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CONSUMER'S WILLINGNESS TO PAY FOR GASOHOL E100 IN CHIANG MAI PROVINCE AND NAKHON RATCHASIMA PROVINCE.

Abstract:

The purposes of this research was conducted to study the behavior of consumers who use gasohol and their willingness to pay for it and also to determine factors that influence consumer to pay for gasohol E100 in Chiang Mai and Nakhon Ratchasima Province. Contingent Valuation Method (CVM) was adopted as a hypothetical situation in the form of questionnaires which consists of double bounded dichotomous choice. Maximum Likelihood Estimation (MLE) was the method of analysis used and willingness to pay for gasohol by using Generalized Ordered Logit Model. Stata is needed for collecting data. The result of research found out that due to 800 samples from two sample group (Chiang Mai 400 samples and Nakhon Ratchasima 400 samples) to compare the willingness to pay for gasohol E100. It is discovered that most consumers was unwillingness to pay for the second gasohol quotation which was lower 32.50 Bath per liter due to most consumer were unconvinced the quality of gasohol E100. The measurement of willingness to pay for gasohol E100 average was 30.64 baths per liter in Chiang Mai group and 27.12 baths per liter in Nakhon Ratchasima group. In addition, attitude toward the environment is one of all factor are determining the willingness of consumers to pay for gasohol E100. Gasohol E100 is unknown among the majority of car users. Thailand Government should carry out promote and inform people about the benefits and drawbacks of gasohol E100 and should research on it. It should be supported as a short term and long term study. As a consequence, consumers will understand and be confident in using gasohol E100. This will change willingness of consumers to pay for gasohol E100

Keywords:

Willingness to pay; Gasohol E100; Energy

JEL Classification: C25, D10, Q58

1. Introduction

Many countries always try to conduct research to find new energy sources in order to replace nowadays highly and continuously consumed and depleting power sources. Energy is considered to be one of the most important resources for developing country, especially, to a developing-country such as Thailand. All sectors of the economic system such as industrial, business, tourism and hospitality, or even households all have need for power consumption in different levels. This amplifies the rate of power and energy consumption of Thailand every year (Ministry of Energy, 2015). Nevertheless, due to the limitation of resources in the country, hence the importing of power and energy from foreign countries, especially, fuel energy such as oil and petroleum products in order to provide sufficient amount of power and energy needed for in-country consumption.

Many organizations in Thailand both government and private sectors have the policies to encourage and support the reservation and preservation of natural resources and environment. Among them is the policy to encourage the people within the country to use clean energy called Ethanol fuel, which is considered to be renewable energy and has great benefits toward the environment. The energy itself can be produced by agricultural crops in Thailand (Nguyen, T. L. T., and Gheewala, S. H., 2008). Therefore, Ethanol fuel has become another alternative energy which helps decreasing Thailand's agricultural problems which is the price decline of agricultural products, moreover, it also helps minimize the amount of importing products such as fuel and petroleum from outside country and also helps to decrease global warming problems caused by air population (CO_2) which starts from engine combustion. Hence, Ethanol fuel will create power and energy stability and durability for Thailand in the future.

Until now, there are many people who are interested in alternative energy and Conducted research on new alternative energy such as electrical energy (Zhang and Yang, 2012; Bigema and Polinori, 2014 and Guo et al., 2014), including alternative energy fuel of the people in many countries (Nguyen, T. L. T., and Gheewala, S. H., 2008; Le et al., 2013 and Ito N. et al., 2013).

Moreover, most of the research and studies in the past did collect information from sampling group by employing Contingent Valuation Method (CVM) to measure the willingness to pay. And mainly used social and economic factors such as sex, age, education, occupation, income and etc., environmental and marketing mix factor as the relative factors used to determine the willingness to pay (Abdullah and Jeanty., 2011; Daniel et al., 2010 and Makoto et al., 2014). The research method used in this study is Generalized Ordered Logit Model (William et al., 2008).

The rest of the research is organized as follows. Section 2 provides the data description. Section 3 discusses the Methodology. The estimation results are presented in section 4. Finally, section 5 Policy Implications and Conclusions.

2. Data description

2.1 Sampling and Survey

In this study, the researcher acquired samples from groups of people who have already obtained private car driving license, with age range from 18 years old on (According to Thai law, the qualified age for driving license is 18 years old minimum) who live in Muang district, Chiang Mai province and Muang district, Nakhon Ratchasima province, which

can calculate the amount the samples from the number of registered cars (Department of Land Transport, 2014) by Taro Yamane's formula (1973) as follows;

Table 1: Sampling

Province	Taro Yamane	Calculate	Sample size
Chiang Mai	$n = \dfrac{N}{1 + Ne^2}$	$= \dfrac{1,273275}{1+1,273,275(0.05)^2}$	$399.87 \approx 400$
Nakhon Ratchasima		$= \dfrac{1,243,580}{1+1,243,580(0.05)^2}$	400

From the calculation of table 1 sampling, it provides major 2 sample groups, 800 samples, which can be divided into 400 samples from Chiang Mai province and 400 samples from Nakhon Ratchasima province for multistage random sampling.

2.2 The Questionnaires

The structure of the questionnaires consisted with both closed-end questions and opened-end questions in order to collect the information for the analysis by Descriptive Statistics and Econometric. The questionnaire used in the study were divided into 2 sets; 50 Pre-Survey questionnaires and 800 Final-survey questionnaires. Each set is consisted with both close-end and opened-end questions, which contain 4 parts in total;

Part 1:Questions about the economic and social status of the respondents; sex, age, marriage status, education background, profession and average monthly revenue.

Part 2:Questions about the patterns and behaviors of the petrol consumption of the respondents.

Part 3:Questions about their willingness to pay for gasohol E100 by simulating and providing situation with details for the respondents. The surveyor provided the information of both advantages and disadvantages of gasohol E100 to the respondents, and presented the question "if there was a service for gasohol E100 in Muang district of Chiang Mai/ Nakhon Ratchasima province, what is the highest rate you are willing to pay for 1 liter?"

Part 4:Questions about the mixture of the marketing aspects and the attitudes of respondents, which allows the respondents to answer with only 1 answer.

3. Methodology

The generalized order logit model

Fu (1998) and William (2006) are developed the generalized ordinal logit model which can relaxes the proportional odds (PO) assumption for ordinal regression analysis by allowing the effect of each explanatory variable to vary across different cut points of the ordinal outcome variable without data restructuring (Liu and Koirala, 2012)

In this study, four categories of willingness to pay (WTP) are defined by an ordinal scale where, j represent four levels of WTP (M=4), namely the respondents' *WTP* value below 32.50 Baht/liter)Y = 0), between 32.50 – 34.90 Baht/liter (Y=1), between 35 - 37.40 Baht/liter (Y=2) and above 37.50 Baht/liter (Y=3). To estimate the ordinal data, generalized order logit is proposed. According to Fu (1998) and William (2006) the model can be rewritten as

$$\ln(Y_j') = \ln\left(\frac{\delta_j(X)}{1-\delta_j(X)}\right)$$

$$= \alpha_i + \beta_{ij}X_i$$

(1)

Where α and $\beta_{i,j}$ are the intercept term and logit coefficients. X_i are the independent variable. This model estimated the odds of being beyond the recent category relative to being at or below this category. In the partial proportional odds model, some of β the coefficients can be the same for all values of j, while others can differ.

$$P(Y_i > j) = g(X\beta) = \frac{\exp(\alpha_i + X_i\beta)}{1+\{\exp(\alpha_j + X_i\beta\}}$$

(2)

Thus, in this study, we can write the model as follows

$$P(Y_i = 0) = 1 - g(X_iB_0)$$
$$P(Y_i = 1) = g(X_iB_0) - g(X_iB_1)$$
$$P(Y_i = 2) = g(X_iB_1) - g(X_iB_2)$$
$$P(Y_i = 3) = g(X_iB_2)$$

Where $j = 1,...M-1$ and $P(Y_i = j)$ are the probabilities of the WTP at each level.

To estimate the parameters in the model, the maximum likelihood estimation is employed. Thus, we need to maximize the following log likelihood function;

$$L(\alpha_i, \beta_i) = \sum_{Y=0} \log\left[\Phi(\alpha_1 - X_i\beta_0)\right] + \sum_{Y=1} \log\left[\Phi(\alpha_0 - X_i\beta_0)\right] - \log\left[\Phi(\alpha_1 - X_i\beta_1)\right]$$
$$+ \sum_{Y=2} \log\left[\Phi(\alpha_1 - X_i\beta_1)\right] - \log\left[\Phi(\alpha_2 - X_i\beta_2)\right] + \sum_{Y=3} \log\left[\Phi(\alpha_2 - X_i\beta_2)\right]$$

(3)

After we obtain the estimated parameter, the marginal effects are compute to explain the effects change of independent variable on the probability of WTP $Y=0, Y=1, Y=2$ and $Y=3$ In case of generalized order logit model, it is therefore, the effects of independent variables are expressed in terms of marginal effects which can be derived as follows (Green, 2008);

$$\frac{\partial P(Y=0|X)}{\partial X} = -(\phi X_i\beta)\beta$$

$$\frac{\partial P(Y=1|X)}{\partial X} = ((-\phi X_i\beta) - \phi(\gamma - X_i\beta))\beta$$

$$\frac{\partial P(WTP=2|X)}{\partial X} = (\phi(\gamma - X_i\beta) - \phi(\gamma - X_i\beta))\beta$$

$$\frac{\partial P(WTP = 3 | X)}{\partial X} = \phi(\gamma - X_i \beta) \beta \tag{4}$$

The marginal effect is the slope of the curve that present the effect of independent variable (X_i) to $P(Y = j | X)$. However, these sign of marginal effects are not required to be same as that of coefficients (Long, 1997).

4. Estimation Results

The result can be divided into 2 parts. The first part shows the general information concerning the consumption behaviors of gasohol in general of the sample groups. The second part shows the willingness to pay and the factors that determine the willingness to pay for gasohol E100 of the sample groups.

4.1 The Information Concerning The Petrol Consumption Behaviors

From the samples of the consumers in Chiang Mai and Nakhon Ratchasima province, it was found that the majority of them use gasohol 91, follows by gasohol 95, gasohol E20 and E85. The refueling time is 3 p.m. - 6 p.m. due to the fact that it is the period after the office hours, and they would travel directly home if they do not have other businesses to attend to. In general, there are 4 -6 times a month for refueling. The consumers in Chiang Mai province spend 2,807.75 baht in average for their petrol, which is close to the average amount of money spent by the consumers in Nakhon Ratchasima province 2,979 baht a month.

4.2 The Willingness to Pay for Gasohol E100 Including the Determine Factor for the Willingness of the Sample Groups

Table 2: Estimated result Generalized Ordered Logit Model (Chiang Mai Province)

Var.	WTP the 1st Bid (Y=1) Coefficient (SE.)	WTP the 2nd Bid (Y=2) Coefficient (SE.)	WTP the 3rd Bid (Y=3) Coefficient (SE.)	Marginal Effect			
				Y=0	Y=1	Y=2	Y=3
Constant	-0.381 (1.150)	-2.298* (1.310)	-3.204* (1.835)				
OIL	-0.201* (0.119)	-0.161 (0.128)	-0.122 (0.164)	0.049	-0.017	-0.019	-0.014
BEH	-0.125 (0.179)	-0.176 (0.199)	-0.100 (0.270)	0.031	0.005	-0.025	-0.011
EXP	-0.001*** (0.001)	-0.001*** (0.001)	-0.001* (0.001)	0.001	-0.001	-0.001	-0.001
TIME	-0.269*** (0.102)	0.044 (0.108)	0.220 (0.134)	0.066	-0.075	-0.016	0.025
CC	-0.187 (0.130)	-0.038 (0.142)	-0.238 (0.205)	0.046	-0.038	0.019	-0.027
SEX	-0.159 (0.234)	0.302 (0.244)	0.697** (0.303)	0.039	-0.102	-0.020	0.082
EDU	0.105 (0.132)	0.051 (0.161)	-0.139 (0.226)	-0.026	0.016	0.026	-0.016
INCF	0.135** (0.057)	0.161** (0.065)	0.214** (0.092)	-0.033	0.0002	0.009	0.024

MEM	-0.049 (0.112)	0.052 (0.116)	-0.335** (-.165)	0.012	-0.023	0.048	-0.038
INFO	0.447** (0.197)	0.383** (0.216)	-0.106 (0.268)	-0.110	0.032	0.067	0.012
KNOW	0.198 (0.194)	-0.225 (0.217)	-0.184 (0.285)	-0.049	0.095	-0.025	-0.021
APRI	0.150 (0.182)	0.170 (0.206)	-0.028 (0.287)	-0.037	0.002	0.038	-0.003
APLA	-0.162 (0.217)	-0.127 (0.225)	0.376 (0.337)	0.040	-0.014	-0.068	0.042
APRO	0.018 (0.221)	0.041 (0.249)	0.340 (0.315)	0.031	-0.039	-0.030	0.038
APROM	0.018 (0.225)	-0.004 (0.248)	-0.460 (0.315)	-0.005	0.005	0.051	-0.052
ATI	0.521*** (0.167)	0.230 (0.184)	0.468* (0.262)	-0.128	0.081	-0.006	0.053

Source: Calculate

Note: *, **, and *** denote rejection of the null hypothesis at the 10%, 5%, and 1% significance levels, respectively.   Y = 0 is lower 32.50 baths per liter, Y = 1 is 32.50 – 34.90 baths per liter, Y = 2 is 35 – 37.40 baths per liter and Y = 3 is upper 37.50 baths per liter.

4.1.1 (WTP 1st Bid) it is Y = 0 versus Y = 1, Y = 2 and Y = 3

Consider the significant variables, the study shows that the consumers regularly change the type of fuel by 1%, in this case is gasohol 91 which increases the probability of willingness to pay for Y = 1 for 1.70%. As for the variable costs of fuel (EXP), the study suggests that if the cost for fuel has increased it will affect the reduction of the willingness to pay of the consumers and the time to refuel (TIME). If the consumers change the period time for refueling from one period to another, the probability of willingness to pay for Y = 1 will reduce for 7.50%. And to the consumers who have positive attitude toward the environment (ATI), it will affect the increasing of the probability of their willingness to pay for 8.10%. According to the result of the questionnaire, the consumers deem that there should be more campaign to help encourage people to use environmentally friendly fuels. In addition, the average income per household variable (INCF) and the variable of the ability and capability for receiving news concerning renewable energy (INFO) also affects the willingness of the consumers to pay within Chiang Mai province.

4.1.2 (WTP 2nd Bid) it is Y = 0, Y = 1 versus Y = 2 and Y = 3

The result of the study about WTP 2nd Bid suggests that the variable costs of fuel (EXP); The average income per household variable (INCF) and the variable of the ability and capability for receiving news concerning renewable energy (INFO) are independent variables that show a significant affect the willingness to pay, and cause The willingness to pay for Y = 2 to reduce. Both variables suggest that the consumers are willing to pay for the fuel if these two variables develop in the same direction.

4.1.3 (WTP 3rd Bid) it is Y = 0, Y = 1, Y = 2 versus Y = 3

In this last part, we can see that the variable costs of fuel (EXP) is still the influential variable that significant affects the willingness to pay of the consumers, which clearly shows that the amount of money paying for fuel is very important to their willingness to pay and in accordance with the rules of demand; when the price increases, the demand will decrease. It is also in accordance with the variable of the number within households (MEM). When the number of the household has increased, the expenses will also be

increased and will affect the probability of willingness to pay for 3.80%. On contrary, when we consider the variable concerning the respondents sex (SEX), it shows that male respondents are more willing to pay than female respondents due to the understanding about engine and mechanism and they are more willing to test gasohol E100 more than female respondents. As same as the median income for household variables (INCF), if the consumers have more income, it will accordingly affect their willingness to pay.

Table 3: Estimated result Generalized Ordered Logit Model (Nakhon Ratchasima Province)

Var.	WTP the 1st Bid (Y=1) Coefficient (SE.)	WTP the 2nd Bid (Y=2) Coefficient (SE.)	WTP the 3rd Bid (Y=3) Coefficient (SE.)	Marginal Effect (Elasticity)			
				Y=0	Y=1	Y=2	Y=3
Constant	-3.340*** (1.251)	-4.204** (1.730)	-4.328* (2.323)				
OIL	-0.032 (0.119)	-0.026 (0.147)	-0.208 (0.274)	0.007	-0.003	0.006	-0.009
BEH	0.129 (0.186)	0.090 (0.249)	-0.149 (0.332)	-0.028	0.016	0.018	-0.006
EXP	-0.001** (0.001)	-0.001*** (0.001)	-0.001 (0.001)	-0.001	0.001	-0.001	-0.001
TIME	-0.168 (0.107)	0.179 (0.146)	0.785*** (0.279)	0.036	-0.060	-0.010	0.034
CC	-0.175 (0.140)	-0.331* (0.179)	-0.383 (0.247)	0.037	-0.007	-0.027	-0.017
SEX	0.267 (0.233)	0.501* (0.280)	-0.360 (0.458)	-0.057	-0.009	0.082	-0.016
EDU	0.355** (0.146)	-0.103 (0.199)	-0.501 (0.312)	-0.076	0.090	0.008	-0.022
INCF	-0.023 (0.062)	0.151* (0.079)	0.233* (0.130)	0.005	-0.025	0.009	0.010
MEM	0.198 (0.130)	0.115 (0.168)	-0.697** (0.274)	-0.042	0.027	0.045	-0.030
INFO	0.412** (0.194)	0.129 (0.245)	0.417 (0.428)	-0.088	0.071	-0.009	0.018
KNOW	-0.043 (0.192)	-0.141 (0.256)	-0.317 (0.447)	0.009	0.010	-0.005	-0.014
APRI	0.023 (0.195)	0.210 (0.277)	0.832 (0.518)	-0.005	-0.023	-0.008	0.036
APLA	-0.480** (0.241)	0.250 (0.304)	0.999** (0.479)	0.102	-0.136	-0.010	0.043
APRO	-0.033 (0.237)	0.160 (0.322)	0.129 (0.438)	0.007	-0.028	0.016	0.006
APROM	0.441* (0.246)	-0.541* (0.302)	-0.671 (0.494)	-0.094	0.166	-0.043	-0.029
ATI	0.249*** (1.251)	0.535** (1.730)	0.148 (2.323)	-0.053	-0.018	0.065	0.006

Source: Calculate
Note: *, **, and *** denote rejection of the null hypothesis at the 10%, 5%, and 1% significance levels, respectively.
Y = 0 is lower 32.50 baths per liter, Y = 1 is 32.50 – 34.90 baths per liter, Y = 2 is 35 – 37.40 baths per liter and Y = 3 is upper 37.50 baths per liter.

4.1.4 (WTP 1st Bid) it is Y = 0 versus Y = 1, Y = 2 and Y = 3

From the study of (WTP 1st Bid) of the consumers in Nakhon Ratchasima province, it was found that if the consumers have height education background (EDU), pay more monthly cost for fuel (EXP), receive more information concerning renewable energy (INFO) and give priority to the promotion of market factors (APROM), all of these factors will has influence on the willingness to pay and the decision to use gasohol E100. On the other hand, it was found that the distribution channel variable (APLA) and the factor concerning positive attitude toward the environment (ATI) are the factors that influence in the opposite direction on the willingness to pay of the consumers due to the realization of the value and importance of the environment of the consumers (Zoric and Hrovatin, 2012).

4.1.5 (WTP 2nd Bid) it is Y = 0, Y = 1 versus Y = 2 and Y = 3

In this part, it was found that EXP, APROM and ATI are still the variables which influence the willingness to pay as previous stated (WTP 1st Bid). Moreover, the variable of the size of the engine (CC) also influences the willingness to pay as well; if the engine is larger and more powerful, it will affect the consumer's willingness to pay to decrease. This is because the larger size of the engine is, the more fuel consumption and cost it will be. As for the variable of sex (SEX) and the average income her household (INFC), these two factors also influence the willingness as well.

4.1.6 (WTP 3rd Bid) it is Y = 0, Y = 1, Y = 2 versus Y = 3

In this final part, it shows that if the consumers do the refueling starts from 6.01 p.m. on (TIME), it will affect the willingness to pay for 3.40%, this is because the consumers know that refueling petrol during low temperature period the petrol density will be higher hence the quantity of petrol the consumers will get. Moreover, it also found that the increasing of household members (MEM) also reduces the willingness to pay due to the increasing number of the members rises up the expenses of the household, which might affect the expenses spent on fuel.

5. Policy Implications and Conclusions

This research aims study the behavior of consumers who use gasohol and their willingness to pay for it as well as finding the factors affecting the willingness to pay. In this research, Chiang Mai and Nakhon Ratchasima Province are the sample province and employ the Contingent Valuation Method (CVM) to form of questionnaires which consists of double bounded dichotomous choice. In the estimation, Generalized Ordered Logit Model is employed as a tool for answers our researches problem. Maximum Likelihood Estimation (MLE) was the method of estimating the parameter in the model. The interesting results of this researches are as follows:

5.1 From the result of the study, it allows both government and private sectors know the price rate that the consumers are willing to pay for gasohol E100, which is 32.5 baht per liter. However, the analysis shows that the price which the consumers in both Chiang Mai and Nakhon Ratchasima are willing to pay for is 31.00 baht per liter, which shows the purchasing power of consumers toward gasohol E100 and real consumer demand. Therefore, the appropriate price which the consumers are willing to pay need to be accounted for in order to establish the policy.

5.2 fuel station entrepreneurs have to allocate the cost of worker's wages. During the

period when many consumers use fuel service, entrepreneurs should provide more workers in order to provide adequate services, and reduce the number of workers when less customers to save the incurred variable costs. And also able to determine appropriate opening - closing hours of the stations.

5.3 As for the consumers, if gasohol E100 is provided in fuel stations throughout country, the domestic consumers will have more choice for fuel in case the fuel price gets higher in the future. Also by using gasohol E100 is considered to promote the use of clean energy that is friendly to the environment and helps reduce the cause of Greenhouse Effect.

This is because gasohol E100 is a fuel that is not yet distributed in Thailand and is not well known by consumers, this makes consumers do not trust in the quality of gasohol E100. Therefore, if there is public relations about gasohol E100 to provide more information of both advantages and disadvantages including research, it might help persuade and change consumers' attitudes toward gasohol E100.

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