Green Vehicle Mileage Fees

Concept, Evaluation Methodology, Revenue Impact, and User Responses

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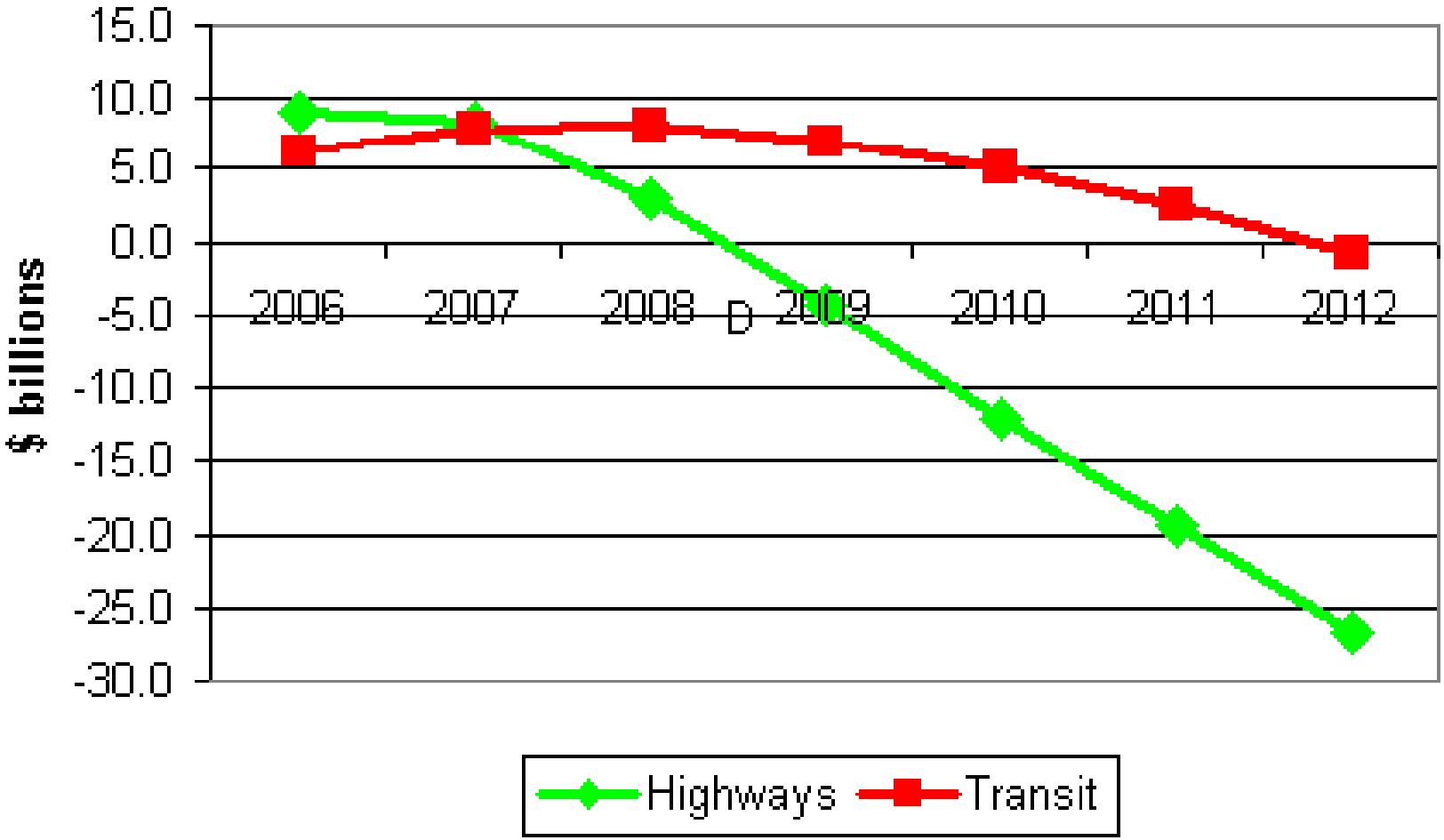
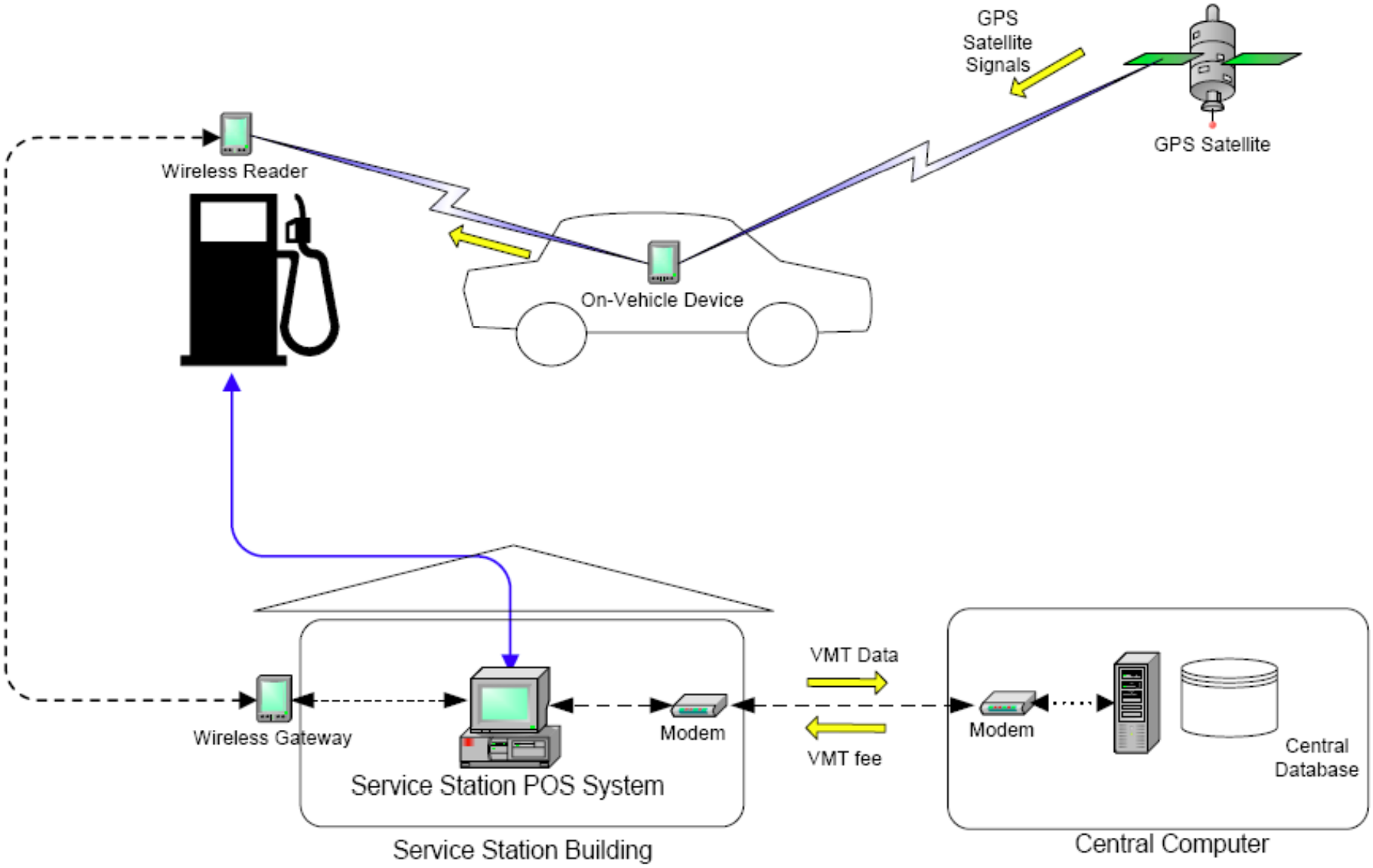
Projected Highway and Transit Account Balances



Source: National Surface Transportation Policy and Revenue Study Commission Final Report

Technology for Vehicle Mileage Fee Systems



Rate Structures for Mileage-Based Fees

Flat Fee Same for All

- Revenue neutral
- Indexed to inflation
- Flat local option add-on rates

Variable Fee Structures based on…

- Dynamic time-of-day factors (peak vs. non-peak)
- Static average levels of congestion in charging zones
- Location (urban vs. rural; different jurisdictions)
- Fuel efficiency
- Vehicle emission
- Other vehicle classification (car vs. truck; weight)
- Income
- Road types (freeway vs. arterial vs. residential street)
- Driver safety record and vehicle accident cost

Vehicle Mileage Fees: Prospects and Caution

What Is Good About It …

- Provide more sustainable revenue streams
- Variablize driving cost for demand management
- Provide flexibility in fee rates and structures
- Allow more efficient pricing schemes
- Enable a single highway taxation package with revenue, environmental, and sustainability goals all considered

Be Aware …

- Still a new technology and new policy in practice
- Cost of collection would be higher
- Issues with transition, enforcement, and communication security not completed resolved
- Some may raise the equity issue
- "Media interpretation"

Green Vehicle Mileage Fees

Definition

Variable vehicle mileage fees that internalize congestion, environmental, and energy externalities, and promote the sustainable design, operation, and use of transportation infrastructure.

Examples

- **Surcharge for congested roads/corridors/zones/cities**
- **Surcharge for clunkers and fuel inefficient vehicles**
- **Surcharge for high emission vehicles**
- **Discount for carpoolers**
- **Discount for off-peak users**
- **Discount for zero- and low-emission vehicles**
- **Discount for hybrid and electric vehicles**

Two Green Vehicle Mileage Fees Policies

- **Policy Alternative #1**

It maintains the gasoline tax for those vehicles with fuel efficiency of <20 miles per gallon and charges a flat 1.2 cents-per-mile VMT fee to those vehicles with fuel efficiency >20 miles per gallon.

- **Policy Alternative #2**

Vehicles with <median fuel efficiency pay 2 cents/mile; between median and 20 mpg pay 1.5 cents/mile; and >20 mpg pay 1 cent/mile.

Performance Measures for Policy Analysis

- Revenue
- Distributional impact
- Total VMT, and VMT by level of congestion
- Fuel consumption
- Pollution emission

Methodology

Household-Level Analysis (Cross-Sectional Data)

- Static model with fixed demand
- Regression models with short-run demand responses
- SEM and Discrete-continuous choice models with short- and long-run responses

State- and County-Level Analysis (Panel Data)

- Longitudinal models of VMT
- SEM models of VMT, vehicle ownership, efficiency, and emission

Household Vehicle Use Model

Dependent Variable: *Annual Miles Driven*			
Number of Observations: 407	**R^2: 0.49**		
Note: Variables in *italic* are logged variables			
Predictors	**COEFFICIENT**	**T-STAT**	**P-VALUE**
constant	-17.67	-2.81	0.005
fuel cost per mile	-8.68	3.63	0.000
income	2.20	3.58	0.000
fuel cost per mile * *income*	0.71	3.01	0.003
fuel cost per mile * substitute	0.45	1.13	0.258
urban	-0.18	-1.85	0.065
number of vehicles	0.53	4.14	0.000
multiple vehicle type (substitute)	1.41	1.34	0.182
household respondent is male	0.17	1.92	0.056
number of workers	0.22	4.19	0.000
number of children	0.04	0.96	0.338

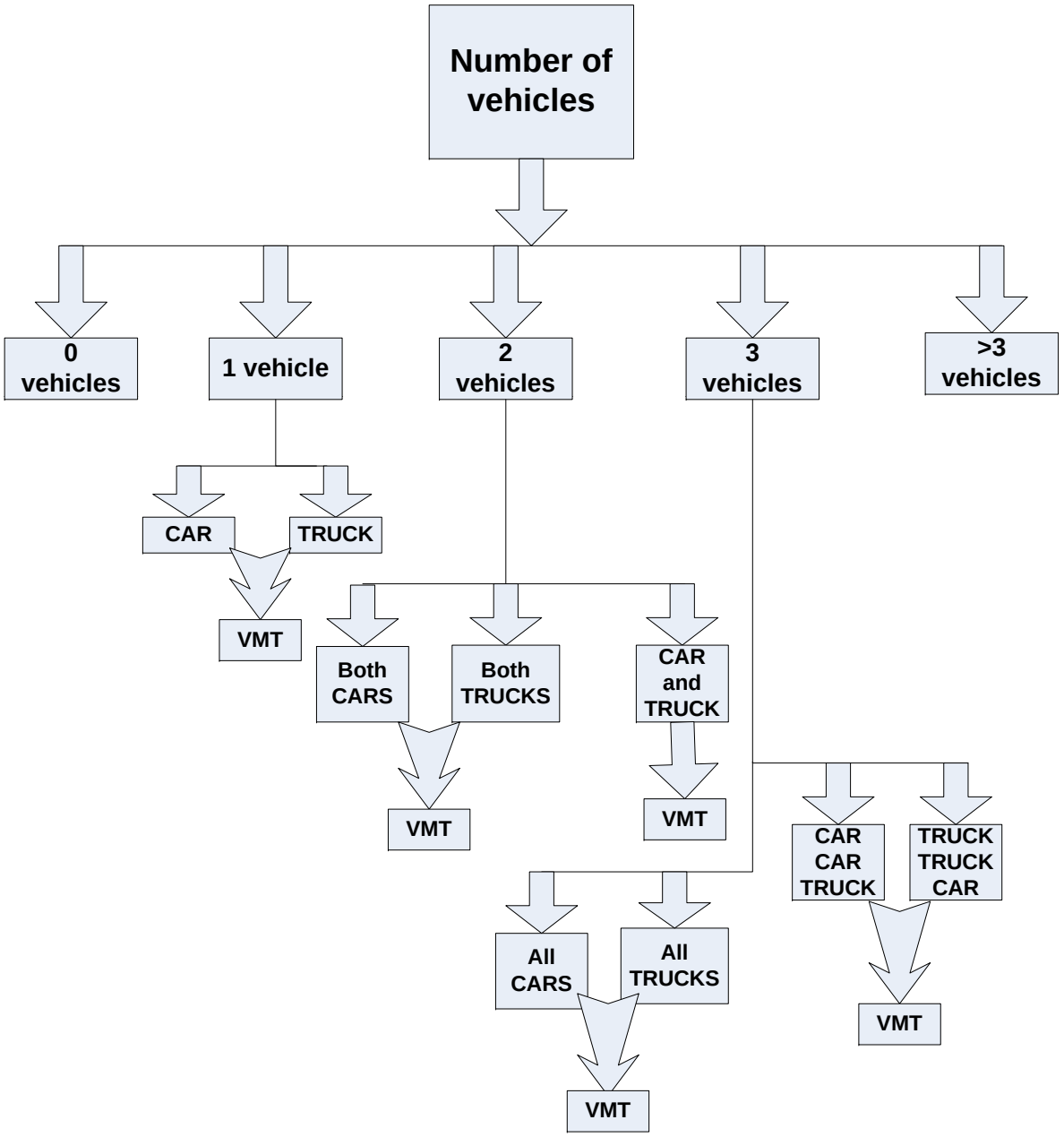
Demand elasticity w.r.t. price ranges from 0.01 to 2.21.

Simultaneous Equation Model

$$V = f\,(M,\ P_V,\ P_F,\ I,\ U,\ \mathbf{HH_V})$$
$$E = g\,(M,\ V,\ \Delta P_V,\ P_F,\ I,\ U,\ \mathbf{HH_E})$$
$$M = h\,(V,\ P_M,\ I,\ U,\ \mathbf{HH_M})$$

Simultaneous estimation of vehicle ownership (V), fuel efficiency (E), and vehicle mileage driven (M)

Discrete-Continuous Choice Model



Vehicle Ownership Model Result

Dependent variable: Number of vehicles a household chooses to own Number of households = 3353 "Zero Vehicle" is used as the reference choice.			
	One Vehicle	**Two Vehicles**	**Three Vehicles**
Variable name	Coefficient	Coefficient	Coefficient
Constant	1.461**	0.504**	-0.834**
Income (I)	0.0003**	0.0005**	0.0006**
Urban (U)	-0.322*	-0.763**	-1.131**
male	0.314*	0.526**	0.710**
Children/Household size	1.174**	2.118**	1.743**
Worker count	0.478**	1.464**	2.034**
Young	-1.485**	-2.173**	-2.772**
Middle	-1.170**	-1.848**	-2.068**

Vehicle Type Model Result (Part I)

One-Vehicle households (Truck as the reference)	
Type of vehicle (Car) **Number of households= 669**	
Variable	**Coefficient**
Constant	-0.22
Fuel cost per mile as a percentage of income (P_m)	-711.20**
Vehicle price as a percentage of income (Pv)	-0.97**
Interaction between fuel cost per mile and vehicle cost per mile (Pm*Pv)	0.02*
Urban(U)	0.62**
Household size	-0.35**
Children/Household size	0.36
Worker count	0.40**
Young	0.51*
Middle	0.12

** Indicates statistical significance at the .05 level

* Indicates statistical significance at the .10 level

Results without Demand Responses

Table 1a : Household annual expenditures on gasoline under Sample Scenario #1*

Income Group	Average Expenditures Under Gas Tax ($)	Average Expenditures Under VMT Fee of $.012/mile ($)	Average Change in user fee paid under VMT Fee of $.012/mile	Average Expenditures Sample Scenario #1 ($)	Average Change in user fee paid under Sample Scenario #1
1	$ 658.90	$ 666.72	$ 7.82	$ 675.36	$ 16.46
2	$ 917.84	$ 923.03	$ 5.19	$ 935.01	$ 17.17
3	$ 1,174.01	$ 1,169.61	-$ 4.40	$ 1,191.91	$ 17.90
4	$ 1,595.10	$ 1,595.33	$ 0.23	$ 1,623.57	$ 28.47
5	$ 1,858.85	$ 1,833.51	-$ 25.34	$ 1,881.25	$ 22.40
6	$ 1,992.60	$ 1,986.60	-$ 6.00	$ 2,023.68	$ 31.08

*Gasoline tax of $.24 for vehicle with mpg<20; VMT fee of $.012 for vehicles with mpg >20

Table 1b : Urban/rural household annual expenditure changes under Sample Scenario #1*

Location	Average Expenditures Under Gas Tax ($)	Average Expenditures Under flat VMT Fee ($)	Average Change in user fee paid under flat VMT fee	Average Mixed Policy Expenditures ($)	Average Change in user fee paid under Sample Scenario #1
Rural	$ 1,600.17	$ 1,586.56	-$ 13.61	$ 1,621.93	$ 21.76
Urban	$ 1,249.55	$ 1,251.58	$ 2.03	$ 1,272.24	$ 22.69

*Gasoline Tax of $.24 for vehicle with mpg<20; VMT of $.012 for vehicles with mpg >20

Results with Demand Responses

Table 4a : Annual household expenditures on gasoline under Sample Scenario #1*

Income Group	Average Change in Consumer Surplus	Average Change in Taxes paid	Average Change in Welfare
1	- $ 11.80	$ 13.52	$ 1.72
2	- $ 16.23	$ 16.25	$ 0.01
3	- $ 11.81	$ 9.07	- $ 2.74
4	- $ 27.51	$ 33.33	$ 5.82
5	- $ 19.12	$ 17.93	- $ 1.19
6	- $ 25.02	$ 22.82	- $ 2.20

* Gasoline Tax of $.24 for vehicle with mpg<20; VMT of $.012 for vehicles with mpg >20

Table 4b: Urban/rural annual household expenditure changes under Sample Scenario #1*

Location Group	Average Change in Consumer Surplus	Average Change in Tax Revenue	Average Change in Welfare
Rural	- $ 17.81	$ 19.68	$ 1.88
Urban	- $ 19.46	$ 18.90	- $ 0.55

*Gasoline Tax of $.24 for vehicle with mpg<20; VMT of $.012 for vehicles with mpg >20

Model Comparison

Static Model versus Regression Model

The static model ignoring demand responses overestimates revenue increase by 11~28%.

Regression Model versus Discrete-Continuous Choice

The regression model overestimates total revenue changes by 4~5%.

Distributional Effects

Results on distributional effects are not significantly affected by modeling methodology

Model Recommendation

RECOMMENDED MODELS MODEL PROPERTIES	Static Model	Multiple Regression	Simultaneous Equations	Discrete Choice
1. Behavioral Realism	**Poor**	**Average**	**Good**	**Great**
1.1. Consider changes in total vehicle use?	No	Yes	Yes	Yes
1.2. Consider changes in the distribution of vehicle uses among multiple vehicles?	No	Yes	Yes	Yes
1.3. Consider changes in vehicle quantity choice?	No	No	Yes	Yes
1.4. Consider changes in vehicle type choice?	No	No	Yes	Yes
1.5. Recognize the discrete nature of vehicle type and quantity choices?	No	No	No	Yes
2. Policy Sensitivity	**Good**	**Good**	**Average**	**Good**
2.1. Consider the distributional effects?	Yes	Yes	Yes	Yes
2.2. Able to evaluate flat-rate mileage taxes?	Yes	Yes	Yes	Yes
2.3 Able to evaluate mileage tax rates differentiated based on location?	Yes	Yes	Yes	Yes
2.4. Able to evaluate mileage tax rates differentiated based on fuel efficiency?	Yes	Yes	No	Yes
2.5. Able to evaluate mileage tax rates differentiated based on congestion?	No	No	No	No
3. Practicality	**Great**	**Great**	**Good**	**Average**
3.1 Data Availability	Good	Good	Good	Poor
3.2 Ease of Estimation	Great	Great	Good	Average
3.3 Results can be easily interpreted	Great	Great	Good	Good

Conclusions

- **Both existing fuel taxes and proposed mileage fees are regressive revenue policies. Green mileage fees could be more (Policy #1) or less (Policy #2) regressive than fuel taxes.**

- **Revenue estimates are sensitive to methodology.**

- **If equity is the most important factor, mileage fees probably should not be used for multiple purposes (maintaining revenue, reducing emission, reducing VMT, reducing fuel consumption, congestion mitigation, etc.).**

Next Steps

- Analyze national-level vehicle mileage fees, and its impact at federal and state levels
- Design and evaluate green mileage fees for various policy objectives
- Study user behavior under vehicle mileage fees
- Conduct large-scale field tests on various mileage fee concepts and implementation schemes

Thank you!

Questions and Comments

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