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HOW MUCH PEOPLE ARE WILLING TO PAY FOR SILENCE? A ONE AND ONE-HALF-BOUND DC CV ESTIMATE

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ABSTRACT
High levels of noise have negative implications not only for health but also for other types of human activities. Noise also affects the development of human activities, and has therefore economic consequences. Noise is, in economic terms, a negative externality and a public "bad", however, is one of the pollution problems which has attracted less attention by environmental economist. One of the goals of this paper is to advance in that direction estimating the economic value of a noise reduction through the contingent valuation method. The objective of this paper is to estimate the economic value of a reduction in the level of noise in the Spanish city of Pamplona. We estimate this value applying the Contingent Valuation Methodology and specifically the one and one-half-bounded (OOH) model. This method is more efficient that the double-bounded alternative (DB) and requires less information than the triple-bounded (TB) model. The preliminary results show that annually each household willingness to pay for a reduction in, both daytime and night-time, noise level is approximately of 6200 pts (38.75 euros).

1 - INTRODUCTION

High levels of noise have negative implications not only for health but also for other types of human activities. That is, high noise levels have physiological, and psychological consequences. The physiological effects include, for example, high blood pressure, stomach ulcers and other digestive diseases. Among the psychological effects we can signal, as well, increases in the level of anxiety and nervousness. Noise also affects the development of human activities, and has, therefore economic consequences. The exposition to high levels of noise decreases the concentration capacity, increases the probability of perception errors, and makes difficult the process of learning in children. Other economic consequences are the loss of property value and the increase in health expenditures.

Noise is, in economic terms, a negative externality and a public "bad", however, is one of the pollution problems which has attracted less attention by environmental economist. Nevertheless, nowadays, is becoming more relevant. Several studies have been carried recently, Yamaguchi (1996), Vainio (1995), Renew (1996), and Grue *et a.l.* (1997) among others. A large proportion of noise studies has focus on studying the loss of property value associated with aircraft noise. Collins and Evans (1994), Levesque (1994), O'Byrne (1985), Nelson (1978, 1979) and Yamaguchi (1996) for example apply the hedonic price methodology to stud y the loss in property values associate with the aircraft traffic of airports. Additionally, hedonic house pricing is also the methodology most widely used in road traffic noise, Soguel (1994) and Renew (1996) apply this methodology, only Vainio (1995) applies CVM to estimate WTP on the reduction of traffic externalities for the city of Helsinki.

One of the goals of this paper is to advance in that direction estimating the economic value of a noise reduction through the contingent valuation method. More specifically, we will estimate the economic value of a noise reduction in the city of Pamplona. In order to estimate this economic value by Contingent

Valuation Method (CVM) we will apply the one and one-half-bound model (OOH) proposed by Cooper and Hanemann (1995). The paper is organised as follows. First we outline a brief description of the methodology used. Second, we discuss the survey design, and explain the data collection process. Next, we present the most representative summary statistics, the estimated results and discuss its implications. And in the last section we summarise the major conclusion of the study.

2 - METHODOLOGY

The basic assumptions underlying the contingent valuation method (CVM) are that individuals know approximately the maximum amount of money that they are willing to pay (WTP) to acquire the good under evaluation, and that individuals would report the true value given that the survey has been designed optimally. The application of this methodology, however, can give rise to several problems that may cause valuation biases that result in the existence of differences between the real and the reported values. In this paper we dedicate special attention to reduce the question format bias applying the methodology proposed by Cooper and Hanemann (1995).

Cooper and Hanemann (1995), proposed an alternative question setting to the classical single-bounded (SB) and double-bounded (DB) question formats: *the one and one-half-bound model*. One of the reasons for this development was that the DB questions were formulated in such a way that forced the respondents to switch from a market setting for the first bid to a bargaining setting for the second bid, making difficult to compare the responses to the two bids. Cooper and Hanemann 1995 present a solution to this problem devising a multiple bounded method that is free of response bias to the follow-up bid. Specifically, they construct the called one and-one-half bounded model (OOH) which specification should strongly lessen the possibility that the survey moves into a bargaining setting when the interviewer proposes the follow-up bid.

The OOH methodology assumes that there is uncertainty about the cost of providing the good to be valued. The interviewer only knows an interval of variation for this cost, it ranges from a lower to an upper bound, called BIDL and BIDU, respectively, (i.e.BIDL $<$ BIDU). The application of this methodology will consist on the following steps, first, and before the questions that elicit his willingness to pay are asked, both, the lower and upper bounds, are communicated to the respondent. Second, the interviewer chooses randomly one of these two points as the initial value to elicit the respondent willingness to pay. Then, if BIDU is chosen and the respondent says NO, the respondent is asked is he is willing to pay BIDL. And similarly, if BIDL were the first value asked. That is, if BIDL were the first value chosen and the respondent says YES, then the respondent would be asked if he is willing to pay BIDU. In the other two cases the questioning stops, when the first price proposed is BIDU and the respondent says YES, and if the first price proposed is BIDL and the answer was NO.

3 - SURVEY DESIGN

The city of Pamplona is located in the northern part of Spain, between the Pyrenees and the Cantabrian Sea. It can be considered, with respect to noise, as an average city among the Spanish cities of its size (approximately 200,000 inhabitants). The acoustic map of the city done in 1997 shows that 59 percent of the measurements were above the 65 db(A), that is the upper limit recommended by the WHO, but only in 9 per cent of the cases the 75 dB (A) were reached, that is the level considered harmful by the WHO. In this study the average level of noise was 67.1 dB(A).

We carried out the survey through 600 telephone interviews, they were done from December 1998 to December 1999. The city was divided in 14 neighbourhoods and the interviews were distributed among them according to their population. The survey included 35 questions, most of these questions had several subsections, therefore the final number of questions really asked was larger than 35. The survey content was divided in three sections: 1) Description of the good being valued, 2) Explanation of the circumstances under which the good will be provided and formulation of the questions that elicit the respondents' willingness to pay for the specified noise reduction, and 3) Personal characteristics of the respondents.

For understanding the implication of each one of the measures we want to value in terms of noise reduction, is necessary to give some examples. So that, in question 15 we described through examples which would be the implications in terms of noise reduction of these three measures. First, we point out that such measures would have implications for both, day and night-time. Therefore, our description would include examples of night and day reductions. For example, we pointed out that the day time reduction on the noise level "would represent to switch from the level of noise that exist in the neighbourhood in a weekday during work hours to the level of noise that exist during a weekday at 9:30 p.m." For the night time reduction we explain that would imply to change from "the level of noise during a Saturday night to a Monday night".

Finally, we fully entered in the valuation questions. First, we explain that these measures were costly and that the respondent will have to contribute to finance them if they are finally approved. Next we announce that a research team of the Universidad Pública de Navarra has estimated the cost of such policies. And we present the respondent with an interval for those costs estimates. The extreme values of this interval coincide with the upper and lower bids that later will be presented to the respondent in the elicitation question (i.e. BIDL and BIDU). In this formulation the cost of the good in question is placed in a framework of uncertainty. The respondent is told that the interviewer in uncertain about the exact cost of the good, but knows that it lies in some interval which extreme values are BIDL and BIDU.
Then, we specified the vehicle of payment. We choose to present increases on city taxes, we found that this was the least disturbing method because other city services are paid through city taxes, for example, trash collection services. Next we announce the BIDL and the BIDU. And finally, we set up the questions to elicit the respondent willingness to pay, WTP.
The values of the BIDL and BIDU ranged between 500 pts. (3.12 euros) and 10.000 pts (62.5 euros). These values were chosen after carrying several experimental open format surveys, where we asked for the maximum willingness to pay. Note, that in order to set up these values we did no consider the real cost of the program and therefore these were not real cost estimates. The one-and-one-half-bound estimation method requires also to present several intervals of variation for the lower and upper bids. The sample was divided in three different pairs of bids i) 500 pts (3.12 euros) and 3500 pts. (21.87 euros); ii) 2000 pts. (12.5 euros) and 7000 pts. (43.75 euros); and iii) 4000 pts. (25 euros) and 10.000 pts. (62.50 euros). Finally, in the third section of the questionnaire we ask for the respondents' characteristics, such as age, gender, and income level. Also, to obtain complementary information we require if the respondent has carried out any investment in their houses to isolate them from noise.

4 - PRELIMINARY RESULTS

600 telephone interviews were done to obtain data regarding people's valuation of noise reduction policies. Respondents showed a lower tolerance level for night-time noise than for daily noise. Trash trucks were signalled as the origin of the most disturbing noise during the night. With respect to daily noise the 33.3% of the population showed that was disturbed by traffic noise. When respondents were asked which type of traffic noise considered more disturbing, the 87.3% of them responded that motorcycle noise, even though the number of cars is 15 times larger than the number of motorcycles in Pamplona. Another focus of noise during daytime is works carried out to improve or repair the city.
When compared with other city problems noise reduction was not considered a priority problem. Neighbourhood security, the cleanness of the city and dogs excrements were considered more important problems for the city. Nevertheless over 50% of the total sample give the problem of noise a score of 5 or over when asked if it is an important issue in their neighbourhood. Also there is agreement in considering that high levels of noise are dangerous for health, most of the respondent consider that stress is the main problem caused by noise. In general 95.3% of the population considers their neighbourhood pleasant and enjoy their life there. However, 227 persons, that is the 37.8% of the sample, have realised investments in their houses to isolate them from cold weather and noise. To be able to distinguish between these two reasons we also asked which of the two was the main reason to carry on the investments. For 21.9% of those who undertook investments the main reason was the excessive level of noise, for 39.3% was to isolate from cold and 34.8% of the population said that both reasons had the same weight.
The valuation estimates were obtained using Gauss 3.1 © (program routines have been developed by Joe Cooper for ERS-USDA and are available from the following internet site: http://rpbcam.econ.ag.gov/gogrbl). The dependent variable is not dichotomous but it takes 6 different values depending on which bid was drawn first and in the type of answer of the respondent. That is, if the low bid was drawn first, the dependent variable takes value 1 if the answer to that first bid was NO. It takes value 2 if the answer to the lower bid is YES and to the upper bid is NO. And takes value 3 if the answer is YES, YES to both the lower and upper bid. On the other side, and if the high bid was drawn first, the dependent variable takes value 4 if the answer is YES to the first bid. It takes value 5 if the answer is NO to the upper bid and YES to the lower one. And it takes value 6 if the answer is NO to both the upper and lower bids.
The data set also contains two additional data vectors. One that includes the low bids asked to each respondent, plus a second vector that contains the high bids asked to the respondents. Even thought two vectors are now added, only one independent variable takes part in the estimation. This independent variable is a combination of these two vectors. The elements of this independent variable, that is, which lower or upper bid are taken as price to estimate the model depends on the answer of the respondent. The results of this OOH estimation are included in Table 1.

Variable	***Coefficient***	***T-Stat***
Constant	1.0304545***	9.815
Bid	- 0.00021627773***	-13.71

Table 1: OOH Estimation, logit results for the pooled model (Log-likelihood -649.66608, N= 592, *** significant at the 99% confidence level; *source: own calculations*).

The mean WTP pay for this model is 6175.46 pts (38.59 euros). The confidence intervals have been calculated using, as before, following the Krinsky and Robb, approach for 99%, 95% and 90% confidence intervals.

5 - CONCLUDING REMARKS

We have applied the one and one-half-bound methodology to estimate the economic value of a non-market good, a reduction in the level of noise in a Northern Spanish city, Pamplona. The preliminary results indicate that the household willingness to pay for a noise reduction is about 6175.46 pts per year. Our household willingness to pay represents 0.19% of total annual income which is significantly lower than the 0.32% reported in M. Vinio (1995) CV study of noise.

The problem of noise seems to be relevant for citizens although it is not the most important urban issue. Nevertheless, we have detected a substantial WTP for policies which can reduce this problem. Next we plan to extend our analysis to include the characteristics of the population, and to analyse the WTP pay by neighbourhood. The goal is to determine which characteristics of the population are important to determine the willingness to pay for a noise reduction. Finally, we plan to model the answers to the open ended questions and compare these to DC results and check for question format bias when using one and a half bound DC question formats.

Program routines have been developed by Joe Cooper for ERS-USDA and are vailable from the following internet site: http://rpbcam.econ.ag.gov/gogrbl.

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REFERENCES

1. **A. Collins and A. Evans**, Aircraft noise and residential property values: an artificial neural network approach, *Journal of the Transport Economics and Policy*, 1994

2. **J. Cooper and M. Hanemann**, Referendum contingent valuation: how many bounds are enough?, In *USDA-ERS Working Paper*, 1995

3. **J. Grue et al.**, Housing prices impacts of exposure to road traffic and location, In *T&I report, 351/97*, 1997

4. **T. Levesque**, Modelling the effects of airport noise on residential housing markets: a case study of Winnipeg International Airport, *Journal of Transport Economics and Policy*, pp. 199-210, 1994

5. **J. Nelson**, Residential choice, hedonic prices and the demand for urban air quality, *Journal of Urban Economics*, Vol. 5, pp. 357-369, 1978

6. **A. Nelson**, Airport noise, location, rent and the market for residential amenities, *Journal of Environmental Economics and Management*, Vol. 6, pp. 320-331, 1979

7. **P. O'Byrne et al.**, Housing values, census estimates, disequilibrium and the environmental costs of airport noise: a case study of Atlanta, *Journal of Environmental Economics and Management*, Vol. 12, pp. 169-178, 1985

8. **W. Renew**, The relationship between traffic noise and house price, In *Conference of the Australian Acoustical Society, Brisbane, 13-15th November*, 1996

9. **N. Souguel**, *Evaluation monétaire des atteintes à l'environnement: une étude hédoniste et contingente sur l'impact des transports*, Imprimerie de l'Evolve SA Neuchatel., 1994

10. **M. Vaino**, *Traffic noise and air pollution: valuation of externalities with the hedonic price and contingent valuation methods*, School of Economic and Business Administration, Helsinki., 1995

11. **Yamaguchi**, *Sustainable Investment and Resource Use*, UNESCO/PAternon, Caraforth, 1996