

HOW SENSITIVE ARE ENVIRONMENTAL VALUATIONS TO ECONOMIC DOWNTURNS?
EVIDENCE FROM THE 2009 RECESSION

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Abstract. This paper assesses the temporal reliability of willingness to pay estimates (WTP) under changing economic conditions. This study uses data from the contingent valuation method (CVM) study conducted after the Prestige oil spill in Spain in 2006, and a second wave of the same survey repeated in 2009, after Spain reached the highest unemployment rate in the EU. Median WTP values are computed in both cases and compared. Our results show that WTP estimates dropped for Spanish society as a whole, from €50.57 in 2006 to €22.76 in 2009 per household, a statistically significant drop. However, the WTP estimates obtained from the geographic area closest to and most directly affected by the spill (Galicia) did decrease, but **not** by a statistically significant amount. Implications of these findings for reliability and temporal stability of CVM passive use values as well as for use in benefit transfer are discussed.

Keywords: Contingent Valuation, Wildlife Losses, Oil Spills, Passive Use Value

JEL Classification: Q51, Q53.

Introduction

Nearly all willingness to pay (WTP) studies use data from a survey done in one particular year. These single year values often get extrapolated out several years into the future when benefit-cost analyses or natural resource damage assessments are performed. Thus, an important policy and empirical question is whether the state of the economy in the year of the survey has a dramatic effect on the WTP estimates obtained at any particular point in the business cycle.

Contingent Valuation Method (CVM) estimates of WTP for passive use values are often subject to great scrutiny. In part this is due to their stated preference basis and the fact that since respondents to passive use value surveys are by definition non-users they do not have first hand experience from visiting the resource in question. The sensitivity of CVM derived estimates of WTP have been tested regarding WTP question format, question ordering, survey mode, etc. Another area of testing has been to investigate the test-retest reliability of CVM estimates of WTP. In this case, sensitivity of estimates over time is seen in most cases as a sign of unreliability of results, *ceteris paribus*. In order to mitigate the possible time sensitivity of estimates, the Blue Ribbon Panel recommended that “Time dependent measurement noise should be reduced by averaging across independently drawn samples taken at different points of time. A clear and substantial time trend in responses would cast doubt on the “reliability” of the findings.” (Federal Register, January 15, 1993, 4609).

Of particular relevance for this present work is the analysis conducted also by Carson et al. (1997) assessing the temporal reliability of WTP estimates obtained from the Exxon oil spill contingent valuation (CV) survey, conducted two years apart. They show that the distribution of responses “for” or “against” the program valued were stable over time. Other

studies evaluating also the temporal reliability of WTP estimates are those by McConnell, Strand, and Valdés (1998); Stevens, More and Glass (1994), Whitehead and Hoban (1999) and Loomis (1989, 1990). However, the premise underlying all these studies is that consistency of WTP estimates indicates a reliable estimator. But this premise is based on the assumption of *ceteris paribus*, particularly that the determinants of WTP have not changed over the time interval. However, reliability also requires that when the underlying determinants of WTP have changed, a reliable method would yield a different, not the same WTP (the reader may recall the broken clock or broken scale analogy of consistency, but not reliability). However, little is known about how passive use values vary when macroeconomic conditions and personal income changes as well as the psychological toll it takes on consumer confidence to spend money on private and no doubt public goods as well.

To investigate this important policy issue, this paper tests the sensitivity of valuation estimates linked to the environmental damages caused by the Prestige oil spill to the Spanish society as a whole, in terms of their passive use values lost. Our hypotheses depart from those previous analyses in that temporal reliability becomes an issue to be investigated when macroeconomic conditions are altered due to exogenous shocks (such as the current economic and financial crisis). In this case, stability of WTP results may not be expected over time. Consequently, in our view, the affirmation that “A clear and substantial time trend in responses would cast doubt on the “reliability” of the findings” is only valid when valuation conditions are not altered. Thus, the main objective of this analysis is to assess to what extent WTP estimates change, when macroeconomic conditions such as the unemployment rate, income, etc., change.

Theoretical Motivation

Environmental valuations can be influenced by socio-demographic variables and time(Whitehead and Hoban, 1999). An additional factor here explored is the role of the exogenous environmental conditions (such as the overall economic conditions). Therefore, preferences towards a particular environmental program can be given by a vector to be estimated θ such that:

$$\theta = \theta(x, z, t),$$

Where x represents a vector of socio-demographic variables, z a vector of overall environmental conditions and t the time period. Perceived environmental quality q depends on actual environmental quality (not formally included in the model), environmental policies (g), and preferences towards the environment, so that

$$q = q(g, \theta),$$

Where

$$\frac{\partial q}{\partial g} > 0, \frac{\partial^2 q}{\partial g \partial \theta} > 0$$

WTP in any time period is the maximum amount of money the consumer would give up in order to enjoy the change

$$WTP_t = e(q(g, \theta), u; t) - (q^*(g^*, \theta), u; t),$$

Where WTP_t is willingness to pay in time period t , so that expenditures to maintain a given level of utility decrease with respect to a government policy that increases environmental quality, so that $q^*(g^*, \theta) > q(g, \theta)$, and $WTP_t \geq 0$.

Empirical Hypotheses

There are three hypotheses to be tested in this analysis. The first one refers to the effects of the explanatory variables on the probability of responding positively to a given bid amount in the dichotomous choice WTP question. In particular we test whether there is equality of coefficients in the logit WTP regression between the two time periods. Our null hypothesis is

$$(1) H_0: \beta_{06} = \beta_{09}$$

Where β_t is the vector of coefficients associated with the variables x described above in 2006 and 2009. The null hypothesis will be tested using a likelihood ratio test for coefficient equality.

The second hypothesis test is whether an intercept shifter, equal to one during the economic crisis of 2009 (and associated with the variable z above), is statistically different from zero. The null hypothesis is:

$$(2) H_0: \beta_{\text{crisis}} = 0$$

The third hypothesis is related to the WTP magnitudes, with the null hypothesis that they are equal across years:

$$(3) H_0: WTP_{06} = WTP_{09}$$

This will be tested by determining if the confidence intervals on the two WTP estimates overlap.

Survey: Stages and Application

In order to check temporal sensitivity of WTP estimates, a CV study was first conducted in 2006 and later repeated in 2009. Valid CV estimates require careful survey design and testing. The pre-existing experience in the passive use oil spill valuation studies, such as the work done in the Exxon Valdez accident (Carson et al., 2003) and the central

Californian coast oil spills (Carson et al., 2004) were very useful in designing our analysis. Nevertheless, in spite of the common research lines and similar objectives shared with these previous studies, the work was rather innovative since we adapted our study to the European socio-economic context, estimating how this catastrophe has been perceived by the Spanish society. Since the details of the survey development and sampling are presented in Loureiro, et al. (2009), we only summarize the key points.

After developing a factually sound survey draft, focus groups were carried out in variety of different Spanish cities, some close to the spill and some a great distance from the spill. Our resulting survey design follows the main Blue Ribbon Panel recommendations from the NOAA panel (Arrow, 1993) to the extent practical. Following Arrow et al.'s. (1993) recommendations, the survey was administered with face-to-face in-person interviews, with an easy to understand WTP question, the voter referendum format. Respondents were reminded that either positive or negative responses to the WTP question were acceptable.

Subsequently, the final version of the questionnaire developed from the focus group was pre-tested both in Northern Spanish cities (A Coruña, León and Oviedo), and in Southwest Spain (Alicante and Murcia). After this first field work and several adjustments to the pilot survey, final surveying was conducted of a general sample of Spanish households. These first in-person interviews were carried out by a market-analysis company. Field work lasted from March 2006 to the beginning of September 2006, since a break was taken from the last week of July to the end of August, due to summer holidays. Details of the sampling are presented in the results section.

The second survey in 2009, contained a common structure to this first one, and identical with respect to the information provided about the oil spill, the valuation scenario, and the valuation questions. However, and based on the changing environment, new focus

groups were conducted in order to assess the sensibility of our valuation scenario to the new economic conditions. Focus groups were conducted in the cities of Seville and Salamanca, during April and May 2009. A survey pretest was also conducted in the cities of A Coruña and León in June 2009. The final survey was conducted during September 2009.

It is noteworthy to indicate that between the implementation of the first and second survey, the Spanish booming economy entered in a very serious recession. Until 2008 the Spanish economy had been regarded as one of the most dynamic within the EU. In fact, the country's economy had created more than half of all the new jobs in the European Union over a period of five years ending 2005, a process that is rapidly being reversed now. Spanish GDP was also growing in this decade at a rate between 3.5-4.0 percent until 2007. However, during 2009 there has been an estimated 24.3 percent decline in investment in capital goods which created an alarming growth of the unemployment rate. The unemployment rate reaches at the time of this writing was 17.93 percent, the highest of the Euro zone (INE, 2009). Spanish GDP has also dropped in 2009 by a -4 percent with respect to 2008, and a growing negative figure is expected for 2010, according to the Spain's central bank governor, Miguel Ángel Fernández Ordóñez (New York Times, 2009). While this economic downturn is unusually severe, it does provide the opportunity to investigate the sensitivity of WTP responses to changes increased unemployment, lowered income and the resulting psychological effects on consumer confidence.

Survey Instrument

As stated earlier, both surveys conducted in 2006 and 2009 share a very large amount of identical questions; in particular, the description of damages, the valuation and payment scenarios of the Prestige oil spill. Like the Exxon Valdez study, we valued the damages from the Prestige spill by estimating WTP to avoid another similar sized spill. Therefore, the survey introduced the possibility of a future oil spill episode like the one caused by the

Prestige, if no preventive measures were to be put in place. Once this was stated, a show card with a proposed program to avoid future spills was presented to participants. The program was specially designed for its initial application in the Atlantic and Cantabrian Spanish coasts. This program was depicted as part of a broader strategy conducted by the EU to avoid marine pollution. The program description identified several action lines, which were in accordance to the focus groups discussions. Such action lines were: a) proper training of personal for surveillance and emergency tasks; b) inspection and surveillance of maritime traffic in all Cantabric and Atlantic coasts of Spain using escort ships that would travel along the coast. c) a rapid and qualified response in emergency situations, using professionals and tools to prevent the oil spill from spreading. In the case of an accident happening, the escort ships would carry qualified personnel and tools to prevent the oil spill from spreading. Full details of the program valued appear in the original article by Loureiro, Loomis and Vázquez (2009).

Next, and based on scientific predictions of damages, individuals were shown the difference between the expected environmental damages in the next seven years with and without the proposed program. This time frame was chosen because it reflects, on average, the frequency of important oil spills in the Northern Spanish coast. Therefore, the difference between the expected damages with and without the described program will allow us to understand the effectiveness of the proposed measures in terms of reducing the environmental damages.

Once the proposed program was presented together with the expected results, interviewees were given the chance to decide over its application, as in a real referendum. Their decision was about whether they would vote in favour or against the program, bearing in mind the costs to their household. In this sense, they were once more reminded about the nature of the program, which will be developed at an EU-level and where each member State

should pay its equivalent contribution, if the respective country supports the program's application.

Next, the willingness to pay (WTP) question was presented. This was in the form of a voter referendum, offering the program implementation if they would vote to pay a specific one time increase in taxes. Moreover, all respondents voting yes or no, were asked about the degree of certainty in their response. The WTP question was the following:

It is expected that this program is in full operation in 2010. If the application of the escort ship program described above would cost your household xx€-, would you vote in favour to pay this amount just <u>one single time (say in the next tax declaration)</u> to reduce the damages described from the oil spill to the nature and fauna by oil spills?		
YES1	NO2	DON'T KNOW..... 9

After this WTP question, a follow-up certainty scale type of question identical to the one employed by Champ et al. (1997) was used in order to provide some insights about how certain participants were about the previous response. Such question proved to be very effective in order to reduce the hypothetical bias effect.

The questionnaire concluded with questions about the socio-demographic profile of the respondents. Finally, interviewers were asked to complete some questions regarding their observations of the respondent's attention to the survey, and whether the respondent gave serious consideration to their answers.

Data

Both in 2006 and 2009, the previously described questionnaire was implemented in all Spanish territories. The sampling method employed in both cases was a multi-stage method, firstly selecting different population areas in each region (Autonomous Community), including big, medium and small cities. The total number of surveys in 2006 collected was 1140, with a response rate of 44.4 percent. In 2009, a total of 750 additional surveys were collected with a response rate of 45.22 percent. These are reasonable response rates for studies in which it was not possible to make previous appointments with the households. This difficulty arose because many Spanish households now have cell-phones instead of land lines, which complicates contacting households due to the large amount of unlisted numbers. In the following analysis all responses are included, even those that may be considered protest. This seems appropriate since in a real election their vote will count.

Table 1 contains the variable description and summary statistics of the explanatory variables, presenting their means and standard deviations in both years. With respect to the characteristics of the samples, these are very similar across years. 51 percent of respondents are men in both years, with an average age of 44.74 years in 2006 and 46.30 in 2009. The average education level in the sample is about the Census average, with 28 percent of the individuals having completed elementary school, and 43 and 49 percent having completed high school in 2006 and 2009, respectively. University studies are completed by 17 and 15 percent in 2006 and 2009, respectively. Income levels dropped from 2006 which had 38 percent in the high income bracket to just 15 percent of respondents in this high income bracket in the 2009 survey. This income drop is mainly due to the highest unemployment rate in years. Finally, with respect to the place of origin, in both years, nearly 40% live by the coast. Thus on a number of social and demographic variables our sample reflects Spanish households in both years and the two surveys are not different from one another in respect to demographics.

Other interesting differences are behind the level of certainty expressed when responding to the WTP question. Such certainty level increases considerably in the 2009 survey, passing from 35 percent of the respondents in 2006 stating that they were fully certain to about 50 percent of the sample in 2009. We should also note that such high certainty in 2009 is usually linked to a negative response. In addition, the reasons given by those participants not willing to pay for the described program (See Table 2) are also different across survey years, and such differences may be attributable to the changing economic conditions. In particular, in 2006, about 15.72 percent of the total sample stated that the amount requested was too high, while in 2009, this percentage increased to 23.83. Furthermore, 9.85 percent of the total interviewed sample state in 2009 that the main reason not to be willing to pay for the proposed program is because they did not have money to pay for it. This reason was never explicitly indicated in the 2006 survey.

Empirical Model

Responses to the WTP questions in both surveys have been analyzed with a logit model. The specification employed in this analysis includes all relevant variables used in the logit valuation analysis. The empirical specification takes the following functional form:

(4)

$$\text{Log}(Y_i / (1 - Y_i)) = \beta_0 + \beta_1 \ln Bid_i + \beta_2 Age_i + \beta_3 Female_i + \beta_4 VisitCoast + \beta_5 HighSchool + \beta_6 University_i + \beta_7 Galicia + \beta_8 MidIncome + \beta_9 HighIncome + \beta_{10} Crisis + \beta_{11} Certainty + \varepsilon$$

Where the right hand side is the log of odds ratio of the probability of an affirmative response (Y_i) over the probability of a negative response to the WTP question ($1 - Y_i$). The variable

specification was chosen based on the statistically significant variables in the analysis of the 2006 data reported in Loureiro et al (2009).

Results

In order to test our first hypothesis about whether WTP coefficients differ between the two sub-samples, we conducted a likelihood ratio test using the test statistic

$$LR = -2 * \left[Ln(\hat{\lambda}_N) - \sum_{k=1}^2 Ln(\hat{\lambda}_{ki}) \right], \text{ where } Ln(\hat{\lambda}_N) \text{ is the value of the maximized log}$$

likelihood function obtained with the full sample (pooled model), and $Ln(\hat{\lambda}_{ki})$ is the value of

the maximized log likelihood function with each of the subsamples, where $k = 1, 2, \dots$. Under

the null hypothesis this LR statistics follows a χ^2 distribution with $\sum_{k=1}^2 T_{ki} - T_N$ degrees of

freedom, where k_i is the number of coefficients estimated for each sample, T_N the

coefficients estimated in the pooled model (full sample model). In our model comparison

between the unrestricted (separate equations for 2006 and 2009) and the restricted model

(one equation pooling data for 2006 and 2007), the LR statistics carries a value of 12.778,

well below the critical $\chi_{11,0.05}^2$ of 19.675. Therefore, we fail to reject our first null hypothesis

about the equality of effects and proceed with an estimation based on a nested logit model.

Table 3 presents estimated coefficients that will be employed to calculate the median WTP estimates. Due to the differential impact that current economic conditions may cause in passive use and use values, we compute the median WTP for the whole sample, and for the subsample from the most affected area (the region of Galicia).

As reflected in Table 3, results from the logit models indicate that those individuals who have previously visited the affected area, those who live in the most affected area

(Galicia) are more likely to pay for the proposed program. Other variables, such as education and income carry the expected signs, although these are not statistically significant. The higher the bid or monetary amount the respondent was asked to pay the lower the likelihood, indicating a negative own price effect as expected by theory. The intercept shift variable on the current economic crisis has a negative effect on the probability of paying for the program and is highly significant. Thus, we reject our second null hypothesis. Another variable decreasing in a statistically significant way the likelihood of paying for the oil spill prevention program is the level of certainty associated with the given response. Table 4 reports the marginal effects associated with the aforementioned coefficients. The current crises decreases the probability of paying for the program by 12.91 percent. This effect is similar in magnitude to the influence of the certainty scale variable, and it follows other results by Champ et al. (1997). On the positive side, however, the fact that the individual is from Galicia (the most affected area) increases the probability of supporting the program by nearly 20 percent. Whether a respondent visited the affected coast (before or after the spill) also has also a positive and significant effect on WTP estimates, increasing the probability to pay for the program by about 12 percent.

The calculation of the median WTP in a log-linear in bid logit model is computed employing the following formula (Hanemann, 1984):

$$(5) \quad WTP = \exp\left(\frac{-\hat{\alpha}}{\hat{\beta}}\right),$$

Where $\hat{\alpha}$ represents the term known as the *grand constant*, being the sum of the products of the means of the explanatory variables times their associated coefficients, and $\hat{\beta}$ being the coefficient associated with the bid amount. To calculate WTP in 2006, the Crisis variable is set equal to zero. The same procedure is used to calculate WTP in 2009, except the Crisis

variable is set equal to one. The magnitude of WTP and the 95% confidence intervals computed by the Krinsky and Robb method are presented in Table 5. Median WTP estimates for the entire sample per household ranges from €50.57 in 2006 down to €22.76 in 2009, with non-overlapping confidence intervals. Thus, we reject the null hypothesis established in (3) for the entire sample. WTP estimates elicited from the sample of the most affected area go from €130.63 in 2006 down to €62.68, with overlapping confidence intervals. Thus, this reduction in WTP is not statistically significant, failing to reject the third null hypothesis for the area in closest proximity and most affected by the oil spill (Galicia). This lack of statistical difference may be due to the possibility that Galicia residents' environmental valuation contains a higher proportion of use value than the rest of Spanish society.

For comparison purposes, Carson et al. (2003) obtained an individual median WTP estimation of \$30.30 to avoid a damage of the magnitude of the Exxon Valdez case in USA in 1991. Updating the Exxon Valdez WTP estimate for inflation to our study year, yields \$43.44. During our interview period the Euro traded about one for one with the U.S. dollar, so the \$43.44 would represent €43.44.

Conclusions

Using an approach similar to Carson et al.'s test-retest approach for assessing the reliability of the passive use values lost in the Exxon Valdez oil spill, we conducted two CVM surveys to measure the passive use values. However, between the first survey in 2006 and the second survey in 2009 the Spanish economy suffered a substantial decline in economic activity and the unemployment rate rose to 18%. Thus, one would expect a reliable indicator of WTP to be influenced by such as dramatic macroeconomic decline and associated personal finances of many Spanish households. Consistent with these expectations, there is a statistically

significant drop in the median WTP estimated for the entire Spanish sample during the 2006 to 2009 time periods, with median WTP dropping from €53.09 to €23.46 per household. However, the difference in WTP estimates computed for area closest to and most affected by the spill is not statistically different, although the median WTP estimates did drop from €150.02 to €61.85. Galician residents suffered both, use and passive use losses in the Prestige oil spill, while most of the rest of the Spanish area suffered only passive use losses. Our results suggest that respondents within the geographic area where values are primarily passive use values have WTP that is more sensitive to economic conditions than those whose total economic values contain some use values. Because of the large deterioration in economic conditions between the two survey time periods, we believe that some differences in WTP values are expected, and should not be interpreted as a sign of “noise” or unreliability, but rather a reflection of changes in real economic conditions. In this case, obtaining the same WTP estimates when the *ceteris paribus* conditions are violated might actually be a sign of an unreliable estimator of WTP.

Our results have two important implications for estimation of passive use values. First, if the timing of a major passive use value survey happens to fall during a recession, this may limit the capacity to generalize the estimates to more normal economic conditions. This could cause underestimates in future benefit streams calculated for benefit-cost analysis or underestimates of natural resource damages if the recession suppressed WTP is generalized into the future. Second, there could be corresponding errors in benefit transfers if the policy analyst were to use WTP estimates from a passive use value survey conducted during an economic recession as a measure of benefits for normal times. Thus a contribution of this paper is to raise awareness of these issues in benefit-cost analysis, natural resource damage assessment and benefit transfer. Obviously much more work needs to be done to replicate

these results for other resources with passive use values, and for recreation use values as well.

Table 1. Summary Statistics for 2006 and 2009 Samples

Variable	Description	2006		2009	
		Mean	Std. Dev.	Mean	Std. Dev.
Age	Age of individual	44.7	17.8	46.3	17.5
Female	Whether the individual is a female	0.51	0.50	0.51	0.50
VisitCoast	Whether the individual visited affected coast	0.30	0.46	0.42	0.49
High School	Whether participant has completed High School	0.43	0.50	0.49	0.50
University	Whether respondent completed University studies	0.17	0.38	0.15	0.36
Midincome	Whether participant belongs to the mid income bracket	0.16	0.36	0.29	0.45
Highincome	Whether participants belongs to the high income bracket	0.38	0.48	0.15	0.36
Crisis	Indicator variable denoting economic crisis	0		1	
Certainty	=1 if certainty score is 10, 0 otherwise	0.34	0.47	0.49	0.50

Table 2. Reasons for not willing to pay for the oil spill prevention program

Reasons given for not paying the bid amount	Total % 2006	Total % 2009
I do not have money to pay for this program	0.00	9.85
This is simply too much money	15.72	23.83
Others should pay for this program (government, oil companies, etc)	12.38	14.91
It is not fair to have to pay for this	0.70	5.59
I pay too many taxes already	23.71	13.72
Maybe the money will not be used for such program	0.00	2.53
It finally depends who propose this program	1.05	0.00
It is bad timing: it depends on the moment	1.76	0.00

Table 3. Estimated Coefficients for WTP Regression

WTP	Coef.	Std. Err.	Z	P> z
Lnbid	-.8515	.0657	-12.96	0.000
Age	-.0112	.0038	-2.98	0.003
Female	-.1068	.1159	-0.92	0.357
VisitCoast	.5912	.1240	4.77	0.000
HighSchool	.0367	.1448	0.25	0.800
University	.2828	.1807	1.57	0.117
Galicia	.8626	.2295	3.76	0.000
Midincome	-.2241	.1571	-1.43	0.154
Highincome	.0361	.1396	0.26	0.796
Crisis	-.6252	.1251	-5.00	0.000
Certainty	-.6042	.1234	-4.89	0.000
Constant	3.8540	.4068	9.47	0.000
Log-likelihood	-899.67			
LR test	283.99			
(P-value)	(0.000)			
N	1648			

Table 4. Marginal Effects from WTP Regression

Variable	dy/dx	Std. Err.	Z	P> z
Lnbid	-.1786	.0136	-13.08	0.000
Age	-.0023	.0008	-2.98	0.003
Female	-.0224	.0243	-0.92	0.356
VisitCoast	.1275	.0272	4.68	0.000
HighSchool	.0077	.0304	0.25	0.800
University	.0614	.0405	1.52	0.129
Galicia	.2012	.0565	3.56	0.000
Midincome	-.0458	.0312	-1.47	0.142
Highincome	.0076	.0295	0.26	0.797
Crisis	-.1291	.0253	-5.11	0.000
Certainty	-.1236	.0244	-5.07	0.000

Table 5. Mean WTP estimates with 95 percent confidence intervals computed by the Krinsky and Robb method (with 10000 repetitions)

	Median WTP 2006	Median WTP 2009
All Sample	50.57 (40.78, 61.11)	22.76 (16.86, 29.15)
Galician Sample	130.63 (76.75, 218.57)	61.85 (36.03, 105.73)

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