuel tax increases (Coussan and Hicks, 2009).³ However, there were legislative increases of the motor fuel tax ranging from 3 cents per gallon in Kansas in 2002 to 6 cents per gallon in Oregon in 2009. Washington implemented a 5-cent increase in 2003 and gradual increases from 2005 to 2008, for a total of 9.5 cents per gallon.

Recent poll results confirm that fuel tax increases are very unpopular with voters. A national poll conducted by HNTB (2010), showed that Americans prefer toll financing (41 percent) to gas tax increases (18 percent) for new roads, and they would rather have no new roads (41 percent) and keep their taxes low. In Virginia, two-thirds of poll respondents opposed a gas tax increase, and one-third was in favor (Meola and Whitley, 2011). An Idaho survey in 2008 revealed that voters were strongly against fuel taxes and tolls and were more likely to favor impact fees, registration fees, and a local option tax (Idaho Highway Users, 2008).

Vehicle Registration Fees

Vehicle registration fees are another revenue source used by all states. The cumulative revenue from such fees in 2008 was \$20 billion (Dierkers and Mattingly, 2009). Registration fees are levied annually and are either flat or depend on the vehicle value, weight, year, and horsepower. Twenty-seven states have flat fees, eight states have a weight-based fee, and the remaining states use a more complex fee structure. In Colorado, the registration fee depends on the weight and year of the car. For example, the registration fee for a small car that is 10 years old is \$16 (Carter and Burgess Inc., 2007).

Some states allow local governments to impose an annual transportation benefit district tax on each vehicle beyond the annual registration fee.⁴ For example, Wisconsin allows municipal and county governments to add an additional fee (called

³ These proposals were for multiple tax increases, including the fuel excise tax and the sales tax.

⁴ A transportation benefit district is a defined area that benefits from some transportation infrastructure.

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a wheel tax) with the revenue earmarked for transportation. Seattle and Olympia, Washington and Milwaukee, Wisconsin impose a tax of \$20.

Registration fees are a fairly stable source of revenue, but due to low vehicle ownership turnover they do not have high revenue potential unless value-based fees are introduced in place of flat fees. Flat fees are not related to the amount of driving and any fee increase is not expected to significantly influence driving behavior. Fees that vary with the vehicle type and value may influence the purchase of particular vehicles, but are not likely to influence driving behavior. There is an indirect link to the cost of transportation infrastructure in the cases where fees are based on weight and value, assuming that heavier cars cause more damage to the roads and that more expensive new cars are driven more.

Flat fees are regressive, since they represent a larger share of the income for low-income individuals. However, registration fees based on the car value are probably progressive. The administrative costs of registration fees would depend on the extent of the change, but are not expected to be prohibitive since most states collect some form of a registration fee.

In the past decade, states have increased a mix of vehicle fees, including registration fees. Specifically, Colorado increased registration fees by \$31 in 2009, and Kansas increased the registration rate by \$4 in 2008 (Coussan and Hicks, 2009). In 2010, poll results released by the Pennsylvania Governor's Office indicated that close to a majority of residents (48 percent in favor, 45 percent against) were willing to support inflation adjustments to vehicle fees for infrastructure spending (Pennsylvania Office of the Governor, 2010).

General Fund Revenue

Thirty-two states use general fund revenues to fund transportation projects, for a total amount of \$8 billion in 2008 (Dierkers and Mattingly, 2009). General funds are a combination of sales taxes, income taxes, property taxes, and other fees and charges. General fund revenues are more important at the local level, where almost half of highway expenditures came from general fund appropriations in 2004 (Cambridge Systematics Inc. et al., 2006).

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The general fund revenues are a large potential source of revenue, but obviously must compete with other public priorities. Using general fund revenue does break the link between what a person “contributes” to the funding for transportation and that person’s use of the road system. Furthermore, the revenue is not linked to the cost of providing and maintaining transportation, and increases in the use of this revenue source are not expected to have any impact on driving behavior. On the other hand, use of general fund revenues might be justified on the basis that transportation infrastructure is a public good and everyone benefits from its development, not just users. To the extent that general fund revenues are substantially drawn from a state income tax, they may provide a less regressive approach to revenue raising since income taxes tend to be progressive. General funds may be more flexible because in most states, fuel tax revenues are legally restricted to use for roads and bridges. General fund revenues are less constrained and can be used to fund transit and other non-highway transportation.

General fund revenues are not as stable a revenue source for transportation as per gallon fuel taxes because general fund revenues fluctuate more with the economic cycle than do fuel taxes.

Driver’s License Fees

Driver license fees are a small revenue source due to their relatively low rates and the fact that licenses are renewed only periodically, anywhere from four to 10 years. Overall, the revenue from driver license fees has been used for administrative expenses. Increases in license fees are not costly to implement but are not expected to influence driving behavior.

Vehicle Rental Tax

The rental car tax is a tax on the rental or lease of a vehicle. It is similar to a sales tax, but the rate may be greater than for the state or local sales tax. Rental car taxes are imposed in 30 states (Sundeen and Reed, 2006). In Colorado, the rental car tax rate is equal to the state sales tax,⁵ while in Minnesota it is a separate tax, which was increased from 3 percent to 5 percent in 2008 (Coussan and Hicks, 2009; Carter

⁵ Colorado also imposed a \$2 per day fee on rental cars in 2009 (Coussan and Hicks, 2009).

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and Burgess Inc., 2007). Arkansas, Florida, and Pennsylvania dedicate some of their rental car tax revenue for public transportation, while New York uses the revenue for highways (Cambridge Systematics Inc. et al., 2006). Indiana, Kentucky, North Carolina and Wisconsin have local rental car taxes that support transit.

The adequacy of this revenue source depends on the extent of leisure travel in the state and any seasonal fluctuations. If the tax needs to be accounted for separately and earmarked for transportation, it will be associated with some additional compliance and administrative costs. To the extent that people who rent cars are not state or local residents this revenue source is a form of benefit tax and thus is a fair tax since visitors are benefitting from local amenities but are not paying many of the state and local taxes that are paid by residents. Also, to the extent that higher income individuals have more leisure time and are more likely to travel, this sales tax is expected to be less regressive than a regular sales tax. The rental car tax probably does not have a significant impact on miles driven, but it may affect the decision on what type of car to rent.

Transit Fares

Fare box revenue is mostly used to fund public transit operations and maintenance, while capital projects are funded by other transportation revenues. In some cases, transit systems use fare revenue to finance capital projects. Notably, Chicago Metra has dedicated 5 percent of its fare increases since 1989 to capital projects (Cambridge Systematics Inc. et al., 2006).

Fare box revenue is directly linked to the use of public transportation and to the cost of operation and maintenance – in other words, the “user pays.” While generally the user pays principle is appropriate in this case, the socially appropriate pricing of transit is complicated.

Mass transit ridership is price inelastic. In a meta-analysis of public transportation studies, Johan Holmgren (2007) reports that the long-run price-elasticity of public transportation in the United States -0.75 , i.e., a one percent increase in fares is expected to reduce ridership by 0.75 percent. This means that an increase in fares will result in an increase in revenue, but will also reduce ridership. If the transit system was used to capacity, then raising fares would be socially

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desirable, but if there is excess transit capacity, such a decrease in usage would not be socially desirable since increasing ridership will have little effect on cost but will generate benefits for the rider. Furthermore, reduced ridership may exacerbate road congestion problems in some areas. To the extent that the use of roads is inappropriately priced too low, shifting transit riders to driving is not socially desirable.

When there is congestion on the transit system, transportation studies report that transit systems can improve their peak-time performance by introducing rates that vary over the day and day of the week. Flat fares per ride do not reflect the additional cost of longer trips. Since low income individuals are more likely to rely on transit, transit fares are likely to be regressive.

V. Tolling or Pricing Options

The basic foundation for financing transportation systems in the U.S. has been to use benefit taxes. Fuel taxes have been the principal method, under the premise that the more one drives the more fuel will be consumed. Fuel taxes are considered an indirect user fee, but there are other, more direct ways of pricing transportation. In this section we consider various forms of tolling, or pricing, road facilities or networks.

Many of the revenue options involve tolling, or direct pricing. (Fares for the use of public transit are a form of a pricing, but we considered that option above.) Tolling has a long history of being employed to fund transportation projects, but there are many variations in how transportation can be priced. More generally, pricing options differ in terms of the infrastructure that the driver is paying to access and what factors determine the price or toll. Tolls can vary with the distance travelled, the weight of a truck (usually measured by the number of axles), time of day, and level of congestion. In what follows, we first list the various transportation infrastructure that could be priced and give some examples. We then turn to a discussion of the advantages and disadvantages of tolls in general, as well as to specific types of tolls or pricing. Finally, we discuss the use of congestion pricing, or varying tolls by the level of congestion on a road or road network.

A. Types of Facilities that Can Be Priced

Access to a Specific Road, Bridge or Tunnel

The most common application of tolls is as a flat charge imposed for access to a transportation facility such as a bridge or a segment of a road. Tolls can be fixed amounts, but may vary with the distance travelled or the weight of a truck (usually measured by the number of axles). Tolls can be allowed to vary by time of day or day of the week to reflect the expected level of congestion during peak periods. Tolls are collected at a toll station, either directly or through an automated mechanism such as E-Z Pass. The development of automated mechanisms such as E-Z Pass has reduced the transaction cost of collecting tolls, regardless of the transportation facilities.

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Car Access to an Express Lane, or HOT Lanes

A toll can be imposed for the use of a particular lane of a freeway, i.e., High Occupancy Toll (HOT) lanes; these are also called managed lanes. A toll on a HOT lane can be a fixed amount to enter the lane or a fixed amount per mile, and can vary by time of day and by traffic volume. With HOT lanes there is usually a zero toll for car pools of, say, three or more passengers per car. Some HOT lanes attempt to keep usage of a lane to a level that ensures free flow in that lane for anyone willing to pay to use the lane. Thus, the price (or toll) varies continuously as the demand changes.

One of the first HOT lanes in the United States was the Riverside Freeway (state route 91) in California where two HOV lanes were converted to HOT lanes. The toll varies by time of day (highest is \$10.25 per trip Friday afternoons). A transponder in each car records road usages. Interstate 15 in San Diego has eight miles of two reversible HOT lanes. Toll varies in real time from \$.50 to \$4.00 depending on the level of congestion. A transponder deducts the payment from a prepaid account.

In Toronto, the Express Toll Road fee varies by time of day and distance. During peak periods, motorists pay \$0.10 (Canadian) per kilometer, during other weekday times the price is, \$0.07 per kilometer, and it is \$0.04 on weekends. The system uses a vehicle identification system (VIS). For those without a VIS, the system photographs license plates and sends a bill to the registered driver. In Minneapolis, the toll for using the HOT lane is 25 cents during rush hour, regardless of the distance driven. Variations of HOT lanes are FAIR (fast and intertwined regular) lanes for which everyone pays including car pools, which do not pay tolls in HOT lanes.

Truck Access to a Specific Lane, or TOT Lanes

A toll can be imposed on the use of a lane devoted to truck use. The use of the lane can be voluntary or mandatory. Although these types of projects have been proposed in several metro areas, including Atlanta, currently there are no TOT lanes in operation in the US. Meyers (no date) provides an extensive discussion of the issues associated with implementing TOT lanes in the Atlanta area.

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Cordon Pricing

Under a cordon price policy the central area of a city is cordoned off and a charge or toll is levied if a driver crosses the cordon boundary. In a cordon pricing system, the toll is a form of congestion pricing although the charge varies by time-of-day and day-of-the-week, not by the level of congestion. These systems are often used to capture revenues from commuters moving into and out of central cities.

Although cordon pricing has not been tried in the US, there are a few international examples of cordon pricing. Singapore adopted cordon pricing, called the Area Licensing Scheme (ALS), in 1975, which was the world's first comprehensive road pricing scheme.⁶ The ALS was adopted because of increased car ownership and the concern that more land could not be allocated to roads. Singapore sought a market-based way to reduce the number of passenger cars and taxis coming into the Central Business District. They instituted a manual system of toll collection at 22 entry points. All non-exempt vehicles were required to buy and display a decal, which cost S\$3 per day (about US\$2.30 at today's exchange rate) if the driver wanted to enter the restricted zone between 7:30 a.m. to 9:30 p.m. Monday through Saturday. To ensure that drivers have a decal, police simply observed each car as it entered the cordoned area to see if it had the required decal. Cars with four or more passengers were exempt, as were public service vehicles, motorcycles, buses, and delivery vehicles. Singapore also increased its parking fees in the restricted area by almost 100 percent and implemented a park-and-ride program. Over time, the daily fee changed as did the peak-toll hours. By 1989, the peak-toll hours were set at 7:30 a.m. to 10:15 a.m. and from 4:30 p.m. to 7:00 p.m.

London adopted a cordon pricing scheme in 2003. Cars entering central London on weekdays between 7:00 a.m. and 6:30 p.m. are required to pay £8.⁷ There are some exemptions such as motorcycles, taxis, buses, and emergency vehicles. Area residents receive a 90 percent discount for their vehicles. Payments can be made at selected retail outlets, at payment machines located in the area, by Internet, and by cellular telephone messaging. Passes for up to a year can also be purchased. A

⁶ This description was drawn from Phang and Toh (2004).

⁷ This description is drawn from Litman (2006).

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network of video cameras records the license plate numbers of vehicles and matches it with the paid list. The fine for not paying is £80.

In 2006, the Swedish national government sponsored a full-scale congestion pricing experiment in Stockholm, creating charges for entering a 30 square mile area of the inner city.⁸ The congestion pricing program was put in place for six months and was combined with short-term increases in public transit capacity. At the time the experiment was approved it was decided to hold a referendum after 6 months to see if there was support for implementing the congestion program on a permanent basis. The referendum passed with 52 percent of the voters approving the plan.

In the current Stockholm system, vehicles are identified by a transponder or a photograph of the license plate. There are four different rates for travel into and out of the condoned area that vary by time of day and days of the week: zero charge at night and on weekends, 10 Swedish crowns (SEK) for off-peak, 15 SEK for early and late peak periods, and 20 SEK for peak-hour travel, with a maximum charge of 60 SEK per day.⁹ Cordon pricing is also used in the cities of Trondheim, Oslo, and Bergen in Norway.

Access to a Road Network, Electronic Road Pricing

Charges can be levied for use of a set of roads or a road network. Hong Kong experimented with electronic road pricing (ERP) in the mid-1980s, but dropped it. In part, the system raised concern about privacy issues, since vehicle owners received a bill indicating where they went and when.

Over time Singapore's ALS also evolved into an ERP system. The ALS system had become complex and the visual enforcement by the police had become more difficult.¹⁰ So, in 1998, Singapore shifted to an electronic road pricing (ERP) system at a cost of about S\$300 vehicle. Transponders, known as In-vehicle Units (IUs) were installed in each vehicle. Motorists have to insert a debit card into the IU before making any trip that includes an ERP charge. Visitors have the option of renting a temporary IU.

⁸ This description is drawn from Hårsman and Quigley (2010).

⁹ 10 SEK is about \$1.45 as of January 2011.

¹⁰ This discussion is based on Phang and Toh (2004).

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The Singapore ERP relies on a pair of gantries (elevated sensors). The first checks the debit card and then debits the card. The second gantry determines the location and identifies the vehicle type. With every transaction, the driver is notified by a beep, and the balance on the debit card is displayed. In case the vehicle does not have a debit card, a camera records a photo of the license plate. Initially the gantries were set up at the existing entry points into the cordon area. Over time other locations were added. As of January 2003, there were 45 points being covered by gantries that included the restricted zone as well as four expressways and four major arterial roads. Charges are changed every quarter based on travel speed reviews. The charge varies by vehicle type, time of day, and location. The charge by vehicle is based on the road space the vehicle occupies. Singapore combined other policies with the implementation of its ERP system, including a motor vehicle quota scheme, parking fee increases, and increases in public transit.

Singapore is an island city-state about the size of Seattle, with a population of 4.2 million. The city is largely isolated from foreign motorists and has a law-abiding citizenry, which are advantages in using an ERP system; with a limited number of foreign drivers the government does not have to instruct many non-residents how to use the system, while a law-abiding citizens makes ensuring compliance easier.

Access to the Entire Road Network (Vehicle Miles Traveled)

Vehicle miles traveled (VMT) taxes are similar to fuel taxes, but rather than the tax being dependent on fuel consumption, VMT taxes are based on miles traveled. And, rather than be dependent on the miles traveled on a particular road or lane as with HOT lanes or ERP systems, VMT taxes apply to all roads.

There is no known example of a fully operational VMT tax. However, there have been two demonstration or test programs in the U.S. The first was conducted in the Portland, Oregon area beginning in 2006. In that program 299 motorists participated. Devices were installed in each car that determined the number of miles driven in the test area. Mileage data and fee collection occurred at the gas pumps at two filling stations that were equipped with special readers. When the driver purchased fuel, the gas pump would download the miles driven, calculate the tax, and

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charge the tax as part of the purchase price of the fuel. The regular fuel tax was not imposed.

The reports of the experiment concluded that the concept is viable. “The pilot program showed that, using existing technology in new ways, a mileage fee could be implemented to replace the gas tax as the principal revenue source for road funding.” (Whitty, 2007, vi.) Ninety-one percent of participants said they would agree to continue paying the mileage fee. The experiment showed that paying at the pump works, and that the mileage fee can be phased in so that integration with current system can be achieved.

A second experiment was the Puget Sound (Seattle) pilot project that was conducted between 2005 and 2007, and in which 275 households participated.¹¹ Each household received a GPS device. Drivers were given a travel budget account based on their expected VMT tax payment, and drivers could keep any positive account balance at the end of the experiment. Unlike the Oregon program, the Puget Sound pilot included a test of congestion pricing. Congestion charges based on prevailing congestion levels were establish for each part of a tolled network of roads at different times of the day. The analysis of the program led to the conclusion that this was a dramatic opportunity to significantly reduce congestion and to raise revenue. However, reviews of the program also concluded that installing the in-vehicle tolling devices would be a costly logistical challenge (\$665 million).

The University of Iowa is testing the feasibility and public acceptance of a mileage-based charging system. The objective of the study is to determine how the public responds to a VMT road user charge system. The system encompasses multiple states where participants have an on-board computer installed in their car. The computer stores a record of charges due from road use, which is then uploaded to a processing center. However, no actual fees are being collected. The results of the study are due out soon.

Those who study transportation funding tend to strongly support VMT taxes. For example, the following is a conclusion from a recent transportation policy conference:

¹¹ Puget Sound Regional Council (2008).

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Many proponents of transportation reform have concluded that the best approach to ensure adequate funding and re-align incentives for road use is to return to a pay-as-you-go system. This means taxing road use (instead of fuel consumption) via a vehicle-miles-traveled (VMT) tax. As discussed at greater length in subsequent sections, the technology exists to implement such a tax in ways that also address privacy and regional equity concerns. Moreover, a VMT-based system could be designed to advance other public policy goals, such as incentivizing travel at different times of day or differentiating among types of vehicles based on their emissions performance or the amount of wear they impose on highways. In short, the technology exists to design funding mechanisms that are not only more rational, but that also create the market signals needed to address important transportation externalities. (Miller Center of Public Affairs 2010, 26.)

Sorensen and Taylor (2006) provide a detailed discussion of 20 electronic tolling systems that they believed to be the most relevant to the concept of distance-based user fees. For the 20 projects, they identify where the projects are located, how they were structured, and what factors have affected their implementation. They also briefly review 68 facility congestion toll projects and cordon toll projects.

B. Advantages and Disadvantages of Pricing

We now turn to a discussion of the advantages and disadvantages of pricing transportation facilities. We then discuss the use of pricing to address congestion.¹²

Revenue

Tolls provide a source of revenue that is very stable and can generate substantial revenue, but do not need to cover the entire cost of constructing and operating a transportation facility. Increasing tolls during peak travel periods would increase revenue. VMT fees could be set to yield any level of desired revenues, but unless indexed to inflation their purchasing power would erode over time, as the fuel tax currently does.

¹² This section is drawn heavily from the Final Report of the National Surface Transportation Policy and Revenue Study Commission (2007).

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Feasibility

Imposing tolls on existing interstate highways is restricted, but pilot programs have allowed tolls on some interstates, particularly for the reconstruction of existing roads. Tolls for new interstate highways are a much greater opportunity, particularly in the longer run. Calculating the real time price required to maintain free flow of traffic is complicated and expensive. Sorensen et al. (2009) provide a discussion of potential technical system options for implementing a VMT tax system and conclude that there are many potential VMT metering and charging systems that could be implemented within a few years. However, they note that there are one or more significant technical drawbacks for each option.

Efficiency

Traditionally, road tolls vary directly with the number of miles traveled and the size of trucks. Thus, they are more economically efficient than fuel taxes, given that fuel efficiency varies across vehicles. However, traditional tolls do not vary with congestion levels. VMT fees, especially if applied as congestion pricing fees or weight-distance taxes can send strong pricing signals to users. Tolls, if appropriately set can result in a congestion-free trip. Among other advantages of tolling include: 1) they encourage the use of transit and carpooling; 2) HOT and TOT lanes reduce accidents between heavy trucks and light-duty vehicles; 3) TOT lanes increase speed and the reliability for deliveries.

There are disadvantages to tolling. Tolling specific roads leads to shifts to non-tolled roads, increasing congestion on those roads. Cordon pricing, or any system in which tolls vary by time of day, causes behavioral changes in an effort to avoid the toll. So, cordon pricing projects have led drivers to change work hours (leading to inconvenience), to speed up in order to cross the boundary before the charge increases or to wait on the shoulder of the road until the toll decreases, to drive around the cordon area rather than through (which increases congestion on those roads), and to shift to exempt vehicles (like delivery trucks).

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Flexibility

Changing tolls can usually be done without approval of elected officials. While tolls are typically used to finance a separate facility, it is possible to use toll revenue to fund new roads or transit facilities. However, there is political resistance to using toll revenue from one to fund other projects.

Administration

Collecting tolls at traditional toll booths is expensive to administer and results in significant traffic delays. Electronic tolling is much less costly. However, unless all cars have transponders or a driver can be billed based on a photo of the car license, then it is still necessary to use toll booths. If the toll is small, then the cost of billing a driver based on a license photo may not be cost effective. Administration and compliance costs for tolling are greater than for motor fuel taxes, although electronic toll collection reduces these costs. Enforcement can be difficult.

If VMT taxes are allocated to local areas or individual states, the system must be able to identify the geographic district in which one drives so that fees can be apportioned to different jurisdictions. If paid at the fuel pump as an alternative to paying the gas tax then the potential for evasion is minimal since, for example, tampering with on-vehicle device would result in default payment of the gas tax. VMT taxes that are collected at the fuel pump do not address the problem of taxing drivers of alternative fuel vehicle that, for example, charge their electric cars at home. Because VMT fees require individual equipment on each car, a significant investment of capital (\$100 per vehicle) is required, which is a major hurdle to implementing a VMT program. There is also the issue of how information is transmitted to the tax collection agency and how to deal with equipment failures (malfunction or tampering).

Finally, a significant issue that would arise with a toll is dealing with visitors to the area. Some options would include allowing visitors to purchase E-Z Pass tags on line before visiting, or selling E-Z Pass tags at welcome stations, although this would miss visitors who do not use interstates or major roads into the state or region. With a VMT tax, the treatment of visitors is even more complicated. One option is to

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impose the fuel tax for cars that are not equipped with the equipment required to calculate the VMT tax.

Equity

Tolls can be set so that drivers pay in proportion to the cost they impose on the road, for example, miles driven and weight of the vehicle. As a form of benefit tax, tolls are more equitable than fuel taxes in which the tax per mile varies with fuel economy. However, tolling existing lanes is widely perceived as inequitable as drivers claim that they are “paying twice” for a road that was originally financed through the gas tax. This is not true to the extent that the revenue is used to maintain and operate the facilities as opposed to retroactively paying for construction costs. Of course users of a toll road also pay fuel taxes that are used to maintain non-tolled roads that the toll-road user might not use. Perceptions of equity may also be strongly influenced by the availability of good alternatives to driving on the priced highways. Survey results suggest that if there are good alternatives to the toll road, so drivers can choose whether to pay the toll, support for tolls is higher.

Tolls also are a regressive tax. Rebate programs have been suggested as one way to reduce adverse impacts on lower income groups. Alternatively, good transit options may be made available for those who cannot afford the toll and cannot change their trip destination or time of day they travel.

Acceptability

As noted above, people tend to oppose tolls on existing lanes. Further, the more lanes of a road that are tolled the more opposition. Thus, HOT lanes may be more likely to be supported while fully tolled roads are not. TOT lane face opposition from the trucking industry as burdensome and costly unless use of the lanes is voluntary. The HOT lane and managed lane applications have generally been well accepted since they provide drivers the choice of whether to pay to avoid congestion or not; however, acceptance of pricing entire facilities or entire areas of a city is more controversial. In a poll conducted in 2010, 33 percent of Americans stated that tolls should be a primary source of transportation revenue, while 16 percent believe toll should never be used (HNTB 2010).

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VMT taxes or cordon systems raise concerns about privacy. Additionally, in many forms, these types of policies are a dramatic departure from current practice requiring new equipment to be installed in cars that track driving practices. As a result, these types of programs may require substantial public engagement as well as political will.

Other Issues

VMT tax are unaffected by changes in fuel efficiency, which gives this option an advantage over fuel taxes. However, VMT also do not automatically provide the same incentive as fuel taxes to increase fuel efficiency. The VMT tax could be made to vary with fuel efficiency, and even the pollution level of the vehicle, but this may increase the complexity and difficulty of administering the tax. Finally, a concern with cordon pricing is that it could reduce local retail business.

C. Congestion Pricing

Congestion pricing is a means to ration available road capacity by setting prices that reduce traffic to a socially desirable level.

The basic theory goes as follows. The economically optimal level of road capacity is the point where the marginal cost of additional capacity equals the marginal benefit that stems from that capacity. Drivers will utilize the road until the marginal benefit equals the private marginal cost of travel. If drivers are not charged for the capacity cost, then utilization of the road will exceed the design capacity, and congestion will occur. So, drivers should be charged a price (or tax) that is equal to the cost of providing and maintaining the capacity (Vickery, 1963). Fuel taxes partially serve that role, but the tax does not vary with the level of congestion and differences in fuel efficiency across cars means that the charge per mile driven varies.

But the demand for road usage varies by time-of-day and day-of-the-week. It would not be economically efficient to provide road capacity equal to the peak demand. Rather, capacity should be expanded based on the weighted average of the marginal benefits of peak and off-peak times, where the weights are equal to the fraction of time that is peak and off-peak. (The problem of calculating the optimal capacity is obviously much more complicated given that demand for road usage

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varies from minute to minute while the investment in capacity must reflect demand over a long period of time.) The result is that, even if road capacity is optimal, at times there will be congestion and at other times there will be underutilization, i.e., an economically inefficient level of drivers trying to use the road. The main concern is overutilization or congestion.

Congestion arises because each individual driver considers only his private cost and not the social cost of the delay imposed on other drivers. This marginal social cost increases as the number of drivers using the road during peak period increases, which increases congestion. To maintain economic efficiency, a charge or price should be imposed on each driver equal to a level that reduces the amount of road usage to the optimal level. This congestion charge would be levied during the peak period.

If road capacity is less than optimal overall (i.e., constant congestion), then a charge would need to be levied during more than peak periods and funds used to expand capacity, either of the road system or of public transit alternatives.

To be fully implemented, the congestion prices charged would vary with the demand for road usage. Thus, the congestion price would vary as the demand for road usage changed. The price would be higher during peak periods of the day, but could vary from day-to-day or hour-to-hour or minute-to-minute depending on what demand was at that time. Furthermore, the price would vary across roads based on the demand for the use of each road.

The congestion pricing policy implied by the previous paragraph is very complex and would be hard to implement. The only congestion pricing program that comes even remotely close to this is in Singapore. The congestion pricing schemes that have been more widely implemented are cordon pricing, road and bridge tolls that vary by time of day and day of the week, and HOT lanes.

The advantages and disadvantages of tolling discussed above also apply to congestion pricing, so we do not discuss these here. The principal advantage of congestion prices follows from the theory, namely, that if appropriately applied congestion pricing will achieve an economically efficient level of road usage, reducing congestion during peak periods and increasing utilization in non-peak periods. (This theory assumes that drivers are responsive to prices on driving. In a

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subsequent section, we explore the evidence that these systems actually work as predicted.) The second advantage of congestion pricing is that it generates revenue that can be used to expand the road network or alternative transportation systems, such as public transit.

There are several disadvantages of congestion pricing. First, there is the cost of installing and operating a congestion pricing system. Before the advent of electronic metering systems, a complete congestion pricing system was simply not feasible.

A second concern is posting of the prices. If the objective is to discourage drivers when traffic gets heavy, either at a particular time or on a particular road, drivers need to know what the price is so they can make a decision to delay the trip, cut the trip short, take an alternative route, or not drive at all. For HOT lanes, prices can be posted a few minutes before they go into effect and in time for a driver to decide whether to get in the HOT lane or get out of the lane. Posting prices is much more difficult when the system includes a network of roads.

When congestion pricing is used on a more limited basis, for example just one or two roads, the benefits of congestion pricing are reduced. The overall benefits may still outweigh the costs of the tolls and the administration of the tolling system. When the price for driving on one road goes up, many drivers will shift to alternative routes and may end up shifting congestion to other non-tolled roads. However, some shifting may be desirable if it reduces congestion on the most congested roads and increases it in less congested areas. There is some evidence that less than complete congestion pricing schemes obtain nearly as much social benefit as a full congestion pricing scheme. If this is correct, then it may be desirable to adopt a less than optimal system given the administrative cost of an optimal system.

VI. Less Traditional Revenue Alternatives

Public–Private Partnership (PPP)

There are three categories of private financing of transportation infrastructure:

- *Contracting out.* The private sector provides the service, but not the capital. For example, the state could contract with a private firm to collect tolls.
- *Privatization.* The private sector has some form of ownership rights (sale or long-term lease) to a transportation facility. The lease of the Chicago Skyway and the lease of the Indiana Toll Road are examples. The public sector may retain some regulatory role.
- *Concession scheme, also known as Public-Private Partnership (PPP).* The major difference between a concession scheme and the two other categories is that in a concession scheme the private sector provides the capital (all or a large percentage of it). In addition the PPP maintains and operates the road.

In this section we consider just PPPs. PPPs are a way of generating financing for new transportation infrastructure, and typically, but not always, involve tolls. The advantages and disadvantages of tolls, as discussed above, apply here as well, but with private sector involvement, there are other factors to consider.

The U.S. Department of Transportation defines a PPP as follows. “A public-private partnership is a contractual agreement formed between public and private sector partners that allows more private sector participation than is traditional. The agreements usually involve a government agency contracting with a private company to renovate, construct, operate, maintain, and/or manage a facility or system.” (U.S. Department of Transportation, 2004).

In a PPP, the project company typically assumes a substantial financial, technical and operational risk for the project. The project company’s revenue usually involves tolls, but the public sector may provide part of the cost of building the infrastructure and/or some guaranteed annual revenues for a fixed period. At the end of the contract the public sector acquires the infrastructure. The project company is responsible for the agreements with the contractors and lenders. Standards for service are defined in the contract, with penalties specified for substandard service. These projects are not usually completely self-supporting.

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PPPs are commonly used in Europe but are not yet widely used in the United States. Over the past two decades more than 1,400 PPP deals were signed in the European Union (Kappeler and Nemoz, 2010), while in the US only around 80 transportation PPPs were completed over the past 20 years (Public Works Financing, 2010).

Below are the potential benefits and concerns with PPPs:¹³

- The private company can overcome public sector fiscal constraints, leading to the delivery of projects that otherwise might have been delayed or not built.
- The responsibility for multiple project phases gives the project company an incentive to reduce costs across a facility's entire lifecycle. It also allows the project company to incorporate state-of-the-art technologies and techniques.
- PPPs allow the transfer of certain project risks from the public to the private sector.
- Some stakeholders express concern about how default by a private partner could affect the public sector, especially for long-term lease agreements.
- Non-compete clauses are not unique to PPPs, but they do impose constraints on the development of future transportation infrastructure.

The costs and benefits associated with tolls imposed by the public sector also apply to tolls on roads developed through PPPs, but for PPP projects there is also a concern about the role of the public sector in setting the tolls. The project company will want to set tolls at a level that will maximize its return on its investment, while the government will want tolls that are socially optimal or at least politically acceptable. Many times this issue will be negotiated as part of the PPP contract; however, there is often substantial uncertainty about how to set future tolls at an economically efficient level which is hard to resolve during initial negotiations.

Local Option Sales and Income (Payroll) Taxes

Local option sales and income taxes have been widely used in many states to support highways and transit. In the 1970s, many cities adopted local option sales and

¹³ This discussion is drawn from Rall, Reed, and Farber (2010), which contains a much longer list of concerns.

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income (or payroll) taxes to fund transit. For example, Atlanta, San Francisco, and Denver adopted sales taxes while Portland and Cincinnati adopted payroll taxes to fund transit. Beginning in the 1980s, states begin to allow local governments to adopt time-limited local option taxes to fund infrastructure, including transportation projects. More recently, local option sales taxes have been adopted in metropolitan areas to fund a mix of transit and highway projects. Regional sales tax increases have been successfully passed, with nine out of 13 proposals approved in the past decade or so. The majority of proposals were focused on transit funding (Coussan and Hicks, 2009).

Significant revenue can be generated from a one percent local sales or income tax, particularly in urban areas. Local sales taxes tend to receive stronger support than other local option taxes. If the local option tax is temporary, the revenue can be used to support capital investments, but that means that funding operations, particularly for transit, has to be addressed in the future. If the collection of local sales and income taxes can be tied to state taxes, the costs of administering the taxes are small.

Local option sales taxes will cause border shopping. Studies have found that if there is a sales tax rate differential among communities, consumers will shift some of their shopping to the jurisdiction with the lower sales tax rate. Likewise, a jurisdiction with a higher local payroll tax rate will likely see a reduction in employment, while a jurisdiction with a higher local income tax rate will likely see migration of families to the lower tax jurisdiction. Such behavioral effects in response to changes in tax rates need to be balanced with the potential increase in economic vitality that may be caused by effectively targeted improvements in transportation infrastructure.

Local Fuel Taxes

At least 15 states allow local governments to assess an additional gas tax, including Alabama, Florida, and Mississippi. In addition to the advantages and disadvantages of state fuel taxes, a local option gas tax allows a community to address transportation issues that are specific to the community but are not statewide issues. Thus, using local fuel taxes to address the community's transportation issue

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does not require the rest of the state to support a statewide fuel tax increase. Allowing the use of a local fuel tax also means that the principle that transportation systems should be financed by user charges is retained.

The major disadvantage of a local fuel tax is that the fuel tax rates, and thus fuel prices, will likely differ from jurisdiction to jurisdiction. This will result in some drivers shifting their purchase of fuel to communities with lower fuel tax rates. This cross-border shopping imposes a practical limit on the fuel tax rate that a local community can impose without significant decreases in fuel sales in the community.

Sales Tax on Fuel

A sales tax is a percentage tax imposed on the purchase of a very board array of good and some services. Ten states include fuel as part of its sales tax, including California (6 percent), Georgia (4 percent), Hawaii (4 percent), Illinois (6.25 percent), Indiana (6 percent), Michigan (6 percent), Nebraska (5 percent) and New York (4 percent) (Cambridge Systematics Inc. et al., 2006; Dierkers and Mattingly, 2009; Coussan and Hicks, 2009). Taxes may be collected from retail purchases, or at the wholesale level, as in Connecticut, Georgia, Hawaii, and New Jersey.

A sales tax on fuel, or a percentage (or ad valorem) excise tax, is better than the per unit excise tax in keeping up with inflation since revenue increases as the price of fuel increases. The fuel sales tax also directly links the source of the revenue to its use. However, the revenue stream is also more volatile given the frequent fluctuations in fuel prices and as a result may be difficult to predict. If the fuel sales tax is collected from consumers by the retailer, it will require reprogramming of the gas pumps and additional state administrative costs to account for the revenues (Carter and Burgess Inc., 2007). The fuel sales tax may be less costly to administer if it is collected at the wholesale level, together with the per unit excise tax. As with a general sales tax, the fuel sales tax may cause some revenue loss as consumers shift fuel purchases to cheaper jurisdictions. This effect may be particularly prevalent with commercial vehicles.

Even though revenues from sales taxes would increase with higher gas prices, this option does not address the expected revenue loss from fuel efficiency. Sales taxes on fuel also have the same economic efficiency limitations as per unit excise

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fuel taxes since they do not vary by the level of congestion. Tax increases would increase the regressivity of this funding source. This type of tax would also have the same effect as any price increase on miles driven, and possibly demand for more efficient vehicles, carpooling, and public transportation.

Statewide changes in the fuel sales tax have been few in the last decade, but notably include a one-percentage point increase of the retail sales and use tax on gasoline from 6 percent to 7 percent in Indiana in 2008, and a new 5 percent tax on the average price of wholesale gasoline in Nebraska¹⁴ (Coussan and Hicks, 2009). The same study finds that there were 99 ballot initiatives for local sales tax increases between 2000 and 2009, with 58 of these approved by voters.

Privatized Rest Areas/Concessions

The concession rights to rest areas, as well as transit stations, that attract a high volume of travelers could be sold or leased. The concessionaire could provide drivers with new amenities such as restaurants and other retailing.

Such concessions should be popular with drivers, and to the extent that such rest areas allowed drivers to rest a bit longer, it should reduce the number of accidents. The concession would generate some revenue, but only a small increase relative to total transportation expenditures. Business owners and local governments in the area are likely to oppose rest area concessions since they are viewed as drawing business away from local establishments.

Truck Weight-Distance Tolls

Tolls on trucks can be imposed that are based on distance driven and the weight of the truck (using size and number of axles as surrogates for weight). Such tolls are commonly used in Europe, but not in the U.S. The toll has to reflect the direct capital and operating costs imposed by the truck. Payment for infrequent users is by manual declaration, with payment at roadside stations or through the internet. For regular users an automated electronic system that uses on-board GPS equipment is used. Charges are calculated and transmitted to the toll collect center, which sends out an invoice.

¹⁴ However, Nebraska lowered the excise tax from 10 to 2.5 cents per gallon.

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The German Toll Collect truck toll system was initiated in January 2005. Per European Union directive, the fee system applies only to vehicles over 12 tons and only to use of the motorways—other roads are exempt. The price varies by distance traveled, by the number of axles, and by the emissions class of the vehicle. The overall fee structure, which is governed by an EU directive, is designed to recoup direct capital and operating costs to the motorway system imposed by truck traffic. For infrequent users, there is a manual declaration and payment method that can be accessed via roadside toll stations or the Internet. For others, an on-board GPS system determines entry to and exit from the motorway network and distance traveled, and a GSM system determines the fee and communicates that to billing office. Toll collect is administered by a private consortium. The revenue is spent on road maintenance and improvement. For a more detail discussion see Sorensen and Taylor (2005).

One advantage of such a toll is that it results in vehicles paying in proportion to costs imposed on system. The opposition to such tolls is likely to be very strong. Opponents have argued that such tolls unfairly targets trucking. The toll may also be reflected in the cost of shipping and thus passed on to consumers. The tolls would provide incentive for shippers to use trains and for truckers to reduce deadheading. Collecting the toll would likely require a new system in order to measure distance travelled in the state and to invoice and collect the tolls. Of course, imposing a toll on a federal interstate would require federal approval, which is not likely to be granted.

Transportation Impact Fee (System Development Charges) or Benefit Districts

Transportation impact fees are one time charges levied against developers based on the road improvements required to accommodate the increased traffic flow related to the development, and are based on the number of vehicle trips each class of property generates. Impact fee legislation exists in about half the states, with impact fees heavily used for transportation improvements in California and Florida.

Impact fees are usually imposed by local governments, but can be imposed at the state level. They would likely produce only an incremental amount of transportation funding, and are typically dedicated to transportation improvements

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that would serve the new development. The level of transportation fee revenue obviously depends on the volume of development.

These charges can be designed to target those who impose cost (both capital and operating) on the road network, and therefore are considered relatively equitable. Transportation impact fees provide an incentive that encourages better transportation and land use integration.

Transportation impact fees are opposed by developers, and competition among local governments for development will limit the use of impact fees. Numerous lawsuits have been filed claiming that the charge or fee is not properly associated with cost or that the revenue is not used for the intended purposes.

Container Charges

Container charges are a means to fund freight-specific transportation improvements that are required because of the rapid growth in international and domestic freight volumes. There would be a fee on every inbound loaded container.

Container fees represent a potentially large source of revenue. Cambridge Systematics Inc. et al. (2006) cite an estimate of \$2.2 billion in revenue through 2017 from a \$30/TEU fee applied at all U.S. ports. Container fees provide a revenue source to fund non-highway freight improvements. To the extent that container fees are used to fund freight handling improvements, then these fees would seem to be a desirable benefit tax.

Given competition for business among ports, it would be difficult for one port or state to impose a very heavy container charge without losing port activity. To be financially successful it would be necessary to obtain agreement among competing jurisdictions on whether to impose a container charge and if so, at what level. Furthermore, reaching agreement among jurisdictions and other stakeholders on the types and locations of projects to be developed with the revenue will also be very difficult.

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Value-Based Tax on Vehicles (Property Tax)

At least 16 states, including Georgia, impose a property tax on motor vehicles. The property tax revenue is largely local revenue, although some states do impose a state property tax.

Property taxes on motor vehicles can generate significant revenue for transportation, particularly for local roads, although the revenue is not generally earmarked for transportation. Property taxes depend on ownership and value of the vehicle, and are therefore not user fees. Property taxes provide an incentive to own less expensive cars, which means either smaller or older cars. However, these taxes do not create any incentive related to vehicle use. In several states, property taxes on vehicles have proven to be politically unpopular, and the number of states that do not impose a property tax on motor vehicles has increased over time.

Safety Violation Fee

States could increase the fines for traffic safety offenses. Revenue from such increased fines could be significant, but still small relative to total revenue needs. Fines are related to the potential costs imposed on the system from safety violations since the penalties target the drivers who are the greatest safety threat. Larger fines could reduce traffic violations or could result in the highway patrol writing fewer citations. An across the board increase in fines for any traffic violation is not likely to be politically popular. However, targeting those violations that have a high probability of resulting in an accident, for example, drunk driving and excessive speeding, may be generally supported by citizens.

Excise Tax on Transportation-Related Goods and Services

Battery and tire fees or excise taxes are discussed below, but sales taxes or charges on transportation-related goods such as auto parts and auto repairs are a possible source of transportation funding. Earmarked non-fuel taxes include sales taxes on purchases of cars and auto parts, as well as on auto services, with the revenue set aside for transportation funding. Twelve states have an excise sales tax

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on cars, with the revenue dedicated to transportation funding.¹⁵ The revenue from the vehicle sales tax in Nebraska was \$143 million in 2005. The total revenue is dedicated to transportation and is roughly divided in half between the state and local governments. Missouri allocates only half of the revenues from a vehicle sales tax to transportation, with two-thirds for the Missouri DOT and the rest for cities and counties (Cambridge Systematics Inc. et al., 2006).

The revenues from these taxes would be cyclical, but with an overall growth potential. According to the Colorado DOT study (Carter and Burgess Inc., 2007), the national annual growth rate for cars and auto parts sales was 5.75 percent for the period 1993-2006. However, during the early 2000s, the sales growth dropped to 2 percent. Earmarked sales taxes would require separate accounting from vendors and the state for the funds that should be dedicated to transportation. Sales taxes on parts and repairs are more likely to impact low income families who cannot afford to buy a new car, so they will be more regressive than a general sales tax. Sales taxes on new cars are less regressive to the extent that higher income households buy new cars more often. Earmarked taxes are more likely to be approved by voters than general tax increases.

While excise taxes on parts and auto repairs are related to transportation generally, they are not particularly related to the use of transportation infrastructure and would be unlikely to affect the amount of driving. Annual expenditures on auto parts and repairs are significant, so the revenue from such an excise tax would be sizable. Since the sales tax already applies to the parts components of auto repair, the cost of collection would be negligible.

Special License Plate Fees

States, including Georgia, charge a fee above and beyond the regular registration fees for special license plates that are either personalized or identify an organization or activity. States could enhance transportation funding by increasing fees for special plates. Harrington and Krynski (1989) find that the demand for “vanity plates” is price inelastic and thus states could increase revenue by increasing

¹⁵ These states are Connecticut, Iowa, Kansas, Maryland, Michigan, Minnesota, Missouri, North Carolina, Nebraska, Oklahoma, South Dakota, and Virginia (Cambridge Systematics Inc. et al., 2006).

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the price of such plates. But the amount of revenue collected would be modest compared to total spending on transportation.

An increased fee on special license plates is a convenient revenue source, and one that would be easy to collect. The fees are tied to transportation, but only very indirectly and certainly would not affect driving patterns. Special plates are very popular, and because they are voluntary purchases, levying or modestly increasing such fees is not likely to generate public resistance.

Tire or Battery Tax

Some states impose an excise tax on the sale of tires and batteries, either a percentage of the sales price or a flat fee, in addition to the general sales tax. Typically the revenue from these excise taxes is used to fund the cost of disposing of the tires or the battery, but such a tax could be used to fund transportation. A tire tax, and to a lesser extent a battery tax, can be seen as a user fee since the more a person drives the more frequently he will need to buy tires and a new battery. The need to replace tires will depend on the quality of the tires, how well the owner cares for the tires, and the road conditions and speed. Similarly, battery replacement is more tied to the life of the battery than the amount of driving.

Title Fee/Vehicle Impact Fee

States, including Georgia, charge a small fee for titling motor vehicles. The issues associated with increasing the annual registration fee would also apply to an increase in the title fee. In particular, title fees are not associated with road use.

An alternative version is a Vehicle Impact Fee (or Transportation Access Fee). For this option, a one-time charge is levied when a vehicle is titled or registered in the state, but only for the first time. Title transfers would not be subject to the fee. This fee is not a user fee and does not depend on actual vehicle use. Such fees have been justified on the basis that new vehicles are tied to the need for capacity. This fee would be in addition to the sales tax on newly registered vehicles.

Alternative Fuel Tax

Vehicles that rely on alternative fuels do not pay the traditional fuel taxes on gasoline and diesel. To bring these vehicles into the transportation financing system,

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taxes equivalent to current fuel taxes would need to be imposed on the alternative sources, including electricity, natural gas, hydrogen, and similar fuels.

Taxing these alternative fuels would reflect use of the highway system by motorists who pay little through gas taxes. Thus, they fit the user fee scheme. Because the fleet of alternative fuel vehicle is still small, such a tax would not generate substantial revenues.

A significant difficulty is the ability to impose the tax on the purchase of these energy sources when they are used by motor vehicles but not when the purchase is for other uses. For example, to impose a charge on wattage generated by an electric or hybrid electric vehicle it would be necessary to either have a special meter on the plug-in for the vehicle or estimate the wattage used based on self-reported miles driven or on an annual inspection. These alternative fuel taxes would also reduce the incentive to use alternative fuel vehicles

Emissions Fees

A fee could be imposed that is based on the amount of pollution an owner's vehicles emits. Such a fee would provide an incentive to reduce emissions. However, administering such a tax would be difficult, the biggest problem being measuring the amount of emissions. Emissions are largely related to the amount and type of fuel used. So, an emission fee would, in effect, be either a fee based on the fuel efficiency, type of fuel, and miles driven.

Road Utility Fees

A road or transportation utility fee is a monthly fee, levied by local governments, that is based on use of the road system generated by the land use. This option is for local governments and is currently used in various communities in Montana, Oregon, and Florida. The fee is imposed across the entire jurisdiction and continues indefinitely. Some property types, for example, undeveloped land, are exempt. See Ewing (1994) for a discussion of this option.

Typically the fee is based upon measures such as motor vehicle trip generation estimates, the number of parking spaces, the number of employees, or front footage. This option is designed to be a fee rather than a tax, since local governments are usually allowed to impose a fee but not a tax. The advantage of the

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road utility fee over using property taxes to fund road construction and maintenance is that road utility fees are more closely aligned with road usage of an individual or business than are property taxes. Furthermore, the fee is also collected from property owners who are exempt from property taxes, for example, non-profits. However, given that the fee is calculated as an average for a class of property, there are inequities.

In Oregon City, Oregon residential households are charged for maintaining local streets while non-residential facilities are charged for maintaining arterials. The costs of collection are shared equally.

While the fee is based on use of the road system, it is not likely to have a large effect on individual use of the road system. To the extent that the fee is based on average road use across classes of property types, there will be little effect on the fee a property owner pays if that particular owner changes his driving pattern. However, if the fee is based on something like the number of parking spaces a retail store has, it provides some incentive to reduce the number of slots and may encourage alternative modes to get to the store. To the extent that a city ordinances mandate the number of parking spots, the fee will not have much effect.

Collection of the road utility fee can be combined with payments of other utility charges such as for water. Thus, the administration of such a fee should be relatively easy once the fee is designed.

Bicycle Registration Tax or Fee

Imposing an excise tax on bicycle sales or a one-time fee for bicycle registrations could generate revenue to be used, for example, to fund bike paths. Only a handful of states and some localities currently tax or impose fees on bicycle sales or registrations.

Such a tax or fee would not generate substantial amounts of revenue. The need or desire for bike paths is likely to be much higher in more urban areas, and thus if the revenue is used to finance bike paths the fee is likely to be supported. However, there likely will be opposition to such a tax or fee in less urban areas of the state. This suggests that such a tax or fee should not be statewide. Environmental groups and bicycle advocacy organizations also may be opposed to such a tax or fee.

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Drive-Through Service Fee

This option envisions a transaction fee on drive-up service at any retail establishment. It could either be based on whether an establishment has a drive-up service or a fee for each customer using the drive-up service. The revenue potential of this approach is unknown.

The drive-through window is a symbol of the car-oriented society, and the intent of such a fee would be to reduce reliance on cars. The effect of such a fee on driving is apt to be negligible although it would most likely induce customers to go inside the establishment rather than use the drive-through service. Such a fee would be difficult to enforce the fee if it was based on the number of users and it is likely to be unpopular.

Advertising Revenue

Transit agencies have for a long time leased interior and exterior spaces for advertising purposes. State transportation departments might consider the same option. However, the opportunities for state transportation agencies to lease space seem rather limited; leasing advertisement space at rest areas being the one obvious possibility. If so, then the potential revenue is small. The main concern is that too many advertisements can be seen as blight.

Naming Rights

Like the sale of naming rights for sports stadiums, transportation officials could sell naming rights to transportation infrastructure, such highways, rest areas, rail and transit stations, toll plazas, etc. Several states—including Massachusetts and Virginia—have explored these options.

Revenue generate is not likely to be substantial. One concern with selling naming rights is that it might overly commercialize public venues, particularly historic or popular transportation facilities. In addition, voters might object to the name put on the facility.

Parking Tax or Fee

Imposing a tax or fee on parking is a frequently proposed option to help finance local government services. The fee could be a tax on the payment to park or

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a fee on each commercial parking space. A parking tax or fee is not seen as a significant revenue generator; for example, a 10 percent tax on all parking charges in the U.S. would likely generate less than \$1 billion in revenue. If the fee on parking is passed on to consumers, it would provide an incentive to use alternative transportation or to car pool. If imposed on retail shopping centers based on the number of parking places, it will provide an incentive to reduce the area devoted to parking, and possibly lead to charges for parking. If the community does not have transit, there is much less rationale for imposing a parking tax or fee. There is likely to be strong opposition from commercial parking lot and garage owners as well as from retail shopping centers.

Collecting a parking tax from a commercial parking facility will be as difficult as imposing a sales tax on other service vendors that operate businesses in which payment is mostly by cash. Imposing a fee on parking spots provided to workers or shoppers will require defining what a parking spot is and measuring each facility.

VII. Conclusions

A substantial number of revenue options for funding transportation are available. However, most of these options would provide only marginal increases in the current level of revenue. Furthermore, most of the available options would not provide incentives for individuals to alter their transportation behavior, that is, the options would not reduce the extent to which the transportation system is used or the use of the system during periods of congestion. Some options, for example, a dedicated sales tax, would generate substantial revenue but would have no effect on transportation behavior. Sales taxes, or any general fund revenue, also break the historic link between taxes (or fees) paid and the use of the transportation system.

Fuel taxes generate substantial revenue and are tied to the number of miles driven, and thus should reduce the extent to which drivers use the transportation system. However, there are several issues with the use of fuel taxes. First, because of increases in fuel efficiency the revenue generated per mile driven by a pennies-per-gallon fuel tax has decreased. Second, there is sizable citizen resistance to increasing fuel taxes. Third, because of differences in fuel efficiency across vehicles there is substantial variation across motorists in what is paid per mile driven. And, in the case of alternative energy vehicles, the tax paid could be zero. Finally, although Florida allows local option fuel taxes, the ability to use local option fuel taxes is limited because the ability to purchase fuel in neighboring jurisdictions restricts the feasible tax rate differential across jurisdictions.

The revenue that tolls generate depends on the nature of the facility and the demand for a particular facility. Because of improvements in technology, the use of tolls is now less costly and thus more feasible. Toll should reduce the use of transportation infrastructure relative to its usage if it were free. Toll will also shift usage from the tolled facility to alternative, non-tolled facilities. Toll can vary by time of day, which would encourage shifting between the period when the toll is higher to when it is lower. Generally, toll systems do not allow the toll to vary with the level of congestion, but HOT lanes are an exception. There is also some public support for tolls, particularly to finance new facilities.

A vehicle miles traveled (VMT) tax has some advantages over the fuel tax. A VMT tax would equalize tax per mile driven since it would not be dependent on fuel

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efficiency, and the available technology would allow a VMT tax to vary with the level of congestion. The major concerns with a VMT tax relate to privacy issues, to how to build a national system for collecting the tax, and to the sizable initial cost. Furthermore, while there has been one demonstration project that proved successful, there remain concerns regarding the ability to fully implement such a tax. Finally, at this time there is a lack of voter understanding of how such a tax would work and, perhaps for that reason, a lack of voter support for such a tax.

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