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The Comparison of Methods of Discrere Payment Vehicle (Dichotomous Choice) in Improving the Quality of the Environment (a case study of air pollution in Tehran)

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Abstract

Using methods to estimate the value of environmental goods seems to be essential for economic planning and moving towards development. In this paper, using methods of Discrere Payment Vehicle (dichotomous choice) i.e. single-bounded and double- bounded dichotomous choice, which are common method of contingent valuation, the value of air pollution in Tehran and households' willingness to pay to improve air quality, in four selected regions (Shahr-e-Ray, Shoosh, Haft-e-Tir and Tajrish) is estimated and the corresponding results of these two techniques were compared. The results showed that the total value of air quality improvement, calculated through two techniques of double-bounded and single-bounded dichotomous choice were respectively 2398657500 and 1492566000 thousands Rials in a year and weighted mean of each citizen's willingness to pay to improve air quality, calculated through these two methods, was estimated to be 282192 and 175596 Rials in a year respectively. Considering the annual damage to health, for any one percent increase in pollutants and yearly cost of pollution reduction which are respectively 1199000000 and 7336000000 thousands Rials, it was determined that citizens' willingness to pay through two methods, includes 20 and 30 percent of the cost of pollution control respectively, while 70 percent of pollution is due to mobile sources, and also citizens' willingness to pay involves a small percent of damage to the health of the citizens. However, citizens' low willingness to pay is attributed to citizens' distrust of government policies as well as their ignorance of the harmful effects of air pollution. In general, the results of this study, with regard to the cost of pollution from single-bounded dichotomous choice are closer to actual market conditions.

JEL: N5, Q21, Q53, Q57
Keywords: environmental economics, contingent valuation, techniques of single-bounded and double-bounded dichotomous choice.

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Introduction

Since environment plays numerous roles in establishing balance among different components of life, it is considered as one of the important pillars of life and development. But now, this component due to lack of certain rules and regulations and not defining particular ownership, is freely and unlimitedly exploited , resulting in environmental destruction and various pollutions in this field.(Gorbani and Firuz Zare, 2008). In recent years environmental economists have studied valuation and assessment of the role of the environment in human welfare. They believe that carrying out valuation for environmental goods is necessary and denying their value in the long run, will have negative consequences for society (Fattahy 2013).

Valuation of goods causes the followings: (1) In the case of economic development strategies, decision-makers are led to better and more rational decisions with minimum environmental consequences. 2. Valuation of environmental goods can provide executives of economic development plans with more accurate and clear definition of benefits and costs of the project 3- Economic valuation can help the public sector to make better use of regulatory measures such as tax or subsidy. Because of the wide variety of environmental goods and services, their valuation proves to be difficult, and since there is no market for these goods other methods must be used, one of which is contingent valuation. This method assumes a hypothetical market for these products and indirect and non-used consumption values are measured with the help of field data (Fattahy 2013). The important thing in this type of valuation is designing a questionnaire which minimizes the bias. In the division of the basic components of valuation, based on the use of natural resources, value is divided into two categories of use value and non-use value. Direct use value also includes two categories of consumptive use and non- consumptive use. These values may include commercial and noncommercial activities. Indirect use value may be interpreted as benefits that individuals intangibly achieve resulting from initial ecological function of a specific resource (Dumas et al., 2004). Therefore, non-use value cannot be seen in market shopping or concluded on the basis of the functions .Non-use value is one of the most controversial components of the economic value of natural resources which is divided into three categories of existence value, heritage value and choice value. Contingent valuation is one of the methods that, individuals should keep both use and non-use value in their mind when they express its value (Gnedenko, et al., 2000). Today, the environment and its pollution has become one of the major management challenges of countries all over the world, so that these countries pursue organizing and managing environment and pollution in international level as well as policies and measures within their borders .An instance of pollution, is air pollution which due to its nature, has been more prevalent in Iran and more or less it is evenly felt in most regions of the world. In Iran, the emission of pollutants has reached a dangerous level in many cities such as Tehran, Mashhad, Isfahan, Tabriz, Shiraz, Karaj, Ahvaz and Arak; however, valuation of air pollution in these cities can be used as an instrument to control air pollution, according to the necessities of valuation mentioned above.

Studies regarding maintaining and improving the quality of environmental goods, have been carried out both at home and abroad. Sadeghi (2011) set out to estimate the willingness to pay for improving air quality in the metropolitan city of Tabriz. The results showed that about 24

percent of people agreed with continuation of the current procedure of capitation allocation to reduce air pollution and 76 percent called for an increase in the budget pertaining to air quality. Gorbani and Firuz Zare (2011) carried out the valuation of air pollution in Mashhad. The results showed that the total value of air pollution in highly polluted area was 7,134,146,560 Rials and in the area with moderate pollution, it was 5,242,428,950 Rials. In total, improving air pollution quality in Mashhad, from the perspective of citizens, is worth 12,376,575,510 Rials. Rasekhi and Talei (2011) estimated factors of willingness to pay to improve water quality in Mazandaran Province. The results showed that willingness to pay to improve drinking water through two methods of open-ended and closed-ended dichotomy was approximately 3771 and 3312 Tomans in a month respectively, for per household.

Using contingent valuation method, Fattahy (2013) estimated Yazd residents' willingness to pay to improve the quality of underground water. The results showed that the mean willingness to pay to improve the quality of underground water amounts to 28.5 USD annually. Imandoost and Garreh (2006) using contingent valuation assessed economic evaluation of environmental goods. In this study, the value of the environment for people, farmers, fishermen, laundry and swimmers in the river has been studied. Through this method people are directly asked about the willingness to pay for pollution disposal and a clean environment. mean willingness to pay of per household was 17 rupees per month. The results show that the environment is very important to people. Fattahi et. al, (2015), estimated the mean willingness to pay of tourists and residents of Sari County to preserve the Caspian Sea, to be respectively 229,870 and 195,170 Rials and preservation value per household was estimated to be 507,500 and 597,700 Rials annually. Using contingent valuation, Fattahy (2011) carried out a case study of watershed protection in Gomishan wetland in Golestan Province. The results suggest that willingness to pay to conserve the wetland is 72,850 Rials per year and preservation value ot this wetland is estimated to be 28 billion. Caudill and Hoehn (1992) used open-ended contingent valuation to examine the willingness to pay of Americans to improve underground water quality. Genius and Tsagsrskis (2006) studied Heraklion's residents' willingness to pay for projects to improve water quality and they preferred dichotomous contingent valuation method to determine the willingness to pay for improving the quality of drinking water. In another study by McLevin and Berglund (1999) the Dichotomous-choice method was applied to estimate willingness to pay for 25 percent reduction in water and air pollution in America. Wang and Vitengtondor in 2000 estimated WTP of Sofia's residents to increase air quality in Sofia, by a research entitled WTP for improving air quality in Sofia, Bulgaria.

Air is one of the most important environmental goods for which there is no market. Thus, in this study we used two common methods of contingent valuation and questionnaire completion and two methods of Single-Bounded and Double-Bounded Dichotomy. Comparing obtained results from these two methods, we tried to determine air pollution value in four regions of Tehran (Shahr-e-Ray, Shoosh, Haft-e-Tir and Tajrish) as well as factors affecting individuals' willingness to pay to reduce air pollution, so that its results can be used as an economic tool to reduce air pollution.

It should be noted that this study compared to other studies comes with some innovations. Most similar studies used only one method of Contingent Valuation to calculate willingness to pay and Payment Vehicle effect method is not taken into consideration.

Materials and methods

According to conducted investigations in different studies, to estimate the value of improving the quality of air pollution in Tehran, this study uses two methods of Single -Bounded Dichotomy (SBD) and Double-Bounded Dichotomy (DBD) which are common methods of Contingent Valuation (CV). CVM is among stated preference methods, which is categorized into methods that do not lead to estimated demand curve. CVM is a non-market and flexible valuation method which is used in cost-benefit analysis and environmental impact assessment (Mitchell and Carson, 1989). This method was first used experimentally in 1963 (Davis, 1963). CVM determines individuals' willingness to pay in the form of hypothetical tools (Li and Han, 2002).

To calculate willingness to pay for conservation of natural resources and environment, in most cases, economists assume that the dependent variable is a series of continuous values. However, there are numerous cases where behavioral determinant comes in the form of a limited set. Models used for such purposes are called models with qualitative dependent variables.

In Logit Model dependent variable is Dichotomous. This means that for a dependent variable there are two values of 0 and 1. For example, a person can be willing to pay or not. If you are willing to pay, 1 is allocated, otherwise 0 will be allocated to it. To determine a model for measuring WTP, it was assumed that the individual accepts or rejects bid amount based on maximizing utility (U) under conditions (Equation 1)

$$U(1, Y - A; S) + \varepsilon_1 \geq U(0, Y; S) + \varepsilon_0 \quad (1)$$

So only under the conditions of equation (1) this amount will be accepted, otherwise it will be rejected. In which U is for an indirect utility an individual obtains, Y is for income, A is for the bid and S is for other socio-economic characteristics including age, gender, membership in organizations preserving the environment , etc. which is affected by individual taste. ε_1 و ε_0 are random variables with zero mean that are equally and independently distributed. Utility difference (ΔU) is described as follows:

$$\Delta U = U(1, Y - A; S) - U(0, Y; S) + (\varepsilon_1 - \varepsilon_0) \quad (2)$$

To estimate models with Dichotomous dependent variable, Logit or Probit model is used. Due to the simplicity and reliability of calculations, Logit model is used in this study.

$$P_i = P_i(Y_t = 1) = F(X_i'\beta) = \frac{1}{1 + \exp(-X_t'\beta)} \quad (3)$$

If the cumulative probability distribution (dU) which shows acceptance probability of offer is defined as F(dU), to estimate the mean of the Payment Vehicle methods, the definite integral of the cumulative probability distribution is calculated as follows:

$$E(WTP) = \int F(dU)dA = \int \frac{1}{1+\exp(-X_t\,\beta)}\,d\tilde{X} \qquad (4)$$

Also in the study elasticity of variable K is obtained through equation 5:

$$E_{ki} = \left(\frac{\partial p_i}{\partial X_i}\right)\frac{X_{ki}}{F(\beta X'_{i)}} \qquad (5)$$

As Equation 5 indicates elasticity is not fixed and depends on the values of the explanatory variables used in the model. Based on the literature related to contingent valuation method, there are three methods for calculating willingness to pay after pattern fitting: 1-technique known as the mean willingness to pay used to calculate the amount of the expected willingness to pay by numerical integration ranging from zero to infinity, 2- A method called total mean willingness to pay which is used for calculation of the expected willingness to pay by numerical integration within the range of ∞- to ∞ + and 3- A method known as mean willingness to pay a portion, which is used to calculate the expected value of WTP by numerical integration ranging from zero to bid maximum (A). The third method due to removing theoretical limits, high statistical performance and capability of being added is preferred over other methods. The study uses this method (Formula 6) and it is calculated as follows:

$$E\ (WTP) = \int_{.}^{maxBID} \left[\left(\frac{1}{1+\exp(-\alpha+\beta BID)}\right)/f(BID_{max})\right]dBID \qquad (6)$$

Where E (WTP) represents the value of expected willingness to pay, β represents offer variable coefficient and α represents the adjusted intercept.

Single-bounded Dichotomous Choice (SBDC)

SBD which was presented by Bishop and Heberlin (1979) involves determining a single bid from a range of preset bids which potentially reflects the respondents' maximum willingness to pay. The respondents are asked to say 'yes' or 'no' for each bid (Mitchell and Carson, 1989). In addition, because this technique lends itself well to create motivation, strategic bias, available in values of WTP, may be minimized (Carson et al., 1996, and Hahnemann, 1994). This technique has disadvantages as well as advantages. . One of its downside is that it can only determine the maximum willingness to pay, or the minimum willingness to pay, but it does not provide real WTP values (Boyle et al., 1996). In addition, it may also have starting point bias (first bid) (Reddy et al., 1996). In this study, to obtain bids, Single- Bounded Dichotomous of Boyle and Bishop (1988), was used. The initial estimate is done by pretest. Choosing bid through this method is conducted in four phases. First, after determining the number of samples (N), the number of N / 2 is chosen from random numbers (P_I probability) that is obtained from a uniform distribution between zero and one. Then, the value of random probability is the same as the number of remaining N / 2. In this stage N represents data probability point. In the third stage available probabilities, are turned into bids applicable to cumulative distribution using the mean and standard deviation of pre-tests. Finally bids are randomly distributed in questionnaires. This process ensures that selected

observations are dispersed in a balanced way in the end of distribution and core bids are around the median.

Double Bounded Dichotomous Choice (DBDC)

In Double Bounded Dichotomous method by Hahnemann and Carson (1985) the respondents faces several bid amounts which according to his response to a bid, he is presented other bids. In fact, more bids, depends on 'yes' or 'no' answer or respondent's reaction to initial bid. The initial bid is obtained from the median of the values of WTP in pretest and following that, lower and higher amounts are extracted. Normally, the lower bid is half of the initial bid and the higher bid is twice as much as initial bid. The main advantage of this technique is that the value of maximum willingness to pay can be determined from the data obtained from this technique. This technique is statistically much more efficient than SBD technique (Canine, 1993 and Hahnemann, 1991).The problem with this technique is that it requires a larger sample size, advanced econometric techniques, etc. which result in high cost of analysis. This method has biased starting point as well as internal conflicts (Whetten, 2004).

In this study, after completing the pre-test, (30) questionnaires, mean and standard deviation of bids were calculated. Then, using Michael and Carson's Method (1989) the number of samples was determined to be 324 samples. Therefore, for every technique 324 questionnaires were collected and a total of 648 questionnaires were completed in 2015. The questionnaire consisted of two parts. The first part included the socioeconomic status of citizens with questions such as age, gender, education level, family size, monthly income and expenses of participants as well as membership of environmental organizations, in order to assess the relationship between the effective factors on WTP. In the second part of the questionnaire, questions about the willingness of citizens to pay for air pollution control were asked.

Through SBD and drawing upon a random pattern and normality of data, four percentile of 25, 50, 75 and 100 were selected for distribution. Finally, four prices 3000, 8000, 13000 and 25,000 Rials were extracted (Boyle and Bishop, 1988) and as a payment for the control and reduction of pollution in four regions (Shahr-e-Ray, Shoosh, Haft-e-Tir and Tajrish) were equally questioned.

Through Double Bounded Dichotomous method three prices of 4000, 8000, 16000 Rials were extracted. In this method, first the amount of 8,000 Rials is offered. If the individual accepts, the higher amount is offered, but if they reject, the lower amount is offered.

To investigate the effect of different explanatory variables on individuals' willingness to pay to reduce air pollution, in the Logit regression model, variables such as bid, income, education, household size, age, gender and four regions (Shahr-e-Ray, Shoosh, Haft-e-Tir and Tajrish), introduced as permanent variables into the model, were used. It should be noted that softwares such as Shazam, Excel and Maple were used for statistical analysis, mathematical calculations and estimate of Logit parameters.

Results and discussion

In this section, statistical results derived from 648 questionnaires given in 2015 are presented. Table 1 shows quantitative variables of socio-economic characteristics such as age, number of family members, years of education and income levels.

Table1: Socio-economic variables of respondents

Variables	Maximum	Minimum	Mean	Standard deviation
Age in years	71	19	38.3	13.8
household size	5	2	3.2	0.7
Education in years	18	5	12.77	2.5
Monthly income(Rial)	50000000	1000000	16053915	9266802

Resource: findings of the study

According to the table respondents are 38/3 years of age in mean, they have Education diploma and mean income is about 16,000,000 Rials. The mean of household's willingness to pay for reducing pollution is 3/2 people. The results of qualitative variables are also presented in Table 2, which shows that 62/3 percent of the respondents were male and 82/1 percent were married.

Table 3 shows percentage of accepting bids through Single-Bounded Dichotomous. According to the table, the results of the study showed that, 70.9% of respondents would accept four bids. 20/37% accepted 3000 rials bid, 18/51% accepted 8000 rials bid, 17/28% accepted 13000 rials bid and 14/81% accepted 25000 rials bid.

Table 2: Descriptive statistics of qualitative variables

Variables	Sex		Marital Status	
	Male	Female	Single	Married
Number	404	244	۱۱۶	۵۳۲
Percent	62/3	37/7	17/9	82/1

Resource: findings of the study

Table 3 - frequency distribution of accepting bids by Tehrani citizens through SBD

Acceptance status		Bid (3000)	Bid (8000)	Bid (13000)	Bid (25000)	Total
Acceptance	Number	66	60	56	48	230
	Percent	81/4	74/1	69/1	59/2	70/9
Rejection	Number	15	21	25	33	94
	Percent	18/6	25/9	30/9	40/8	29/1
Total	Number	81	81	81	81	324
	Percent	25	25	25	25	100

Resource: findings of the study

Considering the acceptance and rejection of bids that were already stated the results of estimations from Logit model come in Table 4. According to this table, all variables are significant and have the expected signs.

Table 4- The results of estimations from Logit model through Single Bounded Dichotomous Method.

Variables	Coefficient	T-Statistic	Elasticity at Means	Marginal Effect
CONSTANT	-23/74	-4/7	-	-
age	٠/15	3/3	٠/02	٠/00077
education	1/06	4/01	٠/06	/005
bid	-/00018	-3/5	-/011	-/000009
household size	٠/98	1/8	٠/015	/005
income	/000005	4/5	٠/046	٠/00000005
Shahr-e-Ray	-3/2	-2/6	-	-
Shoosh	-2/28	-2/24	-	-
Haft-e-Tir	-/39	-/37	-	-
Percentage of right predictions = 0/96				
MADDALA = 0/63				
MCFADDEN = 0/83				
Likelihood statistic = 325				
P-VALUE = 0/0000				

Resource: findings of the study

According to Table 4, income coefficient has statistical significance of one percent and its sign is as it was expected. Positive sign of income coefficient shows an increase in the probability of accepting WTP by individuals with higher income. . Based on the ultimate effect of this variable, with 1 million Rial increase in income, the possibility of accepting the bid amounts increases as much as 0.05 units. The minus sign in coefficient of bid variable indicates that if the bid price increases, the possibility of accepting the bid decreases, but if the bid amount decreases, the possibility of its acceptance increases. According to estimate of elasticity of this variable, with a one percent increase in the bid amount the possibility of accepting the bid will decrease 0/011 percent. Education coefficient is statistically significant and its positive sign indicates that the more educated people are the more likely they are to accept the bid amount. Based on the ultimate effect of the variable of years of education, with one unit increase in academic years, the probability of accepting the bid amount increases 0.005 unit. The coefficient of household size is also significant and its positive sign indicates that as the number of children in a family increases, the probability of accepting the bid amount of willingness to pay increases. According to variable elasticity, an increase of one percent in the number of children translates into 0/015 percent increase in possibility of accepting bid amount. The sign of age turned out to be positive, showing that the elderly are more willing to pay than the youth. According to weighted elasticity of variable of age, one

percent increase in the age of respondents increases the possibility of acceptance of bid amount by 0/02 percent.

McFadden coefficient shows that the explanatory variables of the model explain dependent variable of the model well. The percentage of correct predictions in the estimate model is 96%, so the estimated model has been able to predict an acceptable percentage of dependent values with respect to the explanatory variables. In other words, 96% of respondents, by giving an appropriate ratio of information properly accounted for predicted willingness to pay in terms of 'yes' or 'no'. The sign of dummy variables index (Shahr-e-Ray, Shoosh, Haft-e-Tir) is negative, indicating that the value of pollution in these three regions is less than Tajrish.

Table 5 also shows the percentage of accepting bids through Double- Dichotomous method. The results show that 8/02 percent of people are opposed to any payment to reduce pollution and 91/9 percent were in favor of paying a sum of money for pollution reduction.

Table 5 - frequency distribution of accepting bids by Tehrani citizens through Double Bounded Dichotomous

Acceptance status		First Bid (8000)	Bid Low (4000)	Above Bid (16000)
Yes	Number	223	75	182
	percentag	68/8	23/14	56/17
No	Number	101	26	41
	percentag	31/1	8/02	12/65
Total	Number	324	101	223
	percentag	100	31/1	68/8

Resource: findings of the study

Considering the acceptance and rejection of bids, that were already stated, the results of estimations from Logit model, through Double Bounded Dichotomous come in Table 6. According to this table, all variables are significant and have the expected signs.

Table 6 - the results of estimate of Logit model through Double Bounded Dichotomous

Variables	Coefficient	T-Statistic	Elasticity at Means	Marginal Effect
age	٠/027	2/7	٠/1	٠/003
education	٠/038	٠/84	٠/065	٠/0044
bid	-0/00013	-4/6	-0/17	-0/00001
household size	٠/32	1/8	٠/13	٠/03
income	٠/00000028	9/09	٠/59	٠/000000032
Shahr-e-Ray	-/35	-1/1	-	-
Shoosh	-/06	-0/18	-	-
Haft-e-Tir	-/03	-0/09	-	-
CONSTANT	-4/02	-4/64	-	-
Percentage of right predictions = 0/82				
MADDALA = 0/27				

MCFADDEN = 0/27
Likelihood statistic = 206
P-VALUE = 0/0000

Resource: findings of the study

According to Table 6 income coefficient is statistically significant and its mark is as it was expected. Positive sign of income coefficient indicates an increase in the probability of WTP of those individuals who enjoy a higher income. According to weighted elasticity of this variable with any one percent increase in individuals' income, the possibility of accepting bid amounts increases by one percent. The minus sign of bid variable indicates that if the bid amount increases, the possibility of adopting the bid amount decreases and the same applies in reverse. According to estimates of elasticity of this variable, one percent increase in the bid amount will lead to 0/17 percent decrease in the possibility of accepting bid amount. Education coefficient is also statistically significant, and the positive sign shows that the more educated people are, more likely they are to accept the bid amount. According to weighted elasticity of years of education, with one percent increase in academic years, the possibility of adopting the bid amount will increase by 0/065 percent. The coefficient of household size was significant and its positive sign meets the expectation, because families with children give more value to air. Positive sign expresses that as the number of children increases, the probability of adopting the bid amount of willingness to pay also increases. Considering the ultimate effect of the variable, an increase of one unit in the number of children results in 0/03 unit increase in possibility of adopting the bid amount.

The sign of variable of age was positive, showing that the elderly are more willing to pay than young people. According to weighted elasticity of variable of age, one percent increase in the age of respondents increases the likelihood of accepting the bid amount by 0/02 percent. According to ultimate effect of this variable, an increase of one unit in age increases the possibility of accepting the bid amount by 0/003 unit.

McFadden coefficient shows that the explanatory variables of the model explain dependent variable of the model well. The percentage of correct predictions in the estimate model is 82 %, so the estimated model has been able to predict an acceptable percentage of dependent values with respect to the explanatory variables. In other words, 82% of respondents, by giving an appropriate ratio of information properly accounted for predicted willingness to pay in terms of 'yes' or 'no'. The sign of dummy variables index (Shahr-e-Ray, Shoosh, and Haft-e-Tir) is negative, indicating that the value of pollution in these three regions is less than Tajrish. Tajrish residents are willing to pay more for improving and controlling pollution.

Calculating mean willingness to pay

Having the estimate of the Logit model through single-bounded and double-bounded Dichotomous, we estimated the mean willingness to pay. Expected value of WTP for air pollution control is calculated through formula 7.

$$E(WTP) = \int_{\cdot}^{maxBID} \left[\left(\frac{1}{1+\exp(-\alpha+\beta BID)}\right)/f(BID_{max})\right] dBID \qquad (7)$$

According to table (7) mean willingness to pay for improving air pollution in four regions of Shahr-e-Ray, Shoosh, Haft-e-Tir and Tajrish through single-bounded Dichotomous of contingent valuation was estimated to be 22844, 23237, 23843 and 14141 respectively. Considering that the mean household size was 3.2 (Table 1), thus the mean willingness to pay of each household was estimated to be 73100, 74358, 76297 and 77251 Rials, respectively. In this case, the weighted mean willingness to pay for each household in Tehran is 75,251 per month.

Table 7 - Estimate of WTP in four regions of Tehran through single-bounded Dichotomous

region	the mean WTP for improve the quality of pollution(Rial)
Shahr-e-Ray	22844
Shoosh	23237
Haft-e-Tir	23843
Tajrish	24141

Resource: findings of the study

Also, according to table (8) mean willingness to pay for improving air pollution in four regions of Shahr-e-Ray, Shoosh, Haft-e-Tir and Tajrish through double-bounded Dichotomous of contingent valuation was estimated to be 14135, 14228, 14843 and 15326 respectively. Considering that the mean household size was 3.2 (Table 1), thus the mean willingness to pay of each household was estimated to be 45232, 45529, 47497 and 49043 Rials, respectively.

Table 8 - Estimate of WTP in four regions of Tehran through double-bounded Dichotomous

region	the mean WTP for improve the quality of pollution(Rial)
Shahr-e-Ray	14135
Shoosh	14228
Haft-e-Tir	14843
Tajrish	15326

Resource: findings of the study

The weighted mean willingness to pay of every Iranian citizen for improving air pollution through single-bounded and double-bounded Dichotomous was estimated to be 23516 and 14633 Rials in a month respectively.

The annual value of air pollution

After estimating WTP, the annual value of improving the quality of air pollution is obtained through following formula:

The annual value of improving the quality of air pollution = monthly mean WTP per person × number of months in a year × population

Given that the research was conducted in Tehran and the city has a population of 8500000 people (statistics in 1390), therefore the total value of air pollution in Tehran through two methods of SBD and DBD was estimated to be 2398657500 and 1492566000 thousands Rials in a year respectively.

Conclusion and recommendations

The current study has estimated citizens' WTP for improving the quality of air pollution in four selected from regions of Tehran. The results showed that WTP for improving the air quality through two methods of SBD and DBD was approximately 282,195 and 175,596 Rials in a year for every citizen, respectively. And also the total value of improving the quality of air pollution in Tehran through these two methods was estimated to be 2398657500 and 1492566000 thousands Rials, respectively. Considering that the annual cost of reducing pollution is 7336000000 thousands Rials (Asadi, 2004)[2], it can be indicated that WTP for improving air quality through these two methods, includes respectively 30 and 20 percent of the cost of air pollution control, although in the event more than 70 percent of the pollution in Tehran is due to mobile sources. Furthermore, citizens' willingness to pay involves a very small percentage of damage to health, which is attributed to citizens' distrust of government policies, as well as their ignorance of the harmful effects of air pollution.

Also the current study, drawing on the Logit model, has estimated the effective factors on willingness to pay to improve air quality. According to the obtained results, the variables of household size, income, number of educated people at home, sex and marital status were effective on willingness to pay in both techniques. In other words, the more educated and well-paid individuals are, the more likely they are to pay more compared to those who are illiterate and have a low income. Additionally, households with children are more willing to pay to improve air quality.

Because two methods of single-bounded and double-bounded Dichotomous are fundamentally different from each other, therefore we can observe differences in the estimation of mean willingness to pay through these two methods. Based on the findings of this study, single-bounded Dichotomous is more similar to actual market conditions. Because of the prevailing errors in the method of double-bounded Dichotomous, researchers are recommended that they use single-bounded Dichotomous in their researches. Recommendations are also provided in line with controlling and improving air pollution:

1. Considering that the cost of reducing each ton of SO_2 , NO_2 , PM_{10} and CO emissions is respectively 90/7, 238/5, 14/5 and 17/5 million Rials[3] (Asadi , 2004) and also daily damage to health for any one unit increase in these emissions in Tehran is respectively 446/3, 115/6, 973/4 and 1728 million Rials[4] (The Organization for Energy Conservation, in association with

[2] - This figure is obtained according to the goals of Third Development Plan based on prices in 2004, which is then estimated based on actualization through inflation rate.
[3] - This figure is obtained according to the based on prices in 2004, which is then estimated based on actualization through inflation rate.
[4] - This figure is obtained according to the based on prices in 2002, which is then estimated based on actualization through inflation rate.

Faculty of Health, Tehran University, 2002), in total, the costs of controlling pollution is less than social cost of health care, therefore investing in pollution control is essential and practicable.

2. In polluted cities, households should be demanded to pay taxes corresponding to households' WTP in order to reduce pollution and tax revenues should be used only to reduce air pollution. Also the government, considering the calculated value for air pollution, can claim for tax from any polluting entity.

3. The government should pave the way for investing in pollution-reducing projects such as parks and green space through financial contribution.

4. The government should take measures to boost trust and confidence in citizens in order to engage them in pollution control, to raise their consciousness toward harmful effects of air pollution and to encourage them to cooperate with Department of Environment and environmental organizations.

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