Is A Vehicle-Mile Tax a Viable Alternative to the Gasoline Tax? A Review of Socio-Economics and Distributional Considerations

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I. *Introduction*

In the recent years it has become evident that the gasoline tax – the primary way that highway user fees are collected at both state and federal levels in the U.S. – may no longer be able to generate the funds needed to build and maintain the highway system. According to Cambridge Systematics (2005), maintaining the nation's current highways and transit systems required approximately $222 billon in 2005, and that amount is estimated to be $295 billion for 2015. In order to improve the current highways and transit systems would require $271 billion (2005) and $356 billion (2015). However, 2005 revenues were only about $180 billion from all levels of government, well short of covering even highway maintenance costs.

A large part of the problem has been increasing public resistance to increases in the gasoline tax, at both federal and state levels. At the same time, the purchasing power of revenues has been eroded by inflation, the cost of some construction materials such as concrete and steel have increased even faster than inflation, and highways have been wearing out faster than expected due to higher than predicted traffic flows.

Exacerbating the current highway finance system in the future is the potential for alternative fuels that are not currently subject to gasoline/diesel fuel taxes and increased fuel efficiency. These things have made it clear that an alternative to the gasoline tax is necessary (Forkenbrock, 2002) if highways are to be maintained and built to meet current and future needs.

This has become such an important concern that the State of Oregon established a Road User Fee Task Force (RUFTF) to consider alternatives to the gasoline tax for funding road maintenance and improvement. They found that the most promising alternative to the gasoline tax is a vehicle mile tax, or a distance-based fee. One of the major obstacles to employing this tax collection technique was the absence of a technology sophisticated enough to record miles in the state. Researchers at Oregon State University subsequently have developed the technology to implement such a user fee and a pilot project using this technology to collect road user fees in the Portland, Oregon area is in progress.(Whitty et al, 2006)

Perhaps more problematic than the technology, however are public concerns regarding social equity and distributional effects of a vehicle mile tax. In Oregon there are several concerns expressed regularly to policymakers.

1) It has been suggested that the change in tax structure would shift the burden of the tax to lower income groups.
2) There is a concern that the change in the tax structure will shift the burden of the tax to rural areas from urban areas, creating regional or geographic inequities.

3) Such a shift in tax structure will discourage people from purchasing and driving alternative fuel vehicles, hybrids in particular.

The purpose of this paper is to provide a perspective on these three additional issues that are often raised in objection to the implementation of a vehicle-mile tax. They will be dealt with in turn below. Before dealing with the socio-economic issues, however, the next section discusses the reason for a road user fee from the perspective of a public agency responsible for maintaining and improving highways.

II. Road User Fees

From an economic point of view, and the perspective of policymakers, the purpose of either a gasoline tax or a vehicle-mile tax, is to charge an optimal road user fee. An optimal road user fee is one where the users of the road pay the marginal costs they impose on the road system. There is an extensive literature on optimal road user fees (Morrison (1986); Small, Winston, Evans (1989)) under both congested and uncongested circumstances.

When there is congestion, optimal user fees will be higher than in non-congested circumstances and revenues collected may well exceed those required to maintain the existing road system. The implementation of optimal congestion fees and their political acceptability is the major focus of much research and experimentation in the area of road pricing. Except for a few select areas, congestion pricing is not in place and represents a major change from what road users are accustomed to paying.

Although this study can easily be extended to consider issues involved in charging congestion fees, the main focus of this research is on road user fees under non-congested circumstances. What distinguishes this from congestion pricing is that in almost all countries, road users already pay a road user fee. Thus, the proposed change from a gasoline tax to a vehicle mile tax does not represent a new tax, but rather a different way of collecting user fees that are already being paid.

Indeed, the “user-pay” concept as a basic financing principle in transportation dates back to Pigou in the 1920s. Under certain conditions, the revenue collected from marginal cost tolls will just be sufficient to finance the transportation network to its optimal level of capacity (Mohring and Harwitz, 1962). In practice, this simple and elegant road pricing and investment principle encounters technological, institutional, and political difficulties.

From the state DOT perspective, the purpose of changing from a gasoline tax to a vehicle mile tax is to charge users something closer to the marginal cost they impose on the road system while providing revenues needed to maintain roads. Until recently, the gasoline tax was generally seen as equitable and efficient since there were not the large disparities in fuel efficiency as we see today. Miles driven and thus road damage were highly correlated to gasoline consumption. Given the wide disparity of fuel efficiencies in the current vehicle fleet, however, the gasoline tax has become a less accurate reflection of the marginal costs users impose on the road system.

Marginal costs on the roads from autos and other light vehicles are directly related to miles driven and, despite variance in vehicle weights, there is not much difference in the damage done to the road by different types of light vehicles (whereas there is a big difference in damage to the road done by heavy trucks of different weight groups and with different axle configurations).

Thus, the main goal for the DOT agency is to charge a road user fee that covers the expenses incurred in road maintenance and repair. Road damage is more correlated with distance driven than with gasoline consumption. This means that a distance-based charge will be closer to the optimal user fee in the sense that it forces drivers to be more responsible for the damage they cause to the roads.

In summary, the proposed change from a gasoline tax to a vehicle-mile or distance based tax for light vehicles, is due to the fact that due to a variety of reasons, the gasoline tax is no longer functioning effectively as a road user fee. It is recognized by both policymakers and economists that under the current circumstances, a distance based tax such as the proposed vehicle-mile tax, would be closer to the optimal user fee to charge for road use.

The following sections discuss the socio-economic/political issues that have arisen in response to the suggestion that the current gasoline tax system be changed to a vehicle-mile tax.

III. Incidence from Changing a Gasoline Tax to a Vehicle-Mile Tax

To determine the distributional impact of changing from a gasoline tax to a vehicle-mile tax requires first trying to determine the distributional impact of the gasoline tax.

i. General Incidence

The first question is one of general tax incidence---who pays the gasoline tax---the gasoline retailer or the consumer?

Alm and Sonnoga (2005) find full shifting of gasoline taxes to the final consumer . Chouinard and Perloff (2004) find that while federal gas tax fall about half on the consumer and half on the gasoline retailer, they find that virtually all of a state gasoline tax is borne by the retail customer. In addition, they find that the incidence of state gasoline taxes on the consumer is inversely related to the share of national gasoline tax sales in the state; thus a greater part of the state gas tax is borne by customers in states with a smaller share of the national gasoline bill. Thus, in the case of Oregon, it is reasonable to assume that the incidence of the state gasoline tax falls on the consumer.

For a vehicle-mile tax, it is clear that the tax is being paid by the final consumer. Thus, for practical purposes it makes no difference which way the road user fee is collected, it is ultimately paid by the driving consumer in the state of Oregon.

ii. Income Distributional Impact

First, since the demand for gasoline is known to be inelastic, it is usually argued that the gasoline tax is regressive. For a gasoline tax, the regressivity depends, in part on how responsive miles driven by people in different income groups are to changes in the tax (the price of gasoline). It also depends on the type of vehicle driven by people in the different income groups and also the number of miles driven by people in the income groups.

West (2001) finds that the elasticity of vehicle miles traveled (VMT) with respect to changes in the per mile cost of driving, is greater (-1.51) for those in the lowest decile of income than those in the higher deciles (for example, she finds an elasticity of -.75 for those in decile 8 in her sample). This combined with the fact that a large proportion of households in the lowest decile do not own vehicles and thus do not pay any gasoline tax, argues for the gasoline tax being less regressive than conventional wisdom may dictate.

On the other hand, West (2001)finds that households in the lower deciles own vehicles that have poorer gas miles, making their per mile cost of gasoline higher than those in higher income groups.

Sarah West (2001) uses expenditures as a proxy for income and finds the gasoline tax is progressive across lower income groups, a result she attributes to the greater elasticity of demand lower income groups have in response to changes in gasoline prices. In her empirical results, West (2001) also examines the impact of a per mile emissions tax and finds that taxes on miles is progressive over lower income deciles (as a percentage of total household expenditures) but becomes regressive over the upper deciles.

The West (2001,2005) studies followed Poterba's (1991) suggestion that household expenditures be used rather than household income in examining tax incidence. His argument is that decisions regarding gasoline expenditures may be based on lifetime or permanent income rather than the annual income observed in a typical cross section study. He uses annual expenditures as a proxy for permanent income and his results show low income households actually devote a smaller share of their expenditures to gasoline than higher income households. Further, he finds that households in the top five percent of the income distribution spend a smaller percent on gasoline, so that the gasoline tax actually is progressive over lower income groups and then turns regressive at higher levels of income.

It is important to note that the incidence of the gasoline tax depends partly on the vehicle choice made by different income groups. Typically lower income groups have older cars which often have lower fuel efficiency, reinforcing the regressivity of a gasoline tax. In the 1990's, however, there have been mixed messages regarding fuel efficiency. On one hand there have been very fuel efficient cars that have come on the market, but conventional wisdom suggests that many of those in the middle/upper income groups have gravitated towards heavier SUVs that get fewer mile per gallon. Thus, the trend towards greater fuel efficiency slowed during the 1990's. This complicates the measurement of tax incidence and suggests that the gasoline tax may not be as regressive as once thought. Thus any study of the incidence of the gasoline tax needs to consider the vehicle mix across income groups as well as the elasticity of demand for gasoline across income groups.

The West (2005) and Proterba (1991) studies examine incidence for the entire U.S. using the measure of consumption expenditure from the Consumer Expenditure Survey (CES). For the state of Oregon, however, the CES does not provide a large enough data set for our study. In addition to income distribution, we also want to see how a change in the road user tax structure changes the way in which individual households tradeoff using different household vehicles (in particular high versus low mileage vehicle use). Information on individual vehicle usage (miles) are not available in the CES data set—only toal household mileage is given.

Thus, we use the National Household Travel Survey (NHTS) as the data source for our study. Although data are available on individual household vehicles, only annual consumption group is available for the household, not annual expenditures. There is some evidence that the possible bias introduced by using annual income rather than expenditures, may not be a serious problem. Zupnick (1975) looks at the incidence of gasoline taxes during 1969-70 using annual income data and finds similar results to Proterba: that the gasoline tax was progressive over lower income groups and then turned regressive for upper middle and upper income groups. Zupnick's conclusion was that it was the middle class that incurred the largest burden from the gasoline tax.

iii. Geographic Impact

In the state of Oregon, there is a deep concern that changing from a gasoline tax to a vehicle-mile tax will adversely impact rural areas relative to urban areas. It is usually argued that since there are fewer transportation alternatives in rural areas, the demand for miles driven in rural areas will likely be more inelastic than in urban areas. Changing the pricing mechanism may thus have little (or no) impact on driving behavior in rural areas --- in other words, the elasticity of demand for vehicle miles in response to a change in tax, is inelastic.

However, the response of VMT to changes in the cost of driving also will depend on the type of vehicles driven in the rural areas relative to urban areas. The total impact on the rural/urban areas will depend on the number of miles driven by those impacted by the tax change.

Given the current proposal in Oregon for a flat vehicle mile tax, when changing from the current 24 cents per gallon gasoline tax to a 1.25 cents per mile distance based tax, those people who drive vehicles that get less than 20 mpg will actually pay *less* in road user fees with a vehicle mile tax than under the gasoline tax. Obviously, those who now drive fuel efficient vehicles with fuel efficiency exceeding 20 mpg, will pay more. Thus, the distributional impact on urban/rural as well as high/low income, depends in turn on what type of vehicle is used by the different households.

iv. *Impact on the Adoption of Alternative Fuel Vehicles*

Finally there is concern that owners of fuel efficient vehicles would end up having to pay more in road user fees under a vehicle mile tax than under the current gasoline tax. Will this discourage the use of fuel efficient vehicles, hybrids in particular?

If a vehicle gets 50 mpg, under the current Oregon gasoline tax, it would be paying 24/50 or about .48 cents per mile--- about a third of the 1.25 cents per mile proposed for the vehicle mile tax. If gasoline, exclusive of tax is $2.25 the 50mpg vehicle driver is currently paying 4.5 cents per mile in gasoline expense plus .48 cents per mile in tax, or about 4.98 cents per mile. With a vehicle mile tax this would rise to 5.75 cents per mile, increasing the per mile gasoline and tax cost of driving by about 16 percent. Given recent AAA estimates of per mile total costs of driving between 50 cents and 66 cents per mile, the .77 of a cent higher cost due to a vehicle mile tax, translates into less than a .02 % difference in driving cost per mile. Is this enough to make people decide not to buy a hybrid?

Unfortunately, there is not yet a good enough data set available to estimate a demand function for hybrid vehicles that would allow us to calculate the price elasticity of demand for a change of that magnitude in operating expenses. However, given the fact that this represents a very small amount compared to the purchase price of the vehicle, it is likely that the impact is negligible. In fact, current sales of hybrids are taking place despite the fact that the new vehicle price of a hybrid is often 2-5,000 more than the purchase price for a comparable regular fuel vehicle.

In addition, while some hybrid vehicles get very high fuel economy (greater than 40), others do not. In particular, many of the newer hybrids are aimed at the SUV market and while the fuel economy of these vehicles is higher than a comparable non-hybrid model, it is possible that people who were driving more fuel efficient smaller cars are now buying larger vehicles with the same mileage as their smaller car. The net result could thus be the same amount of total fuel consumed, but an increase in the average size of vehicles---mirroring the phenomena observed in the 1990s as vehicle became more fuel efficient and then the vehicle mix turned more towards larger vehicles.

Thus, one must ask whether the point is to encourage the development of hybrid vehicles or to reduce the U.S. dependency of imported oil --- and these are not necessarily the same thing. If the purpose is to reduce dependency on fossil fuels, the appropriate policy might just be to increase the gasoline tax and be done with it!

On the other hand, there is also the interrelated question of the distributional impact of promotion of hybrid vehicles. West (2005) argues that policymakers have tended to try and promote the use of hybrids through various types of subsidies such as tax credits on new cars. Since these vehicles usually cost more and are usually purchased by those in the higher part of the income distribution, she claims that either gasoline or mile based taxes are significantly less regressive than these subsidies.

IV. Preliminary Oregon Data

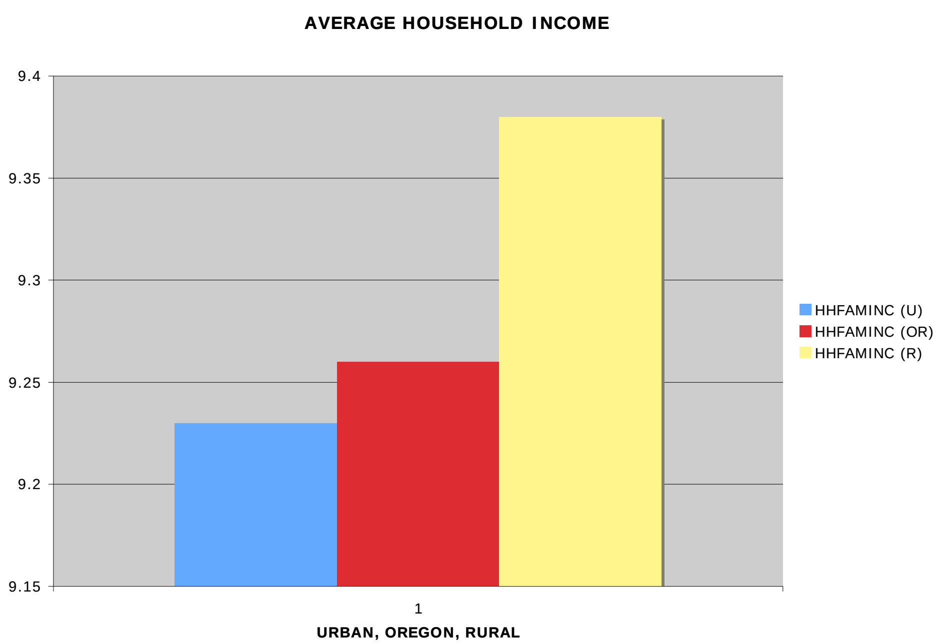
This paper is written at the outset of a study of the socioeconomic impacts of changing from a gasoline tax to a vehicle mile tax in the state of Oregon. A model is being developed to estimate these effects. In the meanwhile, this section provides some summary statistics on data relevant to the project. These data are from the 2001 NHTS for the state of Oregon.

First, it should be noted that the NHTS survey has three components, the household survey, the survey of individuals in the household, and the survey data collected by vehicle. For Oregon the number of observations in each of these surveys for 2001 is shown in Table 1.

Table 1

NUMBER OF OBSERVATIONS			
FILE	TOTAL/OR	URBAN	RURAL
HOUSEHOLD	407	295	112
VEHICLE	893	588	305
PERSONAL	920	658	262

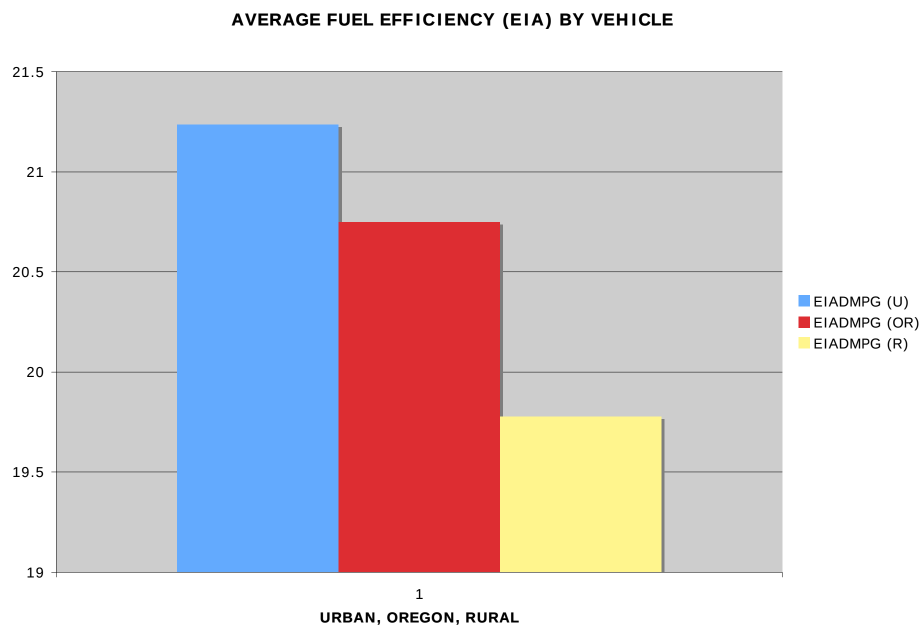
The average household income for the state of Oregon, in the NHTS sample, is 9.26 (out of 18 income deciles) implying an average household income of slightly above $44,999 (the upper bound household income for a value of 9 is $44,999). Surprisingly, the average household income for the rural group (9.38) is higher than that of the urban group (9.23). See Figure1:



One argument to explain the higher income for rural households is that there tend to be more members in the rural households. This is the case, however, there are only slightly more household members (on average) in the rural households (2.49), as opposed to the urban households (2.427). The average household size for Oregon is 2.44 people per household.

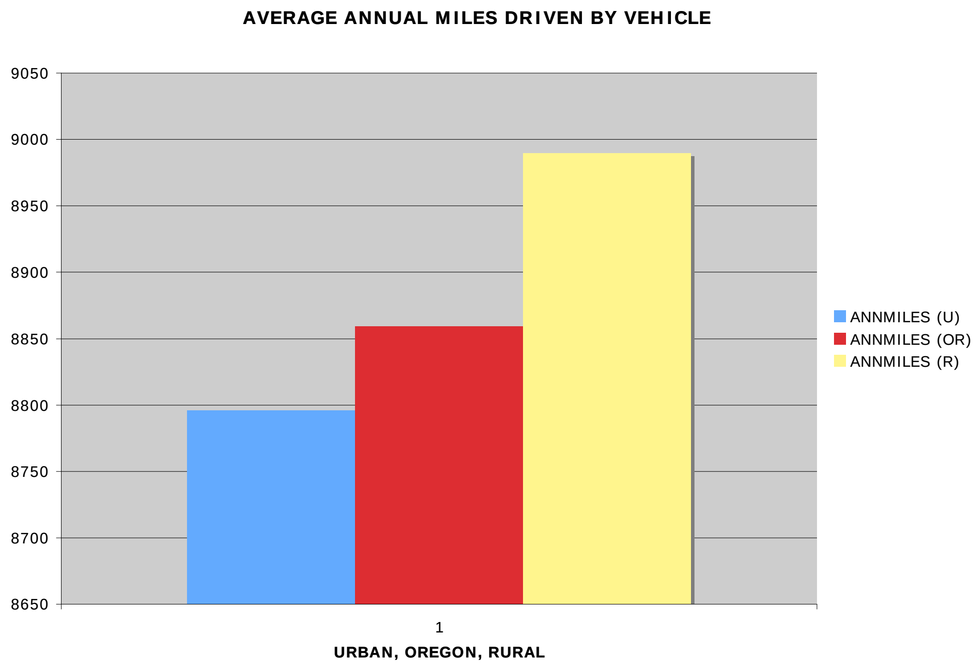
The average household in Oregon owns 2.19 vehicles. Urban households own an average of 1.99 vehicles, while rural households own 2.72 vehicles on average.

The Energy Information Administration (EIA) calculates fuel economy based on the 2001 NHTS household characteristics. The EIA-based average fuel efficiency (EIADMPG) for Oregon households is 20.75, 21.237 for vehicles in urban areas, and 19.779 miles per gallon for vehicles in rural areas. See Figure 2:

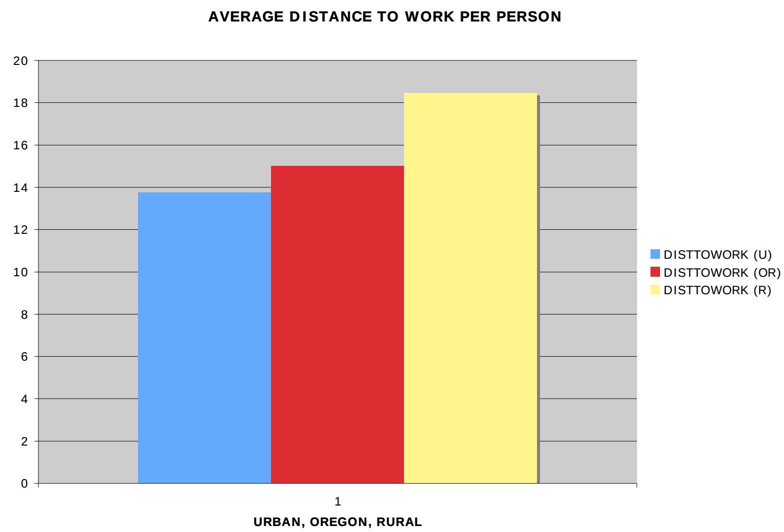


Thus it appears that rural households on average get less than the 20 miles per gallon for which the proposed 1.25 cents per gallon vehicle mile tax “breaks even” with the current 24 cent per gallon gasoline tax. Thus, on average, the rural households would be paying less in road user fees per mile than their urban counterparts after the con version to a vehicle mile tax.

The average vehicle in Oregon was driven 8859.39 miles. The average vehicle in urban areas was driven 8796.01 miles, compared to 8989.708 miles in rural areas. See Figure 3:



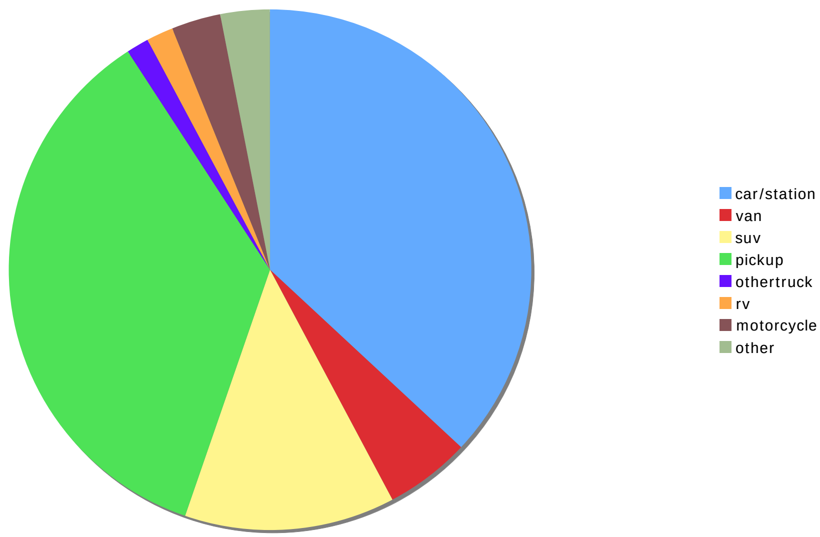
The average person surveyed in Oregon drives 15.01 miles to work. The average person in an urban area drives 13.748 miles, while the average person in a rural area drives 18.457 miles to work. See Figure 4:



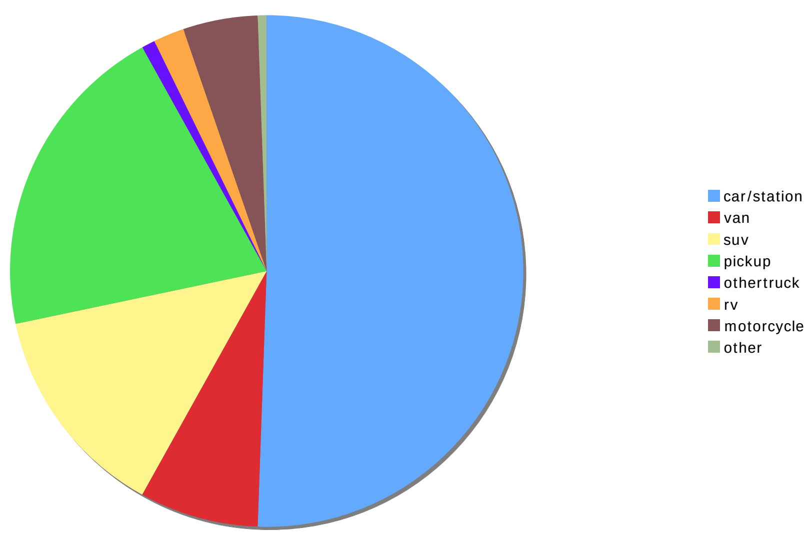
On average, vehicles in rural areas tend to be slightly older than in urban areas. The average vehicle age for Oregon was 11.404 years, compared to 12.017 years in rural areas and 11.08 years in urban areas.

As expected, car choice appears to vary by location. A larger proportion own automobiles and smaller vehicles in urban areas than in rural areas. Those in rural areas are more likely to own SUVs.

Car Types in Rural Areas



Car Types in Urban Areas



Thus, given the vehicle mix in urban versus rural Oregon, it is not clear that the rural part of the state would be adversely impacted overall by a change to a gasoline tax. Rural drivers appear to be driving less fuel efficient vehicles, on average, and those are the ones that will actually experience a decrease in per mile road taxes under a vehicle mile tax.

A more complete analysis of the overall distributional impact of the conversion will be available after the specification and running of a complete econometric model. Preliminary results should be available by summer 2007.

V. Other Possible Impacts from Changing from a Gasoline Tax to a Mile Based Road User Fee

Although there are no studies that empirically examine the use of a vehicle mile tax for collecting road user fees, there is a developing literature that looks at vehicle mile taxes as a mechanism for collecting emissions taxes. West (2004) and Parry and Small (2005) both find that the vehicle mile tax is a much better instrument for approximating optimal emissions fees than a gasoline tax. Thus, a vehicle mile tax for road users may well have the additional social benefit of reducing emissions.

Finally, DeCorla-Souza (2001), Litman (1999, 2006)),and Edlin (2002) discuss the benefits of distance-based insurance. Greater economic efficiency can be achieved by turning fixed costs, such as vehicle insurance, into variable costs. In theory, fixed costs are not considered when making marginal decisions. For example, once a driver pays the insurance premium, there is no incentive to limit distance driven; in fact, assuming there is some utility to gain from increasing miles driven, there is actually an incentive to drive more.

A distance mile fee gives all drivers the option to reduce miles driven and save money. DeCorla-Souza (2001) uses social cost estimates from Delucchi (1997) to estimate the impacts of an optional distance-based insurance program. These estimates include the impacts of externalities such as pollution and accidents. Total social benefits are quantified and estimated to be $645.7, $2464.5 and $2914.4 per mile of congested roadway. Once vehicle mile taxes are in place for road use, this makes it much more likely that insurers will be able to convert from fixed pricing to marginal use pricing, thus attaining some of these social benefits as well.

Thus, it is timely to provide a complete analysis of the overall socio-economic impact of changing from a gasoline tax to a vehicle mile tax. In addition to providing state Departments of Transportation with a more reliable source of revenue, such a tax system might provide added social benefits as described above.

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