Geology and Evolution of the Indian Plate

(From Hadean to Holocene - 4 Ga to 4 Ka)

S.M. Naqvi

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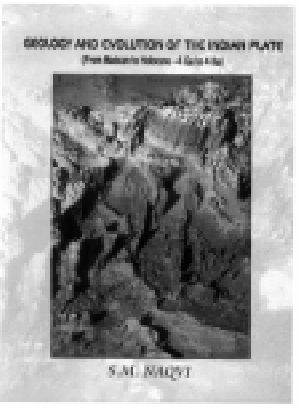

This book is divided into 22 chapters and covers Geology and Evolution of rocks from India, Pakistan, Bangladesh, Nepal, Bhutan, Sri Lanka, Madagascar and Myanmar. It has exclusive coverage of Precambrian, Palaeozoic, Mesozoic and Cenozoic rocks of the continental and oceanic parts of the plate. Position of India and its adjoining parts in Gondwana, Rodinia and other super continents are discussed at length. The book provides details of the birth of the Indian Ocean and death of Tethys when Himalaya developed from Proterozoic to Holocene, faster uplift of Himalaya, recent development of Indo Gangetic plains, Thar deserts and Deltas of the major rivers and their fans. The present book synthesizes the work done on Indian Plate especially after the acceptance of Theory of Plate Tectonics and provides a perception of the present state of knowledge and the glaring gaps. It provides an integrated interpretation of available geological, geochemical and geophysical data in terms of evolution of Indian plate from 4 Ga to 4 Ka.

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Dr. S.M. Naqvi former Director and presently Emeritus Scientist at the National Geophysical Research Institute (NGRI) was born at Amroha (U.P.) And educated at I. M. College (Amroha), Shia College(Lucknow) and Aligarh Muslim University. He has four decades of experience of working on Geology and Geochemistry of Indian rocks. During this period he has established a highly sophisticated national facility and a school of excellence in Geochemistry, guided 30 Ph.D students, wrote more than 200 research papers and authored/ edited seven books published by Oxford University Press, New York, Elsevier, The Netherlands and Geological Society of India, Bangalore. He is recipient of several awards and honours including S.S. Bhatnagar Award, National Mineral Award, APCOST Award, Geological Society Gold Medal, and Decenial Award of the Indian Geophysical Union. He has served as Vice President and Secretary of several societies of Earth Sciences. Dr. Naqvi is a fellow of Indian National Science Academy and one of the most cited earth scientists of India.

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Impact of Air Pollution on Health in Klang Valley, Malaysia

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Abstract: In Malaysia, as in other parts of the world, air pollution has recently been receiving priority among environmental issues. The ambient atmospheric conditions have been progressively deteriorating due to unprecedented growth in urbanization, number of motor vehicles and continuous industrial development. Monitoring data and studies on ambient air quality show that the ambient air quality of the country is clean in general but some of the air pollutants in several large cities especially in Klang Valley, the most densely populated area, are increasing with time and are not always at acceptable levels according to the national ambient air quality standards. This research employed contingent valuation method (CVM) to estimate the willingness to pay of the respondents to avoid the illness episodes due to air pollution. To evaluate the impact of additional information on the willingness to pay (WTP) of the respondents, different sub-samples were presented with contingent valuation scenarios offering different levels of information. One sub-sample was given the cause of ill-health episodes and the policy to be implemented to remedy the cause of the ill-health episodes (context version). Another sub-sample was asked to value the avoidance of episodes of ill-health, but was not given any details of the cause of the episodes nor the policy that would be implemented to remedy the cause of ill-health episodes (non-context version). The study has found that the inclusion of additional information in the presentation of scenarios in contingent valuation exercises significantly influenced WTP for the avoidance of ill-health episodes. The average mean value of WTP of the respondents for the context version was higher than that of the non-context version i.e. RM154 for the context version and RM134 for the non-context version. Since, WTP to avoid the ill-health episodes cannot be shown to be independent of the context in which it is valued, the validity of transferring benefits of avoided ill-health episodes from one country to another must be called into question and the results of the study will not allow decision makers to apply the estimated values for the avoidance of ill-health episodes in the consideration of policies with very different context.

Key words: Air pollution, contingent valuation method, willingness to pay, context version, non-context version.

Introduction

In Malaysia, the ambient atmospheric conditions have progressively deteriorated due to urbanization and industrial development. In 1980, Malaysia's urban population was 34% of the population. The urban population rose to 51% by 1991 and 54% by 1994. Between 1980 and 1991, the number of urban centres increased from 67 to 127 (Department of Environment, 1999). With increased urbanization, the number of vehicles is also increasing. In 1990, total registered vehicles numbered 4.5 million. By 1997, the number had nearly doubled to 8.5 million and in 2000, the number increased to 10.6 million. Motorcycles and private cars are the two largest vehicle categories comprising almost 89% of total vehicles registered. According to

Department of Environment, a total of 5.3 million motorcycles and 4.1 million private vehicles were registered in 2000. Most are in the Klang Valley (Kuala Lumpur and Selangor). Transport vehicles and industrial emissions are the major sources of pollutants in the Klang Valley atmosphere, a problem that has been aggravated by the tremendous increase in the number of mobile sources. Table 1 shows ambient pollutants level in Klang Valley and Malaysian air quality guideline, 2000. From Table 1, it can be shown that nitrogen dioxide (NO_2), carbon monoxide (CO) and particulate matter less than 10 μg (PM_{10}) are not at acceptable levels according to the Malaysian ambient air quality standards. PM_{10} exceeds the Malaysian air quality guideline in Petaling Jaya, Gombak, Kelang, Kajang and Kuala Lumpur.

The major concerns for human health from exposure to particulate matter includes effects on breathing and respiratory functions, damage to lung tissue, cancer and premature death (EPA, 1996). The elderly, children, people with asthma, influenza or lung diseases are especially vulnerable to the effects of particulate matter. It is found that children with diagnosed asthma are more susceptible and showed increased symptoms to the effects of particles than other normal children (Vedal et al., 1998). Other symptoms of health effects that had been associated with particulate matter are reflected through hospital admissions, emergency room visits and restricted activity days. In a study that assess short term effect of concentration of air pollutants in Valencia, Spain, the findings showed that air pollution are significantly associated with emergency room visits for asthmatics even though the association is much more higher for NO_2 and O_3 than for particulate matter and SO_2 (Tenias et al., 1998).The atmospheric conditions in Klang Valley are mainly deteriorating due to the increase in the concentration of PM_{10}. So, this condition is affecting human health in this area. A study conducted by Economic Planning Unit, Prime Minister office, that assess the valuation of morbidity effects in Kuala Lumpur and Petaling Jaya, has found that only three percent of the respondents regarded their health, as below average, seven percent were asthmatic, two percent bronchitis and ten percent suffered from respiratory allergy. Around fifteen percent had suffered persistent cough, sneezing or eye irritation in the previous month, for an average of around six or seven days. Less than four percent had visited casualty in the previous year because of respiratory illness (Duburg, 1998). Their WTP was about RM206 to avoid the ill-health episodes. But the problem of their study is that they did not try to find out the validity and reliability of their findings. Furthermore, few numbers of studies related to valuation of health impacts of air pollution or air quality improvement causes an information gap between the policy makers and researchers of this country. This is the motivation for the current study. The current study tried to evaluate the validity and reliability of contingent valuation method to improve the air quality. So, this study will address the gap in knowledge about air pollution control policy for the case of Malaysia and it will be helpful for the policy makers to compare the results with the associated costs of air pollution control and that way they can achieve the environmental policy target. There are few studies conducted in Klang valley relating to air quality improvement in the Valley, Malaysia. So, there is need to conduct studies related to this topic and there is also need to have effective control of pollutant emissions.

A common problem when dealing with this type of issue is to obtain a monetary value for a good that is intangible and does not have a market price. The increasing importance given to the valuation of intangible good during last decades has given rise to the development of several valuation methods (Rosan, 1999). One of these is the contingent valuation method. The contingent valuation method elicits preferences for public goods by asking people about their willingness to pay (WTP) for them (Mitchell and Carson, 1989). Because the elicited WTP values are contingent upon the particular hypothetical market described in the questionnaire presented to the respondents, this approach is called contingent valuation method. This method presents consumers with hypothetical opportunities to buy public goods, thus circumventing the absence of a real market for them. The attraction of contingent valuation is that it facilitates the construction of a market in which the researcher can observe an economic decision directly related with the good in question (Carson, 1991). The resulting information is very useful to the decision makers since it records both the direction and the strength of a respondent's preferences (Lockwood et al., 1996). The WTP values of the respondents depend on how much information is provided to the respondents and on the knowledge that he has about the good to be valued (Whitehead. et al., 1995; Halvorsen, 1996). In this study, a split contingent valuation survey was carried in some urban areas of Klang Valley, Malaysia to test whether WTP changes significantly when information is added to the contingent valuation scenario. This survey was differed in two groups on the basis of the amount of information presented to the respondent concerning the cause of the ill-health episode and the measures that the respondent would be paying for in order to avoid the

episode. In the first group, the respondents were informed that the episode of ill-health would result from air pollution and were then asked to express their WTP for a policy measure that would reduce pollution to a level that would ensure that they would not suffer the ill-health episode. The survey was called context survey. In the second group, respondents were simply asked for their WTP to avoid the described episode of ill-health without giving them any details of the cause of their ill-health episodes and the policies to be implemented. This survey has been called non-context survey. So, the implication of the study is that without the information provided in the questionnaire, there is a risk that the valuation is based on individual information and subjective references. On the contrary, with additional information, all WTP values are focused on the same cause and it reduces the informational differences and subjective references about the good. Hence this provides a better control over individual responses. Another implication of the study relates to the use of benefit transfer in project appraisal. Benefits transfer can only be considered a reliable tool if the WTP for the good can be shown to be independent of the context in which the good is presented.

Methodology

Theoretical Framework to Avoid the Ill-Health Episode

The literature on models to estimate willingness to pay to avoid illness episode for reduction in air pollution is limited. The model that is developed in this study was based on Cropper and Freemen (1991), Alberini et al. (1996) and Cropper et al. (2000). The utility function of an individual is determined by goods consumed X, leisure time L, respondents characteristics Z, and the individual's health status S, during a year. So, the utility function is then defined by:

$$U = U(X, L, Z, S) \quad (1)$$

where U = utility of the individuals. The individual's health status is determined by air pollution and the mitigation measures introduced. Mitigating activities include seeing a doctor, taking nonprescription medication, staying away from work and limiting work to only those that are most important. The individual's health status also depends on the number of illness days and number of symptoms. The health production function is then defined by:

$$S = S(q, m, d, n) \quad (2)$$

where q is air pollution, m is mitigating activities, d is the duration of ill days and n is number of symptoms. The expenditure function is represented by:

$$\begin{aligned} e &= (P_X, W, P_M, q, d, n, \overline{\ }) \\ &= \{\min P_x X + P_M M - (Y_{NW} + W(T - L \\ &\qquad - s(q, m, d, n)))\} \end{aligned}$$

Subject to $U = U(X, L, Z, S) \geq \overline{U}$ (3)

where Y_{NW} is non-wage income, W is the wage rate, T is the total time available, P_X is the price of the goods consumed and P_M is the price of mitigating activities. For convenience, the argument Y_{NW} and T are omitted from the expenditure function. Improvement in air quality increases utility indirectly by reducing the number of illness days and increasing leisure time. Willingness to pay for air pollution reduction from q^0 to q^1 is defined by:

$$\begin{aligned} \text{WTP} = {} & e(P_X, w, P_M, q^0, d, n, Z, \overline{U}) \\ & - e(P_X, w, P_M, q^1, d, n, Z, \overline{U}) \end{aligned} \quad (4)$$

where U is the average utility of the respondents. Equation (4) implies that willingness to pay to avoid ill-health episodes should vary with wage rate, prices, individual characteristics, air pollution, duration of ill days and number of symptoms and average utility of the respondents.

Willingness to Pay Model with Context Version

In the case of the above model, if there is a respondent who has some uncertainty over his or her preferences or willingness to pay value, there will be many ways to motivate such uncertainty, and the simplest is due to lack of the context in the hypothetical scenario description. This study assumed that the willingness to pay of the respondents depends on wage rate, prices, individual characteristics, air pollution, duration of ill days and number of symptoms. However, it also depends on the context or the level of information about the cause of illness episodes and the policy to avoid the illness that is provided in the questionnaire ($\{I_Q\}$) as well as prior private information held by each respondent individually ($\{I_p\}$) before the contingent valuation questionnaire. This varies from respondent to respondent. So now the new willingness to pay model can be written as follows:

$$\begin{aligned} \text{WTP} = {} & e(P_X, y, w, P_M, q^0, v, n, Z, I_Q, I_P, \overline{U}) \\ & - e(P_X, y, w, P_M, q^1, v, n, Z, I_Q, I_P, \overline{U}) \end{aligned} \quad (5)$$

How the respondent reacts to the additional information provided in the questionnaire, $\{I_Q\}$, depends on how this additional information is aggregated by the respondent. Several possibilities may arise that can be as follows:

- The additional information is irrelevant to the respondent. The respondent's mental accounting is not

influenced by any additional information provided in the questionnaire. In this case, his willingness to pay will not be affected by $\{I_Q\}$.

- The information provided in the questionnaire is redundant with the private information of the respondent ($\{I_p\}\supseteq\{I_Q\}$, in which case $\{I_Q\}$ does not affect his willingness to pay. For example if the respondent already knows that 75 percent of his coughing or shortness of breath or runny nose are due to air pollution, his willingness to pay will be unaffected by providing that additional information in the questionnaire.
- If $\{I_P\}\subset\{I_Q\}$, the additional information provided in the questionnaire increases the available information of the respondent for assessing his willingness to pay. This would presumably lead to more reliable willingness to pay statements. For example, Poe and Bishop (1993) showed that additional information increases willingness to pay for maintaining groundwater quality.

Econometric Analysis

In this study, payment card (PC) question format was used to estimate the willingness to pay (WTP) of the respondents. For the PC format, where WTP values are elicited in form of intervals rather that point estimates, non-parametric as well as parametric approaches have been applied. In the non-parametric approach, average WTP values are estimated by simply setting individual WTP values at the interval midpoints, whereas in a simplistic parametric approach, these midpoints are used as dependent variable in a maximum likelihood (ML) regression. However, setting the WTP values at interval midpoints may bias results. Therefore, a maximum bounded likelihood model is applied where the dependent variable is measured on interval of a continuous scale (Cameron and Huppert, 1989; Welsh and Poe, 1998). On the other hand, the independent and pair-wise *t*-tests were done to test the equality of the mean WTP value of the respondents for context and non-context version. It was hypothesized that the mean WTP value did not differ across the context and non-context version.

Parametric Approach

The statistical analysis of payment card data is relatively straightforward. The approach that was followed in this study was outlined in Cameron and Huppert (1988), which involves directly estimating the parameters of a willingness to pay function using maximum likelihood techniques. The intuition underlying the Cameron and Huppert approach is that an individual circling RM5 on the payment card reveals that $RM\,5 \leq \text{WTP} < RM\,10$. Thus, this individual's contribution to the overall likelihood function is the probability that WTP_i lies between RM5 and RM8, conditional on a vector of explanatory variables X_i and a set of unobservable factors that are captured by the error term, ε_i. More formally, let the vector $t = (t_1, t_2, \ldots t_i)$ represents the values on the payment card and let t_i represent the value selected by the *i*th respondent. Assume that the willingness to pay function can be written as follows:

$$\log \text{WTP}_i = X_i'\beta + \varepsilon \tag{6}$$

where ln WTP is the natured logarithm of WTP, X' is a vector of explanatory variables such as socio-economic variables, age, sex, race, marital status and health variables such as duration of ill-health episodes, number of symptoms and smoking cigarettes, β is a parameter vector, μ is an error term which is independently normally distributed with mean zero and standard deviation σ. However, by simply setting the expected WTP values equal to the internal midpoints, biased WTP values may result. Therefore, we use a multiple bounded likelihood model where WTP becomes a random variable (Welsh and Poe, 1998). The probability that a respondent will vote yes, can be written as:

$$\Pr(t_i) = \Phi\left(\frac{\log t_{i+1} - X_i\beta}{\sigma}\right) - \Phi\left(\frac{\log t_i - X_i\beta}{\sigma}\right) \tag{7}$$

where $\Phi(.)$ is the cumulative density function of the standard normal distribution and $t_{i+1} = +\infty$. The log likelihood function can be written as:

$$\log L = \Sigma \log\left(\Phi\left(\frac{\log t_{i+1} - X_i\beta}{\sigma}\right) - \Phi\left(\frac{\log t_i - X\beta_i}{\sigma}\right)\right) \tag{8}$$

where σ and the element of β have been chosen to maximize the value of this function. By using the estimated values of β and σ we can calculate values of ln WTP. The conditional mean of the ln WTP for any given vector of variables will be βX and the mean of the untransformed WTP variable is $\exp\left(\beta X + \frac{\sigma^2}{2}\right)$ (Dudewicz and Mishra, 1988).

Non-Parametric Approach

In the simplistic nonparametric approach, average WTP values are estimated by simply determining individual WTP values by the interval midpoints between T_L and

T_U where T_L is the lower value of WTP and T_U is the Upper value of WTP. For example, a respondent saying yes to the amount of RM 50 and switching to rather yes for the next bid of RM 55 is given a WTP of RM 52.5.

Survey Design and Sampling Method

Deriving an accurate value is highly dependent upon a survey method. The direct face-to-face interview is the most commonly used approach in contingent valuation studies (Forster, 1989) and was employed in this study. The on-site survey was employed in January, 2002 in the five urban areas of Klang Valley i.e. Shah Alam, Kajang, Klang, Gombak, Kuala Lumpur and Petaling Jaya. The respondents were randomly selected who agreed to participate in the survey. In case of many family members, one person was chosen for the survey. However, a self-administered questionnaire was given to those who preferred to complete the questionnaire by themselves. In the survey, 900 residents of Klang Valley were selected. All the respondents were above 18 years old. Before the final survey a pretest was conducted in December 2001. The first pretest involved 20 participants and was conducted on December 19, 2001 to their understanding of the question asked. A week later, about 50 people were interviewed in the second pretest, which focused on the range of the bids used in the WTP questions.

In January, 2002, the final survey was conducted in five urban areas (Klang, Kajang, Kuala Lumpur, Shah Alam and Petaling Jaya) in Klang Valley. In the final survey, different sub-samples were presented with contingent valuation scenarios offering different levels of information. One sub-sample was asked to value the avoidance of episodes of ill-health, but was not given any details of the cause of the episodes nor the policy that would be implemented to remedy the cause. This is called non-context version. A second sub-sample has been given the cause of ill-health episodes and the policy to be implemented to remedy the cause. This is called context version.

Design of the Questionnaire

The questionnaire has three sections. The first section relates to respondents' attitudes towards their health. The second section focuses on the health valuation questions and the third section relates to respondents' socio-economic information. In the second section, four different episodes of ill-health scenario were adopted from the European five-country studies (European Commission, 1999). The illness episodes are as follows:

(a) Coughing, wheezing, or runny nose and sore throat or shortness of breath (without fever and chills).
(b) Confinement to bed with the symptoms—coughing or wheezing with fever, chills, or aching all over.
(c) Hospital admission for respiratory disease, bronchitis or asthma with the symptoms persistent phlegmy cough every few minutes, and feverish with headache and extreme tiredness.
(d) Eye irritation.

Respondents were asked whether last year they experienced these episodes of ill-health. Respondents were also asked how long each episode lasted. To capture the severity of illness, respondents were asked if the illness episode caused them to miss work, stay in bed or others that interrupted their normal activities. The associated number of work-loss days, bed disability days and restricted activity days were recorded. To focus the respondents' attention on factors that might influence their willingness to pay, the respondents were asked what activities they undertook to relieve the episode of ill-health such as taking medication, see a traditional doctor, take a non-prescription medication or stay away from work.

In the second section, to investigate how the willingness to pay of the respondents is impacted by adding additional information, one sub-sample was asked to value the avoidance of episodes of ill-health, but was not given any details of the cause of the episodes nor the policy that would be implemented to remedy the cause. In that case after describing respondent illness episode in detail, the sample was given the following valuation question.

> *We are going to ask you a hypothetical question. Suppose you were told that within next few days you would experience a recurrence of the illness episode you have just described for us. What would it be worth to you—that is how much would you pay to avoid the illness episode entirely? Remember that you are paying to eliminate all of your pain and suffering, your medical expenditure, the time you spent visiting the doctor or clinic and you missed work, leisure or daily activities.Would you pay to avoid illness episode?*

Another sub-sample was given the cause of ill-health episodes and the policy to be implemented to remedy the cause were also informed. The respondents were given the following information with four show cards:

(a) Recently several studies on air pollution in developing countries (Malaysia, Singapore, Indonesia, Bangladesh etc) have shown that thousands of premature deaths and millions of cases of respiratory illness (coughing, wheezing, runny nose, eye irritation, hospital admission, etc) are associated with air pollution. In these countries, an estimated 0.5–1.0 million die as a result of exposure to urban air pollution (World Bank, 1998).

(b) In Malaysia, air pollution is mainly from three sources such as mobile sources, stationary sources and open burning sources (Show card 1). Mobile sources are personal cars, commercial vehicles and motorcycles. Stationary sources are industry, power stations, and industrial fuel burning processes and domestic fuel burning. Open burning sources are the burning of solid wastes and forest fires. We know that air pollution can cause a number of undesirable effects. Major effects are health effects (Show card 2).

(c) Due to rapid economic development and population growth, the degradation of air quality has become a big problem in Klang Valley. Cars and motorcycles account for more than seventy percent of the total emissions in the urban areas of Klang Valley.

(d) Klang Valley experienced moderate air quality most of the time except for 11 to 32 unhealthy days where the air quality hovered between API 101-200 (Show card 3). The unhealthy air quality conditions experienced in Shah Alam (14 days), Kajang (32 days), Gombak (22 days) and Kuala Lumpur (11 days) were mainly due to the presence of high levels of ozone and particulate matter (PM_{10}). From the air quality standard it has been shown that particulate matter exceeded the Malaysian air quality standard of 50 mg/m^3 especially in Klang and Kuala Lumpur (Show card 4).

(e) Government of Malaysia could implement a public health programme that would reduce the concentration of PM_{10} in Klang Valley. This will reduce the ill-health episodes that you have described for us. The programme includes reduction in traffic congestion, the installation of catalytic converters on all cars, increase the use of natural gas in the transport sectors and the use of public transportation in urban areas, and decrease the use of gasoline and diesel etc.

After presenting this information to the respondents, they were asked the following health valuation question:

> *The government will finance this programme through an increase in general taxes that will increase your family yearly expenditures. So, in order to avoid the illness episodes, are you willing to pay this cost so that the government may achieve this programme? Remember that this will give you less money for, for example, food, clothing, shoes, travel car use and savings.*

Question Format

In the payment card question format (PC), respondents are confronted with an ordered sequence of bids where they choose the maximum amount they are willing to pay. But instead of only choosing the maximum amount they are willing to pay as in the traditional PC format, respondents value each price. In addition, respondents are allowed to choose between five different responses—*yes, rather yes, don't know*, rather no, and *no*. This gives respondents the possibility to express a level of voting certainty, since it seems that respondents have a distribution of possible WTP values rather than a single point estimate of the value for a good (Welsh and Poe, 1998).

Payment Card Format

When the price falls at or below the lower end of the respondent's range of WTP values, then the respondent would be very certain to vote *yes*, whereas at very high amounts the respondent might be very certain to vote *no*. The respondent's WTP then lies somewhere in between the maximum amount she would vote for and the lowest amount she would not vote for. Furthermore, respondents have the possibility to express ambivalence, since they are allowed to make less of a commitment by saying 'rather yes' or 'rather no' than 'yes' or 'no' for sure. Therefore, additional thresholds and likelihood of voting *yes* are included and WTP responses are elicited in the form of intervals instead of point valuations. T_L is defined as the maximum amount that the respondent would vote for and T_U to be the lowest amount that she would switch (i.e. *rather yes*). WTP then lies somewhere in the switching interval (T_L, T_U) where individual WTP values are estimated by using non-parametric as well as parametric models (Cameron and Huppert, 1989). Using this payment card format (PC), WTP was elicited.

Results and Discussion

Table 1 summarises the sample characteristics of the respondents. The selected samples were quite representative for the population of the entire country.

Table 1: Summaries of Sample Characteristics

	Number of respondents	*Percentage (%)*
Respondent's sex		
Male	436	48.4
Female	464	51.6
Respondent's age	900	34.5 (In years)
Respondent's Racial Mix (%)		
Malay	378	42
Chinese	306	34
Indian	135	15
Others	81	9
Respondent's marital status		
Married	522	58
Single	261	29
Widow	63	7
Divorced or separated	54	6
Respondent's education level		
No formal education	19	2.1
Primary Education	40	4.4
SRP/PMR	43	4.8
SPM/SPVM	172	19.1
STPM	51	5.7
Diploma/professional certificate	272	30.2
University degree	303	33.7
Respondent's occupation		
Retired	12	1.3
House wife	28	3.1
Unemployed	15	1.7
Student	73	8.1
Employed part time	95	10.5
Employed full time	581	64.5
Self-employed	96	10.8
Respondent's personal income		
Less than RM 1000	180	19.9
RM1001-2000	213	23.7
RM2001-3000	276	30.7
RM3001-4000	62	6.9
RM4001-5000	59	6.6
RM5001-6000	52	5.8
RM6001-7000	12	1.3
RM7001-8000	12	1.3
RM8001-9000	16	1.8
RM9001-10000	14	1.5
More than RM10000	4	0.5
Respondent's household income	Malaysian Ringit (RM)	3526

The gender distribution in the samples was 48.4 percent male and 51.6 percent female. The average age was just under 34.5, with the lowest being 20 and the highest 65 years old. In this survey, 42 percent of the respondents are Malays, 33 percent are Chinese, 15 percent are Indians and nine percent are others. The highest percentage of the respondents are married (58 percent) followed by 29 percent singles, seven percent widows and six percent divorced or separated. The highest percentage of the respondents have university degree (33.7 percent) followed by 30.2 percent with diploma and certificates, 19.1 percent have reached SPM/SPVM level, 5.7 percent have reached STPM level, 4.8 percent have reached SRP or PMR level, 4.4 percent have reached primary level and 2.1 percent have no formal education. Most of the respondents (64.5 percent) are full time employed. The corresponding 10.8 percent are self-employed, 10.5 percent are employed part time, 8.1 percent are students, 3.1 percent are housewives, 1.7 percent are unemployed and 1.3 percent are retired. The highest percentage of the respondents (54.4 percent) has income range of RM1001 to RM3000 per month while 19.9 percent of the respondents have income range of less than RM1000 per month. There are only 25.2 percent respondents with income range of RM3001 to RM10,000 and the remaining 0.5 percent of the respondents have income range of more than RM10,000 per month.

Table 2 summarises the health experience and activities of the respondents. It was found that 16.4, 14.8, 6.91 and 19.6 percent of respondents reported that they had suffered from coughing or shortness of breath or runny nose, confinement to bed, hospital admission and eye irritation respectively during the last twelve months. In total, 57.71 percent of the respondents have some kind of upper respiratory illness. Table 2 also summarises the respondent's duration of ill-health episodes and duration of restricted activity days. It was found that the duration of coughing/shortness of breath/runny nose was the longest duration of ill-health episodes. This was followed by 5.46 average days for confinement to bed, 1.78 average days for hospital admission and 4.79 average days for eye irritation during last year. The duration of restricted days was 0.90 days for coughing/shortness of breath/runny nose, 0.86 days for confinement to bed, 0.58 days for hospital admission and 1.34 days for eye irritation. It was found that eye irritation was the most likely factor to restrict activity. These symptoms can often occur separately or together but no attempt was made in the survey to distinguish between single and multi-symptom episodes. The results of the study about health experience and activities are also similar to the

Table 2: Health Experience and Activities

Ill-health episodes	*Percentage*
Coughing, wheezing/shortness of breath/ runny nose during last twelve months	
Yes (%)	16.4
Average days (duration)	7.26
Average days restricted	0.90
Confinement to bed	
Yes (%)	14.8
Average days (duration)	5.46
Average days restricted	0.86
Hospital admission	
Yes (%)	6.91
Average days (duration)	1.78
Average days restricted	0.58
Eye irritation	
Yes (%)	19.6
Average days (duration)	4.79
Average days restricted	1.34
Activities undertaken to avoid the illness episodes (%)	
See a medical doctor	53.6
See a traditional doctor	15.7
Take a nonprescription medication	19.1
Stay away from work	5.6
Limit your work to only those that are most important	6.0

results of the study that had been conducted by Economic Planning Unit, Prime Minister Office, 1998 (Duburg, 1999).

Table 2 also presents information on the activities to avoid the illness episodes. This information was collected to remind individuals of the sorts of activities, which can impact their health and also to provide some indication of individuals' preferences towards health improvement. Results presented in Table 2 showed that the highest percentage of the respondents (53.6 percent) have consulted medical doctors followed by 19.1 percent of the respondents who took nonprescription medication, 15.7 percent of the respondents who consulted traditional doctors, 6.0 percent of the respondents stayed away from work and 5.6 percent of respondents limit their work only to those that are most important to avoid the illness episodes. The study has found that 75.9 percent of respondents have never smoked while 24.1 percent of respondents smoke. The study has also found that 58 percent of respondents have health insurance. Among the health insurance holders 66 percent respondents have health insurance that covers hospitalization and disability and 34 percent of respondents stated that their health insurance cover visits to doctors' office and purchasing medicine at drugstore. Finally, the results of simple Pearson correlation have shown that health status and experience and activities are related to one another in the way one would expect. Hence, respondents claiming to be asthmatic are likely to report longer duration of coughing, wheezing or shortness of breath and eye irritation last year and those suffering from allergy to dust or pollen are far more likely to report runny nose. There are some evidence to suggest that days of coughing, wheezing or runny nose and eye irritation are related as might be expected, as these symptoms can often occur together and no attempt was made in the study to distinguish between single and multi-symptom episodes. It was also found that the respondents who smoke and respondents who have health insurance are likely to report longer duration of ill-health episodes.

Response Rate of the Respondents

In the payment card questionnaire the respondents were asked how much they were willing to pay (WTP) to avoid the episode of ill-health. The respondents who reported a WTP value greater than zero were treated as positive WTP. The respondents who reported a zero WTP were asked a follow-up question to establish their reasons for not wanting to pay. The respondents who chose to answer 'can't afford to pay anything and ill-health episode is not bad enough' were treated as valid zero WTP. The respondents who chose to answer 'can't say how much avoiding ill-health episode is worth, paying to avoid ill-health is unrealistic, and not used to making decisions like this' were treated as rejection of contingent market. Table 3 summarises the WTP responses of the respondents according to positive WTP, valid zero WTP and rejection of contingent market for the samples. This study has found that 54.55 percent of the respondents reported a positive WTP to avoid the ill-health episodes and 45.45 percent respondents are not willing to pay. The positive response rate is acceptable since the respondents of this area are not familiar with this type of survey. Another reason is that the income level of most of the respondents is low. So, their willingness to pay to avoid the ill-health episodes due to air pollution must be low. It was also found that among the respondents of not willing to pay, only 29.22 percent are valid zero. More specific, 9.00 percent of the respondents cannot afford to pay anything and 20.22 percent of respondents stated that ill-health episodes are not bad enough. The rest of 16.23 percent zero responses were classified as "rejection of contingent market" and the main reason for this is paying to avoid ill-health episodes is unrealistic and they were not used to make decisions like this.

Table 3: WTP Responses of the Respondents According to Positive WTP, Valid Zero WTP and Rejection of Contingent Market

Reason	*Number of respondents*	*Percentage of respondents*
Positive WTP	**491**	**54.55**
Valid zero WTP	**263**	**29.22**
Can't afford to pay anything	81	9.00
Ill-health episode not bad enough	182	20.22
Rejection of contingent market	**146**	**16.23**
Can't say how much avoiding ill-health episode is worth	29	1.11
Paying to avoid ill-health is unrealistic	95	10.58
Not used to making decisions like this	10	3.22
Others	12	1.32

Table 4 summarises the WTP of the respondents according to positive WTP, valid zero WTP and rejection of contingent market for context and non-context survey. The percentage of respondents reporting positive WTP is higher in context survey than that in non-context survey. This means that the additional information made the contingent valuation survey more realistic to the respondents of the context survey and they are more willing to pay than the respondents of non-context survey. The percentage of respondents reporting valid zero WTP is almost the same for the context and non-context survey. Additional information did not affect valid zero WTP of the respondents. For context version, 14.88 percent of the respondents stated that they couldn't afford to pay anything to avoid ill-health episodes. For non-context version, 17.56 percent of the respondents stated that they couldn't afford to pay anything to pay to avoid ill-health episodes. On the other hand, for context version, 14.01 percent of the respondents stated that the ill-health episodes are not bad enough for them and for the non-context version, 12.22 percent of the respondents stated that the ill-health episodes are not bad enough for them. The percentage of the respondents rejecting contingent market is higher for those answering the non- contextual survey compared to those presented with the contextual survey. Additional information was not given to the respondents of non-context survey and the contingent market was not realistic to them. Most of the respondents (69.8 percent) of non-context survey thought that it was unrealistic to pay to avoid the ill-health episodes or the decision making process is not common to them.

Table 4: WTP Responses of the Respondents According to Positive WTP, Valid Zero WTP and Rejection of Contingent Market for Contextual or Non-contextual Survey

Reason	*Context version*		*Non-context version*	
	No. of Obs	*%*	*No. of Obs*	*%*
Positive WTP	271	60.22	220	48.88
Valid zero WTP	**130**	**28.89**	**134**	**29.78**
Can't afford to pay anything	67	14.88	79	7.56
Ill-health episode not bad enough	63	14.01	55	2.22
Rejection of contingent market	**49**	**10.89**	**96**	**21.33**
Can't say how much avoiding ill-health episode is worth	19	4.22	21	9.33
Paying to avoid ill-health is unrealistic	20	4.44	46	5.11
Not used to making decisions like this	6	1.35	11	2.44
Others	4	0.88	18	4.45

Frequency of Positive Response Rate of Context and Non-Context Version

Table 5 summarises the frequency of positive response rate of the respondents in the context versions. For context version, 60.22 percent of the respondents reported positive WTP to avoid ill-health episodes. It was found that the two most frequent categories of WTP are RM5 to RM10 and RM10 to RM15. Only 6.6, 5.6, 4.6 and 3.6 percent of the respondents are willing to pay RM20, RM25, RM50 and RM75 respectively. Only 12.6 percent of the respondents are willing to pay greater than RM100 and none of the respondents are willing to pay greater than RM750. Table 6 summarises the frequency of positive response rate of the respondents in the non-context version. The results showed that 26 percent of the respondents reported positive WTP to avoid ill-health episodes. It was found that the two most frequent categories of WTP are RM5 to RM10 and RM10 to RM15. Only 8.5, 2.6, 2.5 and 3.5 percent of the respondents are willing to pay RM20, RM25, RM50 and RM75 respectively. Only 9.5 percent of the respondents are willing to pay greater than RM100 and none of the respondents are willing to pay greater than RM750. Figure 1 shows the frequency of bid values for the context and non-context version. It was found that the WTP values for the non-context version are consistently lower

Table 5: Frequency of Positive Response Rate of the Respondents in the Context Versions

Proposed amount (Ringit Malaysia, RM)	*WTP lies in range*	*Frequency of yes answer*	*Percent*
5	0-5	48	38.6
10	5-10	37	18.3
15	10-15	31	9.6
20	15-20	29	6.6
25	20-25	28	5.6
50	25-50	26	4.6
75	50-75	19	3.6
100	75-100	15	3.0
150	100-150	11	3.6
200	150-200	10	2.0
250	200-250	8	1.5
500	250-500	5	1.0
750	500-1000	4	1.5
Total		271	100

Table 6: Frequency of Positive Response Rate of the Respondents in the Non-Context Versions

Proposed amount (Ringit Malaysia, RM)	*WTP lies in range*	*Frequency of yes answer*	*Percent*
5	0-5	41	35.0
10	5-10	39	25.6
15	10-15	25	11.1
20	15-20	22	8.5
25	20-25	19	2.6
50	25-50	18	2.5
75	50-75	15	3.5
100	75-100	11	2.6
150	100-150	9	1.7
200	150-200	8	1.7
250	200-250	7	2.6
500	250-500	4	1.7
750	500-750	2	0.9
Total		220	100

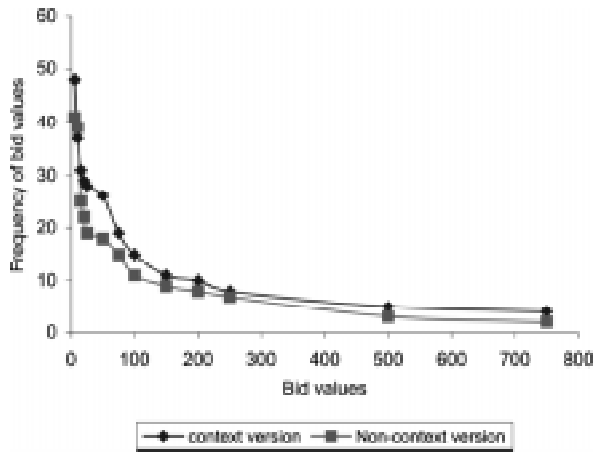

Figure 1: The frequency of bid values for context and non-context version.

than the WTP values for the context version. So, it can be concluded that for the context version, the mean WTP value should be higher than that of non-context version.

The Theoretical Foundation Behind the Econometric Model

The extent to which individuals are more willing to pay to avoid episode of ill-health is likely to depend on a number of variables i.e. socioeconomic variables (sex, age, education, income) and health variables (duration of episode of ill-health, number of symptoms). Table 7 provides an overview of the explanatory variables used in the parametric model in this study. Most of the variables derived from the survey and which have been considered relevant from theoretical point of view were included as explanatory variables.

Table 7: Description of the Variables Used in the Parametric Model

Independent variable	*Definition*	*Type of variable*	*Expected effect on WTP*
Male	1= Male 0= Female	Dichotomous	+/-
Age	Respondent's age in years	Continuous	-
Marital status	1= Married 0= others	Dichotomous	+/-
Education	Respondent's education level 1=No formal education 2=Primary Education	Categorical	+
Annual personal income	Respondent's annual personal income 1=Less than RM1000 2=RM1001-2000	Categorical	+
Asthma	Respondent's experience with asthma 1=Has had asthma 0=Has never had asthma	Dichotomous	+
Cigarette	Respondents who smoke cigarette 1=who smokes cigarette 0=who does not smoke cigarette	Dichotomous	+/-
Duration	Duration of ill-health episodes (number of average days)	Continuous	+
Number of symptoms	Number of symptoms	Continuous	+

Parametric Model for Context and Non-Context Survey

Table 8 summarises the estimated results of parametric model. In this study, the respondents who gave valid zero WTP and rejected the contingent valuation market have been removed from the analysis. The models described were estimated separately for contextual and non-contextual survey. The criterion used to choose the variables to be included in the model was mainly based on the degree of theoretical importance the different variables could have on WTP. For this reason, several variables were kept in the model, even though they were not significant (Rosan, 1999). It was found that in case of context version, age, marital status, education, cigarette and duration of ill-health episodes have significant positive effect on the respondent's WTP but the rest of other variables i.e. income, asthma, number of symptoms do not have significant effect on respondent's WTP. The positive coefficient on age at 5% level of significance indicates that, when other variables remain constants, older people are willing to pay more than younger people. This is expected because older people have the possibility of having ill-health episodes more than younger people and for this reason, they are more willing to pay to avoid the episodes of ill-health. The positive coefficient on education at 5% level of significance indicates that individuals who have higher levels of education such as university level are more willing to pay than less educated people. This result seems reasonable since a higher level of education could be related to a better understanding of the problem. The positive coefficient on income at 5% level of significance indicates that individuals who reported higher levels of income are more willing to pay than those respondents who reported lower level of income. The positive coefficient on cigarette at 5% level of significance indicates that individuals who smoke cigarette are more willing to pay than the individuals who do not smoke. The positive coefficient on duration of ill-health episodes at 5% level of significance indicates that individuals who experienced longer duration of ill-health episodes are more willing to pay than those who experienced shorter duration of ill-health episodes. For non-context version, education, income, cigarette and duration of ill-health episodes variables have significant positive effect on the respondents' willingness to pay to avoid ill-health episodes and other variables do not have any significant effect on the respondent's willing to pay to avoid the ill-health episodes. The difference between these two models for context and non-context survey is that in the non-context version age and marital status variables do not have significant effect on the respondents' willing to pay to avoid the ill-health episodes. The reason behind this, in the case of non-context version, most of the respondents are younger and unmarried. It can be concluded from the results of both models that the contingent valuation estimates to avoid the ill-health episodes are internally valid since it increases with the increase in duration of ill-health episodes, number of symptoms, income and education.

Table 8: Parametric Model for Context and Non-Context Survey

Variables	*Samples*			
	Context		*Non-context*	
	Est.	*St. err.*	*Est.*	*St. err.*
Intercept	5.59*	0.70	6.69*	0.45
Sex	0.07	0.11	0.02	0.10
Age	0.02**	0.007	0.002	0.007
Marital status	0.41*	0.12	0.10	0.09
Education	0.31**	0.17	0.435**	0.146
Income	0.19**	0.07	0.21**	0.04
Asthma	0.10	0.53	0.03	0.12
Cigar rate	0.50*	0.10	0.30**	0.11
Number of Symptoms	0.11	0.09	0.02	0.07
Duration (Number of days)	0.20*	0.04	0.24**	0.03

* Significant at 1% level of significance, ** significance at 5% level of significance

Non-Parametric Approach

In the simplistic non-parametric approach, the average WTP values are estimated by simply determining individual WTP values by the interval midpoints between T_L (Lower value of WTP) and T_U (Upper value of WTP). From this study, it was found that the non-parametric mean of WTP is RM170 for context version and RM150 for non-context version.

Mean Willingness to Pay for Context and Non-Context Survey

Table 9 summarises the non-parametric as well as parametric mean willingness to pay for the contextual and non-contextual survey. It was found that the parametric mean of willingness to pay for context version was 19.91 percent higher than that of non-context version. On the other hand, for the non-parametric mean of willingness to pay for context version is 21.91 percent higher than that of non-context version. It can be also

concluded that the non-parametric means are consistently higher than that of the parametric mean for both context and non-context versions. Table 10 summarises the results of independent and Mann-Whitney tests. In these tests, it was hypothesized that there was no difference between the mean willingness to pay for context and non-context versions. The hypothesis of both tests were rejected and the results indicate that mean value for the contextual survey is significantly higher from that of the non-contextual survey.

Table 9: Mean Willingness to Pay for Context and Non-Context Survey

Survey	*Mean willingness to pay (RM)*	
	Parametric	*Non-parametric*
Context	118	170
Non-context	137	150

Table 10: Tests of Equal Mean of WTP for Context and Non-Context Version

Null Hypothesis (a vs *b)*	*Independent-sample test*		*Mann-Whitney test*	
	test statistic[b]	*2-tailed p≤*	*test statistic*[b]	*2-tailed p≤*
a Mean $WTP_{Context\ Version}$ b Mean $WTP_{Non\text{-}Context\ Version}$	5.46	.001	4.32	.001

Conclusions

From the above results, it can be concluded that the inclusion of additional information in the presentation of scenarios in contingent valuation exercises significantly influenced WTP for the avoidance of ill-health episodes. So, the results of the study suggest that without the information provided in the questionnaire, there is a risk that the valuation is based on individual information and subjective references. On the contrary, with the information, all willingness to pay are focused on the same cause, providing a better control over individual responses. It is also clear from the evidence that the results of the study will not allow decision makers to apply the estimated values for the avoidance of ill-health episodes in the consideration of policies with very different context. This study also suggests that since the WTP may change with the introduction of additional information, doubt must be cast on the validity of transferring benefits across contexts.

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