Effects of Demographics and Attitudes on WTP for Fuel Import Reductions through Ethanol Purchases

By

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Abstract

This study examined willingness-to-pay for reductions in the percentage of a gasoline/ethanol fuel blend imported from foreign countries. Results showed factors increasing the discount on imported fuel were Midsouth location, concerns about fuel security, and concerns about protecting the environment. Being a resident of a Southern Oil state decreased the discount on fuel from imported sources.

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Background

In 2010, over 60 percent of the crude oil consumed in the United States (U.S.) was imported from foreign countries (EIA 2011c). Public opinion polls suggest that Americans have strong views regarding the Nation's dependence on foreign oil as a threat to national security, with 67 percent believing that the U.S. should reduce its dependence on foreign oil (Pew 2011a). More generally, opinion polls in recent years suggest that public concern over energy and energy security has reached levels not experienced since the 1970's (Bolsen and Cook 2008). These polls also suggest that the public generally supports increased domestic exploration and drilling as a means of reducing reliance on oil imports. For example, while the 2010 oil spill in the Gulf of Mexico created a dip in support for offshore drilling, by November, 2011 about 58 percent of the U.S. public favored allowing more offshore oil and gas drilling in U.S. waters (Pew 2011b).

The use of ethanol as an alternative to gasoline can help reduce U.S. reliance on foreign oil. Public support for ethanol, however, has been somewhat mixed. For example, while 59 percent of Americans favor continuing to increase the use of ethanol in our nation's fuel (GQR 2008), only 38 percent favoring ethanol production subsidies (Pew 2011b). Public attitudes toward subsidies may suggest that, in the longer term, public opinion prefers that price signals from consumers rather than the government drive ethanol markets. There are a variety of reasons why the public might support or oppose increased domestic production of ethanol just as there are a variety of reasons why consumers might prefer more or less ethanol in fuel blends. While there is likely to be considerable overlap between public support for increased production of ethanol and consumer willingness-to-pay for gasoline blended with ethanol, there are also likely

to be differences. If the public does prefer that market signals as opposed to government policy drive ethanol markets, then the factors that influence consumer willingness-to-pay for ethanol blends take on added significance.

This study analyzes the extent to which percent of fuel derived from foreign sources effects consumer willingness-to-pay (WTP) for fuel blends and how this willingness-to-pay varies over consumer characteristics. For example, WTP for reducing imports through ethanol blends may vary regionally, since some regions produce ethanol feedstock, while the economies of other regions are more reliant on oil production and refining. This study complements previous research that has evaluated the effects of consumer demographics and attitudes on WTP for ethanol by feedstock source and emission reductions.

Objectives

This study uses a contingent choice exercise embedded in an online survey of U.S. automotive fuel consumers to a) examine consumers' views toward reducing oil imports, drilling, the environment, and food security, b) ascertain WTP for oil import reductions through consumption of E85, an automotive fuel blend comprised of 85 percent ethanol and 15 percent gasoline, and c) estimate the effects of consumer demographics, attitudes and region of residence on WTP for reductions in the share of E85 derived from foreign sources

Prior Research

Public attitudes toward ethanol have been examined in a number of recent public opinion polls. In a 2007 CBS/New York Times Poll, more respondents believed using ethanol was "mostly a good idea" (70%), than coal (43%), natural gas (51%) or nuclear (36%), but less than renewable energy generally (87%) (CBS News/ New York Times Poll, April, 2007). A Pew Research Center poll conducted in 2008 found that support for ethanol research had dipped to 57

percent from a 2006 level of 67 percent, with a lower percentage of respondents supporting it than favored improving automotive fuel efficiency (90%), or increasing funding for alternative energy (81%) or mass transit (72%). However, support for ethanol research did exceed support for promoting more nuclear power (44%), tax cuts for oil exploration (42%) and increasing gasoline taxes (22%). This poll also showed that support for ethanol research funding was stronger among Independents, those who had attended college, and those living in the Midwest (Pew 2008). In another 2008 poll, 59 percent of respondents favored continuing to increase the use of ethanol in our nation's fuel supply, while 30 opposed doing so (GQR 2008). However, when examining ethanol subsidies, consumer support has been found to be relatively weak at only 38 percent (Pew 2011b).

Several studies have examined consumer attitudes toward renewable fuels and their potential for reducing reliance on foreign oil. Skipper, et al (2009) examined consumer perceptions regarding the tradeoff between renewable fuels and food in the United States and Belgium. Results show that respondents in both countries prefer lower food prices to lower fuel prices (67.6% in the U.S. and 78.9% in Belgium). They estimated a logit model to ascertain which variables impacted whether a consumer favored policies that lower fuel prices at the cost of higher food prices. Older respondents placed more importance on lower food prices than lower fuel prices. Gender, education, and income level did not influence the tradeoff between food and fuel prices significantly. Among the attitudinal variables, the stronger the consumer's attitudes toward importance of domestic fuel production, the less likely they were to choose lower food prices over lower fuel prices.

Ulmer, et al., (2004) using a stratified mail survey of 685 registered voters in Oklahoma, found that respondents generally considered cost to be more important than environmental

impact and environmental impact to be more important than vehicle performance in their decision to purchase an ethanol blend. They also found that 59.2 percent of respondents viewed a reduction of dependency on imported oil as the greatest potential benefit from the use of ethanol blends, while 57.7 percent believed that ethanol was better for the environment than gasoline. No significant correlation was found between willingness to purchase an ethanol blend and either gender, education, income, age, or urban or rural location of household.

Van de Velde et al. (2009) investigated the importance of fuel characteristics to Belgian consumers and their beliefs about biofuels. They found that fuel price, availability in fuel stations, safety, quality assurance, and environmental friendliness were perceived as very important in fuel choice by more than 80 percent of the respondents. However, whether the fuel was produced in-country was only rated as very important by about one-third of respondents.

Li, et al. (2009), using a combination of data from a national random digital telephone survey and an online survey, found energy security was also a concern among respondents. The estimated mean annual U.S. household WTP (in the form of increased prices for electricity and gasoline) for the creation of a fund that would invest in research and development for energy sources that were not reliant on fossil fuels was estimated to be $137. WTP was higher for females, liberals, those with higher incomes and those who believed that it was important to reduce dependence on imported energy.

Solomon and Johnson (2009) reports the results of a survey of Michigan, Minnesota and Wisconsin residents that included a contingent valuation exercise to estimate WTP for ethanol produced from cellulosic feedstock. Respondent mean WTP for cellulosic ethanol was estimated to $556 per capita per year, while median WTP was approximately 20 cents per gallon. Using the same survey, Johnson, et al., (2011) conducted a principal component analysis that identified

seven different factors including one titled “Energy Security” that grouped respondents based on their level of agreement (on a Likert scale of one to five) with the statements “I am concerned about America’s energy security” and “America should produce all of its own energy”. However, when the factor loadings were regressed against WTP derived from a “Fair Share” valuation exercise, the Energy Security factor loadings were not statistically significant.

Petrolia, et al. (2010) conducted a nationwide survey of consumer preferences for E10 and E85 using the contingent valuation methodology. They found that when the respondents were asked to choose the best approach to reducing gasoline consumption in the U.S., 51 percent of the respondents chose increased use of hybrid, fuel-cell, and other non-petroleum-based vehicles, 25% chose increased ethanol use, and 24% chose increased public transportation. They also found that 54 percent of the respondents believed that, compared to gasoline, increased use of E10 would have a positive effect on national security, while 45 percent believed that increased use of E10 would have little effect on national security and only one percent believed that increased use would have a negative effect on national security. Also, when given the choice for why the U.S. should pursue an alternative-fuels program, 38 percent chose for national security reasons alone (while 40 percent chose for environmental reasons alone, 18 percent chose for economic reasons alone, and only 4 percent of the respondents saw no reason why the U.S. should pursue an alternative fuels program). Estimated mean WTP for E10 ranged from 6.2 to 12.4 cents per gallon depending on the econometric method used, while mean WTP for E85 ranged from 13.1 cents per gallon to 15.2 cents per gallon.

Jensen et al. (2010) estimated WTP for E85 (from a contingent choice exercise contained in a national survey of consumers. The choice exercise included E85 blends from three different feedstock sources (corn grain, switchgrass, and wood wastes) and an E10 blend (10% ethanol

and 90% gasoline) with corn grain as the ethanol feedstock. Results from the study indicate WTP a premium for E85 from switchgrass compared with E10 from corn. WTP for E85 from switchgrass was nearly 1 cent per mile greater than E10 from corn (about 19 cents per gallon for a 20 mpg vehicle). Concerns about land use for "food versus fuel" had a negative impact on WTP for E85 from corn grain, however, greater concerns about fuel security relative to the environment had a positive impact.

Economic Model

Contingent choice exercises, such as the one used in this study, are based on the theory of utility maximization. They operate on the assumption that respondents, when presented with a choice of alternatives, will choose the alternative that possesses the combination of attributes that would provide them the highest level of utility. Thus, the utility received from a particular alternative is related to a set of observable attributes associated with the choice, and, for individual *i*, the utility received from alternative *j* can be expressed as

(1) $U_{ij}=\boldsymbol{\beta' X_{ij}}+\varepsilon_{ij}$

where $\mathbf{X_{ij}}$ is a vector of observed attributes with conformable parameter vector $\boldsymbol{\beta}$, and the error term ε_{ij} is independently and identically distributed (iid) as type-I extreme value distribution. The conditional logit model (McFadden(1972) and Steckel and Vanhonacker (1988)) can be estimated based on the following probability for individual *i* and alternative *j*:

(2) $$p_{ij} = \frac{\exp(\boldsymbol{\beta' X_{ij}})}{\sum_j \exp(\boldsymbol{\beta' X_{ij}})}$$

The WTP for attribute *k* is then calculated as

(3) $$WTP_k = \frac{\widehat{\beta_k}}{\widehat{\beta_P}}$$

where $\widehat{\beta_k}$ represents the estimated coefficient for the *k*th attribute and $\widehat{\beta_P}$ is the estimated coefficient on price, P.

The conditional logit is restrictive due to its assumptions of homogeneity of individuals as evidenced by the constant β and iid of the error terms ε_{ij} across all individuals and alternatives (Steckel and Vanhonacker 1988). One means of incorporating heterogeneity of preferences across individuals is by relating the deterministic component of the utility function to attitudinal and/or demographic variables in a "mixed" model (Hanley et al. 2001; Steckel and Vanhonacker 1988). With a mixed model approach, the coefficient of the *k*th attribute, β_k, is specified as a function of attitudinal and demographic characteristics, **Z***, such that*:

$$(4) \qquad \beta_k^* = \beta_{k0} + \beta_{k1}\mathbf{Z_1} + \beta_{k2}\mathbf{Z_2} + \ldots + \beta_{kn}\mathbf{Z_n} .$$

The β_k^* can be substituted back into equation (3) to obtain WTP estimates. Hence, in practice, the demographic and attitudinal variables are interacted with the product attribute. WTP can then be calculated at sample means of the demographic and attitudinal variables or at other specified values. Estimates of standard errors around the WTP values can be calculated using the Krinsky Robb method (Krinsky and Robb 1991).

Data

Researchers, via Knowledge Networks, conducted a survey using a MSN WebTV platform on January 16th, 2009 to panel members age 18 or older who represented a general population sample. The survey was fielded to 1,425 panel members, 1,010 responses were received, and 914 survived screening questions and provided useable responses.

Respondents were asked to evaluate combinations of attributes for ethanol blended with regular gasoline (E85) in a conjoint analysis. The exercise consisted of fourteen different choice tasks, with three of these as holdout tasks that were constant across all respondents. Each choice

task had four alternative combinations of fuel attributes and respondents were asked to select their most preferred alternative from these four. In lieu of a "none" option (i.e., the respondent would not choose to purchase any of the other three attributes), the fourth option in each choice task was a "fixed" alternative in which the attribute values did not vary from one choice task to another. The rationale for using the fixed alternative in lieu of a none option was that it was a better representation of the typical choice faced by automobile owners. The fuel blend for the fixed alternative was -E10 (or a fuel blend composed of 10 percent ethanol and 90 percent gasoline) where the ethanol was derived from corn grain. The other three alternatives were all E85, but varied in terms of fuel price ($/gal. and $/mi.), percent of fuel from imported sources, level of GHG reductions compared with E10, and availability of the fuel nearby. Price per mile was calculated using an example vehicle that gets 20 miles per gallon (MPG) with E85. The price levels used for the E85 alternatives were 6.7, 7.1, 7.5, 7.9, and 8.3 cents for each mile driven, while the fixed E10 alternative was priced at 7.5 cents per mile. Assuming a 20 mile per gallon vehicle, these prices per mile convert to $1.34, $1.42, $1.50, $1.58, and $1.66/gallon for E85 and $2.00/gallon for E10. The E85 could come from a variety of feedstocks (including cellulosic), while the feedstock for the E10 blend was corn. The percentages of fuel from imported sources 10, 33, and 50 percent, with the E10 alternative listed as being 60 percent from imported sources. The levels of emissions reductions were 10 percent, 50 percent, and 73 percent compared with E10. Availability of the E85 alternative was stated as being located at a fuel station that was "on your way" or either 2 or 5 minutes "out of your way". The fixed E10 alternative was available at a station that was 2 minutes out of the way. Names, definitions, and means of the fuel attribute variables are provided in Table 1.

The import level attribute was interacted with several demographic and attitudinal variables (Table 1). The attitudinal variables included agreement with the statements that our dependence on foreign oil is important to improving our national security, that farmland should be devoted to producing food and not fuel, that more land in the U.S. should be opened up for oil drilling, and that we have a personal responsibility to future generations to protect the environment. Demographics included dummy variables for whether the respondent was over 50 years old whether the respondent had attended college, whether the respondent's income fell within two different categories ($25K-$50K and $50K-$75K), and whether the respondent resided in one of four different U.S. regions The four regions were the Midsouth (Arkansas, Kentucky, Tennessee, and West Virginia), the Southern Oil States (Louisiana, Oklahoma, and Texas), or the Northeast (Connecticut, Massachusetts, Maine, New Hampshire, New Jersey, Pennsylvania, Rhode Island, and Vermont), with all other states in the omitted category. The means presented in Table 1 are the means of the variable interacted with import level.

Results and Discussion

As shown in Figure 1, nearly 79 percent of respondents agreed that reducing foreign oil was important to national security. Over 52 percent agreed that more land should be opened up for drilling. About 42 percent believed farmland should be used for food, not fuel and nearly 80 percent believed it was our responsibility to protect the environment for future generations. Hence, while there tended to be high levels of agreement that both fuel security and the environment are important, there tended to be less agreement among the respondents about how to attain these goals.

As can be seen in Table 2, from the likelihood ratio test, the Conditional Logit model was significant overall. The Pseudo R^2 was just under 0.23. All of the product attribute variables were significant at the one percent level while all of the interaction variables were significant at the 10

percent level or greater. As would be expected, the estimated coefficient on price was negative as was the coefficient on increased import levels and increased time "out of the way" that the alternative was available. The sign on emission reductions, on the other hand, was positive as one would expect.

Among the attitudinal variables which were interacted with the import level variable, the negative sign on concern about fuel security (Secure_Imp) indicated that those who were more concerned about the Nation's fuel security were less likely to purchase an alternative with a higher quantity of imported fuel than those who were not as concerned about the Nation's fuel security. Thus, those who were more concerned about fuel security would require a larger price discount to choose an alternative with a higher level of imported fuel. Similarly, those who were more concerned about protecting the environment for future generations (Envir_Imp) placed a larger discount on imported fuel. On the other hand, the positive sign on interaction between the dummy variable representing agreement that farmland should be used for food and not fuel and import level (Food_Imp) suggests that those concerned with food security placed a smaller discount on imported fuel. Furthermore, those who felt more land should be opened up for drilling (Drill_Imp) also placed a smaller discount on imported fuel.

The estimated parameters for the interactions between demographic variables and the percent of the fuel blend that was imported suggest that those who were older than 50 years old, had attended college or had household income between $50,000 and $75,000 placed a smaller discount on imported fuel or were somewhat more likely to purchase an alternative with a higher imported content than those who were 50 or younger, had not been to college or had household income less than $25,000 or more than $75,000. Somewhat lower income respondents, , i.e., those with incomes between $25,000 and $50,000 placed a larger discount on imported fuels

than respondents at other income levels. Thus, respondents with lower income levels were generally less likely to choose an alternative with a higher level of fuel derived from imported sources than those with higher household incomes.

While several regions were examined, the only ones for which the parameter estimates for the interaction variables between the region of respondent residence and the level of fuel derived from imported sources were significant were Midsouth (AR, KY, and WV), Southern Oil States (LA, OK, and TX), and the Northeast (CT, MA, ME, NH, NJ, NY, PA, RI, and VT). While Midsouth residents place a greater discount on imported fuel, residents of the Southern Oil States and the Northeast placed a smaller discount on imported fuel. One potential reason for the Southern Oil States residents placing a smaller discount on imports could be the importance of imported oil to the refining industries in these states. Residents in the Northeast may hold smaller discounts on imported fuel due to more ready access to public transportation in certain areas of the Northeast.

The marginal effects of each of the variables on the likelihood of choosing an alternative are provided in Table 2. All of the marginal effects are significant except for the drilling attitude variable.

WTP estimates along with their standard errors are provided in Table 3. The discount placed per percentage point of imported fuel is -0.595 cents per mile. If the estimate of WTP for the import level in fuel is calculated on a per gallon basis, assuming an automobile that has a fuel efficiency rating of 20 miles per gallon, the discount for each percentage point increase in the quantity of fuel imported would be 11.9 cents per gallon. Thus, consumers appear to be quite responsive to changes in the level of imported fuel. Contributions of each of the demographic, attitude, and regional variables to WTP reveal that respondent concerns about fuel security and

the environment had the largest negative contributions (i.e., increased the discount on imported fuel), while being in an oil producing state had the largest positive contribution (i.e., decreased the discount on imported fuel).

The effect of changing each of the attitudinal, demographic, and regional dummy variables from 0 to 1 on WTP is presented in Table 4. Respondents who agreed with the statement about the importance of fuel security, discounted imported fuel by 0.711 cents per mile (14.22 cents per gallon) more than respondents who did not agree with the statement, on average. Respondents who agreed with the statement about the need to preserve the environment for future generations discounted imported fuel by 0.483 cents per mile (9.66 cents per gallon) more than those who did not. Respondents located in the Midsouth discounted imported fuel by 0.663 additional cents per mile (13.26 cents per gallon). However, respondents located in one of the southern oil producing states placed less of a discount on imported fuel (0.785 cents per mile or 15.70 cents per gallon).

To further illustrate how WTP for level of fuel derived from foreign sources varies over consumers, two example profiles were developed based upon the signs of the estimated coefficients in the Conditional Logit model for those placing greater discounts on imports. As can be seen in Table 5, in one profile (Profile 1) the consumer agrees that reducing our dependence on foreign oil is important to improving the Nation's fuel security and that we have a responsibility to future generations to protect the environment, but disagrees with the assertion that farmland should be used to produce food and not fuel and that more lands should be opened up for drilling, while the opposite is true for the other profile (Profile 2). Similarly, for Profile 1, the consumer is assumed to be less than 51 years of age, has no college education, has a household income between $25,000 and $50,000, and resides in the Midsouth. For Profile 2, the

consumer is assumed to be more than 50 years old, had attended at least some college, has a household income between $50,000 and $75,000, and resides in one of the Southern Oil States. The consumer that fits Profile 1places a high discount on imported fuel as that person would be willing to pay 2.077 cents per mile or about 41.54 cents per gallon less for each percentage point increase in the level of fuel derived from foreign sources. On the other hand, the consumer who fits Profile 2 would be willing to pay 1.7 cents per mile or about ___ cents per gallon more for each percentage point increase in the level of imported fuel.

WTP was also calculated at the sample means for each region as shown in Table 6. Notably the WTP calculated at the means for the Southern Oil States is not significantly different from zero, while the WTP for each of the other geographic regions is negative and significantly different from zero. The largest magnitude WTP is for the Midsouth region.

Conclusions/Discussion

The issue of fuel security is clearly a concern for many Americans, with net imports showing an overall rising trend since the 1950's (EIA 2011b). However, the means by which to improve the Nation's fuel security are less clear. One way to ameliorate some of the concerns over fuel security is to increase the domestic production of alternative fuels. However, the public's attitudes toward ethanol have been somewhat mixed. This study examined how consumers view import levels in fuel, in choosing between a blend closely representing the national blend as it currently stands (around 10 percent) (EIA 2011a) and different "varieties" of an 85 percent ethanol blend. The results from the study suggest that while consumers had strong feelings about the environment and fuel security, their feelings about how to attain fuel security while protecting the environment were mixed, with no clear majority supporting additional drilling or reserving farmland for food production. Their views on the fuel security and environmental issues, did however, impact their willingness to pay for import levels in fuels by

increasing the discount they would require to purchase a fuel blend with a higher content of imported fuel. The results also support the notion that there are likely to be regional differences in consumer willingness to pay for reductions in import levels. More particularly, consumers in midsouth states (Arkansas, Kentucky, and West Virginia) are likely to be willing to pay more for these reductions, while consumers in southern oil-producing states (Louisiana, Oklahoma, and Texas) are not as likely to require as high a reduction in price to choose a fuel alternative with a higher content of imported fuel.

References Used

Bolsen, T., and F. Cook. 2009. "The Polls-Trends, Public Opinion on Energy Policy: 1974-2006." *Public Opinion Quarterly* 72(29): 364-388.

Columbia Broadcasting System (CBS)/ New York Times. 2007. "Global Warming Worries Grow." Apr. 20-24. Available at http://www.cbsnews.com/stories/2007/04/26/opinion/polls/main2731709.shtml.

EIA (Energy Information Administration), United States Department of Energy. 2011a "Has Ethanol Share hit the "Blend Wall?" *This Week in Petroleum* November 23. Available at http://www.eia.gov/renewable/.

EIA I(Energy Information Administration), United States Department of Energy. 2011b. "How Dependent are we on Foreign Oil?" Available at http://www.eia.gov/energy_in_brief/foreign_oil_dependence.cfm.

EIA (Energy Information Administration), United States Department of Energy. 2011c. Petroleum and Other Liquids, U.S. Crude Oil Supply and Disposition. Available at http://www.eia.gov/dnav/pet/pet_sum_crdsnd_k_a.htm.

GBR (Greenbert Quinlan Rosner Research). 2008. Public Support for Ethanol: National Survey Results. Available online at http://www.ethanol.org/pdf/contentmgmt/Public_support_for_ethanol_RFA_poll_71508.pdf.

Hanley, N., S. Mourato, and R. Wright. 2001. "Choice Modelling Approaches: a Superior Alternative for Environmental Valuation?" *Journal of Economic Surveys* 15(31): 435–462.

Jeanty, P., T. Haab, and F. Hitzhusen. 2007. "Willingness to Pay for Biodiesel in Diesel Engines: A Stochastic Double Bounded Contingent Valuation Survey." *Selected Paper* presented at the American Agricultural Economics Association Annual Meeting, Portland, OR, July 23-26.

Jensen, K., C. Clark, B English, J. Menard, D. Skahan, and A. Marra. 2010. "Willingness to Pay for E85 from Corn, Switchgrass, and Wood," Energy Economics 32(6): 1253-1262.

Johnson, Dana M., Kathleen E. Halvorsen, and Barry D. Solomen. 2011. "Upper Midwestern U.S. consumers and ethanol: Knowledge, beliefs and consumption," *Biomass & Bioenergy* 35: 1454-1464.

Krinsky, I. and A. Robb. 1991. "Three Methods for Calculating the Statistical Properties of Elasticities: A Comparison," *Empirical Economics* 2**(**16): 199–209.

Li, H., H. Jenkins-Smith, C. Silva, R. Berrens, and K. Herron. 2009. "Public Support for Reducing US Reliance on Fossil Fuels: Investigating Household Willingness-to-pay for Energy Research and Development," *Ecological Economics* 68(39): 731-742.

McFadden, D. 1972. Conditional Logit Analysis of Qualitative Choice Behavior. Institute of Urban and Regional Development, University of California.

Petrolia, Daniel R., Sanjoy Bhattacharjee, Darren Hudson, and Cary W. Herndon. 2010. "Do Americans want ethanol? A comparative contingent-valuation study of willingness to pay for E-10 and E-85," *Energy Economics* 32(1): 121-128.

Pew Research Center for the People and the Press. June 10, 2011. Views of Middle East Unchanged by Recent Events Public Remains Wary of Global Engagement. Available at http://www.people-press.org/2011/06/10/views-of-middle-east-unchanged-by-recent-events/.

Pew Research Center for the People and the Press. November 10, 2011. Partisan Divide Over Alternative Energy Widens Republicans View Gov't Energy Investments as Unnecessary. Available at http://www.people-press.org/2011/11/10/partisan-divide-over-alternative-energy-widens/.

Pew Research Center. 2008. Ethanol Research Loses Ground, Continued Division on ANWR; Public Sends Mixed Signals On Energy Policy. *News Release* (March 6). Washington, D.C.: Pew Research Center.

Skipper, D., L.Van de Velde, M. Popp, G.Vickery, G.Van Huylenbroeck, and W. Verbeke. 2009. "Consumers' Perceptions Regarding Tradeoffs Between Food and Fuel Expenditures: A Case Study of U.S. and Belgian Fuel Users," *Biomass and Bioenergy* 33(6-7): 973-987.

Steckel, H. and W.Vanhonacker. 1988. "A heterogeneous conditional logit model of choice," *Journal of Business & Economics Statistics* 6(3): 391–398

Ulmer, J., R. Huhnke, D. Bellmer, and D. Cartmell. 2004. "Acceptance of ethanol-blended gasoline in Oklahoma," *Biomass & Bioenergy* 27(5): 437-444.

Van de Velde, L., W. Verbeke, M.Popp, J. Buysse, and G.Van Huylenbroeck. 2009. "Perceived Importance of Fuel Characteristics and its Match with Consumer Beliefs About Biofuels in Belgium," *Energy Policy* 37(8): 3183-3193.

Table 1. Names, Definitions, and Means of Variables Used in the Model.

Variable Name	Definition	Mean
Price	6.7, 7.1, 7.5, 7.9, and 8.3 cents per mile	7.499
Import	10%, 33%, 50%, and 60%	38.228
Emission	0%, 10%, 50%, and 73% reductions compared with E10	33.243
Availability	0, 2, or 5 minutes out of way	2.248
E85	1 if E85, 0 otherwise	0.750
Opinion/Import Interactions		(Interacted Means)
Secure_Imp	1 if somewhat or strongly agree that reducing our dependence on foreign oil is important to improving our national security, 0 otherwise	29.332
Food_Imp	1 if somewhat or strongly agree that farmland should be devoted to producing food and not fuel, 0 otherwise	15.263
Drill_Imp	1 if somewhat or strongly agree that more land in the U.S. should be opened up for oil drilling, 0 otherwise	19.533
Envir_Imp	1 if somewhat or strongly agree that we have a personal responsibility to future generations to protect the environment, 0 otherwise	29.828
Demographic/Import Interactions		
AgeGT50_Imp	1 if age greater than 50, 0 otherwise	15.217
College_Imp	1 if some college or greater, 0 otherwise	22.252
Inc2550_Imp	1 if income $25K to $50K, 0 otherwise	11.892
Inc5075_Imp	1 if income $50K to $75K, 0 otherwise	8.009
OInc_Imp	Omitted category-Income less than $25K or at least $75K	
Region/Import Interactions		
MS_Imp	1 if reside in Midsouth, 0 otherwise	1.915
Oil_Imp	1 if reside in Southern Oil states, 0 otherwise	3.535
NE_Imp	1 if reside in Northeast, 0 otherwise	6.230
OSt_Imp	Omitted category-All other states	

Table 2. Estimated Conditional Logit Model[a,b]

Variable	Est. Coeff.	Std. Err.	Z		Marginal Effect	Std. Err.	Z	
Attributes								
Price	-0.950	0.032	-29.66	***	-0.00057	0.000124	-4.60	***
Import	-0.011	0.003	-4.18	***	-6.67E-06	2.14E-06	-3.12	***
Emission	0.007	0.001	10.44	***	3.95E-06	1.05E-06	3.76	***
Availability	-0.159	0.008	-19.38	***	-9.5E-05	2.36E-05	-4.01	***
E85	0.414	0.067	6.23	***	0.000248	8.38E-05	2.95	***
Attitudes Interactions								
Secure_Imp	-0.018	0.002	-7.62	***	-1.1E-05	2.96E-06	-3.57	***
Food_Imp	0.004	0.002	2.36	**	2.41E-06	1.17E-06	2.06	**
Drill_Imp	0.003	0.002	1.74	*	1.84E-06	1.13E-06	1.62	
Envir_Imp	-0.012	0.002	-5.36	***	-7.18E-06	2.23E-06	-3.22	***
Demographic Interactions								
AgeGT50_Imp	0.004	0.002	2.13	**	2.29E-06	1.21E-06	1.89	*
College_Imp	0.005	0.002	2.48	**	2.72E-06	1.28E-06	2.13	**
Inc2550_Imp	-0.005	0.002	-2.59	***	-3.05E-06	1.40E-06	-2.18	**
Inc5075_Imp	0.005	0.002	2.13	**	2.80E-06	1.48E-06	1.89	*
Regional Interactions								
MS_Imp	-0.016	0.004	-4.15	***	-9.85E-06	3.47E-06	-2.84	***
Oil_Imp	0.020	0.003	6.14	***	1.17E-05	3.42E-06	3.40	***
NE_Imp	0.005	0.002	2.13	**	2.75E-06	1.47E-06	1.86	*
N=40,108								
LLR Test Wald χ^2 (16)=3075.10***								
Pseudo R^2 = .2292								

[a] *** indicates significance at α=.01, ** indicates significance at α=.05, and * indicates significance at α=.10.

[b] Standard errors of marginal effects are calculated using the Delta method and are for the average group (group specific deviations are assumed to be zero).

Table 3. WTP Estimates[a.b]

Variable	WTP (¢/mi)	Std. Error	Z	
Attributes				
Import	-0.595	0.186	-3.19	***
Emission	0.007	0.001	5.07	***
Availability	-0.167	0.020	8.33	***
E85	0.435	0.143	3.05	***
Attitudes				
Secure_Imp	-0.546	0.146	-3.74	***
Food_Imp	0.065	0.054	1.20	
Drill_Imp	0.063	0.072	0.87	
Envir_Imp	-0.377	0.140	-2.70	***
Demographics				
AgeGT50_Imp	0.062	0.057	1.08	
College_Imp	0.106	0.084	1.26	
Inc2550_Imp	-0.064	0.049	-1.32	
Inc5075_Imp	0.039	0.037	1.07	
Regions				
MS_Imp	-0.033	0.016	-2.09	***
Oil_Imp	0.073	0.024	3.08	***
NE_Imp	0.030	0.028	1.09	

[a] *** indicates significance at α=.01, ** indicates significance at α=.05, and * indicates significance at α=.10.

[b] Standard errors are calculated using the Krinsky Robb method.

Table 4. Change in WTP for Imports With a Change in Attitudinal, Demographic, or Regional Dummy[a,b,c]

Variable	Change in WTP (¢/mi)	Std. Error	Z	Change in WTP (¢/gal)[c]
Attitudes				
Secure_Imp	-0.711	0.190	-3.736 ***	-14.22
Food_Imp	0.163	0.135	1.205	3.26
Drill_Imp	0.123	0.141	0.874	2.46
Envir_Imp	-0.483	0.179	-2.700 ***	-9.66
Demographics				
AgeGT50_Imp	0.155	0.144	1.075	3.10
College_Imp	0.183	0.145	1.263	3.66
Inc2550_Imp	-0.207	0.157	-1.320	-4.14
Inc5075_Imp	0.187	0.174	1.073	3.74
Regions				
MS_Imp	-0.663	0.318	-2.085 ***	-13.26
Oil_Imp	0.785	0.255	3.077 ***	15.70
NE_Imp	0.184	0.169	1.088	3.68

[a] *** indicates significance at α=.01, ** indicates significance at α=.05, and * indicates significance at α=.10.
[b] Standard errors are calculated using the Krinsky Robb method.
[c] Assumes a 20 MPG vehicle.

Table 5. Two Example Profiles and WTP Estimates Calculated at Profiles[a,b]

Variable	Profile 1:	Profile 2:
Agree that reducing our dependence on foreign oil is important to improving our national security	Yes	No
Agree that farmland should be devoted to producing food and not fuel	No	Yes
Agree that more land in the U.S. should be opened up for oil drilling	No	Yes
Agree that we have a personal responsibility to future generations to protect the environment	Yes	No
Age Greater than 50	No	Yes
College Educated	No	Yes
Income Level	$25K-$50K	$50K-$75K
Regional Location	Midsouth	Southern Oil States
WTP for Import Level (¢/mi)	-2.077 *** [0.426]	1.700 *** [0.507]

[a] Standard errors are in brackets below the WTP estimates and are calculated using the Krinsky Robb method.
[b] *** indicates significance at α=.01, ** indicates significance at α=.05, and * indicates significance at α=.10.

Table 6. Willingness to Pay for Import Levels in Fuel by Region, at Regional Means[a,b]

Region	WTP (¢/mi)	Std. Error	Z	
Midsouth	-1.340	0.376	-3.57	***
Southern Oil States	0.207	0.320	0.65	
Northeast	-0.496	0.250	-1.98	**
Other States	-0.668	0.186	-3.59	***

[a] Standard errors are in brackets below the WTP estimates and are calculated using the Krinsky Robb method.
[b] *** indicates significance at α=.01, ** indicates significance at α=.05, and * indicates significance at α=.10.

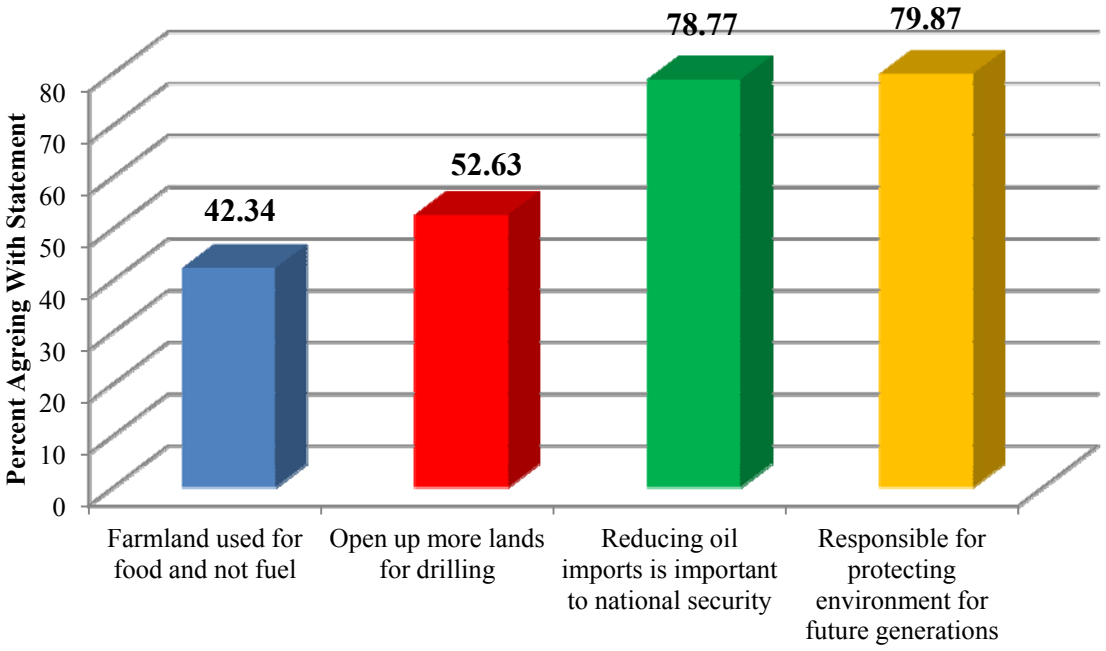

Figure 1. Agreement with Statements About Fuel and Food Security and the Environment.