Road User Fees Instead of Fuel Taxes: The Quest for Political Acceptability

In light of recent regulatory changes in federal fuel economy standards for cars and trucks, the consensus forecast is that motor fuel taxes will not be an adequate source of dedicated funding for roadway maintenance and construction. This article accepts the notion that mileage fees are a promising replacement for the fuel tax and considers steps that might be taken to enhance the political acceptability of such a reform. The authors argue that simple, low-tech ways of implementing mileage fees are possible in the near term and should be complemented by a well-developed audit mechanism. Current trends in the automotive and auto insurance industries as well as social media are likely to reduce opposition to more technologically advanced mileage taxes in the long run.

Although many variables affect the amount of revenue generated by fuel taxes, a key trend is that the average new vehicle is using less fuel to travel the same distance. As motor vehicles become more fuel efficient, the fuel tax loses its revenue-raising capability. This worrisome trend is critical to public administration because the fuel tax is a major source of revenue to the public sector throughout the world.

The trend toward greater fuel efficiency will accelerate in the United States between now and 2025 because the federal government is raising passenger vehicle mileage standards from about 25 miles per gallon to more than 50 miles per gallon by 2025. The state of California is also requiring that at least 15 percent of all vehicles sold in the state run on electricity (or otherwise achieve zero emissions) by 2025. For the first time in history, the federal government is also regulating commercial trucks, including heavy-duty trucks, to achieve steady and significant gains in fuel efficiency. Given these regulatory trends, the consensus forecast is that petroleum consumption in the U.S. transport sector will decline significantly in the decades ahead, which means that motor fuel taxes will not be an adequate source of dedicated funding for roadway maintenance and construction.

The challenges implied by this forecasted decline in revenue have been studied widely by academics, think tanks, and even a bipartisan commission appointed by the federal government (Forkenbrock and Hanley 2006; Furtchtgott-Roth 2010; National Surface Transportation Infrastructure Financing Commission 2009; Sorenson et al 2009; Whitty and Svadlenak 2009). They have all come to the same conclusion: without a new dedicated source of funding for highway construction and maintenance, America’s surface transportation system will gradually deteriorate because of lack of infrastructure investment. A broad technical consensus on the solution has also emerged: federal and state motor fuel taxes should be replaced by road user fees on vehicle miles of travel (VMT). We refer to this policy instrument as VMT-F.

Despite the appeal of road user fees to policy analysts and practitioners, implementation has been very slow. The state of Oregon, for example, has been studying VMT-F for more than a decade but, with the exception of a modest pilot project, has not achieved large-scale implementation. Similar discussions are taking place in numerous states across the country. In fact, 14 states have participated in VMT-F pilot projects, and another eight have expressed an interest in the VMT-F (Slone 2010). The Barack Obama administration has shied away from any endorsement of road user fees at the national level. The European Commission in Brussels has urged member states to enact road user fees, but none has done so on a large-scale basis. The Dutch
government appeared to embrace the idea but then backed away (Dawid 2011).

The main challenge facing the VMT-F, based on its most common proposed form of administration, is political acceptability. First, the tax will be costly to implement because it requires that all vehicles have a tamper-proof global positioning system (GPS) that monitors VMT. This implies mandating that all new vehicles have GPS as a standard feature and that all old vehicles be retrofitted with GPS devices. Implementation also requires investment in software and hardware to read and store VMT data for all vehicles over time.

GPS monitoring leads to a second and possibly even more important challenge: a perceived invasion of privacy. When all vehicles have a GPS device that is linked to a central database, government can track the movement of every citizen in real time. This perceived invasion of privacy is likely to make a VMT-F extremely unpopular among some voters and generate determined opposition.

Our central argument is that there has been too much focus on the use of advanced technology to measure VMT and insufficient consideration of simple, low-tech ways to implement a VMT-F. Unlike Sorensen et al. (2009), we argue that these low-tech strategies ought to play a key role in moving the implementation of the mileage tax forward. For example, VMT data can be collected by departments of motor vehicles (DMVs), which are already well distributed across the country. The data can either be collected directly by DMV staff or by self-reports (i.e., drivers state how many miles they have driven since their last report). The advantage of this approach is that it is low in cost and does not invade the privacy of drivers. However, it increases the opportunity for noncompliance. We suggest promising strategies that might mitigate noncompliance.

Second, while advanced technological solutions such as GPS are more tamper proof and offer greater pricing flexibility, they decrease political acceptability because of their implementation costs and perceived invasion of privacy. Here again, we contribute to the literature by describing certain changes in the private sector that should facilitate political acceptability over time. There has already been a large shift toward manufacturing cars with Internet connectivity, including GPS. This implies that the cost of implementing a GPS-based VMT-F will be much lower in the not too distant future than it is today. The auto insurance industry has also been slowly rolling out “pay-as-you-drive” pricing for insurance policies, which requires insurance companies to track VMT. This development will reduce not only implementation costs but also the fear that the government will be able to track drivers in real time. Additionally, the continued rise of social media reveals an increased willingness to share private information in the public domain, suggesting that the privacy concerns of the VMT-F are likely to diminish overtime, especially if administered through private third-parties such as auto insurance companies.

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The article is organized as follows: The next part reviews the history of highway funding in the United States, traces how motor fuel taxes became the dominant source of federal funding for surface transportation projects, and presents projections of the revenue shortfalls that must be addressed. Then we summarize alternative funding methods, including a description of tax administration strategies aimed at making the tax on VMT more politically palatable. The following section highlights the main characteristics of the tax on VMT that make it superior to the other options, and the conclusion summarizes our major arguments.

The Highway Trust Fund

Structure

The Highway Trust Fund (HTF) is a trust account of the federal government created by the Highway Revenue Act of 1956 (FHWA 2007). It functions as a dedicated financing mechanism for the National System of Interstate and Defense Highways. It also finances the Federal-Aid Highway Program, which was expanded greatly by the Federal-Aid Highway Act of 1956. The Highway Revenue Act expanded existing highway-related taxes, created new ones, and established that said taxes be credited to the HTF in order to accelerate the growth of the U.S. highway system (FHWA 2007). This was the first time that specific highway user charges were directly used to finance highways; prior to 1956, the Federal-Aid Highway Program was financed out of the U.S. Treasury’s General Fund.

The HTF was a single account used solely for highway funding until the Federal-Aid Highway Act of 1973 allowed for greater flexibility in the use of Urban System Funds. In particular, the 1973 act allowed state and local governments to use Urban System Funds, which are financed by the HTF, to pay for mass transit projects (Park 1991; Staats 1977). The HTF did not fully incorporate mass transit until 1983, when Congress determined that a small portion of dedicated highway user revenues should be used to finance public transit. Since then, the HTF has been separated into the new and significantly smaller Mass Transit Account and the large Highway Account. These accounts are financed by fuel taxes whose rates vary by fuel type: gasoline and certain blends of gasohol are taxed at 18.4 cents per gallon, diesel is taxed at 24.4 cents per gallon, and special fuels are taxed at rates ranging from 9.15 cents to 13.6 cents per gallon.2 In addition to these taxes, a small portion (about 10 percent) of Highway Account revenue is received from interest as well as excise taxes on the sale of tires, heavy trucks and trailers, and an annual heavy vehicle use tax up to $550 (FHWA 1998).

Authorizations for HTF expenditures and related taxes have expiration dates and thus must be renewed periodically. These acts have the important function of defining programs and setting upper limits on the funds available to the secretary of transportation. The most recent major authorization act was signed into law on August 10, 2005, under the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). This act guaranteed $244.1 billion (in 2005 dollars) to be spent on highways, highway safety, and public transportation and had an expiration date of September 30, 2009. The SAFETEA-LU was extended 10 times through short-term bills before being replaced by a two-year transportation spending bill in July 2012.

416 Public Administration Review • May | June 2013
The various taxes mentioned here are paid by either the importer or the producer of the taxable product and deposited into the General Fund of the Treasury before being transferred to the HTF. The collected revenues are distributed to the states to assist with the financing of state roadway projects. With few exceptions, the HTF only covers 80 percent of the full construction costs of funded programs (FHWA 2007). However, the SAFETEA-LU has an equity bonus provision that ensures that each state receives a minimum rate of return on its contributions to the HTF.

**Grounding in the User-Pays Principle**

A key feature of the motor fuel tax, as opposed to other forms of taxation, is that it is designed on the benefit principle. That is, those who use the services funded by the fuel tax pay the tax, and the amount paid increases with consumption of the services funded by the tax. Viewed in this way, the tax is considered a user charge, which is no different, conceptually, than the price that one pays for goods and services in a private market. Because vehicle miles traveled and vehicle weight are the main user-related contributors to the wear and tear of road surfaces, a well-designed VMT-F guarantees that those who drive longer distances and use heavier vehicles pay more than others for the use of road services.

The user charge feature of the fuel tax also nudges drivers closer to the socially optimal amount of road consumption. Ideally, drivers will travel an extra mile if the cost to society is less than or equal to the socially optimal amount of road consumption. Ignoring pollution, this can be achieved by setting the user charge equal to the marginal cost of operating the roadway. For this to work, the user charge payment must increase with road consumption. Because fuel economy standards vary across vehicle type and are tightening over time, it is possible for the fuel user charge to decrease as consumption increases, which causes drivers of fuel-efficient vehicles to drive more than is societally optimal.

**Growing Evidence of Inadequate Revenue**

Related to the equity and efficiency concerns raised earlier is the fact that the fuel user charge has become fiscally inadequate. Because the tax rate for each fuel is fixed, revenue adequacy can be compromised because of environmental factors such as rising fuel prices that drive consumption down or higher than anticipated price increases within the construction industry. As greater emphasis continues to be placed on fuel efficiency, the ability of the fuel user charge to fulfill its primary role of revenue generation will be further diminished, and any sudden impact of higher pump prices or construction inputs would be even more damaging.

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To summarize, the fuel user charge has the benefit of ensuring that only road users pay for the services they receive and that the payment increases with use. To summarize, the fuel user charge has the benefit of ensuring that only road users pay for the services they receive and that the payment increases with use. However, recent trends in fuel economy and price levels in the construction industry have seriously weakened the ability of the tax to finance the operation of the roadways. As a result, the government has had to rely on general fund financing, effectively shifting some of the burden of highway financing from users to nonusers. While there are some valid reasons for sharing the burden with nonusers, the alarming rate at which this change is taking place is symptomatic of the pattern of financing woes is obvious in figure 1, which shows declining balances in the HTF since 2001. Because law mandates that the HTF cannot have a negative balance, the Treasury’s General Fund has been tapped to keep the HTF afloat. Three transfers from the General Fund totaling $34.5 billion have taken place since 2008, and additional transfers were expected to be necessary before the end of 2012 (Kile 2011). The biggest influence is the decline in the Highway Account, which accounts for 84 percent of all trust fund receipts and is primarily driven by fuel tax revenue. There is a general consensus that additional funding for road infrastructure is necessary, but the precise amount of investment needed depends on the estimation method. One method is based on what the U.S. Department of Transportation considers minimum tolerable conditions. Achieving this goal will cost an estimated $74 billion. Alternatively, revenue needs can be determined by summing the costs of highway projects that satisfy a benefit–cost test. An annual investment of $220 billion through 2040 will be required to satisfy a benefit–cost approach to spending on highways, bridges, and transit infrastructure (ASCE 2011). A much more minimal standard is one that requires that the current level of highway performance be maintained. An additional $14 billion per year (above the $40 billion currently spent) is necessary to meet this standard. This is troubling because the $40 billion currently being spent is around $13 billion more than what is collected in current taxes, implying that current tax revenues are $27 billion short of covering the annual outlays needed to meet this minimal standard (Kile 2011).
expenditures on highways and other compelling public needs, it is problematic for several reasons. First, it eliminates the user charge feature of the fuel tax. This raises equity concerns because nonusers will have to pay for the operation of the highway system and low-mileage users will pay the same amount as high-mileage users, all else being equal.11 Second, by breaking the link between payment and use, general fund financing lowers the perceived cost of driving a mile, which likely leads to higher levels of roadway consumption than otherwise would be observed. This has serious implications for traffic congestion, wear and tear of roadways, and the extent of vehicle-related pollution. The extra wear and tear of roadways is of special significance because it creates even larger federal revenue needs for highway repair and construction.12 Third, greater financing of the HTF through the general fund implies that the amount transferred from year to year is likely to vary with the priorities of the government, thus making long-term planning for transportation projects even more difficult than it is today.13 This is particularly troubling because many transportation infrastructure projects take a long time (sometimes more than a decade) to finish. Finally, given the poor fiscal condition of the federal government, it is imprudent to rely on general fund financing of highways.

**Higher Fuel Tax Rates and Indexation**

Another common policy proposal is to increase the fuel tax rate and index the new rate to the inflation rate. This policy is also easy to implement, but more important, it makes sense as a stepping stone to a larger problem that will only worsen in the coming years if policy changes are not implemented.

**Policy Options**

Taxes are generally judged on their ability to satisfy four criteria: adequacy, equity, simplicity, and efficiency. These canons of taxation, as Adam Smith called them, are very intuitive. A good tax generates an adequate level of revenue, distributes the tax burden fairly (equity), is easy to comply with and administer (simple), and has very little effect on individual behavior (efficient or small excess burden). Any solution to the current crisis facing the HTF must also be politically feasible.9 This section briefly reviews some of the proposed policy options along the dimensions outlined next.

**General Fund Financing**

The de facto solution to the financing woes facing the Highway Trust Fund has been to transfer funds from the Treasury’s General Fund. Approximately $30 billion was transferred to the HTF between 2008 and 2010, accounting for about 25 percent of the total income deposited in the fund over the period (Kile 2011).10 This method of financing highway expenditure is also common at the state and local levels (Wachs 2003, 2012): approximately one-half of the combined federal, state, and local spending on highways is financed by general fund accounts.

While general fund financing is quick and easy and has the advantage of forcing politicians to make explicit trade-offs between expenditures on highways and other compelling public needs, it is problematic for several reasons. First, it eliminates the user charge feature of the fuel tax. This raises equity concerns because nonusers will have to pay for the operation of the highway system and low-mileage users will pay the same amount as high-mileage users, all else being equal.11 Second, by breaking the link between payment and use, general fund financing lowers the perceived cost of driving a mile, which likely leads to higher levels of roadway consumption than otherwise would be observed. This has serious implications for traffic congestion, wear and tear of roadways, and the extent of vehicle-related pollution. The extra wear and tear of roadways is of special significance because it creates even larger federal revenue needs for highway repair and construction.12 Third, greater financing of the HTF through the general fund implies that the amount transferred from year to year is likely to vary with the priorities of the government, thus making long-term planning for transportation projects even more difficult than it is today.13 This is particularly troubling because many transportation infrastructure projects take a long time (sometimes more than a decade) to finish. Finally, given the poor fiscal condition of the federal government, it is imprudent to rely on general fund financing of highways.
toward more adequate policies. The higher tax rate would increase
revenue collections, thereby making the tax more adequate than it
is now, while indexation maintains purchasing power over time.14
A key advantage of indexation is that it ensures that the fuel tax
reflects changes in the cost of operating the roadways and therefore
provides drivers with a more accurate picture of the cost of driving.
Moreover, the automatic feature of indexation removes from politi-
cians the obligation of voting for tax hikes each time the construc-
tion cost index rises. Political history reveals that elected officials
are disinclined to cast votes in favor of a higher federal fuel tax rate,
though such votes pass more frequently at the state level.

Unfortunately, a higher fuel tax rate indexed to inflation does not
address one of the key problems facing policy makers: growth in
the number of vehicles with high fuel efficiency or the capability to
run on alternative fuels that are not subject to tax (e.g., electricity).
These vehicles will continue to inflict damage on the transportation
infrastructure without corresponding additions to highway revenue.
And these vehicles are likely to be used relatively intensely because
their marginal cost of operation to the owner is low (even though
their fixed price of purchase is high).15 Finally, as a practical matter
of politics, it seems unlikely that members of Congress will vote for
higher fuel taxes in the foreseeable future (either a one-time increase
or through automatic indexation). As shown in figure 2, there have
been only four major rate changes in the almost 80-year history of
the fuel tax, the most recent being in 1993.16

Mileage Tax
An accurate measure of VMT is required in order for the mileage
tax to be feasible. This section provides a detailed description of
measurement strategies, paying particular attention to those that are
likely to improve political acceptability.

Administration of the tax base: Global positioning system. The
most accurate means of tracking VMT given current and foreseeable
technology is with a global positioning system, presumably one that
is professionally installed in each vehicle.17 VMT data collected by
the GPS device can be used in several ways to administer the tax.
First, data can be transferred remotely, via satellite or wireless signal,
to the agency with responsibility for assessing the mileage tax.
This approach was used in a pilot study conducted by the University of
Iowa. Each driver receives a VMT tax bill stating the number of
miles driven since the last bill and the corresponding tax liability.
The bill could be sent out at any frequency chosen by the
government: monthly, quarterly, semiannually, or annually. Second,
VMT can be read every time drivers buy fuel at a gas station. In this
case, the mileage tax would be paid similarly to current fuel taxes
(the Oregon pilot study was administered using this technology).

Source: Authors’ calculations.
Note: Reported is the federal fuel tax rate on gasoline. The real fuel tax rate is reported in 2000 dollars based on the Federal-Aid Highway
Construction composite index. Tax rates shown are in cents.

Figure 2 Trends in Real and Nominal Fuel Tax Rate
This approach would require fuel station owners to invest in the technology required to read VMT from each vehicle. Although this is only a one-time cost, it may induce political resistance from owners of refueling stations. Finally, the mileage tax can be assessed every time owners renew their vehicle registration tag. This approach would require state DMVs to invest in the equipment and staffing necessary to read and assess the mileage tax for large volumes of vehicles.

The GPS-based system provides the greatest level of accuracy, but it is also likely to receive the greatest pushback, for several reasons. First, a GPS-based mileage tax requires tamper-proof devices that are professionally installed in each car, which undoubtedly will be a costly exercise. Fortunately, GPS devices continue to fall in price. A simple over-the-counter GPS device can be bought for less than $100. It will also require costly infrastructure to read, store, and bill millions of drivers. For example, implementing a mileage tax in the state of Oregon would require approximately $33 million in capital costs and $1.6 million in annual operating costs (Whitty 2007).

Similarly, it would cost approximately $1.44 billion in capital costs to fully implement an Oregon-style mileage tax in the large state of New York (Peters and Gordon 2009).

Second, and more important, the GPS-based mileage tax means that the government will be able to track each citizen’s location. The level of detail that the government must collect depends on the complexity of the rate structure used. For example, the government will need data on the number and location of miles driven if the GPS is used to facilitate tolls and congestion pricing. This will undoubtedly represent an uncomfortable invasion of privacy for some individuals. Even if the government decides to use a simple rate structure that only requires the number of miles driven, it will be difficult to convince drivers that only VMT will be collected and that the data will not be used to spy on citizens. That being said, recent pilot studies in Oregon and 12 U.S. cities conducted by the University of Iowa indicate that a GPS-based mileage tax is likely to be more acceptable than expected. For example, only 9 percent of drivers who participated in the University of Iowa pilots preferred tax statements that offered the maximum privacy. The tax liability statements that offered the maximum privacy only had data on monthly VMT; no data on where or when miles were driven were provided. On the other hand, 60 percent of drivers who participated in the University of Iowa pilots preferred statements with very detailed information on their daily driving patterns.

Despite this promising result, objection on the grounds of privacy will be a major obstacle to the adoption of a national tax on VMT, especially given the current political climate. However, we do not feel that this is reason to abandon the mileage tax, as there are “low-tech” ways of measuring VMT that do not affect privacy in the same way that GPS does. Next, we describe two methods that can be used to collect VMT that are less costly and do not share the privacy concerns of GPS.

Administration of tax base: Self-reporting and visual inspection.

Because every car comes equipped with an odometer, the simplest method is to record VMT directly from the odometer. This can be done at the DMV when drivers renew their registration tags. The advantage of this approach is that it does not require any new devices, nor does it monitor VMT beyond what is already done for every car. However, it is susceptible to evasion through odometer tampering. Although this is a serious problem that could undermine the tax, there are ways to minimize it. First, the analog odometer of older vehicles can be physically inspected for tampering. Second, a comparison of mileage information from the odometer with data from the vehicle’s history report (e.g., a CARFAX report; see http://www.carfax.com) should highlight any major discrepancies that might be indicative of fraud. Third, the DMV can maintain a simple profile on each registered driver that can be used to determine any major differences between reported VMT and expected VMT. For example, data on the distance to work, school, and the grocery store and the number of drivers in the household can be used to determine an expected annual mileage for each vehicle. Finally, auto service centers could be required to record and transfer each vehicle’s VMT, along with the date the VMT was collected, to the tax agency. This would not add any significant burden on auto service centers, as they already collect all of this information whenever vehicles are serviced.

Another argument against visual inspection is that some drivers conduct all of their business with the DMV online, so forcing them to visit the DMV to have their VMT recorded would be inconvenient. Moreover, registration cycles are often less frequent than the annual reporting cycle required for fiscal purposes. One way to address this problem is to give drivers the option of self-reporting their VMT online. The reported VMT would be compared with expected VMT based on each driver’s profile as well as with VMT information on the vehicle from other sources.

Minimizing cheating requires that resources be allocated to an audit mechanism, similar to other taxes. Audits could vary with the magnitude of the difference between reported VMT and expected VMT, where expected VMT is derived from the sources described earlier. In other words, differences above a predetermined threshold would trigger an automatic visual inspection. Because drivers may learn these threshold levels over time, the system would also require a random audit; for example, the government could decide to audit 5 percent of all drivers in each state chosen at random.

As with the fuel tax—and all taxes, for that matter—failure to implement an adequate audit mechanism would subject the VMT-F to substantial cheating and thus undermine its revenue-generating capability. The cost of setting up such a system is not likely to be high because most of the data needed for the deterministic component of the audit are already collected. For example, mileage data for newly registered vehicles are collected by DMVs across the country; these data are also available from CARFAX reports for used cars, and most authorized auto service centers already have the capacity to collect mileage data, especially for newer cars. It is also the case that DMVs maintain a record for each registered vehicle, which can be modified to include additional field items needed for a vehicle profile and historical mileage data. The physical inspection component of the audit mechanism would require man hours, which is likely to be
relatively expensive. These costs can be controlled by making adjustments to the threshold that triggers a deterministic audit and/or the share of vehicles subjected to a random audit. This would require a balancing act, as changes that reduce the number of physical inspections and thus costs are likely to increase noncompliance.

It is important that potential cheating be considered within the context of cheating on other taxes. The federal personal income tax is administered on a self-reporting basis complemented by third-party reporting, withholding, and audits. There is almost no way of verifying the reported income of self-employed individuals. Consequently, the level of compliance among the self-employed is believed to be almost one-half that of the employed, whose compliance rate is more than 90 percent (Slemrod 2007). Still, the income tax is the main source of tax revenue for the federal government. Therefore, the fact that some individuals will take steps to cheat on VMT reporting should not cause policy makers to shun it as a viable option to replace the fuel tax.

Administration of tax base: Third-party reporting. While a system built on self-reports and/or direct observation minimizes privacy concerns and thus improves political acceptability, these approaches do not facilitate the level of accuracy or efficient pricing that is possible with a GPS-based system. Therefore, it is important that the GPS-based VMT-F be phased in over time. It is possible that some drivers would want to opt into a GPS-based system immediately, and this option should be available to them. Additionally, recent developments in the auto manufacturing and auto insurance industries and the rise of social media imply that comfort level with GPS tracking is likely to increase in the not too distant future. It also raises the possibility of minimizing cost and privacy concerns in a GPS-based system by relying on third-party reporting (e.g., through auto insurance companies).

First, auto manufacturing companies are already producing cars with Internet connectivity and GPS tracking capability; examples include Ford’s SYNC, GM’s MyLink, BMW’s ConnectedDrive, and Toyota’s Entune. Additionally, Google built a self-drive vehicle using Toyota’s Prius and is now in the process of obtaining permission to test it in Nevada and California. Insurance companies are taking advantage of these developments to introduce a new pricing model for auto insurance: pay as you drive. More important for the mileage tax is the fact that these developments are driven solely by consumer preferences and are likely to be standard within the next decade or so. This implies that the adoption of the GPS-based tax on VMT on a voluntary basis will have little effect on the costs of auto manufacturers and drivers. Although some initial administrative costs would remain—the government would need to install the infrastructure needed to communicate with the in-vehicle GPS devices—it is clear that the total administrative costs would be relatively low because of current trends in the auto manufacturing and auto insurance industries.

The second development is the increased willingness of consumers to share real-time information about their location in the public domain. Each of the major social networking sites allows users to share their location; GPS is now a standard feature of smartphones and is becoming a standard feature of motor vehicles. Facebook allows its 550 million active daily users (in June 2012) to share their location in real time. Google+, Loopt, Gowalla, and FourSquare are a few other social Web sites that offer similar capabilities. While individuals are willing to share these data with firms in the private sector, sharing with the government is more unpopular.

An expanded role for the auto insurance industry may be a solution to the privacy problem. To the extent that the auto insurance industry has the capability to store mileage data collected by their GPS devices, the government can structure the mileage tax to take advantage of this capability. In its simplest form, each insurance company sends its clients a VMT statement that lists the change in VMT since the last bill and the total mileage tax liability; the government would receive a copy of the VMT statement. The driver then sends a copy of the statement along with payment to the Internal Revenue Service. This approach has several advantages. First, it reduces the government’s role to simply receiving payment and therefore should minimize privacy concerns. Second, the third-party information on VMT provided by insurance companies makes it more difficult for the driver to cheat. Finally, because insurers require accurate VMT data to price their policies, they have an incentive to make sure that the VMT data are correct, which further reduces compliance concerns. Additionally, the tax-related administrative costs borne by the companies are likely to be small, assuming that they already have the capability to track and store the VMT data and there is a single flat tax rate.

Third-party reporting becomes more complicated as the full flexibility of the GPS data is utilized. For example, VMT would have to be tracked by vehicle characteristics if the federal tax varies by vehicle weight. An additional layer of complexity is introduced if states also adopt the mileage tax, as this could cause rates to vary both within and between states. For example, suppose New York adopts the mileage tax and decides to have a standard rate for the state, a congestion surcharge for New York City, and a toll surcharge for the Brooklyn Bridge. This would require a VMT statement that tracks VMT for each of these zones, which is fairly easy to do with current GPS technology, but would make privacy concerns more pressing given the finer level of data required. Identifying zones with generic terms such as “congested area” instead of “New York City” or “toll road” instead of “Brooklyn Bridge” might reduce these concerns. The main source of complication arises from the fact that insurance companies would have to keep track of dozens of different tax rates, which would increase administrative costs. Note that the complication here is tracking the rates for changes over time to ensure that the tax liability is being calculated correctly. This is only a problem for insurance companies if they are responsible for calculating the tax liability.

While a GPS-based tax on VMT offers the greatest level of flexibility and accuracy, it is clear that its effect on privacy may outweigh these advantages, at least in the near term.

While a GPS-based tax on VMT offers the greatest level of flexibility and accuracy, it is clear that its effect on privacy may outweigh these advantages, at least in the near term. We argue that the low-tech administrative tools described here should be explored in the short term, with the option to adopt GPS on a phase-in basis as comfort with VMT-F
maintain the current infrastructure. For example, current estimates required to generate the level of revenue required to rebuild and taxes to the federal government. Of course, higher rates would be of transportation (2011), would pay the equivalent of $200 in VMT household, which drives 20,000 VMT per year (U.S. Department that was deposited into the HTF in 2010. Therefore, an average of VMT, then an increase in their tax bill should move VMT drivers are currently driving more than the societally optimal level. If drivers are currently driving more than the societally optimal level of VMT, then an increase in their tax bill should move VMT closer to the desired level. For example, the pavement cost of traveling 1 mile on urban interstate highways in 2000 ranged from approximately 0.1 cent per mile for automobiles to 40.9 cents for an 80,000-pound, five-axle combination truck (FHWA 2000a, 2000b). This compares to the federal user charge of 0.81 cent to 7.74 cents per mile for automobiles and for an 80,000- to 100,000-pound truck, respectively. A more careful look at the numbers shows that trucks—both single-unit and combination trucks—pay user fees that are significantly lower than their marginal costs. This implies that VMT by trucks is most likely greater than the economically efficient level. The increase in vehicle fuel economy since 2000 and the projected increase in the coming years, higher construction costs, and a failure to adjust the fuel tax suggests that VMT for automobiles (passenger vehicles) is also nearing, if not already passed, the desired level.

A sophisticated mileage tax implies greater complexity and privacy concerns, which might lead to adverse effects on compliance costs and welfare losses as a result of changes in driving behavior. For example, keeping track of multiple rates may become burdensome for drivers who travel through multiple taxing jurisdictions. This problem can be solved by programming mileage rates into the GPS devices, which would allow drivers to map and select routes based on the implied tax liability; most GPS devices already offer this capability to avoid toll roads. Companies such as First America provide very detailed geolocation data on taxing jurisdictions that can be integrated with GPS to facilitate this process. Nonetheless, the tax might cause drivers to select routes that they otherwise would have avoided, leading to a welfare loss. Furthermore, the more complicated the tax structure, the greater are the privacy concerns because more data is required to calculate tax liability. Therefore, it is important that policy makers maintain a balance between flexibility and complexity.

Characteristics of a Mileage Tax

The tax on VMT has some good properties, some of which are independent of how it is administered. This section describes four of these properties: adequacy, efficiency, equity, and visibility.

Adequacy

Because VMT is more strongly and directly correlated with road damage than fuel consumption, a tax on VMT provides a more adequate and stable source of revenue for the construction and maintenance of roadways. In particular, a tax on VMT would ensure that VMT (and hence road damage) and tax revenues move in the same direction. This is a major advantage of the mileage tax over the fuel tax, which will become increasingly inadequate as fuel efficiency increases. A simple back-of-the-envelope calculation implies that an implicit tax rate on VMT of $0.01 per VMT ($30 per 3,000 miles driven) would be sufficient to generate the same amount of revenue that was deposited into the HTF in 2010. Therefore, an average household, which drives 20,000 VMT per year (U.S. Department of Transportation 2011), would pay the equivalent of $200 in VMT taxes to the federal government. Of course, higher rates would be required to generate the level of revenue required to rebuild and maintain the current infrastructure. For example, current estimates suggest the federal government needs to spend more than $54 billion per year to maintain roadways in their current condition. Assuming for the moment that VMT stays constant at 3 trillion miles per year, this implies a tax rate of $0.018 per VMT and an annual tax bill of $360 (20,000 * 0.018) for the average household.

Theoretically, we expect an increase in tax bill to lead to a reduction in VMT. For example, the fuel price elasticity of VMT is generally estimated to be 0.10 percent to 0.16 percent in the short run and 0.26 percent to 0.31 percent in the long run (Small and Van Dender 2007). These estimates imply that an 80 percent increase in the cost of driving a mile should reduce VMT by 8 percent to 12.8 percent in the short run and 20.8 percent to 27.2 percent in the long run. Although these changes are small relative to the increase in price, the effect may be amplified by the visibility of the mileage tax relative to the fuel tax. If this is the case, then the tax rate required to generate a given level of revenue will be higher than that calculated here. A reduction in VMT does diminish surface damage to roadways, which implies lower revenue requirements. Therefore, the net effect of behavioral responses on the implied tax rate depends on which of these effects is larger. Even so, the fact that VMT is relatively inelastic implies that a tax on VMT is capable of generating adequate levels of revenue.

Economic Distortion/Excess Burden

A distinctive feature of the mileage tax is its salience. Because drivers are billed for the number of miles driven, a clear link is established between VMT and tax liability that is likely to have an impact on driving behavior. Chetty, Looney, and Kroft (2009) find that consumer spending at supermarkets falls when the sticker price of goods includes the retail sales tax—that is, when the tax is made more salient. While we expect a similar behavioral response among drivers, it is not immediately clear that this is a bad outcome. If drivers are currently driving more than the societally optimal level of VMT, then an increase in their tax bill should move VMT closer to the desired level. For example, the pavement cost of traveling 1 mile on urban interstate highways in 2000 ranged from approximately 0.1 cent per mile for automobiles to 40.9 cents for an 80,000-pound, five-axle combination truck (FHWA 2000a, 2000b). This compares to the federal user charge of 0.81 cent to 7.74 cents per mile for automobiles and for an 80,000- to 100,000-pound truck, respectively. A more careful look at the numbers shows that trucks—both single-unit and combination trucks—pay user fees that are significantly lower than their marginal costs. This implies that VMT by trucks is most likely greater than the economically efficient level. The increase in vehicle fuel economy since 2000 and the projected increase in the coming years, higher construction costs, and a failure to adjust the fuel tax suggests that VMT for automobiles (passenger vehicles) is also nearing, if not already passed, the desired level.

Equity

Another key feature of the mileage tax is that it is structured like a user charge. That is, only individuals who use the roadways pay, and their payments increase with use because of the direct link between VMT and road surface wear and tear. As such, a tax on VMT satisfies the benefit principle of equity, which ties each taxpayer’s share of the tax burden to the benefits received from the goods and services financed by the tax revenue. Additionally, the current fuel tax allows...
drivers of fuel-efficient vehicles to consume the same amount of road services (drive similar distances) as drivers with gas guzzlers at a much lower cost. Because both types of vehicles inflict the same amount of damage to the road surface, conditional on vehicle weight, it is unfair under the benefit principle of efficiency to have a lower tax bill. A tax on VMT would eliminate this source of inequity because its base—VMT—is independent of fuel efficiency.35

Unfortunately, a tax on VMT is regressive under the ability-to-pay principle of equity. That is, poor drivers would pay a larger share of their income in taxes than their rich neighbors. However, it is not clear that the mileage tax will be more or less regressive than the fuel tax; while McMullen, Zhang, and Nakahara (2010) and Zhang et al. (2009) find the fuel tax to be modestly less regressive than the mileage tax, Weatherford (2011) finds the opposite. This particular feature is a characteristic of all user charges and is attributable to the fact that the poor consume a relatively greater share of their income on road transport.

Visibility: Impact on Political Acceptability and Predictability

One of the key features of the VMT-F is that it isolates the tax liability of a given trip from other related costs. The fuel tax, on the other hand, lumps the tax together with the price paid for fuel, which makes it difficult for drivers to separate the tax liability of a given trip from the cost of fuel. In other words, the VMT-F is more visible than the fuel tax, and this increased visibility is likely to affect the political acceptability of the VMT-F. Coate and Morris (1995) show that policy makers tend to adopt policies with hidden costs whenever voters cannot observe the policy makers’ motives. The implication here, as in Oberholzer-Gee and Weck-Hannemann (2002), is that road taxes that are relatively efficient and visible are less likely to be implemented than road taxes that are relatively inefficient and invisible. This preference for invisibility suggests that the VMT-F is likely to face opposition from policy makers. Nonetheless, we are not convinced that the visibility of the VMT-F should be diminished, given that it allows voters to hold policy makers accountable. In particular, visibility opens up the revenue and expenditure decisions of policy makers to public scrutiny and, in so doing, makes the political process more transparent.

The visibility of the tax should also improve its predictability over time. In other words, holding the tax rate constant, calculating the tax liability of a trip should be fairly straightforward.36 This should hold true regardless of when the tax is collected: before or after a given trip. Predicting the tax implication of a trip can be complicated if the trip passes through multiple taxing jurisdictions that have different tax rates. A GPS-based VMT-F has the potential to eliminate this source of uncertainty. For example, a GPS-based VMT-F with preprogrammed, jurisdiction-specific tax rates would be able to calculate the tax liability for any trip. It is also likely that drivers will be able to predict the tax liability fairly well as they become familiar with the tax. Most individuals have predictable driving routes; they drive to work, day care or school, the grocery store, to go out to dinner, and to visit relatives. As a result, most people will be able to predict their weekly or monthly tax liability as they become more experienced with the mileage tax.

One possible unintended consequence of increased visibility of the VMT-F administered alongside tag renewals is that drivers may delay renewing their tags. However, there is already an audit mechanism in place for this type of behavior; drivers can be fined and, in some cases, face jail time if caught. More important, the random audit and fine mechanism accompanying the VMT-F should minimize this type of response.

Conclusion

Given recent regulatory changes in vehicle fuel economy standards, the consensus forecast is that motor fuel taxes will not be an adequate source of dedicated funding for roadway maintenance and construction. This has led to a technical consensus that federal and state motor fuel taxes should be replaced by road user fees based on VMT. This article suggests steps that might be taken to enhance the political acceptability of such a reform.

Our central argument is that simple, low-tech ways of implementing VMT fees are possible if they are complemented by a well-developed audit mechanism. For example, self-reporting and visual inspection when cars are registered are low-tech ways of measuring VMT that do not share the costs or privacy concerns of GPS-based technologies. However, because these low-tech methods are susceptible to fraud, a sophisticated audit system that includes a deterministic and a random component is required. We argue that there are several third-party sources of VMT on which to base the deterministic component of the audit process; examples include CARFAX reports, departments of motor vehicles, insurance companies, and auto service centers. Additionally, the collection agency can develop a driver profile that would be used to estimate expected VMT, which, in turn, can be used to screen for cheaters.

Current trends in the automotive and auto insurance industries as well as social media are likely to reduce privacy and cost concerns of more technologically advanced VMT taxes. Most manufacturers are making cars with Internet connectivity and GPS capability, and auto insurance companies are slowly shifting toward pay-as-you-drive insurance policies. Because insurance companies require accurate mileage information in order to price their pay-as-you-drive policies, they will have to implement credible means of tracking VMT in real time. Therefore, it is possible for the government to rely on the data collected by insurance companies to implement the mileage tax. The most important feature of these developments is that they are driven by market forces. Therefore, making this option available to drivers on a voluntary basis should reduce privacy and cost concerns that have plagued the mileage tax. Furthermore, pilot studies conducted by the University of Iowa and the Oregon...
Department of Transportation suggest that acceptance of a GPS-based mileage tax is likely to increase as drivers become more aware of how the tax works.

Switching to a mileage tax would provide several advantages over the current fuel tax. First, a tax on VMT would ensure that VMT (and hence road damage) and tax revenues move in the same direction, thus providing a more adequate and stable source of revenue for the construction and maintenance of roadways. Second, a tax on VMT increases the salience of the cost of driving and therefore is expected to have a significant impact on VMT. This is particularly important in the context of increased congestion in many metropolitan areas.

Third, a tax on VMT also satisfies the benefit principle of equity, which ties each taxpayer’s share of the tax burden to the benefits received from the goods and services financed by the tax revenue. The current fuel tax is losing this feature, as drivers of fuel-efficient vehicles are able to consume the same amount of road services (i.e., drive similar distances) as drivers with gas guzzlers but at a much lower cost. Because both types of vehicles inflict the same amount of damage to the road surface (conditional on vehicle weight), it is unfair under the benefit principle for fuel-efficient cars to have a lower tax bill. A tax on VMT would eliminate this source of inequity because its base—VMT—is independent of fuel efficiency. If policy makers seek to internalize the pollution-related costs of travel, this may be better addressed by taxing the emissions than by taxing miles driven.

Finally, a GPS-based mileage tax allows policy makers to address multiple issues with one policy, as a GPS is able to track VMT in real time. For example, a surcharge could be implemented for heavier vehicles, driving during peak hours in congested areas, and driving on particular bridges or expressways (similar to a toll). GPS tracking also makes it easy for multiple jurisdictions, such as states, counties, or cities, to have different VMT rates. Each of these taxes requires a separate administrative mechanism under the current regime.

The two main issues affecting political feasibility of the VMT-F are perceived invasion of privacy and implementation costs. Therefore, these are two of the areas that ought to be explored in future research. For example, policy makers need better information on how concerned individuals are about the possible loss of privacy implied by a GPS-based VMT-F. Existing pilot studies show that acceptability of the VMT-F increases with familiarity. However, these findings are based on a selected sample, as individuals who are in favor of a VMT-F are more likely to have participated in the pilot studies. It would be interesting to see whether these results hold for a more representative sample of drivers. There is anecdotal evidence that younger individuals are more willing to share information about their location in the public domain, and future research should also aim to determine whether privacy concerns regarding the VMT-F follow this pattern. This is particularly important because the VMT-F will most likely be implemented in a time when the current cohort of younger drivers makes up a majority of the driving population. Future studies should also aim to determine factors that minimize privacy concerns. For example, are drivers more accepting of a VMT-F administered through third parties, such as insurance companies? Information of this nature is important for identifying the optimal administrative design.

Existing pilot studies also provide useful information on how much it would cost to implement and administer a GPS-type VMT-F. Because this approach is less likely to be implemented immediately, future work should focus on estimating the cost of low-tech solutions, such as those discussed here. For example, how easy is it for DMVs to create and store driver profiles that would allow them to predict VMT for each driver? And how much does this capacity vary, both across and within states? A survey characterizing the current technological capabilities of DMVs would be particularly useful in this regard. It would allow us to estimate the gap between the current capacity of DMVs and what is needed and thus move us closer to estimating the cost of implementing a low-tech VMT-F through DMVs.

There is never an easy time to propose a new tax, even one that replaces an existing tax. Fortunately, the ongoing fiscal debates in Congress may include comprehensive tax reform. Such a bill is a constructive legislative vehicle to include the replacement of the fuel tax with a VMT-F. If the federal government takes the lead, many states are likely to follow.

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Notes

1. DMV here refers to the department in each state that handles the registration and licensing of motor vehicles and the licensing of drivers, among other services. We acknowledge that not all such departments go by this title. For example, the state of Indiana refers to said department as the Bureau of Motor Vehicles.
2. The gasoline and gasohol tax revenues are distributed in the following way: 15.44 cents goes to the Highway Account, 2.86 cents goes to the Mass Transit Account, and the remaining 0.1 cent per gallon is earmarked for the Leaking Underground Storage Tank Trust Fund, an unrelated fund used to clean up environmental damage related to improper fuel storage.
3. Notable exceptions include the interstate system and some emergency relief roadways, which receive 90 percent and 100 percent financing, respectively.
4. The revenues deposited into the HTF are effectively paid by the residents of each state based on their fuel consumption. The SAFETEA-LU guarantees that the amount transferred back to each state to fund roadway projects is at least 92 percent of the amount collected from the residents of that state.
5. The positive correlation between VMT and fuel consumption is expected to decline significantly as vehicle fuel economy improves. This will break the link between fuel consumption and the consumption of road services and thus weaken the user charge feature of the fuel tax. We discuss this as a major drawback of the fuel tax in greater detail later.
6. We acknowledge that road surface damage increases exponentially with equivalent single-axle loadings (ESALs). Therefore, fully accounting for the impact of vehicle weight on road surface damage would require the fuel tax (or VMT-F) to change constantly to account for even modest changes in ESALs. This is not done for the fuel tax and is unlikely to be incorporated in the VMT-F because the complexity likely outweighs the benefits from fully accounting for the exponential relationship between ESALs and road surface damage. A more likely outcome is a surcharge based on vehicle weight.
7. This is attributable to the fact that fuel-efficient vehicles can consume road services at a fraction of the cost facing gas guzzlers. Note that this also violates...
the equity condition of the benefit principle, as those who consume more road services end up paying less.

8. The American Recovery and Reinvestment Act of 2009 made appropriations out of the Treasury’s General Fund and diverted some spending that otherwise would have been used from the HTF.

9. Efficiency in the current context means that individuals’ behavioral responses are mostly limited to income effects; that is, the tax has little or no substitution effects. An alternative but similar concept is “excess burden,” which arises from tax-induced substitution effects. Because an efficient tax has little or no excess burden, and vice versa, we use these terms interchangeably in the discussion that follows.

10. The annual transfers since 2008 are $8.017 billion, $7 billion, and $14.7 billion in 2008, 2009, and 2010, respectively. According to testimony given by Kile (2011), $34.5 billion was transferred from the Treasury’s General Fund between 2008 and 2011, which implies that the 2011 transfer (up to May 17, the date of his testimony) was $4.8 billion.

11. Of course, one might argue that the General Fund is financed by personal and corporate income taxes, which are more responsive to a household’s ability to pay than are fuel taxes and, therefore, more equitable.

12. A weakness in this argument is that motorists may be unaware of how much of the change in fuel price at the pump is attributable to tax changes versus other factors (e.g., changes in market conditions or fuel quality regulations). If this is the case, then switching to general fund financing would have little effect on the visibility of the tax and the effects described earlier would be minimal.

13. This problem is not an intrinsic feature of general fund financing and may not be an issue if the amount transferred is determined by a formula. For example, Congress could determine that a fixed percentage of the general funds must be transferred to the HTF annually. Of course, Congress would have the power to change the formula to match its priorities. Note, however, that Congress also has the power to change the share of fuel tax revenues that are deposited in the HTF, as was actually done during the 1990s.

14. The most recent change in federal fuel tax rates for gasoline, diesel, and special fuels occurred in the 1990s. Additionally, the purchasing power of fuel tax revenues declines steadily over time as price inflation occurs in the construction industry (see figure 2).

15. Unless the scope of the fuel tax is broadened to become an energy-consumption tax, the tax rate on petroleum fuels will have to be raised rapidly as the amount of gasoline consumed declines.

16. Although there is greater action at the state and local level, only 28 of the 50 states changed their fuel tax rate between 1997 and 2010.

17. The GPS device would be installed such that drivers have no control over its ability to record mileage. The pilot in Oregon and the study conducted by the University of Iowa both relied on such GPS devices. Note that over-the-counter GPS devices would make it impossible to prevent fraud because drivers would be able to turn their GPS devices on and off as they wish.

18. Tampering with a mechanical odometer often leaves trace evidence such as crooked dials, fingerprints, and scratch marks.

19. As an example, a driver who must drive 200 miles round trip to work each week is expected to drive at least 10,400 miles (200 * 52) each year. We would expect higher annual mileage if said driver must drop his or her child at school, pick up groceries, or take a family trip or if more than one individual use the same car.

20. They would, of course, have to transfer the information to the government at a cost, but this should not be overly costly given current technology. Furthermore, they already have to submit other tax information: retail sales and excise and income taxes. The police could also be required to collect VMT data every time they pull over a driver. However, it is not clear how receptive drivers would be to police monitoring of odometer readings data.

21. For example, the Internal Revenue Service relies on third-party reporting to effectively administer the personal income tax.

22. For example, an increase in the threshold or a reduction in audit probability will reduce the number of cars subjected to inspection and therefore reduce the number of man hours required. However, the reduction in the number of cars that are inspected might cause more drivers to make inaccurate reports, as the likelihood of being caught is lower.

23. While some insurance companies use their own GPS tracking device, others track mileage with the aid of built-in GPS devices. For example, State Farm uses Ford’s OnStar system to administer its pay-as-you-drive program, while Progressive relies on its own GPS device.

24. According to a press release by Juniper Research, more than 92 million vehicles will have Internet connectivity as early as 2016 (see http://www.juniperresearch.com/viewpressrelease.php?id=383&pr=292). Ironically, the only obstacle that this movement faces is the government, because of concerns about distracted drivers.

25. Older vehicles in the fleet would have to be retrofitted, so some initial setup costs would remain for volunteers with older vehicles. The government could subsidize these installation costs, thus spreading the burden across all taxpayers, or pass the full cost on to the owner of the vehicle but provide a payment plan that spreads the cost over a few years. This raises two important questions, which we leave for future research: how does the cost of setting up a GPS-based VMT-F compare to the cost savings from abandoning the current fuel tax, and how do the compliance and administrative costs of the VMT-F compare to those of the fuel tax?


27. This would cover the majority of drivers because auto insurance is mandatory for all types of vehicles; the uninsured would obviously not be covered. Making it mandatory for auto insurance companies to send the government these data is akin to the W2 statement that employers are required to send to the IRS on an annual basis. The simplest version of the statement would list the opening VMT, closing VMT, and change in VMT.

28. In some cases, it will be impossible to avoid the precise name of a zone. For example, if all states adopt the mileage tax and rates vary by states, then the VMT statement would have to indicate the state in which the miles were driven. Even if it does not list the state by name, it would be trivial to figure out where the miles were driven. The use of generic names also makes it difficult for vehicle owners to verify mileage information. In other words, the taxpayer is more likely to recall driving on a toll road if that toll road is mentioned by name rather than simply “toll road.”

29. This is a major reason why companies are only required to collect the retail sales taxes in states where they have a nexus or an economic presence.

30. This approach is supported by survey results from the Iowa pilots: more than 70 percent of participants favored the tax on VMT at the end of the pilot compared to only 42 percent at the beginning. It is possible that a GPS-based VMT will be more acceptable if drivers are comfortable with the tax on VMT itself.

31. Drivers covered approximately 3 trillion vehicle miles in 2010. At the same time, approximately $30 billion was credited to the HTF from the fuel tax and other excises during 2010. This figure excludes $14.7 billion in transfers from the General Fund account but includes other federal excises on vehicle sales and tire sales. These account for less than 10 percent of the balance in the HTF.

32. This amount is equivalent to the federal fuel taxes paid by the same household assuming an average fuel efficiency of 17.6 miles per gallon estimated by the Federal Highway Administration in 2010: $209 = (20,000 / 17.6) * 0.184.

33. Even if number of VMT remains constant, the level of complexity built into the tax rate structure is likely to lead to other types of distortions that increase the excess burden of the tax. For example, drivers may change the time of day and/or the route they travel in an effort to reduce their tax liability. To the extent that the tax leads to these types of behavioral changes, it will impose an excess burden on drivers that is over and above what they pay in taxes.

34. The study was conducted in 1997 and the numbers are projections for 2000. Pavement cost refers to the marginal cost of repairing the damage to the
interstate road surface caused by 1 mile of travel. The total marginal cost, which includes congestion, crashes, pollution, and noise costs, is much higher: 2.91 cents to 69.64 cents for automobiles and an 80,000-pound, five-axle truck, respectively. The user charge numbers here are a lower bound because they do not account for state and local user charges. Ozbay, Bartin, and Berechman (2001) find that the infrastructure marginal cost in New Jersey is 6.2 cents compared to a federal, state, and local combined user charge of 42.8 cents.

35. It is possible to include a surcharge for fuel efficiency in order to encourage drivers to switch to more fuel-efficient vehicles. We do not address carbon emissions here because it is an environmental policy issue that is outside the scope of the current article. The interested reader is directed to Greene (2011) for a description of how this feature can be incorporated into an energy tax on VMT.

36. Predicting the tax liability requires information on distance and the tax rate. Information on distance is fairly easy to obtain, so the main complication is the tax rate, which is likely to vary across taxing jurisdictions.

References


