PROSIDING PERKEM 10, (2015) 323 – 329
ISSN: 2231-962X

Willingness to Pay (WTP) and Willingness to Accept (WTA): Why Bother?[1]

Bakti Hasan-Basri
Pusat Pengajian Ekonomi, Kewangan, dan Perbankan
Universiti Utara Malaysia
Sintok, 06010 Kedah.
bakti@uum.edu.my

Shamsul Bahrain Rawi
Pusat Pengajian Ekonomi, Kewangan, dan Perbankan
Universiti Utara Malaysia
Sintok, 06010 Kedah.
shamsul@uum.edu.my

Normizan Bakar
Pusat Pengajian Ekonomi, Kewangan, dan Perbankan
Universiti Utara Malaysia
Sintok, 06010 Kedah
normizan@uum.edu.my

ABSTRACT

Non-pecuniary values of environmental goods can be measured in two formats, Willingness to Pay (WTP) or Willingness to Accept (WTA). Broadly speaking, WTP is a maximum amount of money the people are willing to pay for a situation where they gain a positive change. On the contrary, WTA is a minimum amount of money that people are willing to accept as a consequence of negative change. Both formats have been used extensively for non-pecuniary values due to changes in environmental goods. However, review articles that measuring economic values showed that not many authors have discussed why they have used the WTP or applied the WTA format. In this article, an explanation on the difference between these two formats is presented. It includes guidelines on how a choice between the formats can be made. The use of WTP for measuring public preferences on hybrid car's attributes is also shown in the article.

Keywords: Willingness to Pay (WTP), Willingness to Accept (WTA), Hybrid Cars

INTRODUCTION

The economic value due to changes in environmental quality, whether gains or losses, can be measured in two elicitation formats, Willingness to Accept (WTA) and Willingness to Pay (WTP). The former is the minimum value of money that people demand to accept as compensation because of losses so that they are indifferent between being paid and bear the losses. On the contrary, the latter is the maximum sum people are willing to pay so that they are indifferent between paying and enjoy the gains. The application of WTP format however seems more favoured compared to WTA. Many factors contribute to the situation, but the main reason came from the stance made by National Oceanic and Atmospheric Administration panel in 1993. The panel has suggested to apply the WTP format for practical stated preference Contingent Valuation Method (CVM) studies (NOAA, 1993). As a result, a choice of format to measure economic value was underappreciated at that time and usually the WTP is favoured compared to WTA whether for environmental gains or losses because the former format is arguably easier to measure and estimate (U.S. EPA, 2000).

Some analysts (e.g. Diamond, Hausman, Leonard, & Denning, 1993; Henderson, 1941; Willig, 1976) argued that the choice between these two formats is irrelevant because the estimated economic value measured from the formats is assumed to be slightly different due to the presence of income or wealth effects. The effects explain such constraint in income faced by people for payment

[1] The research was sponsored by the Ministry of Higher Education Malaysia, under Research Acculturation Grant Scheme (RAGS)

(WTP) in obtaining a good as compared to compensation demanded where that constraint does not exist. This equivalence assumption, however, received some challenges from analysts (e.g. Hammack & Brown, 1974) particularly from those who applied a stated CVM technique. This can be seen from quite a number of analysts (e.g. Bishop & Heberlein, 1979; Rowe, D'Arge, & Brookshire, 1980) that have undertaken empirical studies on the disparity between WTA and WTP. Perhaps the earliest report on large disparity is a study by Hammack & Brown (1974). In a programme to propagate the number of ducks, the authors found that the bird hunters were willing to pay an average of $247 for preserving a marsh area. But when it came to its destruction, the hunters were found to demand an average of $1044 in compensation. This is consistent with other empirical studies such as Steven, Peter, Glenn, & James (2003) where the authors reported that the respondents are most likely to overstate the WTA if responses are real. Reviews on the WTP/WTA disparity have been undertaken by, among others, Tuncel & Hammitt (2014), Horowitz & McConnell (2002), Kahneman, Knetsch, & Thaler (1991) and Samuelson & Zeckhauser (1988).

The question arises here is how to make a choice between WTA and WTP. Using the case study of public preferences on Hybrid Vehicles (HVs), we explore some theoretical issues on the appropriate format to measure economic values of HVs. Applying the stated preferences Choice Experiments (CEs) technique, we found that the public in Kedah and Perlis preferred environmental attributes than economic attributes.

The remainder of this article as follows. The following section reviews underpinning theory in explaining WTP and WTA. Using the expected gains and losses approach, we argue why the economic value of HVs is appropriate to be estimated with the WTP format. This is followed with the technique applied in the study, the Choice Experiment (CE) where the discussion is on the selection of attributes and the generation of choice cards. This is followed with the results where the economic value is calculated. Finally, some conclusions are drawn.

WILLINGNESS TO PAY (WTP) vs WILLINGNESS TO ACCEPT (WTA)

When Hicks (1941) published his article “The Rehabilitation of Consumers’ Surplus”, he introduced two welfare measurement concepts into the literature, variation and surplus. In both concepts, two types of approach for measuring welfare can be applied either compensating or equivalent. The application of surplus is preferable for changes in the quantity of goods only but since the variation measures and the surplus measures are identical, the explanation is discussed later, the distinction is not provided here. Throughout this paper the variation approach will be applied.

The idea of WTP and WTA was originated from the Hicksian Compensating Variation (CV) and Equivalent Variation (EV). Hicks (1941) explains how improvement or losses in environmental quality can be measured in these variations. The interpretation of CV can be explained in (1):

$$CV = e(p, Q^1, U^1) - e(p, Q^1, U^0) \tag{1}$$

where the *e( )* is the expenditure function, Q is the quality of environmental goods, U is the utility level and superscripts 0 and 1 refer to before and after policy changes. In a situation when a government propose a policy to improve environmental quality such as encouraging public to drive the HVs, public have an option whether to buy the HVs or remain with the non-HVs. If public preference is buying the HVs so that the quality of environment will be improved due to less CO_2 emission for instance, they would give up some amount of money for this improvement and buy the HVs. This is known as public maximum WTP for such improvement. On the other hand, if their preference is the current situation of driving the non-HVs which will continue deteriorating the environmental quality, the ones who support the HVs would require a sum of minimum WTA for the perceived environmental quality losses.

The opposite situation of CV could be applied to explain the EV. In this case, if a government changes its policy from HVs to non-HVs. Due to expectation in environmental deterioration in the future, public that supports the HVs would require a minimum compensation for the deterioration. This is known as a sum of minimum WTA. But if they preferred to remain with the old policy of driving the HVs, then they would require a sum of maximum WTP from those who opt for the non-HVs. The EV is explained in (2):

$$EV = e(p, Q^0, U^1) - e(p, Q^0, U^0) \tag{2}$$

Figure 1 illustrates this WTP and WTA. Supposedly the market good is a single Hicksian composite good, say the HVs and non-HVs, and is measured in a quantity of X. The maximum amount that public is willing to pay for HVs so that they can benefit an improvement in environmental quality form Q^0 to Q^1 is a vertical distance of AB. At this point, it doesn't affect their current utility. Or the public is willing to accept a vertical distance of CD if they have to forgo such improvement in environmental quality but still can achieve the new utility level after environmental change, U^1.

Figure 1 clearly shows that the value of WTA and WTP is supposedly identical. This standpoint has been supported by many analysts, among them, Willig (1976), Henderson (1941), and Diamond et al. (1993). Willig (1976) for instance attributed the difference of WTP and WTA, if they exists, to the income or wealth effects. However, empirical findings (e.g. Bishop & Heberlein, 1979; Hammack & Brown, 1974; Rowe et al., 1980) that have been conducted on the WTP/WTA disparity empirical studies show contrary results. One of the reasons in explaining the disparity came from the psychological discipline (Knetsch, 1995). The explanation based on human preference where most people are more affected from losses rather than gains. It is argued that not easy for most people to forgo what they already have (or promised to have it) and now is required to receive some amount of money as compensation if they agreed to let it go. That is the reason why they demand a high compensation value (WTA) as compared the value when they are asked to pay (WTP) to have the goods.

Facing the question of measuring economic value of public preference for the HVs, which concept should be used, WTP or WTA, and what are the guidelines? Knetsch, Riyanto, & Zong (2012) and Knetsch (2007) have proposed a suggestion for this where they can be concluded in two divisions. One is the value of positive change and the other is the value of negative change. Prior to discussing this in details, the reference state of people's valuations of change has to be determined first. Without this, perhaps what people believe the change as gains actually is a reduction in losses. In addition, the reference state is essential to differentiate welfare measurement whether it is CV or EV. The difference between CV and EV lies in the reference state position. The CV measures changes in welfare where the reference state being the position before changes in a policy, while the EV for the position after the policy change.

The positive change can be discussed in two ways- positive change in a domain of gains and positive change in a domain of losses. Knetsch et al. (2012) has suggested using the WTP format if positive change happens in a domain of gains (i.e. CV measurement), otherwise applying the WTA if the positive change occurs in a domain of losses (i.e. EV measurement). Similar to the positive change, the negative change can also be discussed in a domain of losses and gains as well. In this case, the authors have recommended applying the WTA if negative change in a domain of losses (i.e. CV measurement) and the WTP for negative change in a domain gains (i.e. EV measurement).

Based on Knetsch et al. (2012) suggestions, this paragraph seeks to determine which elicitation format is appropriate to measure the economic value of HVs. One of the main reasons for encouraging public to buy the HVs is due to the pollution of Green House Gases (GHG) carbon dioxide (CO_2). Many factors contribute to CO_2 emission but human activities such as burning fossil fuels are one of the major contributors. This can be seen from the number of vehicles on roads that increase from time to time. Efforts to reduce CO_2 have been determined such as (1) using non-engine vehicles such as bicycles; (2) car-pooling; or (3) utilizing public transportation. But the focus of the study is a transportation policy made by the Malaysia government to encourage public to drive the HVs. Since the public are seeking to improve air quality due to CO_2 emissions from the non-HVs and applying the before change reference state, we sense the policy will measure the positive change value. As suggested by Knetsch et al. (2012), this is appropriate to be measured in CV where the public are willing to pay (WTP) for improvement in air quality. For measuring this economic value we have applied the CE technique. The technique is explained in the following section.

CHOICE EXPERIMENT (CE) and STUDY DESIGN

Louviere & Woodworth (1983) could be one of the earlier analysts who used the CE technique. Since then the technique has been applied in many subjects for various motives such as valuing heritage sites (Willis, 2003), recreational parks (Siderelis & Moore, 1998) and renewable energy (Bergmann, Colombo, & Hanley, 2008), to name a few. The technique requires respondents to choose their most preferred alternative from a series of alternatives presented to them (Bateman et al., 2002).

Following the standard procedure for identifying attributes and their levels in CE as proposed by Bateman et al. (2002), this study reviewed relevant articles including environmental effects, government incentives, and consumer preferences (e.g. Antweiler & Gulati, 2013; e.g. Hidrue,

Parsons, Kempton, & Gardner, 2011; Messagie, Boureima, Coosemans, Macharis, & Mierlo, 2014). The next step was conducted the focus group meetings and followed with the meeting with stakeholders such as garage owners and relevant officers from the government agencies. The study has focused on two general motives; public motivation to buy the HVs, either economic or environment. Both attributes were classified into three levels: basic, medium and high. For attribute of price, the study applied the average maintenance cost of the HVs. Table 1 provides the details about the attributes and their levels. In terms of generating a choice card, the study employed the fractional factorial design in SPSS. With the nine choice cards produced by the software, the random pairing format without replacement was used for forming the choice set. The example of a choice card is shown in Figure 2.

RESULTS and DISCUSSION

The choice data in the study was analysed with the Multinomial Logit (MNL) model as shown in (1):

$$P_{in} = \frac{\exp(V_{in})}{\sum_{j \in J_n} \exp(V_{jn})} \tag{1}$$

where *P* is a probability of choosing HVs *i* for individual n. The model can be computed through the maximum likelihood (ML) procedures as stated in equation (3):

$$\log L = \sum_{i=1}^{N} \sum_{j=1}^{J} y_{in} \log \left[\frac{\exp(V_{in})}{\sum_{j=1}^{J} \exp(V_{in})} \right] \tag{3}$$

Based on the attributes applied in the study, the indirect utility function for public buying the HVs is shown in (4):

$$V = \beta_1 . \mathrm{Env1} + \beta_2 . \mathrm{Env2} + \beta_3 . \mathrm{Eco1} + \beta_4 . \mathrm{Eco2} + \beta_5 . \mathrm{Price} \tag{4}$$

V in (4) is an individual's choice of HVs and each respondent was required to answer 4 choice cards in the choice set. The study has interviewed 197 respondents and that produced 788 observations. The estimates for equation (3) are presented in Table 2. Though the goodness of fit for the model considered low with 2%, all variables are highly significant. The results in Table 2 show that an improvement in Env 2 will increase the respondents' utility, on average, 0.7528. That means if the respondents driving the HVs, their utility will increased by such value because environmental quality is improved from the current state to a higher level. Using the similar notes, the impacts of attributes on the respondents' utility can be determined. The ranks of the impact from high to low as follows: Env 2, Eco2, Env 1 and lastly Eco 1.

Normally the WTP is calculated using the ratio of attribute of interest and the attribute of price/ cost. For instance, to calculate the WTP for Eco 2, the formula is $WTP = -\frac{\beta_{Eco2}}{\beta_{Price}}$. The negative sign is required to cancel out the negative sign of the price coefficient. The computation of WTP in the study, however, applied the Delta method. The method has many advantages compared to the alternatives ones such as Krinsky & Robb (1986). According to Bliemer & Rose (2013), the Delta method required less simulation than the latter. The WTP results are shown in Table 2. All the WTP values are highly significant. The results show that the respondents, on average, are willing to fork out RM2,900 for the HVs if the vehicles are able to increase environmental quality from basic to higher level. In similar notes, they are willing to pay a maximum of RM2,300 if economic factor of HVs could be increased from basic to higher level. Examples of economic factors are mileage coverage travelling with HVs and life span of hybrid battery.

CONCLUSION

This paper explores the issue of elicitation formats in calculating economic value of environmental goods. The two formats are Willingness to Accept (WTA) and Willingness to Pay (WTP). Based on the theory proposed by Hicks (1947), the economic value estimated from both formats should produce identical results. If they differ, it comes from wealth or income effects. However, empirical studies on the disparity WTA/WTP found different results. Then analysts such as Knetsch et al. (2012) have proposed guidelines to be followed whether to apply the WTA or WTP.

The study applies the guidelines in the case of Hybrid Vehicles (HVs) where such vehicle is expected to give more gains than losses in the sense of environment and economic factors. Based on the Knetsch et al.(2012) suggestions the WTP format seems more suitable to be applied in the study. The results show that the respondents put higher value on environmental factor rather than economic ones. In terms of WTP values, on average, they are willing pay between RM1500 and RM2900 if they can see an improvement in environment and economic factor.

REFERENCES

Antweiler, W., & Gulati, S. (2013). Market-based policies for green motoring in Canada. *Canadian Public Policy, 39*(SUPPL.2), S81-S94.

Bateman, I., Carson, R. T., Day, B., Hanemann, M., Hanley, N., Hett, T., et al. (2002). *Economic valuation with stated preference techniques*. Cheltenham, Uk and Northampton, MA, USA: Edward Elgar.

Bergmann, A., Colombo, S., & Hanley, N. (2008). Rural versus urban preferences for renewable energy developments. *Ecological Economics, 65*(3), 616-625.

Bishop, R. C., & Heberlein, T. A. (1979). MeasuringValues of Extramarket Goods: Are Indirect Measure Biased? *American Journal of Agricultural Economics, 61*(5), 926-930.

Bliemer, M. C. J., & Rose, J. M. (2013). Confidence intervals of willingness-to-pay for random coefficient logit models. *Transportation Research Part B, 58*, 199-214.

Diamond, P., Hausman, J., Leonard, G., & Denning, M. (Eds.). (1993). *Does contingent valuation measures preferences? Experimental evidence* Amsterdam: Elsevier Science Publishers.

Hammack, J., & Brown, G. M. (1974). *Waterfowl and Wetlands: Toward Bioeconomic Analysis.* Baltimore: Resources for the Future.

Henderson, A. (1941). Consumer's surplus and the compensation variation. *Review of Economic Studies, 8*, 117-121.

Hicks, J. R. (1941). The Rehabilitation of Consumers' Surplus. *The Review of Economic Studies, 8*.

Hidrue, M. K., Parsons, G. R., Kempton, W., & Gardner, M. P. (2011). Willingeness to pay for electric vehicles and their attributes. *Resource and Energy Economics, 33*, 686-705.

Horowitz, J. K., & McConnell, K. E. (2002). A Review of WTA/WTP Studies. *Journal of Environmental Economics and Management, 44*(3), 426-447.

Kahneman, D., Knetsch, J. L., & Thaler, R. J. (1991). The Endowment Effect, Loss Aversion and Status Quo Bias. *Journal of Economics Perspective, 5*(1), 193-206.

Knetsch, J. L. (1995). Asymmetric valuation of gains and lossess and preference order assumptions. *Economic Inquiry, 33*, 134-141.

Knetsch, J. L. (2007). Biased valuations, damage assessments, and policy choices: The choice of measure matters *Ecological Economics, 63*(4), 684-689.

Knetsch, J. L., Riyanto, Y. E., & Zong, J. (2012). Gain and Loss Domains and the Choice of Welfare Measure of Positive and Negative Changes. *Journal of Benefit-Cost Analysis, 3*(4), 1-18.

Krinsky, I., & Robb, A. L. (1986). On Approximating the Statistical Properties of Elasticities. *The Review of Economics and Statistics, 68*(4), 715-719.

Louviere, J., & Woodworth, G. (1983). Design and analysis of simulated consumer choice or allocation experiments: An approach based on aggregate data. *Journal of Marketing Research, 20*(NOVEMBER), 350-367.

Messagie, M., Boureima, F. S., Coosemans, T., Macharis, C., & Mierlo, J. V. (2014). A range-based vehicle life cycle assessment incorporating variability in the environmental assessment of different vehicle technologies and fuels. *Energies, 7*(3), 1467-1482.

NOAA. (1993). *Report of the NOAA panel on contingent valuation, Federal Register*: National Oceanic and Atmospheric Administration.

Rowe, R. D., D'Arge, R. C., & Brookshire, D. S. (1980). An experiment on the economic value of visibility. *Journal of Environmental Economics and Management, 7*(1), 1-19.

Samuelson, W., & Zeckhauser, R. J. (1988). Status Quo Bias in Decision Making. *Journal of Risk and Uncertainty, 1*(1), 7-59.
Siderelis, C., & Moore, R. L. (1998). Recreation demand and the influence of site preference variables. *Journal of Leisure Research, 30*(3), 301-318.
Steven, N., Peter, F., Glenn, W. H., & James, C. L. (2003). Hypothetical bias and willingness to accept. *Economic Letters*(78), 423-430.
Tuncel, T., & Hammitt, J. K. (2014). A New Meta-Analysis on the WTP/WTA Disparity. *Journal of Environmental Economics and Management, 68*, 175-187.
U.S. EPA. (2000). *Guidelines for Preparing Economic Analyses* Environmental Protection Agency, Washington, D.C.
Willig, R. D. (1976). Consumer's surplus without apology. *American Economic Review, 66*(4), 589-597.
Willis, K. G. (2003). Pricing Public Parks. *Journal of Environmental Planning and Management, 46*(1), 3-17.

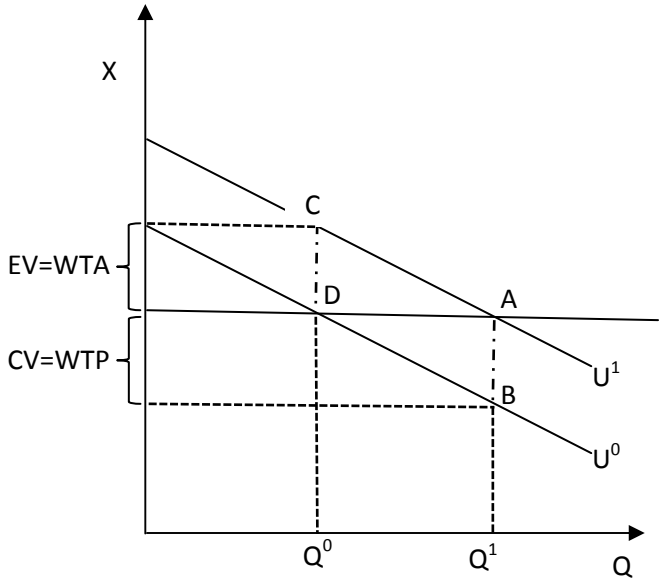

FIGURE 1: WTA and WTP

Option 1	Option 2	Option 3
Environmental: High	Environmental: Low	Environmental: Low
Economic: Low	Economic: High	Economic: Low
Yearly Maintenance Cost: RM11,500	Yearly Maintenance Cost: RM12,500	Yearly Maintenance Cost: RM9,500
I prefer this option ☐	I prefer this option ☐	I prefer this option ☐

FIGURE 2: The Example of a Choice Card

TABLE 1: Attributes and Their Levels

Attribute	Description
Env 1	Motive of environmental factor at medium level
Env 2	Motive of environmental factor at high level
Eco 1	Concern for economic factor at medium level
Eco 2	Concern for economic factor at high level
Price	Maintenance costs (measured in RM): RM9,500; RM10,500; RM11,500; and RM12,500

TABLE 2: Estimates of Multinomial Logit (MNL) Model and Their Respective WTP

Variable	Coefficient	CV (or WTP) in RM
Env 1	0.40404***	1544.81***
	(0.12127)	(438.7709)
Env 2	0.75828***	2899.22***
	(0.13485)	(491.0462)
Eco 1	0.38128***	1457.7***
	(0.12054)	(426.2919)
Eco 2	0.59177***	2262.61***
	(0.13159)	(451.4694)
Price	-0.0002615***	-
	(0.0000531)	
Log likelihood function	-843.38115	-
Psuedo R-sqrd	2%	-

***,**, and * indicate significance at 1%, 5% and 10% level