RFF Workshop on proposed CAFE reforms for light-duty trucks

Recent Estimates of The Rebound Effect

And Their Relevance to Proposed CAFE reforms for light trucks

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1. What is the rebound effect?
2. Why is it relevant?
3. How large is it? How large is it likely to be?
4. Concluding comments

1. What is the rebound effect?

Higher fuel economy reduces the fuel cost of driving.

$$P_M \equiv \frac{P_F}{E}; \quad \text{units: } \$/mile = \frac{\$/gallon}{miles/gallon}$$

When driving becomes cheaper, people drive more.

The rebound effect measures the size of this reaction:

$$\varepsilon_{M,P_M} \equiv \frac{\partial M}{\partial P_M}\frac{P_M}{M} \left(\frac{\%\text{ change } M}{\%\text{ change } P_M}\right)$$

When people drive more, more fuel is consumed.

2. Why is it relevant?

Effectiveness of policy tools to reduce fuel consumption.

Side-effects of policies to reduce fuel consumption (e.g. mileage related externalities).

e.g. assume $\varepsilon_{M,P_M} = -0.4$

A fuel economy increase that reduces the fuel cost of driving by 10% increases driving by 4%, so fuel consumption falls by 6% (not 10%, as would have been the case had demand been fixed).

This is a fairly strong increase in demand and of the benefits from driving, but limited effectiveness in curbing fuel consumption and potentially strong increases in the costs of congestion etc.

3. How large is it? How large is it likely to be?

Consensus estimate from literature: ca. 20% in long run

Our recent estimates: cross sectional time series, rebound effect embedded in model of demand for travel, vehicles, fuel economy (simultaneity)

~ 20% in long run

~ 4.5% in short run

at sample averages (across states, 1966-2001)

Our estimates for an **average state, 1997-2001:**

~ 6.8% in long run

~ 1.3% in short run

Why this reduction? Higher real incomes, lower real fuel costs of driving.

A much reduced share of fuel costs in the total cost of driving.

How large is the rebound effect likely to be?

Projections require income and fuel price scenarios.

4. Concluding comments

- PRIA uses 20%. That seems high.
- The rebound effect depends on income and the fuel cost of driving. Use explicit scenarios, rather than a single long run estimate?
- The share of fuel costs in the total cost of driving a truck may be higher than the fleet average. Larger rebound effect?

Table 2. Usage Equation

	Estimated Using 3SLS		Estimated Using 2SLS		Estimated Using OLS	
Variable	Coefficient	Stndrd. Error	Coefficient	Stndrd. Error	Coefficient	Stndrd. Error
vma(t-1)	**0.7961**	0.0132	**0.7447**	0.0162	**0.7414**	0.0159
vehstock	**0.0319**	0.0117	**0.0347**	0.0155	**0.0485**	0.0126
pm	**-0.0435**	0.0045	**-0.0846**	0.0052	**-0.0849**	0.0051
pm^2	**-0.0155**	0.0072	**0.0215**	0.0092	*0.0150*	0.0088
pm*inc	**0.0660**	0.0182	**0.0626**	0.0234	**0.0783**	0.0193
pm*Urban	*0.0218*	0.0128	0.0266	0.0166	0.0157	0.0144
inc	**0.1071**	0.0143	**0.1156**	0.0159	**0.1109**	0.0157
adults/road-mile	**-0.0220**	0.0053	**-0.0182**	0.0069	**-0.0178**	0.0068
pop/adult	**0.1582**	0.0456	0.0009	0.0521	0.0328	0.0489
Urban	**-0.0497**	0.0203	**-0.0578**	0.0228	**-0.0510**	0.0224
Railpop	-0.0049	0.0068	-0.0001	0.0090	0.0001	0.0089
D7479	**-0.0449**	0.0035	**-0.0373**	0.0035	**-0.0367**	0.0035
Trend	0.0005	0.0004	**-0.0010**	0.0004	**-0.0008**	0.0004
constant	**1.9449**	0.1255	2.5068	0.1533	**2.5232**	0.1520
rho	**-0.0875**	0.0242	-0.0174	0.0294	-0.0142	0.0295
No. observations	1,734		1,734		1,734	
Adjusted R-squared	0.9801		0.9809		0.9809	
S.E. of regression	0.0317		0.0311		0.0311	
Durbin-Watson stat	1.9369		1.9985		1.9924	
Sum squared resid	1.6829		1.6184		1.6154	

Notes: Bold or italic type indicates the coefficient is statistically significant at the 5% or 10% level, respectively.

Estimates of fixed effects coefficients (one for each state except Wyoming) are not shown.

Variables *inc* , *Urban* , and the constituent variables in *pm* are normalized by subtracting their mean value in the sample, both in the variable itself and in any interactions it takes. As a result, the coefficient of any variable in its uninteracted form gi

Table 5. Rebound Effect and Other Price Elasticities

	Estimated Using Three-Stage Least Squares		Estimated Using Two-Stage Least Squares		Estimated Using Ordinary Least Squares	
	Short Run	Long Run	Short Run	Long Run	Short Run	Long Run
Elasticity of VMT with respect to fuel cost per mile: (a)						
At sample average	-0.0436	-0.2191	-0.0846	-0.3355	-0.0847	-0.3377
	(0.0045)	(0.0236)	(0.0052)	(0.0242)	(0.0051)	(0.0251)
US 1997-2001	-0.0135	-0.0685	-0.0694	-0.2751	-0.0798	-0.3175
	(0.0093)	(0.0463)	(0.0114)	(0.0456)	(0.0109)	(0.0439)
Elasticity of VMT with respect to new veh price:	-0.0025	-0.0824	-0.0028	-0.0733	-0.0038	-0.0975
	(0.0015)	(0.0502)	(0.0019)	(0.0479)	(0.0021)	(0.0553)
Elasticity of fuel intensity with respect to fuel price:						
At sample average	-0.0772	-0.3370	-0.0883	-0.3555	-0.0862	-0.3502
	(0.0067)	(0.0361)	(0.0071)	(0.0410)	(0.0070)	(0.0405)
US 1997-2001	-0.0794	-0.3764	-0.0896	-0.3753	-0.0867	-0.3566
	(0.0070)	(0.0400)	(0.0071)	(0.0428)	(0.0071)	(0.0424)
Elasticity of fuel consumption with respect to fuel price:						
At sample average	-0.1208	-0.5561	-0.1729	-0.6911	-0.1710	-0.6879
	(0.0063)	(0.0401)	(0.0085)	(0.0436)	(0.0084)	(0.0437)
US 1997-2001	-0.0929	-0.4449	-0.1590	-0.6504	-0.1664	-0.6741
	(0.0097)	(0.0493)	(0.0126)	(0.0501)	(0.0122)	(0.0505)

Notes:

(a) The rebound effect is just the negative of this number (multiplied by 100 if expressed as a percent).

(b) Elasticities measured at the average 1997-2001 values of *pm* , *inc* , and *Urban* for all US.

Standard errors, shown in parentheses, are calculated exactly from the covariance matrix of estimated coefficients using the Wald test procedure for an arbitrary function of coefficients in Eviews 5.

Projections

For the period from 1997 – 2032,

If real income grows by 26.7%, and if real fuel prices increase by 58.1%,
the rebound effect in 2032 equals 0.012 (instead of 0.0135 for 97-01).

If real income grows by 26.7%, and if real fuel prices increase by 65.6%,
the rebound effect in 2032 is the same as it was in 97-01).