Willingness to Pay for Emission Reductions with E85

By

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Background

- Passage of the Energy Independence and Security Act of 2007 required that the annual consumption of renewable fuels increase from around 5 billion gallons in 2006 to 36 billion gallons in 2022.
- 21 of the 36 billion gallons must be cellulosic ethanol or other "advanced biofuels".
- Cellulosic ethanol appears to have environmental benefits over ethanol produced from corn grain, including substantially lower greenhouse gas (GHG) emissions per BTU of energy, compared with both gasoline and corn grain ethanol (Wang, 2008).
- **The purpose of this study is to examine consumers' willingness to pay (WTP) for reductions in GHG emissions through the purchase of E85 for their vehicles.**

Research Methods

The Choice Experiment

- **Conducted through national online survey of members of Knowledge Networks' KnowledgePanel®**
- **Survey fielded in January, 2009 to panel members who were car owners and age 18 or older.**
- **Respondents participated in a contingent choice exercise in which they were asked to choose between regular gasoline and three varieties of E85 (85% ethanol and 15% gasoline) that differed in terms of price, level of emission reductions, availability nearby, and percent imported. Each respondent was asked to complete 14 exercises, resulting in a total of 34,980 observations in the model.**

Repeated Fuel Choice Exercise from 4 Alternatives Via Internet Survey

If these were your only fuel options, which would you choose? Please assume that your automobile can safely run on all of these options. Choose a fuel by clicking one of the buttons below:

Product Attributes	E85	E85	E85	Gasoline
	70% of MPG of Gasoline	70% of MPG of Gasoline	70% of MPG of Gasoline	100% of MPG of Gasoline
Price	$1.40	$1.32	$1.56	$2.00
Price per mile*	7 ¢	6.6 ¢	7.8 ¢	7 ¢
Ethanol made from	Corn	Wood Wastes	Switchgrass	No Ethanol
% imported from foreign countries	33%	10%	33%	67%
Greenhouse Gas (GHG) Emissions	10% less than gasoline	73% less than gasoline	50% less than gasoline	0% less than gasoline
Available at:	Gas station located 2 minutes out of your way	Gas station located on your way	Gas station located 2 minutes out of your way	Gas station located 2 minutes out of your way
Which option do you prefer?	•	•	•	•

* The price per mile is calculated for an example automobile that gets 20 miles per gallon.

Results

Estimated Random Parameters Logit for Emissions Reduction

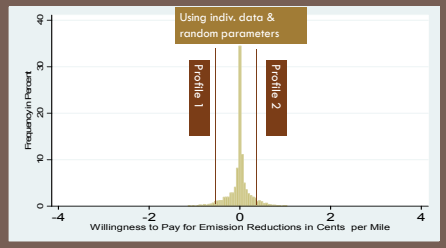
Variable	Definition	Coeff.	Robust S.E.	Z
Fuel Price	Cents per mile (6.2, 6.6, 7.0, 7.7, 8.0)	-1.2033	0.0646	-18.62***
Means				
Imported	10%, 33%, 50%, and 67% imported fuel	-0.0228	0.0022	-10.40***
Emissions Reduction	Emission reduction compared with regular gas (0%, 10%, 50%, and 73% reductions compared with E0)	0.0114	0.0045	2.54**
Inconvenience	0, 2, or 5 minutes out of way	-0.2084	0.0172	-12.13***
E85	1 if E85, 0 if regular gasoline	3.2361	0.5237	6.18***
Interactions with Emissions Reductions:				
Age	Age of respondent in years	-0.0001	0.0001	-1.73**
Female	1 if female, 0 otherwise	0.0031	0.0020	1.50*
Income < $25K	1 if income less than $25K, otherwise	-0.0016	0.0029	-0.56
$25K<Income<$50K	1 if income is $25K to $50K, otherwise	-0.0007	0.0024	-0.31
College	1 if some college or college graduate, 0 otherwise	0.0006	0.0024	0.25
Metro	1 if reside in a metropolitan area, 0 otherwise	0.0037	0.0031	1.20
Hispanic	1 if Hispanic, 0 otherwise	-0.0007	0.0039	-0.18
Other Race	1 if race other than White, Black, or Hispanic, 0 otherwise	-0.0025	0.0050	-0.50
Black	1 if Black, 0 otherwise	-0.0015	0.0043	-0.34
West	1 if reside in West, 0 otherwise	0.0006	0.0033	0.19
South	1 if reside in South, 0 otherwise	0.0006	0.0030	0.20
Midwest	1 if reside in Midwest, 0 otherwise	0.0016	0.0035	0.46
Climate Change	1 if agree that climate change will lead to environmental & health problems, 0 otherwise	0.0072	0.0022	3.28***
Food vs. Fuel	1 if agree that farmland should be used for food & not fuel, 0 otherwise	-0.0045	0.0022	-2.09***
Drill	1 if agree that more U.S. lands should be opened up for drilling, 0 otherwise	-0.0035	0.0022	-1.56*
Flex Fuel	1 if own or likely to own a FlexFuel vehicle, 0 otherwise	0.0059	0.0034	1.75**
SUV	1 if current primary vehicle is an SUV, 0 otherwise	-0.0041	0.0025	-1.65**
NACO	1 if reside in an EPA non-attainment county, 0 otherwise	0.0021	0.0023	0.91
Standard Dev.				
Import	------	0.0398	0.0027	14.54***
EmissRed	------	0.0141	0.0014	9.99***
Inconvenience	------	0.2286	0.0210	10.87***
E85	------	5.1610	0.5578	9.25***
LLR Test		761.87***		

Estimates of Mean WTP using Sample Means

	Cents/ Mile	S.E.	Z
Import	-0.0189	0.0040	-4.68***
Inconvenience	-0.1732	0.0313	-5.53***
E85	2.6957	0.9122	2.96***
EmissRed (Interactions at means)	**0.0067**	0.2343	0.03

Estimates of WTP for Emission Reductions using Two Example Profiles[a]

EmissRed Profile 1	**-0.2916**	0.2027	-1.45*
EmissRed Profile 2	**0.1906**	0.1363	1.40
Difference between profiles	**0.4824**	0.1878	2.57***



[a]**Profile 1: Age 65, Male, Income<$25K, Not college educated, in a non-metro area, Other Race, Northeast, Do not agree that climate will impact the environment, Believe farmland should be used for food and not fuel, Believe more lands should opened up for drilling, Do not own or likely to own FlexFuel vehicle, Primary vehicle is an SUV, Not in a non-attainment area.**

Profile 2: Age 25, Female, Income>$50K, College educated, Metro area, White, MW, Agree that climate change will impact the environment, Believe farmland should be used for food and not fuel, Do not believe more lands should opened up for drilling, Own or likely to own FlexFuel vehicle, Primary vehicle is not an SUV, Non-attainment area.

Economic Modeling

- Random Parameters Logit incorporating both demographics and attitudes is used (Lavin and Hanemann, 2008)
- Given this model, WTP for emissions reduction can be expressed as: $WTP_{Ei}=(\Theta_{Ei} + \gamma_1 E_i D_{1i} + \gamma_2 E_i D_{2i} + \ldots + \varphi_1 E_i A_{1i} + \varphi_2 E_i A_{1i} \ldots)/ \Theta_p$, where Θ_{Ei} is the random parameter on emissions for the *ith* individual, E is the emissions reduction variable, γ are the parameters on the interactions between emissions reduction and demographics, D_{ji}, and φ are the parameters on the interactions between emissions reduction and attitudes, A_{ki}, and Θ_p is the parameter on price. The WTP can also be calculated at the parameter and sample means.

Conclusions

Although the emissions reduction attribute is statistically significant in the model, the estimate of mean WTP of .08¢/mile for a 1% reduction in emissions is not significantly different from zero. However, the interaction variables suggest that WTP is higher for those who are female, concerned about climate change, and own a Flex Fuel vehicle, but is lower for those who are older, own an SUV, support additional oil drilling, and oppose the use of farmland for fuel production. These influences can be illustrated with example profiles. Thus, respondents who are younger, female, concerned about climate change, oppose additional oil drilling but not the use of farmland for fuel production, own or are likely to purchase a FlexFuel vehicle, and do not drive an SUV are willing to pay as much as 0.19¢/mile or, for a 20 MPG vehicle, about 3.18¢/gallon for a 1% decrease in emissions from regular gasoline.

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