Overcoming Hypothetical Bias in Dichotomous Choice Contingent Valuation Studies: Some Preliminary Results

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Abstract
Contingent Valuation studies, in which respondents are presented with a hypothetical choice, can be prone to hypothetical bias as respondents could overstate their willingness to pay. The purpose of this paper is to present a method to detect hypothetical bias in the single bound dichotomous choice model. The method borrows the tools from the stochastic frontier model, as in the case of Hofler and List (2004) for open ended auctions, and applies them to the dichotomous choice case. The cumulative distribution function of the resulting composed error term is approximated using the results of Tsay et. al.,(2013). Some preliminary simulation results are presented and the method is applied to a study of willingness to accept (WTA) for the establishment of a wind park in South Rethymno, Crete.

Key words: Environmental Econometrics, Stochastic Frontier Analysis, Contingent Valuation, Hypothetical Bias
1. Introduction

Most environmental goods have no market in which they can be purchased, so economists had to find other methods for evaluating them. Methods such as revealed preference and stated preference have been applied to evaluate environmental goods. One approach of stated preference is the Contingent Valuation Method (CVM) (Carson and Hanemann, 2005:824). Contingent Valuation Method (CVM) evaluates environmental goods through questionnaires and the use of Willingness To Accept (WTA) and Willingness To Pay (WTP) measures it evaluates the amount that the responders will be willing to accept or respectively the amount that they would be willing to pay to allow an environmental change and the measure to be used depends on the property rights.

In CVM surveys, researchers have to deal with a number of problems, many of which have led to a long and heated debate about the validity of the method. A main concern about the CVM results is that they are based on respondents’ answers to the CVM scenario. Furthermore the answers are based on the fact that the respondents know that the scenario is hypothetical. If they knew that the scenario was about to be implemented their answers would be different. As it is mentioned by Haab, Interis, Petrolia and Whitehead (2013:596) “What people say is different from what they do”.

More specifically, because the supply of the good that is examined in the scenario is hypothetical, and so is the amount of payment that the respondents agree to pay, the CVM results are not trustable (Aadland and Caplan, 2006:563).

In this paper we are going to focus on overcoming this basic critique namely the existence of hypothetical bias. “Hypothetical bias can be defined as the difference between what a person indicates they would pay in the survey or interview and what a person would actually pay” (Loomis, 2014:35). To overcome hypothetical bias researchers have introduced two approaches, the ex ante and the ex post approach. This paper aims to deal with hypothetical bias through an ex post approach and specifically using stochastic frontier analysis as in the case of Hofler and List (2004) for open ended auctions, by applying the approach for a single bound dichotomous choice model to include the possibility of overestimation. Furthermore the results of Tsay et al., (2013) for the cumulative distribution function of a composed Normal-Half-normal error are also used in the present paper.
As a start we run a number of simulations in order to test the validity of the model to overcome the problem of overestimation in a WTP case. As a second step we use empirical data that we have gathered from primary sources in order to evaluate the WTA of the installation of a wind park in South Rethymno, Crete.

The remaining parts of this paper are arranged as follows. The second part presents the theoretical model of the Normal-Half Normal composed error. The third part the simulations for a Normal distributed error term model and for a Normal-Half Normal composed error model that includes the possibility of overestimation for a WTP survey. In the fourth part the empirical results of the application for the wind park South of Rethymno and finally the last part has the conclusions.

2. Overcoming Hypothetical Bias, Composed error model

In Contingent Valuation Method surveys, researchers have to deal with a number of problems, many of which have led to a long and heated debate about the validity of the method. One basic critique refers to the difference between the real and the hypothetical payments. There are two types of possible forms of hypothetical bias. The first case is Overestimation, where the hypothetical estimates are higher than the real ones. In case of WTA there are more no-saying answers (i.e respondents overstate the amount of compensation) while for WTP yea-saying answers (i.e respondents overstate how much they are willing to pay). The other case of Hypothetical Bias is Underestimation where the hypothetical estimates are smaller than the real ones. In case of a WTA survey we have more yea-saying answers and in a WTP no-saying answers.

It should be mentioned that in the case of overestimation which means more yea-saying answers in WTP surveys, one reason is the idea that respondents might answer positively in order to satisfy the interviewer. Respondents believe that the positive answer is the answer that the interviewer would like to hear so they say yes (Bateman et al., 2006:6).

The main reasons for the existence of hypothetical bias are two. Firstly the respondents may not understand or misunderstand the description concerning the characteristics of the good that is evaluated. And secondly, especially in developing countries, the respondents treat contingent
valuation scenarios less seriously and thus they answer the scenario questions very quickly (Whittington et al., 1990:299).

Other reasons exists as well attempting to explain the fact that there is a difference between the hypothetical and the actual payments. As Sinden (1988:98) mentions the differences may be explained by strategic behavior, in different notions concerning the good that is evaluated and in the timing of the choices. Finally an important parameter that plays a crucial role in the issue of hypothetical bias is the incentives.

Many techniques have been devised to overcome hypothetical bias. The approaches that have been used are separated in two main categories. The first category is ex ante and the second one is ex post approaches (Loomis, 2014:34). But it should be mentioned that in general, it is difficult to measure hypothetical bias and the reason which explains this difficulty is that in order to test if the hypothetical bias exists there has to be a comparison with real payments (Jakobsson and Dragun, 1996:84).

In this paper an ex post procedure is going to be used and more specifically an econometric approach based on stochastic frontier estimation is going to be applied. The stochastic production frontier approach has an important advantage, “only data that are typically gathered in contingent valuation survey, such as stated values and other demographic characteristics, are needed to carry out the calibration exercise”(Hofler and List, 2004:213).

Stochastic production frontier models were introduced by the articles of Meeusen and van den Broeck in 1977 and Aigner, Lovell and Schmidt in 1977. The key feature of a stochastic frontier model is that these models permit technical inefficiency and also recognize that there is a possibility that random shocks can occur and affect the output (Kumbhakar and Lovell, 2000:72).

Hypothetical bias, as it is mentioned above, indicates that there is an unwanted difference between what the respondents answer about the maximum they would be willing to pay and what they would actually pay. This fact leads researchers that use CVM to evaluate a good to derive less reliable results if they don’t take into account this potential gap.
Since there is a gap between the hypothetical and the real estimates, this difference must be included in the models in order to get more reliable and realistic evaluations. Hofler and List (2004) design an experiment to examine if the results are different between a hypothetical and an actual auction for a baseball card. They used stochastic frontier approach with the following form (Hofler and List 2004:215)

\[ Y_i^H = X_i\beta + v_i + u_i, i = 1, \ldots, n \]  

- \( Y^H_i \) represents the hypothetical bid for each i person,
- \( X_i \) is a row vector that represents the determining characteristics of the bid,
- \( \beta \) is a column vector of the coefficients.

The function though, has two error terms, \( v \) is the error term and \( u \) is an additional error that represents the gap between the hypothetical and the true bid for each person (Hofler and List 2004:216).

Additionally the model can be written in the following form (Hofler and List 2004:216)

\[ Y_i^H = Y_i^A + u_i, \quad i = 1, \ldots, n \]

- \( Y^A_i \) represents the actual bid for each i person.

All the analysis is based on the hypothesis that \( u_i \geq 0 \). In the case that the actual bid is equal to the hypothetical the estimate of \( u_i = 0 \) and the respondent answered sincerely, otherwise it is implied that the respondents overestimate the bid since when \( u_i > 0 \) the hypothetical bid is bigger than the actual (Hofler and List, 2004:216).

Taking into account the experiment above we are going to apply this methodology in order to estimate the model \( WTA_i = \beta_1 + \beta_2 x_{i2} + \ldots + \beta_k x_{ik} + v_i \) where \( v_i \sim N(0, \sigma^2_v) \) and \( x_{il}, l=2,\ldots,k \) are the variables that influence the WTA and \( i \) represents each one of the respondents.

\[ y_i = \begin{cases} 1 & \text{yes to bid}_i \ , \ i = 1, \ldots, n \\ 0 & \text{no to bid}_i \ , \ i = 1, \ldots, n \end{cases} \]

For yes, \( y_i = 1 \)

\[ P(WTA_i \leq bid_i) = P(v_i \leq bid_i - (\beta_1 + \beta_2 x_{i2} + \ldots + \beta_k x_{ik})) = \]
\[ p \left( \frac{v_i}{\sigma_v} < \frac{\text{bid}_i - \beta' x_i}{\sigma_v} \right) \text{ where } \beta' = \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_k \end{bmatrix} \text{ and } x_i = \begin{bmatrix} x_{i1} & \cdots & x_{ik} \end{bmatrix} \]

And for No, \( y_i = 0 \) we have

\[ P(WTA_i > \text{bid}_i) = P(v_i > \text{bid}_i - (\beta_1 + \beta_2 x_{i2} + \cdots + \beta_k x_{ik})) =
\]

\[ p \left( \frac{v_i}{\sigma_v} > \frac{\text{bid}_i - \beta' x_i}{\sigma_v} \right) = 1 - p \left( \frac{v_i}{\sigma_v} < \frac{\text{bid}_i - \beta' x_i}{\sigma_v} \right) \]

So the log-likelihood function that will be estimated for \( \beta \) and \( \sigma \) is

\[ \ln \prod_{i=1}^{n} f(y_i) = \sum_{i=1}^{n} y_i \ln \phi \left( \frac{\text{bid} - \beta' x_i}{\sigma_v} \right) + (1 - y_i) \ln (1 - \Phi \left( \frac{\text{bid} - \beta' x_i}{\sigma_v} \right)) \]

In case of WTP the log-likelihood function is

\[ \ln \prod_{i=1}^{n} f(y_i) = \sum_{i=1}^{n} y_i \ln (1 - \Phi \left( \frac{\text{bid} - \beta' x_i}{\sigma_v} \right)) + (1 - y_i) \ln (\Phi \left( \frac{\text{bid} - \beta' x_i}{\sigma_v} \right)) \]

And we have that Mean WTA = \( E(\beta' \tilde{x}) \)

In terms now of overestimation, our initial model was \( WTA_i = \beta_1 + \beta_2 x_{i2} + \cdots + \beta_k x_{ik} + v_i \)

where \( v_i \sim N(0, \sigma_v^2) \) becomes

\[ WTA_i^* = WTA + u \text{ where } u_i \sim iid N^+(0, \sigma_u^2) \text{ nonnegative Half Normal, The Normal-Half Normal Model (Kumbhakar and Lovell, 2000:74)} \]

Since we have that \( WTA_i = \beta_1 + \beta_2 x_{i2} + \cdots + \beta_k x_{ik} + v_i \) and

\[ WTA_i^* = \beta_1 + \beta_2 x_{i2} + \cdots + \beta_k x_{ik} + v_i + u_i \]

\( WTA_i^* - WTA_i = u_i \) if the estimate of \( u_i = 0 \) then \( WTA_i = WTA_i^* \)

- \( v_i \) is the two sided “noise” component and
- \( u_i \) is the nonnegative technical inefficiency component of the error term.
\[ WTA_i^* = \beta_1 + \beta_2 x_{i2} + \ldots + \beta_k x_{ik} + v_i + u_i \]

The composed error is given by \( \varepsilon = v + u \). Very often the model is parameterized in terms of the two parameters defined below

\[ \sigma^2 = \sigma_v^2 + \sigma_u^2 \text{ and } \lambda = \frac{\sigma_u}{\sigma_v} \]

\[ WTA_i^* = \beta_1 + \beta_2 x_{i2} + \ldots + \beta_k x_{ik} + \varepsilon \]

Since we have a dichotomous choice model, in order to estimate it we need to have the expression of the cumulative distribution of the composed error term \( \varepsilon \).

Taking into consideration Tsay et al., (2013:261) calculations for the cumulative distribution function of the composed error we have.

The density of the composed Normal-Half Normal error term \( f(\varepsilon_i) \) is known,

\[ f(\varepsilon_i) = \frac{2}{\sigma} \phi \left( \frac{\varepsilon_i}{\sigma} \right) \Phi \left( \frac{\lambda}{\sigma} \varepsilon_i \right) \text{ where } \phi(.) \text{ is the density function of N}(0,1) \text{ so we have to compute} \]

\[ F(-x' \beta) = \int_{-\infty}^{-x' \beta} f(\varepsilon) d\varepsilon \text{ and the distribution function can be expresses as } F(Q) = \frac{2}{\sigma} I(Q) \]

where \( Q = -x' \beta \),

\[ I(Q) = \int_{-\infty}^{\alpha} (\int_{-\infty}^{\alpha} \phi(\zeta) d\zeta) \phi(b\varepsilon) d\varepsilon \text{ and } \alpha = \frac{\lambda}{\sigma}, b = \frac{1}{\sigma} \]

Tsay et.al, (2013:261) in their paper mention that the calculation of this cdf has no analytic method to approximate \( F(-x' \beta) = \int_{-\infty}^{-x' \beta} f(\varepsilon) d\varepsilon \), so they derive an approximated formula \( I_{app}(Q) \) for \( I(Q) \) and they derive the approximation of the cumulative distribution function which is \( F_{app}(Q) = \frac{2}{\sigma} I_{app}(Q) \).

We estimate the WTA and we expect that the mean WTA we estimate is less than the mean WTA* that would be estimated if hypothetical bias was not taken into account. If overestimation occurs then the parameter \( \lambda \) should be statistical significant and higher than zero. If \( \lambda = 0 \) that means that \( \sigma_u = 0 \) which means that \( u = 0 \) and \( \varepsilon = v \), the composed error no longer exist and our estimates have no Hypothetical bias.
For yes

\[ P(\text{WTA}_i^* \leq \text{bid}_i) = P(\varepsilon_i \leq \text{bid}_i - (\beta_1 + \beta_2 x_{i2} + \ldots + \beta_k x_{ik})) = \]

\[ P(\varepsilon_i < \text{bid}_i - \beta' x_i) \text{ where } \beta' = \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_k \end{bmatrix} \text{ and } x_i = [x_{i2} \ldots x_{ik}] \]

For no

\[ P(\text{WTA}_i^* > \text{bid}_i) = P(\varepsilon_i > \text{bid}_i - (\beta_1 + \beta_2 x_{i2} + \ldots + \beta_k x_{ik})) = \]

\[ P(\varepsilon_i > \text{bid}_i - \beta' x_i) = 1 - P(\varepsilon_i \leq \text{bid}_i - \beta' x_i) \]

So taking into account the approximated cumulative distribution function (Tsay et al., 2013:261) we have that

\[ P(\varepsilon_i \leq \text{bid}_i - \beta' x_i) = F_{\text{app}}(\text{bid}_i - \beta' x_i) \text{ and } \]

\[ 1 - P(\varepsilon_i \leq \text{bid}_i - \beta' x_i) = 1 - F_{\text{app}}(\text{bid}_i - \beta' x_i) \]

So the log-likelihood function in the WTA case will be estimated for \( \beta, \sigma \) and \( \lambda \) is

\[
\ln \prod_{i=1}^{n} f(y_i) = \sum_{i=1}^{n} y_i \ln(F_{\text{app}}(\text{bid}_i - \beta' x_i)) + (1 - y_i) \ln(1 - F_{\text{app}}(\text{bid}_i - \beta' x_i))
\]

Respectively for WTP the log-likelihood is

\[
\ln \prod_{i=1}^{n} f(y_i) = \sum_{i=1}^{n} y_i \ln(1 - F_{\text{app}}(\text{bid}_i - \beta' x_i)) + (1 - y_i) \ln(F_{\text{app}}(\text{bid}_i - \beta' x_i))
\]
3. Econometric modeling of hypothetical bias

3.1 Data generation

In order to test the validity of the model we do simulations. 500 observations of WTP have been generated with Hypothetical Bias and more specifically with overestimation. Real WTP is given by $WTP_i = 27 + 1.5x_{i1} - 3x_{i2} + 0.5x_{i2} + v_i + u_i$ where $v_i \sim Normal(0, \sigma_v^2)$ and $u_i \sim Half - Normal(0, \sigma_u^2)$. The bids that we generated were 51, 73, 96 and 117€ and the Mean WTP=84.582.

The true parameters that we use in the data generation are given analytically in Table 1.

<table>
<thead>
<tr>
<th>True values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
</tr>
<tr>
<td>$\beta_1$</td>
</tr>
<tr>
<td>$\beta_2$</td>
</tr>
<tr>
<td>$\beta_3$</td>
</tr>
<tr>
<td>$\sigma_v$</td>
</tr>
<tr>
<td>$\sigma_u$</td>
</tr>
<tr>
<td>Mean WTP</td>
</tr>
<tr>
<td>27</td>
</tr>
<tr>
<td>1.5</td>
</tr>
<tr>
<td>-3</td>
</tr>
<tr>
<td>0.5</td>
</tr>
<tr>
<td>15</td>
</tr>
<tr>
<td>35</td>
</tr>
<tr>
<td>84.582</td>
</tr>
</tbody>
</table>

Table 1: true parameters

At this point the estimation of WTP and $WTP^*$ will take place. The first doesn’t take into account the overestimation that the data have and the second does. We expect that the model that takes into consideration the hypothetical bias will give better estimators and closer to the real values.

3.2 Simulations results for the single bound model with normal error

The model that is estimated is $WTP_i = a + \beta_1 x_{i1} + \beta_2 x_{i2} + \beta_3 x_{i2} + v_i$ where $v_i \sim Normal(0, \sigma_v^2)$ and we don’t take in to consideration that the data have overestimation. 1000 replications took place and for each replication we estimate the model and we present the mean value of each estimator and the Mean WTP. The results of the normal error model are presented in Table 2.
<table>
<thead>
<tr>
<th>Mean Estimates</th>
<th>Bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>53.288</td>
</tr>
<tr>
<td>$\beta_1$</td>
<td>1.534</td>
</tr>
<tr>
<td>$\beta_2$</td>
<td>-3.036</td>
</tr>
<tr>
<td>$\beta_3$</td>
<td>0.766</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>24.34</td>
</tr>
<tr>
<td>meanWTP</td>
<td>112.46</td>
</tr>
</tbody>
</table>

Table 2 Normal error model

The bias of the constant term is very large and the Mean WTP is 112.46, much larger than the real WTP.

2.2. Simulations results for the single bound model with Normal-Half Normal composite error

As a next step we use the same data that we have generate with overestimation and we estimate a composed error term model $WTP^*_i = a + \beta_1 x_{i1} + \beta_2 x_{i2} + \beta_3 x_{i2} + v_i + u_i$ where $v_i \sim \text{Normal}(0, \sigma_v^2)$ and $u_i \sim \text{Half Normal}(0, \sigma_u^2)$

After 1000 replications the results are presented in Table 3.

<table>
<thead>
<tr>
<th>Mean Estimates</th>
<th>Bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>constant</td>
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</tr>
<tr>
<td>$\beta_1$</td>
<td>1.514</td>
</tr>
<tr>
<td>$\beta_2$</td>
<td>-3.080</td>
</tr>
<tr>
<td>$\beta_3$</td>
<td>0.81</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>36.721</td>
</tr>
<tr>
<td>$\lambda$</td>
<td>5.414</td>
</tr>
<tr>
<td>MeanWTP*</td>
<td>88.098</td>
</tr>
</tbody>
</table>

Table 3 Composite error model

As we notice in Table 3 the means of the estimates are closer to the parameters’ true values and the bias has been reduced significantly. Mean $WTP^*$=88.098 which is smaller than the Mean
WTP as it was expected. The first model that gave Mean WTP didn’t include in the estimations that the data were overestimated. The composite error model did include overestimation so the Mean \( WTP^* \) is closer to the real Mean. Furthermore the mean estimate of the parameter \( \lambda \) is 5.414 which means that \( \sigma_u \) is higher than \( \sigma_v \) and \( u \) as the inefficiency part of the composed error is important and not zero.

In our replications we noticed that we had 370 replications with standard error problems so we remove them and we calculate Mean \( WTP^* \) for the remaining 630 replications which gives us a Mean\( WTP^* = 87.93661 \), an estimate even closer to the real mean WTP.

In general we can conclude that the composed error model helps in order to reduce the bias and get correct the estimates under the presence of hypothetical bias.

4.WTA to install a wind park in South Spili, Rethymno

4.1 The case of a simple error term model

In the empirical application we use that the WTA follows a log-Normal distribution

\[
\ln(WTA_i) = \beta_1 + \beta_2 x_{i2} + \ldots + \beta_k x_{ik} + v_i \text{ where } v_i \sim N(0, \sigma_v^2)
\]

where \( v_i \sim N(0, \sigma_v^2) \) and \( x_{il}, l=2,..,k \) are the variables that influence the WTA and \( i \) represents each one of the respondents.

We collected 300 questionnaires, 100 from three different bids, 20, 50 and 100. 150 questionnaires where gathered from the city of Rethymnon (around 50km away from the project area) and the other 150 from Spili (8 km away) and some villages around the project area.

Taking into consideration previous surveys we made several trials with different variables in order to find our final model of this survey. The factors that were tested in order to find the WTA is if the respondent was a member in an environmental organization. We expected a negative sign. The same expectation we had for the respondents that worry about climate changes and for the respondents that are aware about environmental problems. These respondents will be more willing to accept the installation of the proposed wind park and so they would ask for less compensation.
Another determinant factor is the distance between the permanent residence of the respondents and the area of the proposed wind park. The expected outcome was that the NIMBY syndrome exists, which means that the residents near to the proposed wind park would like higher amount of compensation than the ones who live further away.

In addition, the respondents that have the belief that windmills affect negatively the area would ask for higher compensation. Respondents who believe that the wind park that already exists in the area have affected them in a negative way in regards of the landscape, the noise, tourism and the flora and fauna of the area would ask as well for higher compensation. Furthermore, it is expected that respondents who have ancestors in the area, kids in their household or they plan to retire in the project area would have higher WTA.

Other possible factors are if the respondents visit the beaches that have visual contact with the windmills. Unfortunately they would ask for more compensation in order to sacrifice the aesthetics of the area. Finally a few possible determinant factors of the WTA could be the age, the sex and how they react in generally about wind energy. If they believe that wind energy is an important type of renewable energy they would ask for less compensation. On the other hand, if they believe that is not such an important type of renewable energy or they don’t prefer it at all they would ask for higher amount of compensation in order to accept the proposed wind park.

The final econometric model of the CVM, after a number of trials and tests with the Likelihood ratio test in a 5% significance level is:

\[
\ln(WTA) = \beta_1 + \beta_2 \cdot \text{member in an environmental organization} + \beta_3 \cdot \text{negative effect from windmills} + \beta_4 \cdot \text{negative effect on landscape} + \beta_5 \cdot \text{visits} + \beta_6 \cdot \text{kids} + \beta_7 \cdot \text{ancestors} + \beta_8 \cdot \text{Spili} + \beta_9 \cdot \text{medium Income} + \beta_{10} \cdot \text{wind energy Important} + \beta_{11} \cdot \text{retire} + \beta_{12} \cdot \text{age} + \epsilon_i
\]

To estimate the median WTA we use that min WTA follows a log-normal distribution since \(\ln(\text{minWTA})\) has a normal distribution and the estimator is given \(\text{Median WTA} = \exp(\hat{\beta} \cdot \bar{x})\) (Cameron, 1988:367) where \(\bar{x}\) is a dimension of the mean values of \(x\) and also we calculate the confidence interval of the median WTA is given from the Delta Method.
The model was estimated with maximum likelihood in language R using the package “maxLik” and the results are the followings as they are presented in Table 4.

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>Std error</th>
<th>t value</th>
<th>Pr(&gt; t)</th>
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</tr>
<tr>
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<td>2.192864</td>
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<td>Negative effect of wind mills</td>
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<td>1.281735</td>
<td>2.0055</td>
<td>0.04491 *</td>
</tr>
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<td>Neg. Effect in landscape</td>
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<td>-0.9660</td>
<td>0.028713</td>
<td>0.33403</td>
</tr>
<tr>
<td>Sigma</td>
<td>2.774140</td>
<td>1.258951</td>
<td>2.2035</td>
<td>0.02756 *</td>
</tr>
<tr>
<td>Median WTA</td>
<td>38.054</td>
<td>C.I.95%</td>
<td>(14.77,61.34)</td>
<td></td>
</tr>
</tbody>
</table>

Table 4 Estimates of the determinants of WTA

As we can see in Table 4, the variable “member of environmental organization” has a negative sign as it was expected. One possible explanation is because respondents who are aware of environmental issues are more willing to accept investments for renewable energies.

“Negative effect of landscape” has a positive sign because this variable represents the respondents who believe that the wind park that is already installed has negative effects on the landscape. As a consequence if more windmills will be installed this means that the negative effect will increase so in order to accept a bigger wind park they would ask for higher compensation. A result that it was found in other surveys as well (Du Preez et al., 2012:6).
The same explanation is given for the positive sign of the “negative effect of windmills”. Since respondents believe that windmills have negative effects in order to accept more they want a higher WTA.

The variable “visits” has also positive sign which means that the respondents who visit the beaches that have visual contact with the windmills in order to accept a bigger wind park ask for more compensation. The explanation is that since there is an impact at the aesthetics of the area, in order to overcome this negative effect they ask for more WTA.

Respondents who have kids seem to want more compensation than the ones who don’t have. This result can be explained by the fact that parents would like to keep the area as it is for next generations. In order to accept a wind park they would ask for higher compensation. “Ancestors” has also a positive sign. This is a result that has been found in other empirical surveys. Respondents who have ancestors form the project area tend to be less likely to accept the wind park and as a consequence they will be willing higher compensation (Groothuis et al., 2008:1545).

The residents of Spili want higher compensation than the respondents that live in Rethymno or in the villages near the wind park since Spili was the only area that was statistical significant. This means that there is no NIMBY syndrome because the respondents that are closer to the wind park are not willing the highest compensation. The explanation is given form Van der Host (2007:2707) who mentioned that opposition tends to be reduced when the project is finished. Many fears about the windmills that the residents of the project area might have, after the project where not confirmed. This fact explains why residents in far away areas are more opposite for windmills, just like in our case. The residents of Spili are more opposite because they lack of experience about windmills so they ask for higher compensation.

Furthermore Koundouri, Kountouris and Remoundou, (2009:1943) studied the case of the installation of a wind park in the island of Rhodes. They used CV in order to estimate the amount of willing to pay in order to install a wind park. In their results they also found no NIMBY syndrome because in the area there was already a wind park installed so the respondents were aware about windmills.
Medium income is the income variable that was statistical significant. It represents the net monthly family income between 1001- 2500€. It was calculated from the average yearly available income of the households which is 21,590.07€ around 1800€ per month based on the Greek Statistical Department (2011:1). The variable “medium income” has negative sign which means that respondents in these group are willing less compensation. In Groothuis et al., (2008:1548-49) survey in the first model the income was statistical significant with negative sign which means that respondents with higher income were more willing to accept the project.

As it was expected, the variable “Important wind energy” has a negative sign. The respondents who believe that wind energy is important as a renewable source in Greece are willing less amount of compensation in order to accept the installation of the wind park. A result that agrees with the general notion that people who believe that wind energy is a good type of energy are more willing to accept the installation of wind parks (Groothuis et al.,2008:1545).

Furthermore, the variable “retire” has as well a negative sign. This means that people who are already retired or are planning to retire nearby the project area are willing less compensation. This result is in contrast with the results of other surveys that find that retirement in the area of the project has a positive impact on the WTA. The reason for this findings is that the choice of the place of retirement is based on the aesthetics of the place, something that is effected from wind parks (Groothuis et al.,2008:1545). Additionally retirement was found in other surveys with a positive sign because if a person is retired is more positive to accept a compensation (Du Preez et al.,2012:6).

In the present survey the negative sign can be explained by the fact that people who choose to retire in South of Spili area are people that already have property in the area so the reason they choose to retire there is not the aesthetics. More specifically 95.4% of the respondents that have plans to retire in the project area or they are already retired have property in the area. So we can conclude that the choice of the place of retirement is independent from the aesthetics and as a consequence independent form the installation of a wind park.

Finally, the variable “age” has also negative sign which means that older people want less compensation. One possible explanation of this result is that older people have less life
expectancy so they are more willing to accept changes. They are not going to live long with the proposed changes as someone younger will.

It should be mentioned that in the present survey we have compute the individual measurement of welfare WTA and we have not compute the total welfare.

Finally the median min WTA amount that the respondents would accept as a compensation in order to accept the installation of a bigger wind park is 38.054€ as a yearly reduction in the households electricity bill. A higher amount than other surveys have found. Du Preez, Menzies, Sale, and Hosking,(2012:6) found R12.21 per month and R146.52 per year (around 0.95€ and 11.44€ respectively). And on the other hand Groothuis, Groothuis and Whitehead, (2008:1550) have found 23$ per year.

4.2. WTA and composed error term

At this point further work needs to be done in order to estimate the empirical data with the model that takes into consideration hypothetical bias with the form of overestimation. As a start we checked our data overall the 300 questionnaires and the most of the responders said “No” in their proposed bid, exactly 169/300, 130/300 said yes and 1 missing value (didn’t answer). Because we had more No-saying responses, if hypothetical bias exists it will be in a form of overestimation.

After a number of estimations until now no hypothetical bias exists in our empirical data. Further work has to be done in order to make sure that no overestimation occurs in subsets of the data.

5. Conclusions

In our study we have done simulations for the WTP with a single error and a composite error model and we have found that the composite error model helps in order to overcome Hypothetical Bias. Furthermore we applied the simple dichotomous choice model in empirical data in order to estimate the WTA for the installation of a wind park in South Rethymno. The
composite error model in the empirical data showed no hypothetical bias so as a next step in this paper the composite error model will be applied in subsets of the data.

6. REFERENCES


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