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"Willingness to Pay for Silence in Mumbai City"

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Abstract: *Noise is one of the major local disturbances associated with road traffic. Despite its major importance in the urban environment, the problem of noise has received little attention from environmental economists. In this paper we estimate the willingness to pay for silence for a noise reduction program in Mumbai city. The chosen technique is contingent valuation method. The main objective of this paper is to study different social and economic factors affecting peoples' willingness to pay (WTP) and their attitudes toward the noise reduction programme in Mumbai. Through our estimations we have found, that Mumbai household is willing to pay approximately 287.46 per month to reduce noise levels.*

Keywords: *contingent valuation, noise, road traffic, willingness to pay*

I. Introduction

Noise, which continues to be one of the main environmental problems facing India, is gaining its importance as a result of the rise in noise levels that comes about with increasing economic activity. Noise is something to which we are exposed throughout life. It is exposure to levels above 40 dB (A) that begins to influence our well being, while levels above 60 dB (A) are considered detrimental to our health.[1] Excessive levels of noise have both physiological, and psychological consequences. The physiological effects include, for example, hearing impairment, disturbed sleep, high blood pressure, stomach ulcers and other digestive disorders. Among the psychological effects we can also mention greater levels of anxiety, irritability and nervousness; it also influences social behaviour and cognitive development. [2] Exposure to aircraft noise and road traffic noise can impact on certain aspects of children's episodic memory. The World Health Organization guidelines say that for a good sleep, sound level should not exceed 30 dB (A) for continuous background noise, and 45 dB (A) for individual noise events. [3]

Monetary valuation of the external costs is also necessary in order to determine optimal environmental taxes on road traffic, rail traffic and air traffic. Noise is a major environmental effect of traffic.[4] According to report almost 45% of the people, have been estimated to suffer from noise levels considered by scientists and health experts to be unacceptable, that is levels where most people become annoyed and sleep is disturbed, and where adverse health effects are to be feared. An additional many of the people are living in so-called 'grey areas' where the noise level cause serious annoyance during the daytime. A wide variety of studies have examined the question of the external cost of transport noise to the society. The estimates range from 0.2% to 2% of GDP. [5]

Noise is therefore economically important and it stands to a reason that noise should be part of any ex-ante evaluation of major infrastructural projects. An ex-ante evaluation is often carried out in the form of cost – benefit analysis (CBA). In a CBA, as many as possible relevant economic, ecological and social impacts are assessed and monetised. [6] During the last few decades, much research has been done to develop monetisation methods for environmental effects as there is a consensus that environmental effects should be included in the appraisal, but no consensus as to how. [7]

II. Objective of the study

1. To determine the willingness to pay for silence by using contingent valuation method.
2. To study different social and economic factors affecting peoples' willingness to pay and their attitudes towards noise reduction in Mumbai city.
3. To find out the monetary valuation of the noise in order to determine optimal environmental taxes on road traffic.

III. Research Methodology

3.1 Profile of the study area:

Mumbai (formerly known as Bombay) is located on the western seacoast of India on the Arabian Sea at 18053' N to 19016' N latitude and 720 E to 72059' E longitude. The city is divided into different administrative zones known as *'wards'* to ease the day-to-day functioning of the civic authority. The Region's estimated 2005 population is nearly 21 million, which is expected to grow to about 34 millions by the year 2031, with the

distinction of becoming the largest metropolitan region in the World (*TRANSFORM, 2007)*. The workforce participation rate is anticipated to reach about 45% by the year 2031 (37% in 2005). According to CPCB Mumbai is among the three cities with highest rate of noise pollution in India. [8] The increasing number of vehicles, musical instruments, small scale industries, and urbanization and human activities are the main source of noise pollution. Road traffic is the most important source of community noise. Even though very high levels of community noise, i.e. average day-night A-weighted equivalent noise levels exceeding 65dB(A), seem to have stabilized in some countries, the group living in dwelling exposed to 55-65 dB (A) is increasing. [9]

3.2 Survey Design

The questionnaire was tested and revised through focus group meetings. Furthermore, a pilot study was conducted to check the reliability and validity of questionnaire. The final survey as started in June 2012 based on 24 wards in Mumbai. Face to face interview was conducted or a total sample size of 683 respondents. Cronbach's Alpha reliability coefficient is used to determine the consistency of the data. Generally, the Cronbachalpha value following this rule of thumb: less than 0.60 is poor; 0.60 to 0.80 is acceptable; more than 0.80 is good. Since the Cronbach's Alpha stated for all variables is stated in Table is more than 0.60, this indicates that the survey instrument (questionnaire) is having good and reliable to measure the six constructs consistently.

3.3 Description of Variables

The goal of the first set of questions is to focus the respondent's socio –economic variables like age, gender, income, employment status, size of the family, educational background etc. The second part of the questionnaire consists of variables related with the problem of noise pollution. We started by formulating questions that would help people recall the everyday noise levels to which they were exposed. Among other questions, we asked: i) what type of noise was more disturbing for the respondent and how loud it is ; ii) when noise was more of a nuisance, during the day or at night; iii) are you aware of noise pollution (iv) health problems they are facing due to exposure of noise. Through this range of questions we expected respondents to recall the noise levels to which they were usually exposed and, therefore, to be able to understand the noise reduction proposed. The third section includes the precautionary measures they have ever taken to tackle with this problem just to observe what mitigation measures they have taken at their level to reduce noise. It also includes if they are at home among different types of noise which one disturbed or annoyed them most. In the fourth section of the survey, we presented the features of the provision of the good, "noise reduction" and elicited the amount that the respondents would be willing to pay for a particular degree of noise reduction. In other words, we explained how a reduction in the noise level would be provided, what the baseline level of provision would be, who would provide this reduction, how it would be provided, and the method of payment.

3.4 Descriptive Statistics

As mentioned, the total sample size was 683, comprising 61.4 % men and 38.9% women. We also obtained a representative sample of educational levels: 6.1 % of the population had only primary studies, 24.0 % are undergraduate, 24.8% are graduate and approximately 29.2 % of the population had undergone university studies (at master's level or higher education). We divide the age group into four parts up to 25 years, 26-35, and 36-45 and above 45 which includes are 39.5, 27.8, 20.4 and 12.1 respectively. The employment status includes 1.28% Retired respondents, 11.2% students, 5.15 % academicians, 15.9% Private Sector employees, 29.6 % public sector employees and 24.4 % belongs to Self-employee category which includes business or any other earning activity. 21.2 % of the respondents belong to the category of 1lac to 5 lac. 30.7 % belongs to 5lac to 10 lac, 23.4 % are from 10 lac-15 lac and 22.2% belongs to more than 15 lac category. We should mention that there were 202 zeros .We follow the recommendations of the National Oceanic and Atmospheric Administration report by Arrow *et al*. (1993) and differentiate between *real zeros* and *protest zeros*. [10] Therefore, zero answers had a follow-up question in order to detect whether these zeros were real or protest based.

IV. Result and Discussion

This section briefly discusses the effect of socio-economic factors on willingness to pay of the respondents. The prior objectives in willingness to pay survey are to calculate mean willingness to pay and estimating parametric model to allow inclusion of respondent's socio-economic factors in to WTP function. Inclusion of individual's socio-economic characteristics into the CVM helps to gather the information on validity and reliability of the CVM results and increase confidence in practical application of results obtained from the CVM empirical analysis.

4.1 Multiple Regression Model

Multivariate analysis used by different people for willingness to pay, the multiple regressions function was specified as the maximum willingness to pay amount mentioned by the respondents is function of the socio-economic characteristics of the respondent, as

$$Max_{WTP} = \alpha + \beta_1 AGE + \beta_2 EDU + \beta_3 M\_STAT + \beta_4 H\_SIZE + \beta_5 SEX + \beta_6 H\_OWN + \beta_7 W\_SER + \beta_8 INCOME + \beta_9 E\_AWR + ui$$

MaxWTP = Maximum willingness to pay, this variable is used for the open ended question in questionnaire, which accounts for the maximum amount the respondents are willing to pay for reduction of noise levels.. Other variables as AGE, EDU, and M_STAT are already defined and the expected signs of the variable are also discussed earlier.

μi = The random error term, also known as disturbance term is used to capture the unobservable affect of particular variables. This also accounts for the data errors, no doubt how good the model is specified, there always exists chances of error. This error term is normally distributed with 0 mean and has a constant variance.

Table: ***Multiple Regression Results for the Determinants of Willingness to Pay***

Dependent Variable : WTP Multiple Regression Results		
Variable	**Co-efficient**	**Probability**
Age	-0.325618	0.7067
B_A	57.68003	0.0084*
M_A	98.44190	0.0003*
Sex	-1.768804	0.8879
E_AWR	52.08488	0.0052*
H_OWN	-13.73659	0.2959
H_SIZE	- 11.95707	0.0055*
M_STAT	- 30.61121	0.0776
INCOME	0.004363	0.0000*
Mean Dependent Variable 287.46	R Squared 0.587792	
Durbin-Watson Statistics 1.992912	Adjusted R Squared 0.57915	

Thus in the regression results the E_AWR (environmental awareness) has coefficient value of 51.084, which shows that if the E_AWR within the respondents increase by one unit, on average the MAX_WTP increase by 51 units. This variable shows positive relation between environmental awareness and maximum willingness to pay and is also significant at 5 percent and 1 percent level of significance. This show that the environmentally aware people are willing to pay and it also increase concern about their surrounding environment and adverse impacts of noise pollution. In accordance to theory and logic they will be aware of all the threats, diseases and damages that are caused because of improper management. To have such sort of activities we need to aware our population.

As Lambert (2009) [11] also revealed that awareness of the respondents has a significant positive relationship with willingness to pay for noise reduction, this show that the variable of environmental awareness is effective in this study which is highly significant and positively related with willingness to pay for reduction of noise pollution services. The variable labelled as H_SIZE (Household size) has a coefficient value of – 11.957, which show that if the household size increases by on unit, on average the MAX_WTP reduces by 11.96 units and is significant with negative relationship the effect of H_SIZE is significant at 1 percent and 5 percent level of significance.

The M_STAT (marital status) showed a high significance level .This show a positive relationship between marital status and willingness to pay, the respondents who are married are willing for such services than those who are unmarried. This may be the reason for their concerns about their family's health; they may not have the enough time to properly manage the noise levels or to take precautionary measures to avoid noise pollution.

The variable of household monthly income ladled as INCOME has coefficient value of 0.004363, if all other variables are kept constant it shows that if income of the respondents increase by one unit, on average the MAX_WTP increase by 0.004363 units. This effect of this variable is significant at 1 percent, 5 percent and 10 percent level of significance but its contribution is very low.

Regarding the education of the respondents this variable was split into different levels of education as otherwise the effect of highly qualified and low qualified respondents could not be differentiated. So two levels of education were specified as, variable B_A specified for respondent who responded as 13 – 14 years of

education. The level of education M_A specified for respondents having 15+ years of education. Education as B_A and M_A in order to capture the effect of lower and higher education on the maximum amount of respondent's willingness to pay. The first level of education B_A has coefficient value of 56.68003 this shows that if all other variables are kept constant, as respondents with B_A level of education increases by one unit, on average the MAX_WTP goes up by 56.68 units. And this variable is significant at 1 percent level of significance. Likewise M_A has coefficients of 97.441, showing that as the respondents with M_A levels education increases by one unit, on average the MAX_WTP increases by 97.44 units. Both the variables are significant at 1 percent level of significance. These results show that education level is an important determinant of willingness to pay.

The AGE coefficient of −0.3156 indicates that with the influence of other variables held constant, as AGE increases, say, by a year, on average, MAX_WTP goes down by 0.3156 units. This variable shows a negative relationship between age and maximum willingness to pay for services. This may be because these services were not priced before and they are of the opinion that even now these should be offered free of cost. Or the aged people may not be aware of the severity of the environmental and health problems caused by noise pollution.

The Durbin–Watson *d* value is closer to 2 suggesting that there is no issue of "autocorrelation" in the model. The value of coefficient of determination i-e 0.58 indicates that the fit is good, and 58 percent of the total variations in willingness to pay are explained by the included explanatory variables

Our household willingness to pay (without protest zeros) represents Rs 287.46 per month. These results are also consistent with those found in developed as well as other developing countries. Taking this evidence as a whole, the findings do seem to point to CVM providing lower values than SP in the area of traffic related externalities. This is consistent with evidence in the broader area of environmental valuation where there have been many more studies that have compared different methods Kempen (2012). [12] As Hanley et al. (2001) point out, the evidence is clear that the values obtained from and the intended payments of CVM are generally less than the values and payments of actual behaviour. [13]

V. Conclusion

With the existing poor environment quality and no reduction programmes for noise and very less legal provision, it is extremely difficult for authorities to recover the cost of provision and maintain the silence of Mumbai city. Active participation of the community is of prime importance. The regression estimated MAX_WTP gave an average willingness to pay value of Rs 287.46 per month per household. If such charges are properly collected the government would able to properly handle the situation. This process would be cost recovery and revenue generating for the government. Road Traffic noise has a cost to the society. A considerable amount of money is spent every year by government and local authorities to reduce or limit transport noise. Unfortunately the financial resources dedicated to noise control are limited, so must be used in the most effective way possible. In India, few policy decisions related to noise concerns actually use as an economic tool as cost –benefit analysis, although the economic analysis of noise now has a rather good rational basis. Consequently, in order to introduce a more rational utilization of resources, the costing of noise pollution has to be developed, and encouraged especially in developing countries like India.

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