Chapter 6

Analysis of Survey Results on the Willingness to Pay for Renewable Energy in Five ASEAN Cities

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Chapter 6

Analysis of Survey Results on the Willingness to Pay for Renewable Energy in Five ASEAN Cities

This chapter analyses the results of the willingness to pay (WTP) survey for renewable energy (RE) in five ASEAN cities.

1. Discrete Choice Model Results

1.1. Regression Analysis

As shown in the previous chapter, the sample covered 800 households (Thailand: 250, Malaysia: 300, Philippines: 250). From this sample, households with outlier values of the monthly electricity bill have been excluded for the purpose of the following regression analysis.

We estimated household the WTP using the conditional logit. The utility was assumed to be a linear function of attributes of RE share and price. RE types, including solar, biomass, hydropower, wind, mini-hydro, and small-scale hydro, were represented by dummy variables. Solar (Thailand and Malaysia) and hydro and geothermal (Philippines) were considered the status quo type in the model. Mathematically, for respondent *i*, the utility of choosing an alternative *j* is a function of the characteristics of the alternative *j*, and the utility function (U_{ij}) contains two parts: a deterministic part V_{ij} for observed characteristics and a stochastic error part ε_{ij} for unobserved variables.

$$\boldsymbol{U_{ij} = V_{ij} + \varepsilon_{ij}} \quad (6\text{-}1)$$

The deterministic part V_{ij} represents the observable portion of the utility that can be measured and is related to both attributes of alternatives and characteristics of the respondent. It is expressed as a linear-in-parameter function:

$$\boldsymbol{V_{ij} = \alpha_j + \sum_k X_{jk}\beta_k} \quad (6\text{-}2)$$

where α_j is an alternative specific constant, X_{jk} is the *k* attribute value of the alternative *j* , and β_k is the coefficient associated with the *k*th attribute.

Table 6.1 presents the results of our utility model.

Table 6.1: Utility Function Estimates

Variables	Cities		
	Thailand	Malaysia	Philippines
Price	−0.118***	−0.061***	−0.062***
(% of the monthly bill)	(0.007)	(0.005)	(0.005)
RE share (%)	0.015***	0.009***	0.017**
	(0.005)	(0.003)	(0.006)
Renewable energy types			
Base type	Solar	Solar	Hydro and Geothermal
Solar	-	-	0.902***
			(0.121)
Biomass	−0.361***	−0.183**	0.437***
	(0.114)	(0.078)	(0.123)
Hydropower	−0.337***	-0.065	0.361**
	(0.114)	(0.077)	(0.126)
Wind	−0.272**	-	0.407**
	(0.112)		(0.125)
ASC (SQ)	0.174	0.145	
	(0.126)	(0.089)	
Obs	5691	6978	5907
Number of households	250	298	249
Log-likelihood	−1645	−2402	−2025

ASC = alternative-specific constant, RE = renewable energy.

Note: Robust standard errors are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. The ASC for the Philippines would be perfectly correlated with the dummy variable for the base type and has thus been dropped.

Source: Authors' calculation.

The results can be summarised as follows:

- Respondents prefer higher RE shares, and the RE share coefficients in all three cities were positive and significant.
- The increased price reduces the utility of households.

1.2. WTP Estimations

Estimates of WTP for different RE share levels and different RE types were calculated using the results of the conditional logit. We converted both significant and insignificant parameters into marginal WTP by dividing the marginal utility of attributes by the marginal utility of price. The utility function of the household can be expressed as follows:

$$\boldsymbol{V_j = ASC_j + \beta_1 REshare_j + \beta_2 Solar_j + \beta_3 Wind_j + \beta_4 Hydro_j + \beta_5 Price_j,}$$

(6-3)

where V_j is the utility of choice set j; $REshare_j$ is the RE share amongst total electricity production of choice set j; $Solar_j$, $Wind_j$, and $Hydro_j$ are dummy variables representing RE types of choice set j; and $Price_j$ represents the percentage of increasing monthly electricity tariffs. Here we have taken biomass as the base for the RE type dummy variable.

To examine $Price_j$ at different $REshare$ levels, we specified $REshare_j$ and determined the changes in WTP_j using the following function:

$$\boldsymbol{WTP_j = Price_j = \frac{\beta_1(REshare_j - REshare_{sq}) + \beta_2 Solar_j + \beta_3 Wind_j + \beta_4 Hydro_j}{-\beta_5}}$$

(6-4)

As expected, the RE share is an influential attribute when households evaluate RE types. Households prefer a higher renewable proportion in the electricity mix.

	RE Share	**Solar** % of monthly electricity bill (USD)	**Biomass** % of monthly electricity bill (USD)	**Hydropower** % of monthly electricity bill (USD)	**Wind** % of monthly electricity bill (USD)
Thailand (status quo = 9%)	20%	2.92% (2.33)	−0.14% (−0.12)	0.06% (0.05)	0.61% (0.49)
	30%	4.23% (3.38)	1.17% (0.93)	1.37% (1.10)	1.92% (1.54)
	40%	5.54%	2.48%	2.68%	3.24%

		(4.43)	(1.98)	(2.15)	(2.59)
Malaysia (status quo = 6%)	10%	2.97% (0.81)	−0.04% (−0.01)	1.90% (0.52)	-
	20%	4.52% (1.22)	1.50% (0.41)	3.44% (0.93)	-
	30%	6.06% (1.64)	3.04% (0.83)	4.99% (1.35)	-
Philippines (status quo = 30%)	40%	17.31% (8.74)	9.82% (4.96)	8.60% (4.35)	9.34% (4.71)
	50%	20.11% (10.16)	12.63% (6.38)	11.41% (5.76)	12.14% (6.13)
	60%	22.91% (11.57)	15.43% (7.79)	14.21% (7.18)	14.95% (7.55)

shows the estimation of the mean WTP in the percentage of monthly electricity bills in United States dollars (USD) when increasing the RE share. The average WTP values for solar are highest in the three ASEAN cities. It follows the same pattern as the results of last year. In Thailand and Malaysia, biomass energy was valued lowest.

Table 6.2: Willingness to Pay Estimates for Renewable Energy Types in % of Monthly Electricity Bill

	RE Share	Solar % of monthly electricity bill (USD)	Biomass % of monthly electricity bill (USD)	Hydropower % of monthly electricity bill (USD)	Wind % of monthly electricity bill (USD)
Thailand (status quo = 9%)	20%	2.92% (2.33)	−0.14% (−0.12)	0.06% (0.05)	0.61% (0.49)
	30%	4.23% (3.38)	1.17% (0.93)	1.37% (1.10)	1.92% (1.54)
	40%	5.54% (4.43)	2.48% (1.98)	2.68% (2.15)	3.24% (2.59)
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	60%	22.91% (11.57)	15.43% (7.79)	14.21% (7.18)	14.95% (7.55)

Note 1: The official exchange rate by the World Bank in 2019 was used for the conversions (USD1 = THB31.1 = RM4.1 = PHP51.8). https://data.worldbank.org/indicator/PA.NUS.FCRF

Note 2: The mean monthly electricity bills are as follows: Thailand, USD79.0/month; Malaysia, USD27.1 /month; Philippines, USD50.5/month.

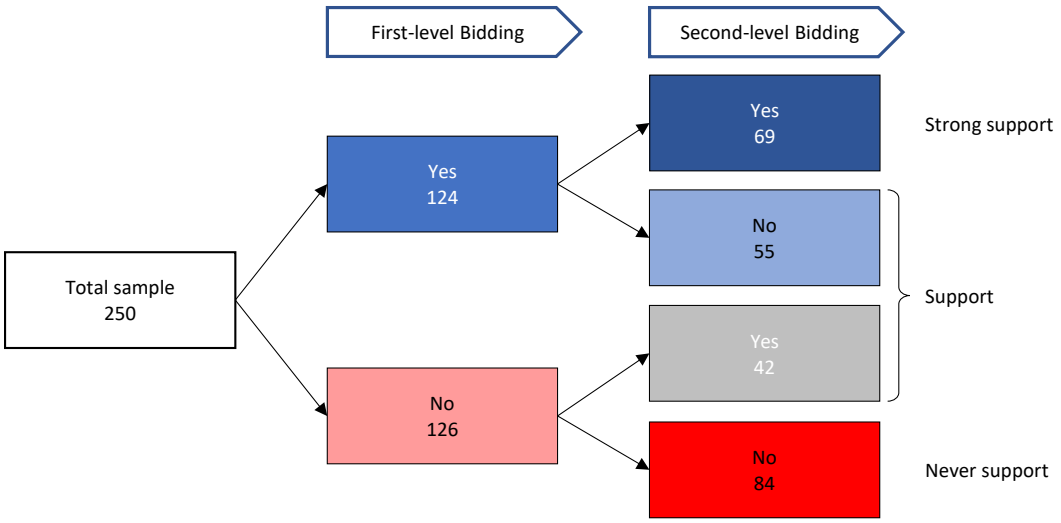
Note 3: The status quo of renewable share is different in cities (Thailand, 9%; Malaysia, 6%; the Philippines, 30%).

Source: Authors' calculation.

1.3. Contingent Valuation

Figure 6.1 illustrates the bidding process of contingent valuation. At the first bidding level, 124 of 250 participants responded 'Yes,' whereas 126 rejected the bid. At the second bidding level, 69 respondents (27.6%) supported the plan to increase the renewables share to 50%. The results are as follows: 55 respondents (22.0%) responded affirmatively to the first bid level but negatively at the second bid level; 42 respondents (16.8%) responded negatively at the first bid level but affirmatively at the second bid level. Finally, 84 respondents (33.6%) responded negatively at both bid levels.

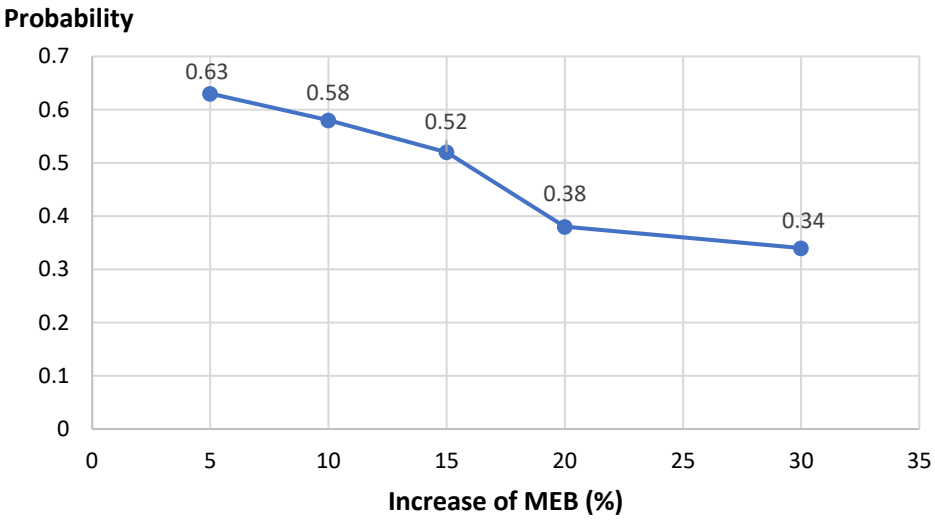
Figure 6.1: Bidding Process Based on the Contingent Valuation Model



Source: Authors' calculation.

The results (Figure 6.2) show that respondents were willing to support the 50% RE capacity target by paying extra through higher electricity prices. As expected, more than 63% of all respondents who answered the contingent valuation question stated that they were willing to pay 5% more on their current monthly electricity bill to support the target. Approximately 58% of respondents were willing to pay 10% more, 52% were willing to pay 15% more, and 34% were willing to pay 30% more to support the Plan. Less than half of the respondents were willing to pay 20% more.

Figure 6.2: Willingness to Support the Philippines Power Development Plan: 'The share of Renewable Energy will be Increased from only 30% in 2019 to 50% in 2030.'



MEB = monthly electricity bill.

Source: Authors' calculation.

Logistic regression models were used to estimate the WTP to support the government RE target (Table 6.3). The model includes socio-demographic household variables in addition to the price increase in the electricity bill. The results of the regression indicate that higher education level can lead to higher WTP to government RE target.

Table 6.3: Results of the Logistic Regression Model for Contingent Valuation

	Model (SBDC)		Model (DBDC)	
	Coefficient	**SE**	**Coefficient**	**SE**
Sigma (Cons)	−3.532*	1.429	−2.405	1.271
Ln (Average electricity price, Philippine pesos)	0.267	0.181	0.217	0.165
Gender	0.209	0.314	0.272	0.285
Age	0.016	0.011	0.015	0.009
Education level	0.475***	0.138	0.494***	0.124
Extra electricity price	−0.058***	0.017	−0.118***	0.010
Obs	250		250	
Log-likelihood	−156		−350	

DBDC = double-bounded dichotomous choice model, SBDC = single-bounded dichotomous choice model.

Note: ***, ** and * indicate statistical significance at 1%, 5%, and 10% levels, respectively.

Source: Authors' calculation.

Table 6.4 shows that the mean WTP (logistic regression) is a 21.1 % increase in monthly electricity bills in SBDC Model and a 15.2% increase in DBDC Model. The mean monthly electricity bill of the sample is 3,010 PHP; therefore, the mean WTP is PHP634/month (USD12.2/month) in SBDC and PHP458/month (USD8.8/month) in DBDC.

Table 6.4: Estimated Willingness to Pay Values (% of monthly electricity bill)

Model	Mean WTP	95% Confidence Intervals
SBDC	21.078	16.175−35.382
DBDC	15.228	13.153−17.485

DBDC = double-bounded dichotomous choice model, SBDC = single-bounded dichotomous choice model.

Source: Authors' calculation.