Effectiveness and Equity of Future Transportation Financing Options in the U.S.

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Abstract

As vehicle fuel-efficiency and alternative-fuel vehicle sales increase, fuel taxes, without major rate increases, are unlikely to generate the revenue needed to maintain, operate, and grow the extensive surface transportation system in the U.S. With the expiration of SAFETEA-LU at hand, the current U.S. administration faces tough choices regarding how to ensure with a new surface transportation authorization that the surface transportation system is efficient, equitable, and sustainable. The objective of this research is to identify the most effective and equitable portfolio of revenue policies for achieving these revenue goals at the federal and state levels. Our revenue forecasts under various financing options (increased fuel taxes, and vehicle mileage fees) take into account users' responses to policy changes, recognizing that revenue is a function of both tax rates and behavior.

It is the recommendation of the American Association of State Highway Transportation Officials and the Transportation Research Board that in the interim the federal gasoline tax is increased 10 cents to ensure the Highway Trust Fund is able to continue to pay out its obligations. Two expert groups recently commissioned by the U.S. Congress both recommend gas tax rate increase as a short-term solution, and vehicle mileage fee as a long-term solution to the transportation financing problem in the U.S. This paper analyzes the revenue and distributional affects (by region, state, income, age, gender, ethnicity etc.) of these proposed transportation financing policy scenarios. The hope is that a better understanding of how various population groups and agencies are affected will lead to the selection of a U.S. transportation financing policy that achieves the best balance between revenue and equity goals.

1. Introduction

Spending to operate, maintain and develop the highway system and road networks in the United States has exceeded Highway Trust Fund (HTF) receipts in recent years and threatens insolvency of the Fund. The HTF is set up as a pay-as-you-go system in that the users generate the funding to maintain and improve the highway system through a structure of taxes applied to the user. A series of surface transportation acts have authorized the use of a federal consumption tax on fuel, the topic of this paper.

State and federal fuel taxes generated about 1/3 of the total revenue in 2001 to fund highway spending (Puentes 2003); however at the federal level, the gas tax constitutes about 60 percent of HTF revenues (Puentes 2003). Since the HTF is not as diversified as all levels of road and transit spending, it is all the more dependent upon the revenue generated by fuel taxes. The Federal Gas Tax rate is currently set at 18.4 cents per gallon and has not changed since 1993. When considering inflation, the current purchasing power in 2009 of this tax is 35 percent less than it was in 1993. Please refer to Chart 1 in Appendix A for more information about the breakdown of how the gas tax is distributed.

We are not only faced with inflation depreciating the purchasing power of the gas tax but potentially less revenue generation because VMT and fuel consumption may not increase at the same rate. In a time when the United States is trying to become less dependent on foreign oil and decrease greenhouse gas emissions, there is a big push to increase corporate average fuel economy standards (CAFE). As CAFE standards increase, the HTF may find itself in a disadvantageous situation where, for example; households are driving the same annual VMT or more but are consuming less fuel, therefore, revenues may decrease while the need for revenue will continue to increase. As vehicles are continually driven and become more fuel efficient and eventually electrically powered, the gas tax will become less and less effective.

When predicting revenue generation of a consumption tax, changes in demand must be considered. Gas tax revenue is a function of both vehicle miles traveled (VMT) and vehicle fuel efficiency. Because total revenue is a function of not only the tax rate but also consumer behavior, if there is demand elasticity associated with the price of gasoline, as the price of gasoline becomes more expensive, households may adjust to the change in price by driving less. The degree to which this occurs depends on several variables considered within our model that were selected to reflect a household's unique sensitivity to changes in the price of fuel. This point also introduces issues of equity and fairness given that each household will change their behavior based on their unique circumstances.

What is the solution to preventing insolvency of the HTF? There are longer-term solutions (e.g. distance-based VMT fees) that will take time to implement due to policy and engineering constraints. There are short-term solutions (e.g. increasing the gas tax) that could alleviate some concerns immediately and buy more time for the implementation of long-term solutions to be prudently planned and phased into place. For this paper we develop a model to evaluate both short- and long-term solutions. Other finance mechanisms to charge users must be fully considered and evaluated to determine effectiveness and fairness.

2. Brief History of Transportation Financing in the U.S.

The Congressional Budget Office (CBO) has made astute observations over the past few decades regarding the potency of the Highway Trust Fund and its ability to provide funding to not only complete the highway system but to maintain it as well. The CBO Interstate Highway System – Issues and Options Reports provide an ominous picture of accumulating repairs, escalating construction costs, and declining revenue sources as vehicles become more fuel efficient. These reports continuously identify these problems over time as "major problems." The first report was written in 1982. Substantial headway has not been made to alleviate concerns. Highway Trust Fund Revenues are still not sufficient enough to support program spending and the fund now faces a near-term insolvency crisis.

Two commissions were created by congress under the Safe, Accountable, Flexible, Efficient Transportation Equity Act – a Legacy of Users (SAFETEA-LU): the National Surface Transportation Policy and Revenue Study Commission (from now on referred to as the Policy Commission) and the National Surface Transportation Infrastructure Financing Commission (from now on referred to as the Finance Commission). The Policy Commission focused on how investments should be prioritized and delivered. The Finance Commission focused on how revenues should be raised. Both commissions were created because it is of national interest to preserve and develop our surface transportation system to meet the growing demands of the 21st century.

The Finance Commission addressed the question: how much revenue is needed? Determining investment requirements is based largely upon addressing current needs and determining the future demands of the system. The travel demand growth rate has exceeded the population growth rate in part due to a shift to single occupant vehicles, and also due to increases in trip making, trip length, and a switch to the auto from other modes of transportation. Predicting future demand involves not only projecting current VMT demands but also how the aforementioned trends will evolve.

The deterioration of our system is not only a result of under investing but also a result of being underpriced. Using basic economic theory, when something is undervalued and provided at a price less than the true value of its cost, the demand will exceed the supply and what results is a shortage. In the case of our highway system, a shortage manifests as congestion (9). Congestion has a large negative impact on our personal lives, security, and economy including lost time, long queues, and wasted fuel.

A report developed by the American Association of State Highway and Transportation Officials (AASHTO) called The Bottom Line Technical Report: Highway and Public Transportation Nation and State Investment Needs approaches investment needs by first acknowledging that there are many challenges the nation currently faces in investing in its infrastructure. Challenges such as declining revenue at all levels of government, higher costs of capital construction, higher fuel costs, internal competitiveness and an overall weak economy are just a few that prove make the current authorization cycle particularly challenging.

The Bottom Line Report predicts the needed spending per year based on two scenarios. The first scenario is a 1.4% annual growth rate. The first scenario would require an investment of $166.8 billion (2006 dollars) a year from all levels of government to close the investment gap for highways and bridges. The second scenario considered is a VMT growth of just 1% mirroring the population growth rate. The second scenario would require an annual investment of $132.4 billion (2006 dollars) per year from all levels of government to close the gap. Considering inflation, those values are $186.6 billion and $148.1 billion (in 2008 dollars) respectively. Please refer to Figure 1 in Appendix B for a depiction of the projected funding gap.

An important baseline to consider is to maintain the current physical condition and performance of the system. While this is not a useful goal for an underperforming system, it establishes the minimum investment required to prevent further degradation. The value determined in the AASHTO report for this baseline condition is $93.3 billion per year. The current level of spending is $68 billion per year. These projections only consider investment in highways and bridges. There is no consideration for public transit which is also funded by fuel taxes through the HTF.

The fact of the matter is that even with a projection of no growth and constant travel demand; there is still a lot to be gained from increased highway capital investment. Current backlogged investments reached $430 billion in 2006, 80% of which are in urban areas. Capacity deficiencies account for roughly 58% of the backlog. Even since 2006 the backlog has gotten considerably higher, estimated to be about $488 billion today (2006 dollars).

The Final Report of the Policy Commission takes a look at several options from both a short term and long term perspective. Admitting that alternatives to the gas tax must be considered down the road, the federal gas tax is currently an attractive source of revenue. The Policy Commission lists 4 reasons: 1) low administrative and compliance costs, 2) ability to generate substantial amounts of revenue, 3) relative stability and predictability, and 4) ease of implementation. They recommend indexing the tax to inflation in order to protect the purchasing power of the tax.

After reviewing many alternatives, the Finance Commission, with support from Transportation Research Board (TRB) and AASHTO studies, concluded that the consensus choice for a federal funding system in the future, based on "user pay" charges is the distance-based, VMT fee. However, they suggest this to be a medium to long-term solution as there are many physical and political barriers that would require time to implement a mileage-based user fee system and the Finance Commission doesn't expect a full implementation until the year 2020.

In the meantime the Finance Commission, and the Policy Commission's assertion of the attractiveness of the current mechanisms of the federal gas tax, makes such recommendations as to increase the current federal gasoline tax 10 cents to $0.284 per gallon. To supplement the increase in the gasoline tax, the Finance Commission also recommends increasing the federal tax on diesel fuel $0.15 per gallon and additionally double the Heavy Vehicle Use Tax considering it has not increased since 1984. The Finance Commission predicts an increase in the federal gas tax will cost households an additional .5 cents more per vehicle mile traveled, $5 a month for each vehicle and $9 a month for each household. These calculations are based on the following statistics: 1.89 vehicles per household, 11,818 miles driven per vehicle, and 20.4 average MPG fuel consumption (National Surface Transportation Infrastructure Financing Commission 2009).

3. Literature Review: Considering Efficiency and Fairness

Optimal solutions for road pricing need to be both economically efficient and equitable. The current pricing mechanism of fuel tax is not optimal since it does not reflect many of the factors that affect vehicle costs (Litman 1999). The gas tax is the most commonly used distance-based user tax (Litman 1999). The gas tax is also the simplest of all regulatory measures (Truelove 2008). One study suggests that evaluating equity based on a percent of total expenditures rather than income provides a different, a more equitable perspective on the distribution of costs and benefits of a fuel tax (Poterba 1991). Despite arguments that the gas tax is more equitable, that is neither here nor there when considering economic efficiency. “While policymakers generally consider [the current financing mechanism] fuel taxes to be a reasonable proxy for user fees, it is actually a poor proxy for the actual value of transportation services and resources” (Ungemah 2007).

One of Litman’s explanations for the current market’s overall inefficiency is that vehicle-based transportation is underpriced. While conceding that low transportation costs can increase economic efficiency and productivity, underpricing transport costs actually increase total transport costs (Litman 1999). He argues underpricing may seem beneficial in the short-term, but in the long term it creates more vehicle dependency, consequentially reducing the overall efficiency of travel modes and increasing total travel costs. The current pricing scheme does not properly incentivize drivers to drive less and give alternative modes of transportation much consideration because driving is underpriced.

A major concern with increasing the price of driving is that this is considered inequitable by many politicians. Equitability is a major hurtle to public and political acceptance of increasing or changing road usage taxes. “It is necessary to consider both efficiency and equity in the evaluation of public sector investments” (Levinson 2002). Levinson acknowledges that “Transportation Engineers are taught to provide for the safe and efficient movement of people and goods. They are not taught to ensure that transportation systems are equitable.”

Looking at two, well established, industrialized countries: one has a fuel tax of $.40 per gallon (2001 USD, the United States) and one has a fuel tax of $2.80 per gallon (2001 USD, the United Kingdom) – which country has the right gas tax (Parry 2010)? Under the authors’ assumptions, they determine the optimal tax for each country to be $1.01 for the US, more than twice the current tax rate, and $1.34 for the U.K., slightly less than half of the current fuel tax. It looks like neither country has the right tax but due to political constraints neither country expects that to change in the near future. Using simulation, the paper did determine that both countries, by converting their current fuel tax system to a more efficient VMT fee system, would see welfare gains.

We can look at previous projects and learn from their successes and failures. Hong Kong was the first to test the viability of Electronic Road Pricing; including, the technology, economic efficiency, and administration (Ison 2005). It is stressed that the scheme design is extremely important. Pointing out the reason why Hong Kong was not successful was a failure in the scheme that prompted insecurities about invasion of privacy. The technology used actually mollified drivers fears but the attempt at road pricing was not successful. Again invasion of privacy and lack of openness and trust was the predominant reason for failure in Cambridge. The success of road pricing in London can largely be attributed to Ken Livingston who acted as a political champion in introducing road pricing to the city of London.

A study was conducted at the University of Oregon as part of the Road User Fee Task Force (FURTF) to estimate the distributional impacts for a VMT fee program, at the time, to be administered in the state of Oregon. The RUFTF were looking for policy recommendations. There were concerns about equity, particularly with households in rural from switching to a state gasoline tax to a VMT fee. What the study found was that, in the short run, households in rural areas actually benefited more from a flat VMT fee than households in urban areas (Zhang 2009). This is thought to be from rural households owning vehicles with lower fuel efficiency standards.

The Oregon Pilot Program was conducted from April of 2006 to April of 2007. There were 285 equipped vehicles, 299 volunteer drivers, and 2 service stations that were able to charge the VMT fee. Once the program concluded, the RUFTF found that many of the common beliefs that are regarded to as obstacles were not actual but merely perceived; for example, invasion of privacy, potential for tax evasion, and administrative costs to name just a few (Whitty 2007). While the RUFTF and the Oregon DOT considers the project a success it is admittedly a small population sample and small area. A larger study must be conducted.

Many researchers have emphasized the importance of clear objectives in presenting an alternative pricing mechanism. It may prove to be a difficult case explaining to the public that in order to achieve maximum efficiency in the provision of a scarce good; the good must be priced using marginal cost pricing (Viegas 2001). Viegas recommends easy-to-understand terms that could serve as targets for mobility managers; i.e. increasing the level-of-service. Researchers also have warned against any drastic changes that may disrupt existing balances, believing that changes should occur gradually (Truelove 2008).

4. Data and Model

The dataset we used to perform our analysis is the 2001 National Household Travel Survey (NHTS); the most recent nationwide travel survey that captures driver and household characteristics that was accessible during our analysis. To perform our analysis we needed to create a model that would predict how drivers within a household would react to changes in tax policy. We developed a multiple regression model with interaction variables to allow for the heterogeneous demand responses to policy changes. The dependent variable is measured as the natural log of total household VMT. For the continuous independent variables, we took the natural log except those where zero was a possible answer; for example, number of children – this was treated as simply a continuous variable.

Only households that were surveyed in the National survey and households with complete information were used within our model. Each characteristic identified in the survey was considered as to whether or not it would contribute to the accuracy of developing our vehicle miles traveled (VMT) demand model. The dataset was reduced to the variables that would influence VMT in theory, and then were further scrutinized for political relevancy and statistical significance.

Caution was taken to avoid multicollinearity and causality. Variables that are highly correlated and are used in the same model will display a false depiction of their contribution to the results of the model and this can be easily misinterpreted. In the case of causality, variables that seemingly contribute to the prediction of the dependent variable can create false predictions; changes in these variables may not actually cause changes to the dependent variable. For example; higher levels of education reported at households also reported higher VMT. It's not actually the higher level of education that causes households to drive more, but a higher level of education results with households earning higher income and higher income makes household less sensitive to changes in the price of fuel. Households that have higher education also have fewer children which make them less sensitive to changes in the price of fuel. For our model we do not use household education as a variable.

Our resulting model uses 16,288 households from 35 states and includes 22 independent variables capturing 17 household characteristics. Of the variables used, 9 were dummy variables and 2 were interaction variables. The R-squared value for the model was 0.6997 and the adjusted R-squared value was .6993. Please refer to Table 1 for all of the variables used in the linear regression model, the variable type, coefficient value, T-value and statistical significance.

Explanation of Variables Used:

"Fuel_cost_per_mile" is a weighted average of each individual household's fuel efficiency divided into each household's fuel cost per gallon (dependent upon the state they live in) to give a unit of fuel cost per mile in USD. "Income" represents the total annual household income in USD. "Veh_count" is the total number of vehicles owned by each individual household. "Substitute" indicates that a household owns more than one vehicle and of different fuel efficiencies providing them with the ability to substitute driving one for the other. "Male_respondent" indicates the person who answered the phone is male. "Worker_count" represents the number of workers living in the household. Similarly "driver_" and "children_count" represent the number of drivers and children living in the household. Three dummy variables are used to identify the respondent's ethnicity as being African American, Asian, or Hispanic. If neither of these ethnicities are indicated, the household is represented by a group of all other races including Caucasian and several small ethnic groups that were not represented by a large number of survey participants (e.g. Native American). "Resp_age_16-35"or "_36-64" indicates which age group the respondent representing the household is in. If neither of these groups is indicated within the survey, the respondent is 64+ years old. "Pop_density" is the density of the population or population per square mile. We took the ratio of housing density or housing units per square mile, to worker density or workers per square mile. The "MSA_cat-1," "-2," and "-3" represent Metropolitan Statistical Areas (MSA) identified as category 1, an MSA with a population greater than 1,000,000 people with access to rail; category 2, an MSA with a population greater than 1,000,000 people without access to rail; and category 3, an MSA with population less than 1,000,000 people. If the household did not indicate any of these categories, then the household is not in an MSA. The last variable is "hh_public_transit_trips_per _day," indicating the average number of public transit trips for each household taken by all household members.

This model is a short run analysis and therefore some variables are held constant. For example, individual households do not have the ability to change vehicle ownership, the veh_count variable remains constant. However; individual households do have the ability to substitute driving a less fuel efficient vehicle with a more fuel efficient vehicle if the vehicle is already in the household's possession, lessening the impact of the increase in tax. The only variable that is changed for this policy analysis is the fuel cost per mile for individual households.

The use of interaction-variables allows for an independent variable to behave differently when the independent variable they are interacting with changes. For this model, we use two interaction variables with the price of fuel: one variable that will interact with fuel price is the dummy variable, substitute and the other is household income. What these interaction variables imply is that sensitivity to the price of fuel is different when incomes are different or if the household has the option to substitute driving between multiple vehicle types. The variable with the lowest significance is the ratio of housing density to worker density. This variable was used to capture the opportunity for a household to work and live in the same neighborhood.

Interpreting the coefficients:

Continuous variables
Example – Children_count: All other things being equal, compared to a no-child household, a one-child household drives 4.1% ($e^{0.040\times1}/e^{0.040\times0} - 1$) more VMT, and a four-children household drives 17.4% more ($e^{0.040\times4}/e^{0.040\times0} - 1$).

Natural Log of a continuous variable
Example – Ln(pop_density): All other things being equal, a one-percent increase in population density in the census tract/group where the household resides will lead to 0.065% reduction in household VMT.

Dummy Variables
Example – Resp_age_16_35: all other things equal, a young household headed by someone between 16 and 35 years old drives 33.0% or ($e^{0.285}$- 1) more than a senior household headed by someone who is over 65 years old (the reference age group).

The fuel-cost-per-mile variable and the two interaction variables make the demand elasticity of fuel with respect to the price of fuel. The sensitivity to changes in the price of fuel ranges from -2.17 for a high sensitivity to changes in the price of gasoline, to -0.36 for households that are not very sensitive to price changes. This indicated highest-sensitivity households would drive 2.17% less, while lowest-sensitivity households would reduce driving by .36%, if fuel prices were increased 1% and all other variables were held constant. Households that have high sensitivity are low income households with no option to substitute driving between vehicles, while households that have low sensitivity are high income households with the option to substitute driving.

Variables such as the number of drivers per household, children, and workers were predicted to be factors that would increase the number of vehicle miles traveled. Testing variables found that certain ethnic groups such as Asian (more) and Hispanic (less) households drove significantly different VMTs than other ethnically defined households. In addition Asian and Hispanic households are more sensitive to changes in tax policy. Age group dummy variables were introduced to represent at what stage in life the household was in. Both age group dummy variables were found to drive more than households that would be at or near retirement. The different age groups also showed to be more or less sensitive to changes in tax policy. All of these sensitivities will be further discussed in the following “Policy Scenarios” section.

Total actual household annual vehicle miles traveled was a household attribute provided in the survey. The total estimated annual household vehicle miles traveled was calculated using the model and then compared to the value reported in the survey. The total VMT of all the 16,288 households estimated by the model was about 3% less than the summation of the VMTs reported by individual households in the survey.

5. Effectiveness and Equity of Future Financing Options

Different policy scenarios were applied to the model to estimate changes in behavior and consequently estimate more accurately the tax revenue that would be generated by the policy change. To measure distributional impacts, we looked at change in consumer surplus, change in total revenue/payment, and change in total welfare as they relate to the household's income, location, age, and ethnicity. Please refer to table 3: Income Demographics, to see the distribution of households throughout the different income groups used within our model. Household characteristics such as income, ethnicity and age group were examined, permitting us to determine which classifications within these characteristics were the most and least affected by these policy changes. Also regional impacts were considered acknowledging that land use patterns and income distribution vary throughout the country. Since not all states are represented in our survey, we looked at regional impacts and variations rather than state impacts and variations (At TRB, several state officials approached me about the state-level impact. It might be good to show the impact on the states for which we have data. The results on state-level revenue and user impact may be presented on a map, e.g. states that benefit a lot is shown in darkest gray, states that get almost neural effects in lighter gray, states losing a lot shown in white, and so on. I can ask Cory and Nick to prepare these graphs if you send us the state-level revenue and user impact, i.e. CS changes per households).

Converting to a VMT fee: (Make this Policy Scenario #1)

The first policy that we consider is converting the current gasoline tax to a revenue neutral Vehicle-Miles-Traveled or VMT fee. In order to apply the VMT fee to the model, the federal gasoline tax had to be subtracted from the total price of gas. The remaining price of gasoline was then converted to a price per vehicle mile traveled for each individual household by dividing the remaining price for gallon by the household's household average fuel efficiency rate. The derived VMT fee was then added to the fuel cost per mile to determine the total fuel price per mile including the Federal VMT fee.

We used the model to determine what the revenue-neutral fee per mile would need to be and what the distributional impacts of using a VMT fee would be. Using a flat VMT fee, the revenue-neutral fee to the current gas tax was calculated to be .88 cents per mile. It was expected that using a flat VMT fee would assist those households that have lower average household fuel efficiency than the national average, what the VMT fee is loosely based on. Households with higher average fuel efficiency will be worse off in this scenario.

While there were minimal impacts on each household as a percent of total income, total VMT decreased by 1% upon the conversion to a VMT fee while keeping the fee revenue-neutral to the current gas tax. Overall on a percent basis the effect to VMT was small but speaking on absolute terms, this is a large quantity. The average changes in household consumer surplus, federal revenue, and social welfare were all less than one dollar and all changes as a percent of total household income were negligible.

Once the income, age, location, and ethnic groups were evaluated individually we saw slight variations in the impacts. What we found was that the two older age groups would actually see a positive increase in consumer surplus. Rural areas also saw, on average, an increase in consumer surplus. Rural areas and the age classification +64 years saw an increase in annual household VMT. Asian households were affected the most by this policy change, decreasing household VMT by 1.8% and suffering a loss of $13.98 in consumer surplus per household. This is due to the significantly higher fuel efficiency of their vehicles and the increase in the average Asian household price of fuel per mile traveled, 1.43%.

The only income group significantly impacted by this policy change was the highest income group or those households whose annual income is greater than $190,000 a year. They have the lowest vehicle fuel efficiency and therefore will gain the most from the decrease in fuel price per mile. While the highest income group would experience the largest annual increase in consumer surplus ($18.32) it was the lowest income group that would increase their annual VMT the most by .83%. Please refer to the list of tables for a table of income distributional impacts from a revenue-neutral VMT fee.

Increasing the gas tax by $0.10 per gallon:

The second policy scenario evaluated using our model was to increase the federal gas tax 10 cents, as recommended by The Finance Commission in their final report – Paying Our Way (National Surface Transportation Infrastructure Financing Commission 2009), to a total of $0.284 per gallon of gasoline. According to our model results, this change would increase tax revenue by 44.5 percent while decreasing total VMT by 6.5 percent. As anticipated we found that all of the households would decrease the number of annual vehicle miles traveled but their individual circumstances would determine to what extent they would be affected.

What we found after applying this gas tax increase to the model was that households in rural areas suffered larger decreases in consumer surplus, made larger contributions to federal tax revenue, and made a significantly higher total gas tax payment as a percentage of household income. Rural areas also had the largest percent decrease in total VMT. While it should be kept in mind that the impacts on a household are on the scale of 0.1 to 0.2 percent of total household annual income, a significant discovery is the difference between rural and urban impacts relative to the difference in their income. Urban households take home annually 41 percent higher incomes than rural households, but rural households will suffer a 15 percent larger loss in consumer surplus than urban households.

Rural households in region 9 suffered the most. Not too far behind rural households in region 9, are households in region 6. These regions ultimately comprise of the Southeastern corner of the US. Within both of the regions households would experience an average loss in consumer surplus of about $115 annually; costing each household on average about $95; and suffer an average loss in social welfare of approximately $20 annually. The households that suffered the least are urban households in Region 7, the Northeast and Region 1, the Western seaboard. Households within Region 7 suffered an average loss of consumer surplus equivalent to $89 annually while Region 1 has an average loss of $92 annually. Urban households in Region 7 forfeited $77 annually in federal tax revenue while Region 1 forfeited $80 annually. The total loss in social welfare for each region is approximately $12 for both Region 1 and Region 7. Please refer to Fig 2 for a map displaying the regional distributional impacts of a 10-cent gas tax increase.

The regions with the largest disparity between urban and rural households were Regions 1 and 2. There was a total loss of consumer surplus in rural households equivalent to about 22 percent and 19 percent, respectively, more than the average household loss of consumer surplus in urban households. The remaining regions were between 11 and 15 percent. However, Region 6 had the lowest difference of only 8 percent.

Households that were classified as Asian were impacted significantly less than other ethnicities. Their percent change in VMT was lower as was their change in revenue generation as a percent of total household income. These households reported an average 5.5 percent fewer annual VMT and also a 30 percent higher income than the averages for other ethnicities. The higher income lowers their sensitivity to increases in the price of fuel.

For the different age groups, households that were in or near retirement reduced annual VMT the most but suffered the smallest changes in consumer surplus, revenue generation, and total welfare. These houses are characterized by driving less and having significantly lower household incomes. It should be noted that their reported annual VMT was about 20 percent less than the other age group categories and their annual income was also significantly less. (Tables on the distributional effects by age groups, by ethnical groups, by states, and by urban/rural/MSA will help the presentation of results)

For the different income groups, the changes in consumer surplus, revenue generation, and total welfare all increased as the income group was higher. Incomes between $160,000 and $170,000 a year suffered the largest loss of consumer surplus and change in revenue generated while incomes between $70,000 and $80,000 per year suffered the largest change in social welfare. When considering these changes relative to income, the lower income groups suffered the largest impacts – reducing their annual VMT by 7.5 percent and experiencing a change in revenue equivalent to 0.26 percent of the total household income. Please refer to Table 2 for all of the average household impacts from a 10-cent increase in the federal gas tax.

Another thought that should be considered is the impact of a federal gas tax increase upon state tax revenue. If annual mileage is going to decrease, gas consumption will also decrease. If state tax rates are not raised simultaneously, they would experience a negative impact equivalent to their tax rate times the amount of fuel no longer consumed. States also use gas taxes to collect revenue for road projects. The state of Virginia for example suffers a total loss of VMT equal to approximately 4.3 billion miles per year. The total decrease in fuel consumed equals approximately 195 million gallons. Based on the state fuel tax in Virginia in 2001, the state of Virginia would see a loss of about $34.1 million annually in tax revenue while total federal revenue generated in the state is about $126.3 million annually. Depending on whether that state is a donor (provides more federal tax revenue than is received) or a donee (receives more in federal revenue than provides) state will affect their budget at the end of the year. The point to take away from this is that state revenue is significantly impacted and this must be considered when making federal tax policy decisions. (A map/picture showing state-by-state findings will be great as mentioned in my earlier comments)

VMT - Fee Equivalent to a 10-Cent Federal Gas Tax Increase:

For the last policy we consider, we determined that the revenue-neutral VMT fee needed to generate a 44.5% increase in revenue would be $0.0136 per mile. The average loss of consumer surplus for individual households in the model is -$101.01 annually; the average increase in tax revenue is $84.02 annually per household; and the average loss of total social welfare is -$16.99 annually per household. The conversion from a gas tax to a VMT fee results in households with lower fuel efficiency seeing a reduction in their loss of consumer surplus; a reduction in their increase of tax revenue; but a decrease in their net social welfare. The opposite is true for households with higher than average fuel efficiency.

The households with lower fuel efficiency are the two lowest income groups and the two highest income groups, households living in rural areas, and MSA_CAT3 or households living in large metropolitan statistical areas with no access to rail and populations less than one million people. These groups will be better off with a revenue-neutral VMT fee than a gas tax. These groups will have a smaller loss of consumer surplus, pay less annually, but as a result you will see a larger decrease in net social welfare. The households with higher fuel efficiency are most notably younger households and Asian households. These households are hit the worst for a couple of reasons. Please refer to figure 3 for a map displaying the distribution of impacts regionally.

Comparing the gas tax increase to the revenue-neutral VMT fee, you find that there is a larger reduction in VMT when using the VMT fee equal to about 1 percent. The impacts of using a VMT fee instead of a gas tax increase would reduce total annual VMT by 7.4% instead of 6.5% while generating the same amount of revenue. The VMT fee closes the disparity between urban and rural areas in both differences of change in consumer surplus and percent change in VMT. However the loss of consumer surplus, previously mentioned to be -$101.13, is more than the loss of consumer surplus of a $0.10 gas tax increase. Please recall the average loss of consumer surplus associated with a 10-cent increase in federal gas tax is $99.61 annually per household. The average revenue is the same, being revenue neutral, but this means that there is also a greater loss of total social welfare.

For different ethnicities, while African American households will reduce VMT a total of 10.2 percent, one percent less than a gas tax increase, it is Asian households whom will see the biggest negative impact reducing VMT from a 7.2 percent reduction from a gas tax increase to a 9.5 percent reduction from a VMT fee. Hispanic and African American households are only slightly negatively impacted; Hispanic households more so than African American households. “Other” households are impacted the least, seeing a slight further reduction VMT from -7.34 percent to -7.40 percent. However it is the Hispanic and African American households that see the largest reduction in consumer surplus as a percent of total household income of -0.212 percent and -0.195 percent respectively compared to an average loss of -0.123 percent in Asian households.

Looking at the different income groups, it is the lowest 4 income groups and the top income group that sees a decrease in VMT reduction from the 10-cent gas tax increase. Despite these income groups seeing an increase in VMT between the two policies, only the top four income groups experience a reduction in their decrease in consumer surplus converting from one policy to the other. The rest of the income groups all experience a decrease in consumer surplus from the 10-cent gas tax increase. The difference becomes greater as you start looking at the higher income groups. The highest income group will experience a reduction from $136.27 per year to $109.13 per year. Please refer to table 4 to see the distribution of impacts over different income groups.

6. Conclusions

When comparing the several policies discussed within this paper, the gas tax increase proves to have the smallest average decrease in consumer surplus for households. The average loss of consumer surplus for the gas tax increase is $99.61 per household. Increasing the gas tax causes a total decrease of 6.5 percent (this seems high. How is this average computed?) in total annual VMT from our model and creates the largest disparity between different income, age, and ethnic groups but reduces overall average consumer surplus the least. Converting to an equivalent VMT fee generates the same amount of revenue as the gas tax but increases the reduction in household VMT to 7.4 percent. The flat VMT fee creates a larger decrease in consumer surplus ($101.01 – a little more than a dollar) also at the same time narrows the gap in "loss of consumer surplus" between the different income groups by increasing the loss of consumer surplus for lower income groups and decreasing it for higher income groups.

There is no difference in the revenue generated by each policy as the foundation for comparing each policy is revenue neutrality. It should be noted however that if one were to assume zero price elasticity, or that households will not change their behavior if taxes were increased, there would be significant differences in revenue on the scale of about $2 billion or 7% of the behavior adjusted revenue estimation for the gas tax and about $2.2 billion or 8% of the behavior adjusted revenue estimation for the VMT fee policy. These are significant numbers and show how easily revenue estimation can vary if price elasticity is not considered.

All households, to some degree or another, suffer from an increase in the federal gas tax. Regarding impacts on ethnic groups, the smallest impact seen by increasing the tax on driving is the Asian ethnicity at 7.2 percent for a 10-cent gas tax increase and the largest is the African American ethnicity at 9.2 percent. However, when converting from a 10-cent gas tax increase to a VMT fee, Asian households will see the largest reduction in household VMT of over 2 percent while households categorized as "other" see the smallest reduction in household VMT when converting from a 10-cent gas tax to a revenue neutral VMT fee; from 7.3 percent to 7.5 percent. African American households still see the largest reduction in an overall reduction of household VMT of over 10 percent.

It is important to note the scale in which these differences are on; a 2 percent reduction for an Asian household is a little more than 400 miles a year. However a 10 percent overall reduction in VMT for African American households is over 2000 VMT annually. African American households see the smallest change in revenue contribution at only $75. African American households will also, despite the largest reduction in Annual VMT, experience the smallest loss in consumer surplus.

The oldest households, in or near retirement, suffer the largest decrease in annual household VMT but the smallest decrease in consumer surplus and revenue contribution from an increase in the gas tax. These households see a slight reduction in these losses upon converting to a VMT fee. The other two age groups also experience reductions in VMT but merely half of those seen by households characterized as 64+ and simultaneously experience twice the loss of consumer surplus and revenue contribution despite only half the loss in VMT. Upon converting to a VMT fee, these two younger age groups, households will reduce their VMT twice that of a gas tax increase. The youngest age group will suffer a moderate increase in their loss of consumer surplus while the middle age group will stay about the same.

Surprisingly, the variations between different urban rural areas are not as large as those of the ethnic or age groups. All suffer a loss of consumer surplus on the order of between $95 to $110. All categories experience a larger loss of consumer surplus and reduction in annual VMT upon to conversion to a VMT fee except those households that are not in an MSA category. These households experience a slight decrease in their loss of consumer and a smaller reduction in annual VMT.

The lowest income groups experience in the highest reductions in VMT and the smallest losses of consumer surplus for both scenarios but these increase slightly from a conversion to a VMT fee from a gas tax. The loss of consumer surplus and reduction in annual VMT seems to spike at households that make $170,000 a year. Households making more than this suffer slightly smaller losses and reductions than households making just less.

This trend seems to be true of all household characteristics. Households with smaller incomes suffer the largest reductions in annual household VMT, while suffering the smallest losses in consumer surplus. Households with larger incomes have the smallest reductions in VMT, but relatively larger losses in consumer surplus. If you consider the losses on consumer surplus relative to the household's income, the lower income households suffer the largest losses by many times more than households with higher incomes. Speaking on scales, all losses are less than one percent of the household's total annual income. Althought there are stark differences between different income groups, the magnitude is virtually insignificant.

To conclude this research - as cars become more fuel efficient and the gas tax becomes less affective, the gas tax will become obsolete. This research shows that a VMT fee is not inequitable, there are differences in losses and reductions but the scale is not large. This research also shows that a gas tax can generate reliable revenue until a viable VMT policy can be implemented. A distance-based pricing scheme is viable, especially if there is political support behind it.

Future Research

This research project was initiated because the United States is facing a Highway Trust Fund that is no longer able to afford the commitments it has made and must request additional funding from congress. The surface transportation network is deteriorating at a rate faster than we are able to repair and maintain it. The new administration is pushing for higher fuel economy in automobiles without increase the gas tax that is a function of gasoline consumption. If these trends continue as they are, the Highway Trust Fund will face the inability to keep itself in the black and will become insolvent. Meanwhile our roads will become increasingly insufficient in moving people and goods around the country and also increasingly unsafe. The amount of money generated by the Highway Trust Fund must be increased to not only repair infrastructure in disarray but to increase the level of maintenance to prevent infrastructure from needing drastic repairs. This research could be expanded to include not only what the distributional impacts are from an increase in tax but what is the needed increase in the tax to generate enough revenue to adequately fund the Highway Trust Fund.

Another way to expand upon this research would be to look at utilizing variable VMT rates to not only evaluate how increases can generate more revenue to fund the gap but also how these varying rates can be used to alleviate congestion. Millions of gallons of fuel are wasted annually because of lost time spent stuck in congestion during rush hour. This model could be used to evaluate VMT impacts from MSA specific VMT fees. Reduced VMT can be calculated; increased tax revenue; and also the distributional changes in household impacts. Other considerations should be made such as time savings and fuel savings from higher levels of service. This model could also be used to create a more equitable policy by exploring options such as reimbursing households with demographic disadvantages with travel vouchers created from the tax revenue that has been generated.

There are many obstacles that hinder an expeditious implementation for a VMT fee system and must first be addressed before serious consideration of a VMT policy can be made. Considerations such as how to phase in the technology, avoiding tax evasion, temporal sequence in the adoption of VMT fees by different states, administration, and privacy. These are areas for future research.

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List of Tables, Charts, and Figures:

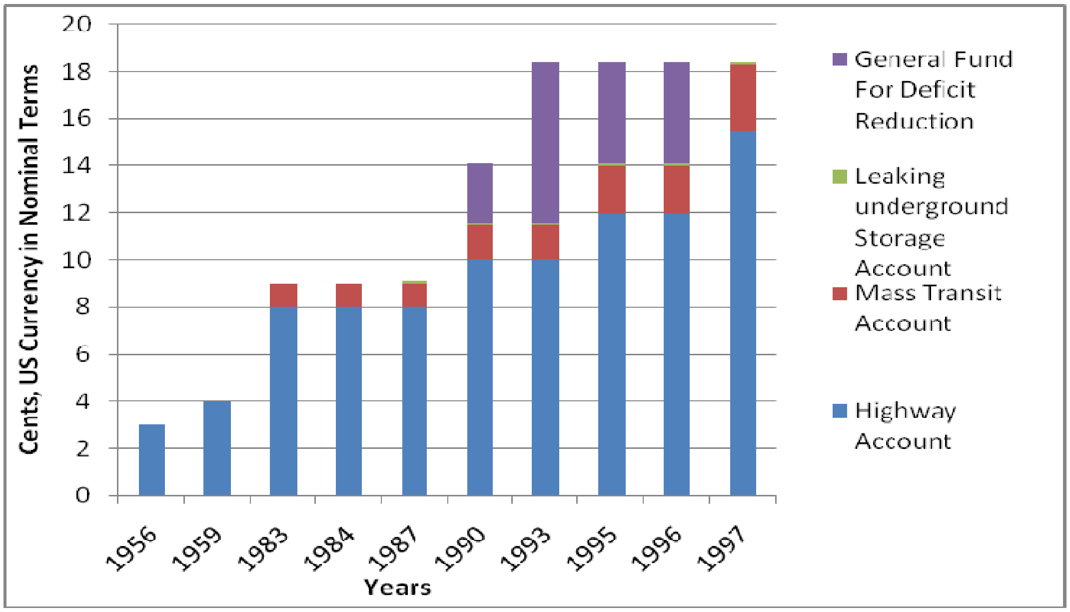

Chart 1: History of the Federal Gas Tax (1997 indicates the last year changes were made to the Federal Gas Tax). (Ref: FHWA – Financing Federal-aid Highways).

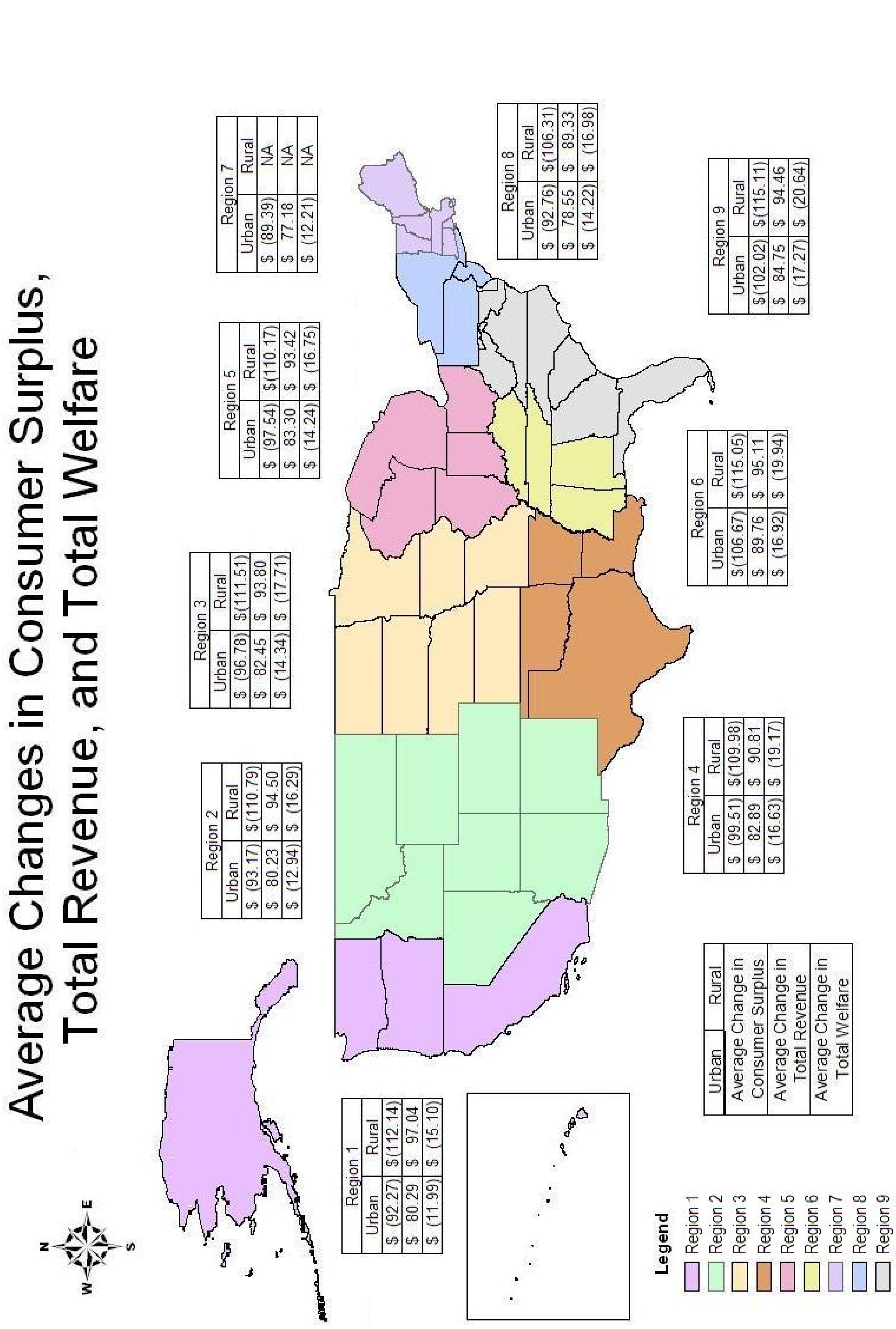

Figure 1: Regional Distributional Effects of a 10-cent Federal Gas Tax Increase on Households

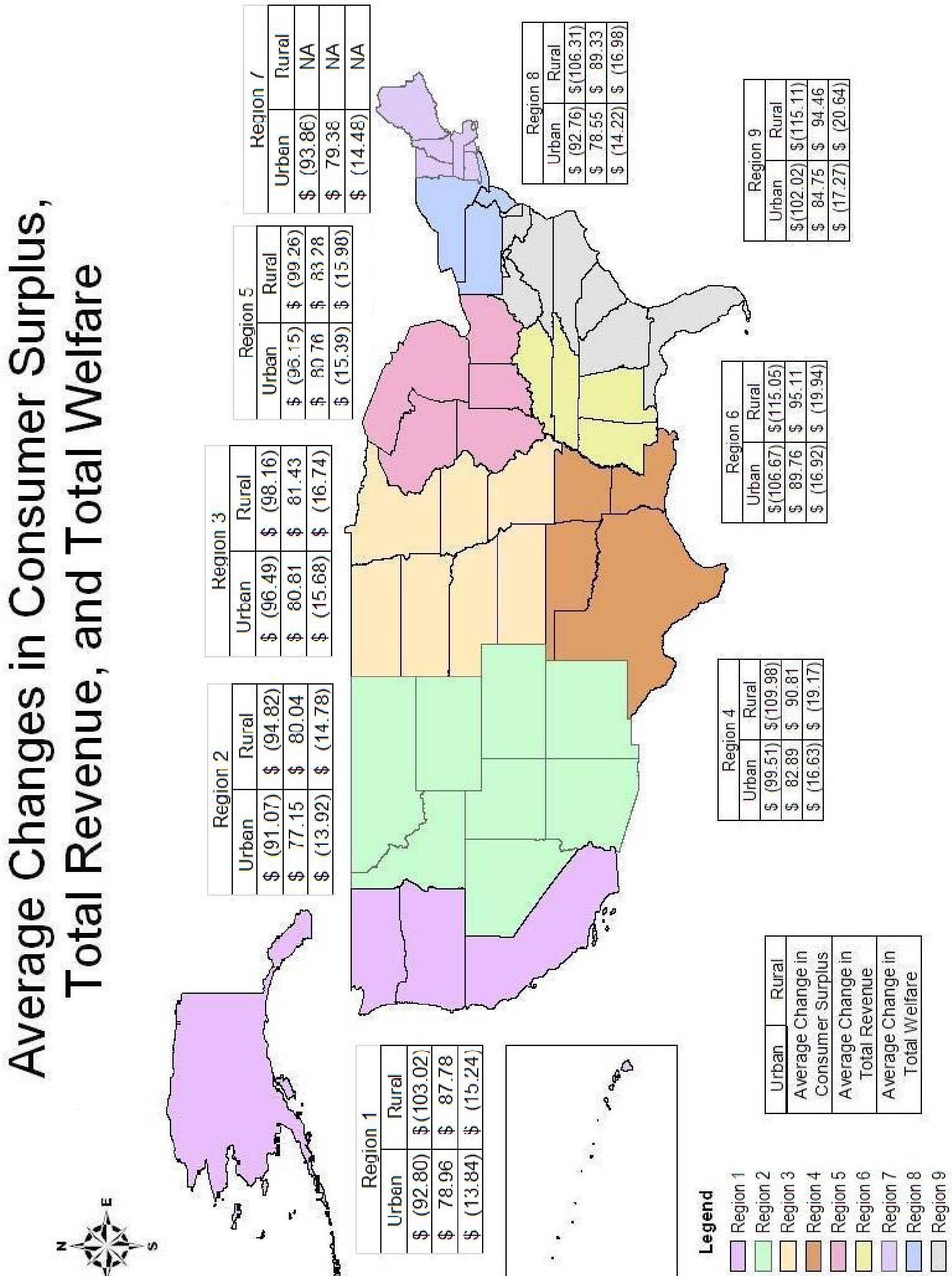

Figure 2: Regional Distributional Effects of a VMT fee revenue-neutral to a 10-cent Federal Gas Tax Increase

Table 1: Regression Results

Variable	Variable Type	Coefficient Value		T-statistical significance	P>t
ln(fuel_cost_per_mile)	ln(cont var)	β_1	-5.262	-25.28	0
ln(income)	ln(cont var)	β_2	1.126	20.72	0
ln(income)*ln(fuel_cost_per_mile)	Interact var	β_3	0.354	17.72	0
ln(fuel_cost_per_mile)*substitute	Interact var	β_4	0.580	16.57	0
ln(veh_count)	ln(cont var)	β_5	0.589	55.42	0
Substitute	dummy var	β_6	1.754	18.28	0
resp_male	dummy var	β_7	0.081	12.07	0
worker_count	cont var	β_8	0.083	15.39	0
driver_count	cont var	β_9	0.083	12.16	0
children_count	cont var	β_{10}	0.040	11.81	0
resp_race_africanamerican	dummy var	β_{11}	0.023	1.62	0.104
resp_race_asian	dummy var	β_{12}	-0.148	-5.92	0
resp_race_hispanic	dummy var	β_{13}	0.037	2.27	0.023
resp_age_16-35	dummy var	β_{14}	0.285	22.89	0
resp_age_36-64	dummy var	β_{15}	0.211	20.03	0
ln(ht_pop_density)	ln(cont var)	β_{16}	-0.065	-26.55	0
ln(ratio_hsingden_to_wrkrden)	ln(ratio of con var)	β_{17}	0.014	1.45	0.147
MSA_category_1[1]	dummy var	β_{18}	0.029	2.38	0.017
MSA_category_2[2]	dummy var	β_{19}	0.025	2.24	0.025
MSA_category_3[3]	dummy var	β_{20}	-0.022	-2.14	0.033
hh_public_transit_trips_per_day	cont var	β_{21}	-0.078	-4.6	0

1 – "MSA_category-1" – Metropolitan Statistical Area with Population greater than 1,000,000 people and access to rail

2 – "MSA_category-2" – Metropolitan Statistical Area with Population greater than 1,000,000 people and no access to rail

3 – "MSA-category-3" – Metropolitan Statistical Area with Population less than 1,000,000 people

Table 2a: Overall Average Impacts from a $0.10 increase in Federal Gas Tax

Measurement	Household Average for Total Survey	As a percent of Average Total Household Income	Urban Average	Rural Average
Change in Consumer Surplus	-$99.94	-.15%	-$96.82	-$111.79
Change in Federal Revenue	$84.54	.13%	$82.20	$93.63
Change in Total Social Welfare	-$15.36	-.02%	-$14.62	-$18.16
Household Income	$65,300	NA	$69,545	$49,208

Table 2b: Overall Average Impacts from a Revenue Neutral VMT Fee

Measurement	Household Average for Total Survey	As a percent of Average Total Household Income	Urban Average	Rural Average
Change in Consumer Surplus	-$102.15	-.16%	-$101.01	-$106.44
Change in Federal Revenue	$84.58	.13%	$84.02	$87.77
Change in Total Social Welfare	-$17.35	-.03%	-$16.99	-$18.68
Household Income	$65,300	NA	$69,545	$49,208

Table 3: Income Demographics

Income Group	Total Number of House-holds	Number of House-holds in MSA-CAT 1	Number of House-holds in MSA-CAT 2	Number of House-holds in MSA-CAT 3	Number of House-holds in Rural Areas	Average House-hold Fuel Consumption Rate (MPG)	Average Household VMT
>/=$0,<$10K	**601**	98	130	172	201	20.48	11,713
>/=$10K,<$20K	**1476**	219	372	432	453	20.96	13,352
>/=$20K,<$30K	**2069**	308	584	598	579	21.06	16,769
>/=$30K,<$40K	**2163**	408	656	565	534	21.11	19,957
>/=$40K,<$50K	**1908**	350	553	544	461	21.35	22,878
>/=$50K,<$60K	**1719**	371	567	432	349	21.35	24,458
>/=$60K,<$70K	**1286**	315	448	305	218	21.34	26,719
>/=$70K, <$80K	**1195**	340	419	254	182	21.3	28,706
>/=$80K,<$90K	**0**	0	0	0	0	NA	NA
>/=$90K,<$100K	**1439**	417	529	312	181	21.27	29,519
>/=$160K,<$170K	**1432**	337	551	353	191	20.83	32,712
>/=$170K,<$180K	**360**	250	59	34	17	21.05	30,972
>/=$180K,<$190K	**637**	327	205	74	31	21.00	30,944
>/=$190K	**3**	0	3	0	0	19.84	21,393

Table 4: Household Income Effects

A. 10-cent Federal Gas Tax Increase

Income Group	Change in Consumer Surplus	Change in Revenue Generated	Change in Social Welfare	Change in CS as a percent of household Income	Percent Change in Average Cost per Mile	Percent Change in annual household VMT
>/=$0,<$10K	-$43.95	$29.42	-$14.53	-0.72%	7.39%	-13.71%
>/=$10K,<$20K	-$55.20	$40.77	-$14.43	-0.36%	7.33%	-11.17%
>/=$20K,<$30K	-$70.35	$54.84	-$15.51	-0.26%	7.34%	-9.57%
>/=$30K,<$40K	-$83.29	$67.24	-$16.06	-0.23%	7.29%	-8.46%
>/=$40K,<$50K	-$97.34	$80.70	-$16.64	-0.21%	7.30%	-7.58%
>/=$50K,<$60K	-$104.73	$88.26	-$16.47	-0.19%	7.28%	-6.96%
>/=$60K,<$70K	-$111.13	$94.84	-$16.28	-0.17%	7.26%	-6.49%
>/=$70K, <$80K	-$120.68	$104.56	-$16.12	-0.16%	7.24%	-5.09%
>/=$80K,<$90K	NA	NA	NA	NA	NA	NA
>/=$90K,<$100K	-$128.18	$112.43	-$15.75	-0.14%	7.26%	-5.46%
>/=$160K,<$170K	-$150.67	$137.35	-$13.31	-0.09%	7.35%	-4.03%
>/=$170K,<$180K	-$145.46	$133.09	-$12.37	-0.08%	7.15%	-3.96%
>/=$180K,<$190K	-$138.75	$128.07	-$10.68	-0.07%	7.01%	-3.64%
>/=$190K	-$136.27	$120.85	-$15.43	-0.07%	7.75%	-5.41%

B. Revenue-Neutral VMT fee (current tax policy)

Income Group	Change in Consumer Surplus	Increase in Federal Tax Revenue	Change in Social Welfare	Change in CS as a Percent of Total Household Income	Percent Change in Fuel Cost per Mile	Percent Change in Annual Household VMT
>/=$0,<$10K	-$2.22	$0.87	-$1.35	-0.04%	-1.10%	0.83%
>/=$10K,<$20K	-$2.77	$1.49	-$1.28	-0.02%	-0.64%	0.07%
>/=$20K,<$30K	-$1.92	$0.79	-$1.12	-0.01%	-0.50%	-0.14%
>/=$30K,<$40K	-$0.75	-$0.17	-$0.92	-0.00%	-0.41%	-0.21%
>/=$40K,<$50K	-$2.12	$1.09	-$1.03	-0.01%	-0.22%	-0.37%
>/=$50K,<$60K	-$1.58	$0.63	-$0.95	-0.00%	-0.17%	-0.40%
>/=$60K,<$70K	-$2.27	$1.29	-$0.97	-0.00%	-0.15%	-0.35%
>/=$70K, <$80K	-$1.72	$0.84	-$0.88	-0.00%	-0.21%	-0.29%
>/=$80K,<$90K	NA	NA	NA	NA	NA	NA
>/=$90K,<$100K	-$1.37	$0.65	-$0.72	-0.00%	-0.16%	-0.26%
>/=$160K,<$170K	$4.99	-$5.18	-$0.19	-0.00%	-0.40%	-0.06%
>/=$170K,<$180K	$2.26	-$2.69	-$0.42	-0.00%	-0.28%	-0.15%
>/=$180K,<$190K	$3.13	-$3.39	-$0.26	-0.00%	-0.28%	-0.14%
>/=$190K	$18.32	-$17.45	$0.87	-0.01%	-0.84%	0.31%

C. Revenue-Neutral VMT Fee (10-cent Gas Tax Increase)

Income Group	Change in Consumer Surplus	Increase in Federal Tax Revenue	Change in Social Welfare	Change in CS as a Percent of Total Household Income	Percent Change in Fuel Cost per Mile	Percent Change in Annual Household VMT
>/=$0,<$10K	-$46.76	$29.70	-$17.06	-0.77%	5.72%	-12.52%
>/=$10K,<$20K	-$58.89	$41.95	-$16.93	-0.38%	6.37%	-11.00%
>/=$20K,<$30K	-$72.87	$55.15	-$17.72	-0.29%	6.59%	-9.69%
>/=$30K,<$40K	-$84.20	$66.31	-$17.89	-0.24%	6.68%	-8.68%
>/=$40K,<$50K	-$100.31	$81.57	-$18.74	-0.22%	6.99%	-8.03%
>/=$50K,<$60K	-$106.93	$88.53	-$18.40	-0.19%	7.05%	-7.45%
>/=$60K,<$70K	-$114.38	$96.10	-$18.29	-0.17%	7.05%	-6.93%
>/=$70K, <$80K	-$123.19	$105.26	-$17.94	-0.16%	6.93%	-6.27%
>/=$80K,<$90K	NA	NA	NA	NA	NA	NA
>/=$90K,<$100K	-$130.28	$113.02	-$17.26	-0.15%	7.04%	-5.79%
>/=$160K,<$170K	-$143.39	$129.69	-$13.71	-0.09%	6.75%	-4.10%
>/=$170K,<$180K	-$142.21	$128.94	-$13.26	-0.08%	6.74%	-4.15%
>/=$180K,<$190K	-$134.26	$123.02	-$11.24	-0.07%	6.60%	-3.82%
>/=$190K	-$109.13	$95.55	-$13.58	-0.06%	6.48%	-4.99%

Table 5a: Distributional Effects within Age Groups and Ethnicities – 10-cent Federal Gas Tax increase

	Average Fuel Efficiency Rate	Annual Household Income	Consumer Surplus	Total Revenue Generation	Total Social Welfare	Reduction in Annual VMT
Hispanic	21.8	$50,451	-$97.06	$80.21	-$16.85	-8.28%
African American	21.8	$49,150	-$85.89	$69.03	-$16.85	-9.19%
Asian	23.19	$84,989	-$84.77	$71.97	-$12.80	-7.17%
Other	21.01	$66,770	-$101.37	$86.14	-$15.23	-7.34%
Age Group 16-35	22.04	$60,346	-$109.70	$91.76	-$17.94	-3.94%
Age Group 36-63	21.12	$74,983	-$111.32	$95.45	-$15.87	-3.56%
Age Group 64+	21.15	$40,679	-$52.68	$41.98	-$10.70	-9.44%

Table 5b: Distributional Effects within Age Groups and Ethnicities – VMT fee revenue-neutral to a 10-cent Federal Gas Tax increase

	Average Fuel Efficiency Rate	Annual Household Income	Consumer Surplus	Total Revenue Generation	Total Social Welfare	Percent Reduction in Annual VMT
Hispanic	21.8	$50,451	-$108.15	$86.74	-$16.94	-9.33%
African American	21.8	$49,150	-$96.65	$85.08	-$16.98	-10.28%
Asian	23.19	$84,989	-$105.52	$80.20	-$17.06	-9.55%
Other	21.01	$66,770	-$102.15	$87.77	-$18.68	-7.47%
Age Group 16-35	22.04	$60,346	-$122.47	$99.67	-$22.80	-8.89%
Age Group 36-63	21.12	$74,983	-$111.58	$94.11	-$17.47	-7.14%
Age Group 64+	21.15	$40,679	-$48.62	$38.06	-$10.56	-8.40%

Tables 6: The proportion of fuel efficient v. fuel inefficient vehicles

	Count (house-holds each)	Average Fuel Consumption (MPG)	Urban	Rural
			Count	Count
Fuel Efficient	9521	23.7	7785	1736
Fuel Inefficient	6767	17.5	5106	1661
Totals	16288	-	12891	3397

Table 7a: Impacts of Policies on Federal and State Tax Available to Each State

	10-cent Gas Tax Increase		VMT Fee – revenue neutral to a 10-cent gas tax increase	
State	Difference in State Gas Tax Revenue	Difference in Federal Tax Available to the State	Difference in State Gas Tax Revenue	Difference in Federal Tax Available to the States
CA	$ (107,147,769.78)	$ 949,323,016.31	$ (120,247,474.65)	$ 990,782,153.41
HI	$ (2,077,364.32)	$ 111,762,718.82	$ (2,313,306.20)	$ 130,370,751.74
OR	$ (18,960,735.22)	$ 108,073,372.63	$ (19,136,034.62)	$ 103,569,964.68
WA	$ (29,399,117.39)	$ 232,958,302.11	$ (31,048,541.45)	$ 230,027,691.77
AZ	$ (18,389,390.33)	$ 116,355,803.80	$ (18,823,327.50)	$ 116,733,985.95
CO	$ (21,322,479.17)	$ 150,071,795.79	$ (21,347,602.00)	$ 145,077,197.97
UT	$ (13,499,925.79)	$ 73,590,459.94	$ (14,257,473.80)	$ 74,403,508.74
IA	$ (14,859,885.69)	$ 91,859,920.33	$ (14,490,274.38)	$ 87,252,535.99
KS	$ (14,322,344.53)	$ 91,059,938.35	$ (14,014,365.53)	$ 84,860,283.39
MN	$ (22,955,072.71)	$ 178,230,650.43	$ (24,743,143.96)	$ 181,793,215.92
MO	$ (27,356,746.11)	$ 154,889,308.21	$ (28,239,403.76)	$ 153,948,591.89
AR	$ (14,320,036.41)	$ 79,233,084.67	$ (13,898,761.77)	$ 69,133,997.83
LA	$ (24,567,812.01)	$ 122,936,995.35	$ (23,195,680.61)	$ 111,307,450.04
OK	$ (17,497,163.59)	$ 92,351,553.06	$ (17,295,301.15)	$ 86,854,811.57
TX	$ (109,679,046.02)	$ 481,268,915.22	$ (101,378,542.99)	$ 436,063,107.69
IL	$ (49,650,338.81)	$ 366,878,387.02	$ (53,551,224.37)	$ 379,089,809.21
IN	$ (25,234,287.07)	$ 163,165,952.32	$ (25,680,370.52)	$ 156,290,883.79
MI	$ (47,287,367.41)	$ 365,830,341.77	$ (47,273,693.56)	$ 347,514,961.54
OH	$ (64,447,395.55)	$ 321,542,635.95	$ (68,859,391.15)	$ 328,992,393.12
WI	$ (28,685,248.48)	$ 157,259,161.88	$ (28,903,768.95)	$ 158,953,274.26
AL	$ (24,560,162.95)	$ 122,124,747.44	$ (25,433,291.02)	$ 120,554,979.77
KY	$ (19,080,256.18)	$ 109,893,903.43	$ (19,408,392.79)	$ 109,532,463.81

MS	$ (15,235,115.58)	$ 79,388,758.06	$ (15,213,145.37)	$ 74,653,067.92
TN	$ (35,465,642.95)	$ 165,083,183.68	$ (34,539,437.85)	$ 153,444,677.96
CT	$ (21,703,896.58)	$ 174,113,614.57	$ (25,686,386.42)	$ 191,043,327.49
MA	$ (27,384,928.76)	$ 472,567,855.11	$ (30,898,634.04)	$ 502,488,046.21
NJ	$ (20,527,210.25)	$ 285,844,654.43	$ (22,403,894.70)	$ 291,386,717.68
NY	$ (86,377,029.88)	$ 606,037,560.26	$ (100,414,700.81)	$ 683,663,689.68
PA	$ (80,818,703.72)	$ 418,371,393.74	$ (86,277,311.02)	$ 425,893,892.94
FL	$ (62,466,288.20)	$ 368,191,015.55	$ (67,472,540.49)	$ 376,608,763.82
GA	$ (21,528,109.12)	$ 231,097,387.23	$ (21,908,714.55)	$ 218,988,714.61
MD	$ (29,617,027.26)	$ 179,466,111.96	$ (35,779,440.12)	$ 205,771,325.78
NC	$ (49,909,967.32)	$ 236,897,466.13	$ (52,444,256.54)	$ 231,950,030.54
SC	$ (18,059,583.26)	$ 90,858,350.11	$ (18,314,631.33)	$ 88,782,623.32
VA	$ (34,143,726.94)	$ 205,360,283.98	$ (38,568,670.08)	$ 217,517,246.09

Table 7b: Estimated Summary of Net Effects on State Tax Revenue

State	Total Tax Revenue Available to the State (Current Gas Tax Policy)	Total Tax Revenue Available to the State (10-cent Gas Tax Increase)	Total Tax Revenue Available to the State (VMT fee)
CA	$ 4,070,897,326.54	$ 4,913,072,573.06	$ 4,941,432,005.30
HI	$ 281,811,996.31	$ 391,497,350.81	$ 409,869,441.85
OR	$ 569,996,491.77	$ 659,109,129.18	$ 654,430,421.83
WA	$ 1,032,810,103.11	$ 1,236,369,287.83	$ 1,231,789,253.44
AZ	$ 558,099,550.10	$ 656,065,963.57	$ 656,010,208.55
CO	$ 720,321,060.84	$ 849,070,377.46	$ 844,050,656.81
UT	$ 385,940,470.27	$ 446,031,004.43	$ 446,086,505.21
IA	$ 433,770,078.77	$ 510,770,113.41	$ 506,532,340.38
KS	$ 430,735,347.29	$ 507,472,941.11	$ 501,581,265.15
MN	$ 792,996,684.22	$ 948,272,261.94	$ 950,046,756.17
MO	$ 759,102,401.28	$ 886,634,963.37	$ 884,811,589.41
AR	$ 386,896,559.13	$ 451,809,607.40	$ 442,131,795.20
LA	$ 645,488,728.04	$ 743,857,911.39	$ 733,600,497.47
OK	$ 458,893,230.37	$ 533,747,619.84	$ 528,452,740.79
TX	$ 2,667,730,871.96	$ 3,039,320,741.16	$ 3,002,415,436.67
IL	$ 1,655,361,799.69	$ 1,972,589,847.90	$ 1,980,900,384.53
IN	$ 757,436,814.63	$ 895,368,479.88	$ 888,047,327.90
MI	$ 1,601,016,088.59	$ 1,919,559,062.95	$ 1,901,257,356.57
OH	$ 1,728,868,903.95	$ 1,985,964,144.35	$ 1,989,001,905.92
WI	$ 872,153,196.66	$ 1,000,727,110.07	$ 1,002,202,701.98
AL	$ 631,901,426.24	$ 729,466,010.73	$ 727,023,115.00
KY	$ 537,265,535.00	$ 628,079,182.26	$ 627,389,606.02

MS	$ 402,963,208.10	$ 467,116,850.58	$ 462,403,130.66
TN	$ 900,044,111.39	$ 1,029,661,652.13	$ 1,018,949,351.50
CT	$ 773,196,435.25	$ 925,606,153.25	$ 938,553,376.32
MA	$ 1,515,528,150.58	$ 1,960,711,076.93	$ 1,987,117,562.75
NJ	$ 965,299,018.96	$ 1,230,616,463.13	$ 1,234,281,841.94
NY	$ 2,798,180,899.93	$ 3,317,841,430.31	$ 3,381,429,888.80
PA	$ 2,163,769,293.98	$ 2,501,321,983.99	$ 2,503,385,875.90
FL	$ 1,673,146,069.06	$ 1,978,870,796.40	$ 1,982,282,292.39
GA	$ 829,953,696.62	$ 1,039,522,974.73	$ 1,027,033,696.67
MD	$ 867,383,367.70	$ 1,017,232,452.40	$ 1,037,375,253.36
NC	$ 1,297,312,503.33	$ 1,484,300,002.14	$ 1,476,818,277.33
SC	$ 467,432,628.70	$ 540,231,395.56	$ 537,900,620.70
VA	$ 988,307,332.55	$ 1,159,523,889.58	$ 1,167,255,908.56