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# Going Forward: Prospects for Transitioning from Gas Taxes to Vehicle-Miles-Traveled Fees

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The U.S. transportation system is facing a funding crisis. In 1956, Congress established the Highway Trust Fund to ensure a dependable source of revenue for U.S. highways and transit systems. However, over time, inflation has eroded the purchasing power of the gas tax because it is fixed in nominal terms per gallon, and fuel efficiency is increasing. As a result, the costs of maintaining roads and highways are now outpacing revenue generated from the gas tax.

The last long-term surface transportation legislation expired in 2009, and Congress extended existing financing on a temporary basis. This funding shortfall comes at a time when the United States needs new investments to meet continued transportation challenges such as aging infrastructure, a growing population, and an expanding economy. The House Committee on Transportation and Infrastructure introduced the Surface Transportation Authorization Act of 2009 to modernize national transportation policy and is currently holding hearings on the issue. This upcoming reauthorization offers an opportunity to discuss the funding shortfall alongside other key priorities such as greenhouse gas emissions, energy independence, and distributional equity of funding the transportation system.

## Transportation Funding Mechanisms

Two mechanisms that can potentially address the shortfall in funding are increasing the

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## About the Authors

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This graduate team prepared this report as part of the graduate Practicum in Public Policy, a two-quarter sequence required for Master's students in both the Public Policy and International Policy Studies Programs. The client for this project was the Carnegie Endowment for International Peace. The full report can be obtained from the Public Policy Program at publicpolicy@stanford.edu.

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current federal gas tax and introducing a new federal vehicle-miles-traveled (VMT) fee. Whereas gas taxes charge users based on gallons of gas consumed (fee per gallon), VMT fees would charge users based on miles driven (fee per mile). We evaluate the two tools by considering their revenue generation potential, as well as their relative tax burden on consumers at various income levels. Though revenue generation is the main focus of this report, identifying the economic incidence of new transportation policies will provide a better understanding of the relative strengths and political viability of the alternative policies.

The policies under consideration are structured based on revenue equivalence. We calculate that a 0.91 cent VMT fee would raise the same amount of revenue as the current 18.4 cent gas tax, assuming drivers do not change their driving behavior in response to a new fee. (We consider changes in behavior in a subsequent section.) These options would generate about $20 billion per year, the current level of revenue. We consider five additional policy options with gas taxes ranging from 18.4 cents to $2 per gallon. The corresponding VMT fees range from 0.91 cents to 10 cents per mile as shown in Table 1.[1]

## Approach

Our analysis uses 2001 National Household Travel Survey data to calculate the baseline incidence of these policies on consumers at various income levels and finds both tools to be regressive—lower income consumers pay proportionately more of their income than higher income consumers. For example, consumers in the lowest income quintile spend 6.4 percent of income on gas consumption compared with 1.57 percent for those in the highest income quintile. Under the assumption of revenue equivalence and no consumer response, a 1 cent VMT fee would have roughly the same incidence.

**Table 1.**
**Revenue-equivalent gas tax and VMT fee options**

| Options | | Federal Gas Tax | VMT Fee | Source of Gas Tax Policy Option |
|---|---|---|---|---|
| 1 | Current | $0.18 | $0.009 | Current federal gas tax |
| 2 | + 15 cents | $0.33 | $0.017 | National Commission on Fiscal Responsibility and Reform (2010) |
| 3 | + 25 cents | $0.43 | $0.021 | Senators Tom Carper and George Voinovich (Letter to Fiscal Commission 2010) |
| 4 | + 60 cents | $0.78 | $0.039 | Ian Parry (2002) |
| 5 | 1 dollar | $1.00 | $0.049 | 5x current federal gas tax |
| 6 | 2 dollars | $2.00 | $0.099 | 10x current federal gas tax |

Source: Authors' calculations.

1 For example, a 25 cent increase in the federal gas tax to $0.43 per gallon raises the same amount of revenue ($46 billion) as a $0.021 VMT fee per mile.

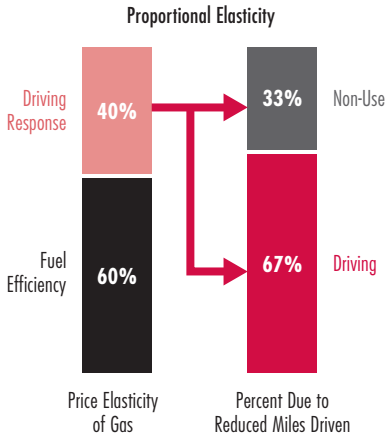
In order to more accurately understand both the revenue generation potential and the economic incidence of new pricing policies, we relax the assumption that driving behavior would not change in response to a new tax or fee. When faced with higher driving costs, we assume that consumers can reduce expenditures related to the costs of driving in three ways: buying a more fuel-efficient car, driving less, or not driving at all.

### Incorporating Consumer Responses

Because most studies conducted to date have focused on consumer response to higher gas prices and not other driving costs, our analysis relies on gas demand elasticity as a proxy for how consumers would respond to a fee-per-mile charge like the VMT fee.

Figure 1 illustrates the levers of longer-term household response to gas price increases based on Parry (2005).[2] Parry finds that when faced with higher gas prices, 60 percent of the change in fuel demand is due to a shift to more fuel-efficient cars ("fuel efficiency") and 40 percent is due to consumers driving less ("driving response"). Of that 40 percent in reduced driving, two-thirds is due to an actual reduction in the number of miles consumers drive and one-third represents consumers who stop driving entirely.

**Figure 1.**
**Components of Gasoline Price Elasticity**




Source: Ian W.H. Parry, "Is Pay-As-You-Drive Insurance a Better Way to Reduce Gasoline than Gasoline Taxes?" Resources for the Future, April 2005.

In our analysis, we apply Parry's driving response assumption to existing gas price elasticity estimates to obtain proxy estimates for how consumers would respond to a VMT fee. For example, to calculate the revenue generation potential of different gas tax options with consumer response, we use an estimate of long-term gas price elasticity (-0.55) reported by Parry. To calculate the revenue generation potential of corresponding VMT fee options, we obtain a proxy elasticity estimate for VMT fees by applying Parry's driving response assumption to the long-term gas price elasticity estimate—i.e., 40 percent of -0.55, which is equivalent to -0.22.

Since we are also interested in the economic incidence of various gas tax options and corresponding VMT fees, we use gas price elasticity estimates across quintiles reported by Wadud et al. (2009).[3] To analyze the economic incidence of different VMT fee options, we apply Parry's driving response assumption to Wadud et al.'s estimates to obtain proxy values for how consumers would respond to different VMT fees.[4]

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2 Ian W.H. Parry, "Is Pay-As-You-Drive Insurance a Better Way to Reduce Gasoline than Gasoline Taxes?" Resources for the Future, Discussion Paper 05-16, April 2005, p. 13.

3 Zia Wadud, Robert B. Noland, and Daniel J. Graham, "A Semiparametric Model of Household Gasoline Demand," Energy Economics 32, 2009, p.99. Wadud et al.'s gas price elasticity estimates are intermediate-term estimates, meaning that consumers are unlikely to change their vehicle ownership during this period of time. However, variation in fuel efficiency is captured through inter-household differences in vehicle stock.

4 Since Parry's "driving response" assumption (40 percent) is arguably a national average, we adjust this assumption across income quintiles to account for the fact that lower income quintiles are more likely to adjust their driving response compared with higher income quintiles. Lower income quintiles subsequently reflect a higher proportion of driving response (up to 72 percent) while higher income quintiles reflect lower proportions (as low as 10 percent).

## Results

Our study explores the revenue generation capacity and economic incidence of two transportation financing options: gas taxes and VMT fees. Our key findings integrating consumer response are as follows:

Result #1: We find that increasing the gas tax or implementing the VMT fees could raise significant revenue. Increasing the gas tax by nearly $2 and introducing VMT fees of 10 cents could generate from $64 to $154 billion in revenue. However, VMT fees raise more revenue than gas taxes in the long term. A successful gas tax causes households to purchase more fuel-efficient vehicles in addition to driving less. As such, it naturally implies reduced gasoline consumption and a subsequent decline in revenue.

On the other hand, under VMT fees, households can only compensate for rising driving costs by changing driving patterns—a difficult mandate in the short and intermediate terms given work schedules and strong habits. Even if households started to adapt, our analysis indicates that consumers would not drive significantly less. They would not be able to optimize mileage beyond a certain point without drastic residential or professional adjustments. Subsequently, the VMT fee remains a strong tool for policymakers concerned with sustaining funding for road operations and repair.

Result #2: Under smaller incremental increases in the gas tax and corresponding VMT fees, we find that both policy tools remain regressive. Figure 2 illustrates how those in the lowest income quintiles pay proportionately more when the cost of driving increases, whether from gas taxes or VMT fees.[5] The lowest income quintiles continue to spend slightly more than 6 percent of their income on gas tax and VMT fee expenditure, while the highest quintiles continue to spend around 2 percent.

In general, however, VMT fees raise more money and therefore account for a higher percentage of income compared with gas tax expenditure across the board. For example, taking into account consumer response in the third quintile, the average household pays almost 4 percent of its income under the $2 gas tax and almost 6 percent of its income under the corresponding VMT fee.

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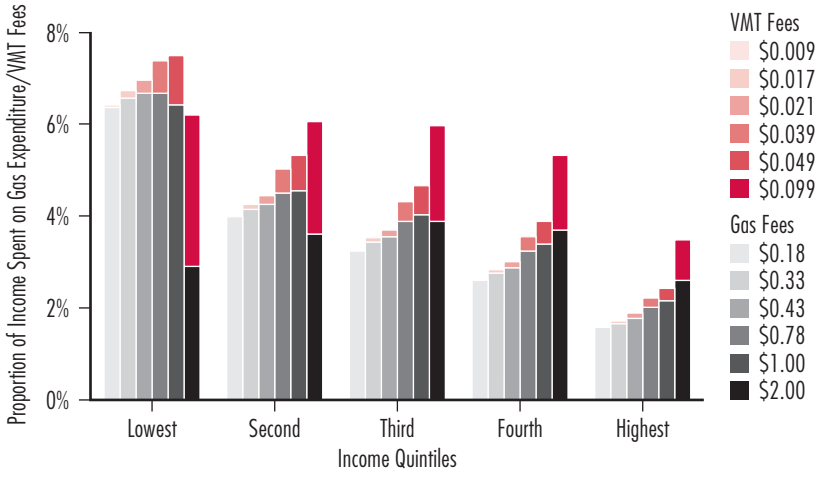
**Figure 2.**
**Gas Tax and VMT Fee Expenditure Incidence Across Income Quintiles**




Source: Authors' calculations.

5 Calculations also include the amount paid for state gas taxes under both federal gas tax and VMT fee mechanisms.

The lower share under federal gas taxes compared with VMT fees may arise from a combination of factors. For higher quintiles, this gap may reflect a greater utilization of more fuel-efficient vehicles under a higher gas tax. Higher income groups average about three cars per household compared with two cars per household for the lower income groups. With more fuel-efficient options at hand, they can likely drive the same number of miles using less gas.

For lower income households, higher expenditure for VMT fees may mean something different. According to our data, average vehicle age for low-income households is 12 years, compared with eight years for the highest income households. Under the $2 gas tax, lower quintiles are directly penalized for their older, less fuel-efficient cars. In order to cope, they might stop driving, change jobs, or find their way to mass transit.[6]

Result #3: Higher charges will lead to more significant behavioral change. Households display more significant change in gasoline consumption and road use, once the driving costs exceed a critical threshold. In our analysis, trade-offs between spending more and driving less only begin when taxes and fees approach the $2 per gallon level. This may be because households start with the easiest changes, like forgoing discretionary trips. At the higher tax levels, more fuel-efficient cars are used. At higher VMT fees, driving patterns begin to change. Assuming alternative transportation options remain the same, dramatic adjustments must stem from a change in jobs or residences.

Essentially, consumers would find ways to adjust driving habits if policymakers set prices sufficiently high. The small, incremental increases being discussed in Congress today will unlikely lead to consequential vehicle upgrades or shifts in driving.

## Going Forward

Our study remains illustrative because states have only just begun piloting VMT fees and limited data exist regarding behavioral response to fee-per-mile policies. The above revenue and distributional impact results are highly sensitive to the choice of elasticity values and the use of proxies such as gasoline prices to calculate driving elasticities. Despite these uncertainties, our analysis clearly conveys the relative strengths of each policy. Although gas taxes advance environmental stewardship and energy security, VMT fees provide a more sustainable future for funding of transportation infrastructure. Neither policy is immensely equitable, which could pose a barrier to public acceptance. Moreover, consumer response is more complex than the three simple levers discussed here. Further studies should explore how other factors such as privacy, implementation cost, and industry fuel-efficiency standards will also influence the debate.

6 Despite this pressure at the 10 cent per mile level, VMT fee expenditure does not appear to fall as drastically as gasoline consumption for the lowest income quintile. One reason may be the lower VMT elasticity in general. Another may be that our assumptions are not robust enough to capture the change in elasticity that would undoubtedly occur at the higher 10 cent per mile level.

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