

Revving up the Tax Engine: Gas Taxes and the DC Metro Area's Transportation Dilemma

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Issue Briefs are short reports designed to provide topical, timely information and analysis to a broad nontechnical audience.

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Peter Nelson, Kenneth Gillingham, and Elena Safirova

Introduction

The metropolitan Washington, DC area is consistently ranked as having some of the worst traffic congestion in the nation. According to one estimate, congestion in the region now causes over 200 million hours of delay each year.¹ Over the past 10 years, commuters have seen traffic conditions worsen significantly on heavily traveled roads like I-95 in Virginia and the Capital Beltway. This trend is expected to continue; the latest projections by the Metropolitan Washington Council of Governments show significant decreases in average vehicle speeds on roads across the region over the next 20 years.²

Following the recent defeat of a transportation funding referendum in Northern Virginia, the metropolitan Washington area remains at square one with respect to its ability to address its many transportation challenges. The shortfall is dire. According to a 2002 National Capital Region Transportation Planning Board (TPB) analysis, the region needs an additional \$1.74 billion per year³ (a budget increase of over 50%) to meet rehabilitation and expansion needs. The Northern Virginia referendum was expected to raise about \$140 million annually in its first years, less than 10 percent of the area's total shortfall.

But securing additional funds would only provide a partial solution to the gridlock. Future investment in roads and mass transit is not likely to be sufficient to keep traffic congestion from getting worse. Even if unlimited funds were available, factors such as land scarcity in the urban core and local opposition to new roads will prevent transportation capacity from keeping pace with population growth. Furthermore, in an era of fiscal constraint, some increased congestion might be an acceptable tradeoff for other uses for public funds, such as education or social services.

This is the first of a series of issue briefs by researchers at Resources for the Future that will explore different policy options for raising the revenue needed to address the region's

¹ Texas Transportation Institute (2001)

² National Capital Region Transportation Planning Board (2001)

³ National Capital Region Transportation Planning Board, 2002. "The Region: Focusing on the Here and Now: Transportation Priorities for the Immediate Future," Vol. 41.

transportation needs. The focus will be on measures that not only raise money, but also influence driver behavior. This issue brief will analyze a traditional method of raising transportation revenue—the gasoline tax. Subsequent analyses will focus on other revenue-raising options, including 1) road pricing, 2) a cordon pricing scheme similar to the one currently utilized in London, and 3) an area-wide parking tax.

The Declining Power of the Gasoline Tax

The central role of the gasoline tax in transportation funding reflects a long-standing tradition in the United States of relying on user fees to pay for transportation infrastructure. Although in recent years states and localities have begun to shift toward non-user fees such as general issue bonds and sales taxes, the gas tax still accounts for a fairly large share of state revenues devoted to highways (40% in Maryland, 32% in Virginia, and 25% in the District).⁴

Currently, the federal gasoline tax is 18.4 cents per gallon. On top of this amount, drivers pay state gasoline taxes. Maryland's gas tax is now 23.5 cents per gallon, Virginia's is 17.5 cents, and the District's is 20 cents. Thus, the average gasoline tax (federal and state combined) for the region is close to 40 cents per gallon.

For the most part, area jurisdictions have been reluctant to increase their fuel taxes to keep pace with inflation. Virginia's last increase was in 1987, while the District and Maryland last raised gas taxes in 1992. Because of the failure of nominal taxes to keep pace with inflation, the real tax revenue received by the state from each gallon of gas sold has eroded over time. The changes in state and federal taxes on gasoline from 1957 to 2002 in real terms are shown in Table 1.⁵

Table 1
Combined state and federal taxes on gasoline from 1957 to 2002

Jurisdiction	1957 gas tax (cents per gallon)	1957 gas tax (cents per gallon in 2002 dollars)	2002 gas tax (cents per gallon)	Percentage change in real terms 1957–2002
DC	9.0	49.0	38.4	-21.6%
Maryland	9.0	49.0	41.9	-14.4
Virginia	9.0	49.0	35.9	-26.7

Looking at revenue per gallon of gas sold, however, only tells part of the story. Of greater interest is the amount of revenue received per mile driven. Miles, after all, are probably

⁴ Highway Statistics 2001, Table SF-1

⁵ Surface Transportation Policy Project. Measuring Up: The Trend Toward Voter Approved Transportation Funding, Table 1, page 14, <http://www.transact.org/report.asp?id=201>

more closely related to revenue needs than is fuel use. Over time, the fuel economy of the vehicle fleet has improved markedly. Increased fuel economy means that drivers can travel farther on a gallon of gas, thus lowering the revenue raised per mile of travel. Table 2 shows the changes in the real revenue (federal and state combined) per mile driven from 1957 to 2002 for all three jurisdictions.⁶

Table 2
Combined state and federal tax revenue raised per mile driven from 1957 to 2002

Jurisdiction	1957 revenue (cents per mile)	1957 revenue (cents per mile in 2002 dollars)	2002 revenue (cents per mile)	Percentage change in real terms 1957-2002
DC	0.7	3.8	2.3	-38.4%
Maryland	0.7	3.8	2.5	-32.8
Virginia	0.7	3.8	2.2	-42.4

A New Gasoline Tax: Revving the Tax Engine

To restore the total per-mile gasoline tax to its 1957 level would require an increase of over 50 percent, or about 25 cents per gallon.⁷ This would raise a substantial amount of money—about \$600 million annually in the region. In comparison, raising a similar amount of money from a sales tax would only require a modest rate increase.

The recent referendum in Northern Virginia provides a pertinent example. The referendum was expected to produce \$140 million annually in its first years from a half-cent (11%) increase in the sales tax rate. To raise a similar amount of revenue, the gas tax in Northern Virginia would have to be raised by 15 cents per gallon⁸ (an 86% increase in the state tax or 42% increase in the combined state and federal taxes). The contrast in rates brings into focus one of the important disadvantages of the gasoline tax: its narrow base. Narrow-based taxes are not particularly efficient revenue-raising, and they are also quite unpopular because they are highly visible to the public.

Compared to gasoline taxes, however, sales taxes suffer from a very serious disadvantage; they depart from the user-fee principle that those who benefit from the investments

⁶ The real revenue is computed based on the data from Energy Information Agency, Department of Energy. 2001. "Annual Energy Review 2001," Table 2-9, <http://www.eia.doe.gov/emeu/aer/enduse.html>.

⁷ 25 cents per gallon is the amount required to return revenue per mile to its 1957 levels (in 2002 dollars): 3.8 cents per mile.

⁸ Author's calculations based on data from the Northern Virginia Transportation Coordinating Council's "2020 Transportation Plan Summary Report" (1999) and the Northern Virginia Transportation Alliance (2002)

should be the ones who pay. Worse, they fail entirely to correct for the social costs imposed by motor vehicle operation in the form of increased traffic congestion, air pollution, carbon dioxide emissions, and potential automotive accidents.⁹ Since gasoline taxes vary according to vehicle use, these taxes do, in part at least, correct for social costs by collecting from those who impose them. They also tend to reduce those costs by providing an incentive to drive less and buy more fuel-efficient vehicles.

However, the gas tax is for several reasons an imperfect method for addressing the social costs of driving. First, many of these costs, such as road costs, are much more closely related to vehicle miles traveled than they are to fuel consumption. Differences in fuel efficiency among vehicles mean that drivers of gas guzzlers will pay more in taxes even if they impose the same social costs as other drivers. A tax on vehicle miles traveled rather than on gasoline would perform better on this score.

Secondly, the magnitude of congestion and accident externalities depends greatly on where they occur. For example, a vehicle mile traveled in the outer suburbs produces much less congestion than a vehicle mile traveled inside the urban core. Such location-specific distinctions are lost with a gasoline tax, which affects drivers solely based on their VMT and the fuel efficiency of their vehicles.

Third, individuals respond to higher gas prices by reducing their fuel consumption by both driving less and, in the long term, buying more fuel-efficient cars. Thus, only a portion of the resulting drop in fuel consumption in the long term is due to decreased driving. Both effects have a positive environmental benefit—reduced air pollution and carbon dioxide emissions—but only a reduction in driving actually addresses congestion.

Taking social costs and the efficiency of the tax system into account, Ian Parry and Kenneth Small's central estimate of the optimal gasoline tax for the United States is \$1.01 per gallon (federal and local combined). This is significantly higher than current levels in the Washington area of about 40 cents. In fact, because Parry and Small's estimate is for the United States as a whole, the optimal tax for the Washington region is likely to be substantially higher because of the area's high levels of congestion and relatively poor air quality.

A gasoline tax much lower than this could still achieve substantial benefits, however. For the remainder of this brief, we examine the properties of a gasoline tax increase of 25 cents per gallon. While this seems like a substantial increase, it would simply restore the gasoline tax to its 1957 inflation- and mileage-adjusted levels. To analyze the impacts of such a tax increase, we utilize a transportation policy simulation tool developed by RFF researchers and applied to the Washington metropolitan area.

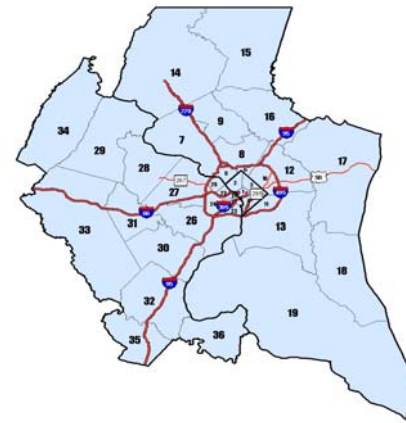
⁹ There is a very large body of literature on the social costs of driving; for references and a review, see Harrington and McConnell (2003) or Parry and Small (2001).

The Washington START model

To analyze the impact of raising gasoline taxes in the Washington region, we use the Washington-START model.¹⁰ The major advantage of the START model over other commonly used transportation models (such as the Council of Governments' Version 2 model) is its detailed treatment of transportation demand. Unlike these other models, transportation decisions are modeled in a consistent economic framework to help us gauge the overall effect of the policy on the well-being of area residents.

The Washington model has eight household types (broken out along income and car ownership status). A different time value is assigned to each of the income groups, reflecting their different demands for time savings. In addition, there are six trip types, five travel modes (single-occupancy vehicle (SOV), high-occupancy vehicle (HOV), bus, rail, and walk/bike), and three times of day.

As a tradeoff for the detailed modeling of demand, transportation supply (road and transit networks) is modeled in less detail. The model has 40 zones, each with three stylized links (inbound, outbound, and circumferential). In addition, there are a number of "special links" representing segments of freeways and bridges. Two mass transit modes, rail and bus, are modeled.



The model's structure makes it straightforward to examine a wide range of transportation demand management policies, such as road pricing, cordon pricing, HOT lanes, and parking fees and supply restrictions.

A 25 Cents-per-Gallon Tax on Gasoline in the Washington Area

For this simulation, we restore the total per-mile gasoline tax to its 1957 level through an increase of 25 cents per gallon. This places the combined federal and regional gas taxes at about 65 cents per gallon, still well below Parry and Small's optimal tax of \$1.01. The increase raises an additional \$734 million per year in revenue, based on an average regional fuel efficiency of 18.5 miles per gallon. Because we impose this tax on an area larger than the Washington region, the actual amount raised for investment in the DC area is slightly lower: approximately

¹⁰The Washington-START model was developed by Resources for the Future using MVA Consultancy's START modeling suite. The Washington-START model is the first application of START in North America. However, it has been widely used in the United Kingdom, with applications in Birmingham, Edinburgh, Bristol, and the southeast of England. See Croombe et al. (1997) and May et al. (1992).

\$600 million, or about a third of the revenue that the Transportation Planning Board says it needs. The policy also has the following effects on travel behavior:

- **A negligible effect on the total number of trips taken.** Total trips fall by just 33,000 from a base of over 22 million (a decrease of just 0.15%). This reflects the fact that most trips are made for good reasons (work, shopping, personal errands, and so forth). Policies like a gas tax hike have relatively little influence on the need for these trips. Instead, they affect choices like the length of the trip and the mode of travel.
- **A noticeable shift away from solo driving.** Daily single occupancy vehicle (SOV) trips drop by over 220,000 from the base, a decline of over 2 percent. The bulk of the shift is to carpooling. HOV trips rise by 130,000 (about 1.4%). Nonmotorized trips increase by a relatively small amount in absolute terms, although the increase is higher in percentage terms because these trips accounted for a small share of the base. There is a relatively small shift toward mass transit (only 6,000 additional trips).¹¹ The net effect of all these changes is a reduction of about 160,000 daily car trips (slightly over 1%).
- **Drivers take shorter trips.** The total vehicle miles traveled falls by an even larger percentage than vehicle trips. Daily VMT decreases by about 3.9 million, or 2.5 percent. This is due in part to the mode shifts discussed above, but also to a decrease in average vehicle trip length from 9.6 miles per trip to 9.4 miles.
- **Poorer households are more responsive to the gas tax.** Single occupancy vehicle trips by the lowest income group fall by almost 5 percent, with large increases in carpooling and transit usage. VMT by this group drops by over 5 percent. In contrast, solo driving and VMT by the wealthiest households fall less than 1 percent. Interestingly, wealthier households use public transit less following the increase in the gas tax. One possible reason for this is that the gas tax improves traffic flow on heavily traveled roads, making driving a more attractive option for those who can afford to pay the tax.
- **A small but noticeable increase in speeds on the most congested roads.** For example, some of the worst congestion in the DC area occurs on the inner loop of the Capital Beltway between the American Legion Bridge and I-66 during the morning rush. The imposition of the gas tax raises average speeds along this stretch from 36.8 miles per hour to 37.2 mph. Other congested sections (for example, the Wilson Bridge) experience similar increases. These may appear to be fairly small increases, but small changes in mean speeds can mask more significant changes, such as a reduction in the portion of morning rush hour spent in stop-and-go conditions.

¹¹ Note that transit capacity is held constant in this simulation to isolate the effects of the gas tax. If the gas tax revenue were used to increase transit capacity, the shift to transit could be more significant.

- **Trip times fall.** The time savings for the entire region are about 7.5 million hours a year (or a little over 80 minutes per person). The bulk of the savings is due to decreased congestion on the roads. However, some of the improvement is due to shorter parking search times in the urban core. The average per car trip travel time (18 minutes, 10 seconds) falls by about 14 seconds.

Examining Costs and Benefits of the Policy

The gas tax policy imposes higher costs on drivers for car trips. In addition to the out-of-pocket costs, those who switch modes of transportation and/or make shorter trips also “pay” in terms of forgoing their preferred driving option. Offsetting these costs are the improved traffic flows and consequent time savings along congested routes.

One of the most attractive features of the Washington-START model is its ability to analyze these costs and benefits comprehensively and in a manner that is consistent with economic theory. Drivers pay an additional amount in direct costs (the tax) and may also experience positive or negative travel-related changes. Positive travel-related changes are essentially improved traffic flows. Negative changes encompass such things as the adjustment costs of switching modes or increased crowding on the transit network.

This framework allows us to examine the policy from both the societal perspective and the traveler’s perspective. The societal perspective can be seen in Table 3 and is useful to examine the general efficiency of the gas tax policy. The traveler’s perspective is presented in Table 4 and provides insight into the distributional consequences.

From the societal perspective, the government gains \$734 million per year in additional revenue. However, this is merely a transfer between travelers and the government and, from an efficiency perspective, it is treated as neither a cost nor a benefit. Accompanying this transfer of funds are travel-related improvements valued at \$249 million. In other words, travelers transfer \$734 million to the government, but perceive a welfare loss of just \$485 million. Hence, nearly a third of what travelers pay to the government (\$249 million) is offset by travel-related benefits, such as reduced car trip times. These travel-related benefits are the net gain to society resulting from the policy.

Revenue raised	Welfare change (loss) To travelers	Net welfare gain to society (travel-related benefits)
734	-485	249

However, looking at aggregate benefits tells only part of the story. Because of concerns that the gas tax may disproportionately burden lower income drivers, information on the distributional aspects of the policy is also important. To assess the distributional aspects of the policy, it is most illustrative to approach the welfare analysis from the traveler's perspective. From the point of view of individual groups, transfer payments (taxes) count as costs and benefits. Table 4 presents the tax burden and welfare changes for different income quartiles, in the way travelers perceive them.

Quartile	Amount paid by travelers and percent of total		Travel-related welfare benefits/losses	Welfare change (loss) to travelers
1	-\$141	19.2%	-\$18	-\$159
2	-156	21.2	4	-152
3	-222	30.2	55	-167
4	-215	29.4	208	-7
Total	-734	100	249	-485

As shown in Table 4, the upper half of the income distribution (quartiles 3 and 4 combined) generates about 60 percent of the total additional tax revenue. But an examination of to whom the benefits of the policy accrue reveals an interesting picture. To begin with, look at the policy from the perspective of travelers in the top income quartile. The top income quartile pays \$215 million a year to the government, or nearly 30 percent of the total gas tax revenue. At the same time, the wealthiest quartile receives \$208 million in travel-related benefits. These considerable benefits primarily come from reduced congestion and the high value that the wealthiest quartile places on faster trip times. Thus, regardless of what the government does with the revenue, after paying \$215 million, the wealthiest income group only loses \$7 million in welfare. Hypothetically, if the government returned the \$215 million back to the top income group in a lump-sum payment, the top quartile would receive \$208 million in net benefits.

The lowest quartile presents a very different story. Travelers in the lowest quartile pay the government \$141 million per year, but actually have a negative travel-related welfare change. This welfare loss results primarily because travelers from the lowest income group value trip time improvements less than higher-income travelers and suffer from increased crowding on transit networks under a gas tax policy. Thus, the total welfare loss to travelers in the lowest income group before government revenue is distributed totals \$159 million. In the hypothetical case where the government returns exactly \$141 million in a lump-sum payment to the lowest income group, this group would lose \$18 million. The middle two quartiles receive travel-related benefits in between the two extremes of the top and bottom quartiles.

A striking result is that travelers in the top quartile receive almost 80 percent of the aggregate travel-related benefits. These distributional consequences of a gas tax do not necessarily call into question the equity of a gasoline tax. Rather, they provide some justification for targeting a portion of the revenues from a gas tax increase to transportation investments or other programs that benefit lower-income households. Because low-income travelers value time savings less, they receive much less benefit from the improved traffic flows that are a consequence of the higher gas taxes.

Once the likely uses of the revenues are considered, however, the fairness issue would appear to be mitigated. The Washington area, like many large metropolitan areas, devotes a considerable share of its transportation budget (52%) to mass transit. Because lower-income travelers account for a large portion of transit ridership, the likely pattern of future investment will offset many of the regressive aspects of the gasoline tax. Of course, there would still be winners and losers of such a policy, particularly geographically, as most transit service is located in the inner urban core, while much of the driving (even by the lowest-income group) occurs in the suburbs and surrounding metro area. This underscores the notion that how the revenue is spent is significant in determining who ultimately wins and loses from a policy. It is also important to consider that the changes in travel behavior that result from the public spending of the tax revenue are at least as large as the changes that result from the taxes themselves (although perhaps more localized).

Cost-benefit analysis is frequently criticized for giving too much weight to the interests of higher-income groups. However, as this analysis demonstrates, even if such complaints are valid with respect to measures of aggregate welfare changes, appropriate sub-group analyses can illuminate not only who wins and who loses from various policies, but also how potential inequities could be redressed.

Conclusion

A gas tax increase of the magnitude analyzed here would only cover a portion of the additional revenue the Washington area's Transportation Planning Board says that it needs. Furthermore, raising the gasoline tax by this amount may not seem politically plausible. But a tax increase of 25 cents per gallon would return the real per mile tax to its approximate 1957 levels and improve traffic flows throughout the region. These traffic flow benefits will be experienced mainly by upper-income drivers, a fact that should be considered when determining how the additional revenue will be used.

Further Reading

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