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Economic Valuation of Premature Mortality and Morbidity

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ABSTRACT: The air in Tehran is one of the most polluted airs in the entire world. Because of the air pollution in the Great Tehran area, morbidity, mortality and symptoms emerge. This study has been conducted for the first time in Iran. According to this study the total annual direct medical costs of morbidity estimated at US$ 3258255.48.Our work also led to the estimation of an income elasticity of WTP for reduction in the probability of premature mortality ,that is, an income elasticity of the value of a statistical life. The total annual mortality damage cost estimated at US$ 232538684.38. Contingent valuation (CV) was utilized in order to place monetary values on symptoms. By using CV, the economic value of each symptoms was estimated per person per day. The use of CV in this study required that a questionnaire be prepared and the Willingness to Pay of Tehran citizens be estimated by a random sampling. Finally the total health damage costs of air pollution in Tehran or benefits of reducing air pollution estimated at US$ 663776276 annually.

Key words: Symptom, contingent valuation method, Willingness to pay, value of statistical life, Cost of illnesses

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INTRODUCTION

A number of economic studies have been published in the developed countries to value the health effects of air pollution, but relatively few studies have taken place in countries with significantly lower incomes. In a Bangkok, Thailand study, Chestnut, *et al*. (1997) found that the WTP for avoiding a respiratory-illness day actually exceeds what would be predicted following a simple national income adjustment, suggesting that health may be viewed as a basic necessity and "that those with lower incomes may be willing to pay a higher share of that income to protect their health." Alberini and Krupnick (1998) reached a similar conclusion in a comprehensive health valuation study of three urban areas in Taiwan. More recently, Bowland and Begin (2001) derived a prediction function for developing countries. For the first time this study has been done in Tehran. Tehran, the capital of Iran, has a population of about 7 million people which is about 10 percent of the total population of the country. The area of Tehran is 2500 km^2 which constitutes about 15 percent of the total area of the country. In general, 20 percent of the total energy of the country is consumed in Tehran. The air in Tehran is one of the most polluted airs in the entire world. Pollutants such as SO_2, NO_2, HC, PM_{10} and CO are the major air pollutants in Tehran, about 80-85 percent of which is produced by mobile sources of pollution (Sci, 2002).

At the moment, the concentration of these pollutants is higher than the standard level most of the time which means that they have numerous effects on the health of Tehran citizens. These effects can be divided into categorizes from headaches to premature mortality (Osto,1987). In this paper, we have tried to distinguish the health effect of air pollutants in Tehran, and then estimate the monetary value of these effects by using different methods.

MATERIALS & METHODS

Unfortunately, there are few estimates of the V.S.L. for developing nations in the economics literature. With this in mind, Bowland and Beghin (2001) conducted a Meta -Analysis of value of statistical life (V.S.L) studies from the industrialized Nations to derive a V.S.L. prediction equation that could be used for developing countries. This equation accounts for difference in risk, human capital levels, and perhaps more importantly, income between more and less developed nations. At the beginning of this study, the V.S.L. of Iran was calculated. The V.S.L. is the Willingness to Pay of the people of a society to reduce one case of fatality among those who die. The meaning of V.S.L. is quite different from the Value of Life which estimates the value of life of a specific person. Therefore, in this study, we use the concept of V.S.L. which is different from the concept of the value of life of a specific person. The concept of V.S.L. is used for policy-making and social and governmental decision makings around the world. Based on the existing studies, V.S.L. generally has a wide extent, which is quite natural considering the different methods that are used in estimating the V.S.L.

There is no doubt that these monetary estimates can be quite different based on the differences in cultural norms and the income levels of different countries. Therefore, as the V.S.L. is estimated in Iran for the first time, the most necessary effort was made in this study so that by using the current scientific methods in the world, the estimation of V.S.L. would be accomplished with maximum care and precision
In recent years, environmental economists and policy makers have taken a lot of effort to estimate the value of change in the quality of the environment, and especially in reducing air pollution and its effect on the reduction of mortality in developing countries. One of these efforts is estimating V.S.L. through income elasticity method. This elasticity, which Bowled and Beghin estimate to range from 1.52 to 2.269, can be expressed as part of the following formula:

$$WTP_A = WTP_B (INC_A / INC\text{-}_B)^a$$

Where A and B subscripts denote two different countries, WTP represent the willingness to pay for a particular health effect (here, the value of avoiding premature death), and INC denotes the per capital income in each nation. The a term is the income elasticity of WTP.

To provide a check on the validity of our previous V.S.L. estimates, we use this Bowland-Beghin along with our Iranian V.S.L. numbers, to infer the value of a for Iran. Assuming a US value of statistical life of $5 million, PPP-adjusted per capital incomes to estimate the V.S.L. through this method, the simple concept of income elasticity in microeconomics is used. Using this method, it is possible to use the V.S.L. of other countries to determine the V.S.L. for Iran. When the V.S.L. of another country is used to estimate the V.S.L. of Iran, the effect of income should be considered in the estimation and the V.S.L. should be adjusted on that basis. In order to achieve more precision and care, in this study the researchers used three income elasticity of 1, 1.5, and 2. If WTP_A is kept constant, the elasticity of 1 will show a higher elasticity compared to 1.5. Similarly, the income elasticity of 1.5 demonstrates a higher elasticity compared to income elasticity of 2 for Iran. Therefore, the income elasticity of 1 is Upper Limit, the income elasticity of 2 is Lower Limit and the income elasticity of 1.5 is mid Limit.

In order to estimate the direct medical costs, at first, the list of all the hospitals of Tehran were obtained from the Ministry of Health, Treatment and Medical Education. Then, regarding the nature and type of the illnesses caused by the air pollution in Tehran, it was clear that the patients would mainly be found in General hospitals. Therefore, the list of all the general hospitals in Tehran was prepared in order to cost effectiveness.

After the list of the general hospitals in Great Tehran area was prepared, these hospitals were divided into the following 5 main groups based on the type of the managing organization.
Group 1 – Medical Science Hospitals
Group 2 – Private Hospitals
Group 3 – Social Security Hospitals
Group 4 – Charity Hospitals
Group 5 – Hospitals that were dependent on other organizations (Others).

In order to estimate the direct medical costs, sufficient number of general hospitals were selected from each of the above groups based on

the rating of the hospitals (ratings were 1, 2, and 3) from among the hospitals that had codification systems (at least one hospital from each group). Then, all the files pertaining to the illnesses caused by Tehran air pollution in 2002 were extracted. After that, 10 percent of these files were selected, the required information were extracted from the files and registered in the prepared forms. This information included the number of the patient's file, age, sex, the costs of hoteling, cost of drugs, cost of physician, cost of surgery, cost of physiotherapy, cost of consumed materials, duration of hospitalization, type of insurance, job and the total expenditure. In the end, the mean of the total direct costs of each illness in each and every group of hospitals was estimated.

The Contingent valuation (CV) was utilized in order to place monetary values on symptoms avoidance. CVM plays a major role in research aimed at estimating the value of non- market goods. Basic to the survey technique for valuing non- market goods is establishing a hypothetical market in which a commodity/service can be traded. A survey instrument was developed to obtain Willingness to pay (WTP) estimates for preventing future symptoms. A pilot survey was conducted to assess the effectiveness of the preliminary survey instrument and to identify any difficulties respondents might encounter in answering the questions posed. We also assessed whether the questions captured the range of circumstances of the selected subjects. And were flexible enough to cover most respondent's status. The results of the pilot surveys were used an assess whether changes were needed before full survey implementation was undertaken.

Standard contingent valuation techniques were employed in this study where the total societal WTP to prevent 10 different symptoms were estimated. We also utilized the survey to obtain a monetary value on the individual WTP to prevent a set of symptoms. Finally, we estimated average societal WTP for each symptom independently. Ten symptoms were identified for valuation: Cough, shortness of breath, chest pain, irregular heartbeat, vomiting headache, sore throat, eye irritation and impatience. Three thousand random surveys were completed from the population of the Greater Tehran Area. To collect the desired information through the survey technique the following steps were taken. First, the interviewers introduced themselves and presented the purpose of the study. After the introduction, a detailed description of good health and how it is negatively impacted by symptoms was given. This section was designed to give all respondents homogenous information regarding good health and its values. Once the objective of the survey was fully understood a series of questions were asked to determine respondents' overall health and lifestyle. For instance, rating their health status, whether they suffer from any air pollution health related symptoms, smoking habit, and overall health status were among the questions asked in this section. Finally, the respondents were specifically asked about whether they had experienced any of the 10 symptoms during the last month. The next section of the survey was designed to determine the individual's concern for better health and being cured from any of the symptoms. Although one does not typically place a dollar value on improved health, such items do possess market value. Since deterioration in health negatively impacts individuals, utility. We are interested in finding out how much improved health is being valued. In this section, the individual respondents were placed in a marked- like situation and were asked about their willingness to pay for improved health. Respondents were divided into two groups; those who had experienced one or more symptoms during the last month and those who did not experience any symptoms during the same time. This separation aimed to determine whether the recent experience with any of these symptoms would have any impact on bids offered. Furthermore, before bid elicitation the individual monthly income and total expenditures were asked and recorded. This question was asked to force the respondent to consider their budget constrain during their valuation. Following this instruction, respondent were then asked to state their willingness to pay to avoid having any of these symptoms. Respondent were asked to place a dollar value on all symptoms independently and asked to be as accurate as possible. We must note that this procedure constitute a direct attempt to determine how much improve health is valued. The willingness to pay a question was designed as follow: "if you were placed in a hypothetical market and are to purchase avoidance of any of the listed symptoms,

giving your budget constraint, please identify your willingness to pay for avoiding one day of these symptoms".Finally, in the last part of the survey the respondent were asked a set of socioeconomic question in the following order: sex, age, marital status, education level, whether the respondent is the primary income earner, number of people in the household, employment status and how many hours per day spend outdoors. These questions were asked because the knowledge of key parameters, such as age and income, was expected to be useful in accounting adequately for the difference in behavior across individual. The variations in socioeconomic characteristics are assumed to explain the observed difference among individuals. The collection of socioeconomic data also helps the researcher to obtain a sample, which encompasses different types of people in such a way as to be more representative of the total population. In summer 2002, nearly 3000 survey were completed from the residents of Tehran, Iran, regarding their preference related to preventing future symptom episodes. The symptom episodes were defined to be those that have been associated with air pollution, but air pollution was not presented to survey as a factor in their chance of having a future symptom episode. After the data were collected and organized, the analysis of the data was conducted. This section presents results obtained from information collected in the survey described in the previous section. All values are given as" means" with "standard deviations" in parentheses. Table 10 summarizes the socio-economic variables of the sample; all values are means with their standard deviation in parentheses. After the questionnaire was prepared and pilot studies were conducted, as the incidence of the minimum index of the symptoms in the study was P = 0.02, with a confidence level of 0.95 and at d=0.005 level of significance, the sample volume was estimated to be 3000. In order that the questionnaires be filled in, all the citizens of Tehran, Eslamshahr and Shahre-Rey were divided into clusters, with each cluster including 450 people. The 450-people clusters were chosen so that there would be enough chance for the selection of people at the age of 18 and above. In the first stage, from among all the 450-people clusters, 60 clusters were randomly selected. These clusters were selected from among the complete list and framework of the blocks that were provided by Iran Statistics Center. The procedure was conducted in such a way that the probability of the selection of the clusters in each block would correspond to the volume of the clusters in each block of proportion probability sampling (P.P.S). In the next stage, those who were 18 and above were enlisted. From among them, and by using simple random selection method, 50 people were selected and interviewed.

RESULTS & DISCUSSIONS

In this section, we use income elasticity methods to derive an estimate of the value of a statistical life (V.S.L.) for Iran (Table 1). The following formula is used for converting Exchange rate to ppp, purchasing power parity, (World Bank, 2003)

Gross National Income per capita of (GNI) of Iran $\frac{2002 \text{ ppp} = 6230}{} = 3.56$
Gross National Income (GNI) per capita of Iran 1750

Among the illnesses under study, Angina, Arrhythmia, CVA and COPD demonstrated relationships with air pollution in Tehran (Table 4). Regarding the item of number of deaths, the calculations have been conducted in two different ways: one based on different age groups (under 1, 1-35, 35-65, over 65) and the other without regarding the age. Only one of them should be used when adding up.We remind the reader here again that if we are to obtain the number of incidences pertaining to the air pollution (or the preventable number, in case of the reduction in air pollution) we should first define an obtainable level, and then obtain the results using the presented coefficients and a simple calculation. It is obvious that defining an obtainable level of reduction in air pollution is the responsibility of organizations that are involved in evaluation, planning and administration; and that what is presented in this paper as the number of incidences pertaining to air pollution is an estimation of the number of acute and preventable health problems pertaining to air pollution in three air pollution reduction scenarios. Table 6 demonstrates mariginal (per each unit increase in pollutants pre day)health damage costs of premature mortality caused by air pollution in tehran. After 3000 questionnaires which belonged to 60 blocks in Great Tehran Area were filled in, the gathered data were analyzed by SPSS computer software. The results of these analyses are presented in the Tables 10-14.

Table 1. The results obtained from the Income Elasticity Method for the estimation of V.S.L. in Iran 2002

Number	Elasticity	V.S.L.(US$) ppp*	V.S.L. (US$) Exchange rate
1	1	893318	250932
2	1.5	200122	56214
3	2	44831	12593

*** Purchasing Power Parity**

Table 2. The Mean of the Direct Medical Costs based on the type of the Illness in the Hospitals of Tehran (US$ 2002)

Type of Illness	Cost
Unstable angina. Angina Pectoris. Coronary artery disease (CAD).	421.83
Ischemic heart disease (IHD) Arrhythmia, dysrhythmias	1399.86
CVA	1611.66
Chronic obstructive pulmonary obstruction (asthma chronic bronchitis, emphysema, …	598.99

Table 3. Marginal (Per each unit increase in pollutant per day) number of mortality in different age groups and the confidence level of %95 (Yunesian, 2002)

Age Group	Pollutant	Number of Increased items		
		Upper Limit	Lower Limit	Mean
Mortality in all ages	PM_{10}	0.049	0.007	0.028
	SO_2	0.076	0.016	0.046
Mortality among people aged 30-65	CO	0.204	0.023	0.113
	SO_2	0.029	0.003	0.016
Mortality among people aged over 65	PM_{10}	0.028	0.004	0.016

Table 4 . Marginal (per each unit increase in pollutants per day) number of hospitalizations in Tehran with the confidence level of %95 (Yunesian, 2002)

Illness	Pollutant	Number of increased item		
		Upper Limit	Lower Limit	Mean
Angina	CO	1.09	0.258	0.68
Arrhythmia	PM_{10}	0.046	0.0086	0.027
CVA	NO_2	0.03	0.0023	0.017
COPD	CO	0.52	0.06	0.29

Table 5. Estimation upon Maximum 10 percent of Days Over standard Level of Japan, 2002 (Yunesian, 2002)

Group	Effect Group	Pollutant	Mean daily effect/unit	Mean Annual Effect	Minimum Annual Effect	Maximum Annual Effect
Death	All Death	PM_{10}	0.028	786.8378	196.70945	1376.96615
	All Death	SO_2	0.046	228.6798	79.5408	377.8188
	30-65	CO	0.113	397.6018	80.9278	717.7944
	30-65	SO_2	0.016	79.5408	14.9139	144.1677
	Over 65	PM_{10}	0.016	449.6216	112.4054	786.8378
Hospitalization	Angina	CO	0.68	2392.648	900.7616	3835.274
	Arrhythmia	PM_{10}	0.027	758.73645	241.67161	1292.6621
	CVA	NO_2	0.017	356.97365	48.296435	629.9535
	COPD	CO	0.29	1020.394	211.116	1829.672
Telephone survey	Efficacy	PM_{10}	2580	72501483	34283647	111281346
	Nausea	SO_2	575	2858497.5	939575.7	4782390.6
	Eye	SO_2	915	4548739.5	1004202.6	8103219
	Eye	PM_{10}	1940	54516619	16411188.4	92734455
	Headache	SO_2	1430	7108959	2351424.9	11881407
	Headache	PM_{10}	4040	113529454	52830538	174509383.5
	Sputum	NO_2	961	20179510.45	6488521.05	33807504.5
	Cough	NO_2	946	19864533.7	4094697.75	35697365

The results show that the highest average of WTP for moodiness was 14993.72 Rials. WTP for headache was 12085.66 Rials, WTP for efficacy was 11953.33 Rials, WTP for eye irritation was 9124.38 Rials, WTP for cough was 8999.87 Rials, WTP for nausea was 7236.17 Rials, WTP for sputum was 6956.33 Rials and WTP for sore throat was 6743.83 Rials. Regarding the symptoms, it was found that there were meaningful relationships between the following pairs: particles which were smaller than 10 micrometer with decrease in efficacy, eye irritation and headache; SO_2 with nausea, eye irritation and headache; and NO_2 with sore throat, cough and sputum. In order to estimate the total number of symptoms, we should first see how much it is possible to reduce the air pollution, and then, we can calculate the number of occurrences that are avoidable based on this reduction in air pollution. In this report, in order to obtain an estimate of the magnitude of avoidable (and measurable) consequences of air pollution, the Japanese standards were used as the allowable limits for the pollutants.

Table 6. Mariginal (per each unit increase in pollutants per day) health damage costs of premature mortality caused by air pollution in Tehran (US$ 2002)

Pollutant	Age	Upper Limit	Lower Limit	Mean
SO_2 microgram/m^3	Under 1 year 1-30 30-65 Over 65 All ages	7277.03 19070.83	752.80 4014.91	4014.91 11542.87
CO_2 miligram/m^3	Under 1 year 1-30 30-65 Over 65 All ages	51190.13	5771.44	28355.32
PM10 microgram/m^3	Under 1 year 1-30 30-65 Over 65 All ages	7026.09 12295.67	1003.73 1756.52	4014.91 7026.10

Table 7. Annual health damage costs of premature mortality caused by air pollution in tehran based on maximum %1 of days in which the level of pollutants has been higher than the standard level (US$ 2002)

Pollutant	Age	Upper Limit	Lower Limit	Mean
SO_2	Under 1 year 1-30 30-65 Over 65 All ages	36184394.4	378886.8	19949094
CO	Under 1 year 1-30 30-65 Over 65 All ages	180093896.38	20300398.8	99770563.2
PM10	Under 1 year 1-30 30-65 Over 65 All ages	18947433297.63	2820481.8	112819027.2

Table 8. Marginal(per each unit increase in pollutants per day) health damage costs of hospitalizations caused by air pollution in Tehran (US$ 2002)

Type of Illness	Pollutant	Lower Limit	Upper Limit	Mean
Unstable angina. Angina Pectoris. Coronary artery disease (CAD). Ischemic heart disease (IHD)	CO	108.83	459.79	286.84
Arrhythmia, dysrhythmias	PM_{10}	12.04	1.25	37.80
CVA	NO_2	3.71	48.35	27.40
Chronic obstructive pulmonary obstruction (asthma chronic bronchitis, emphysema, …	CO	35.94	311.47	173.71

Table 9.Total direct costs of illnesses caused by air pollution in Tehran based on maximum %1 of days in which the level of pollutants has been higher than the Japan standard level (Rial, 2002)*

Type of Illness	Pollutant	Lower Limit	Upper Limit	Mean
Unstable angina. Angina Pectoris. Coronary artery disease (CAD). Ischemic heart disease (IHD)	CO	380065.34	1617703.19	1009429.92
Arrhythmia, dysrhythmias	PM_{10}	338766.73	1810022.21	1062495.64
CVA	NO_2	77359.46	1015341.84	575361.01
Chronic obstructive pulmonary obstruction (asthma, chronic bronchitis, emphysema, …	CO	126386.71	1096150.10	610968.91
Total				3258255.48

*1 US$= 9200 Rials

Table 10. Socio-economic characteristics

AGE	Education	Household Size	Income/ Month (US$2002)
38.8	9.9	4.5	254
(15.5)	(4.68)	(1.7)	(215)

The Standard Deviation is mentioned in the parentheses

Table 11. WTP descriptive indices for each symptom (Rial 2002)*

No.	Illness	Quantity	Average	S.D.	Median
1.	Cough	3000	8999.87	18483.28	4000
2.	Sputum	3000	6956.33	15956.31	3000
3.	Nausea	3000	7236.17	12962.88	4000
4.	Headache	3000	12085.66	20648.35	5000
5.	Sore throat	3000	6743.83	11590.32	3000
6.	Eye Irritation	3000	9124.38	15089.25	5000
7.	Moodiness	3000	14993.72	25592.54	7000
8.	Efficacy	3000	11953.33	20753.14	5000

*1 US$= 9200 Rials

Table 12. Increase number of symptoms for each level of pollutants with average daily symptoms and a confidence level of %95 (Yunesian, 2002)

Symptom	Pollutant	Number Of Increased Occurrence		
		Upper limit	Lower limit	Mean
Efficacy	PM_{10}	3.96E+03	1.22E+03	2.58E+03
Nausea	SO_2	9.62E+02	1.89E+02	5.75E+02
Eye irritation	SO_2	1.63E+03	2.02E+02	9.15E+02
	PM_{10}	3.30E+03	5.84E+02	1.94E+03
Sore throat	NO_2	2.39E+03	4.73E+02	1.43E+03
Headache	SO_2	2.39E+03	4.73E+02	1.43E+03
	PM_{10}	6.21E+03	1.88E+03	4.04E+03
Sputum	NO_2	1.61E+03	3.09E+02	9.61E+02
Cough	NO_2	1.70E+03	1.95E+03	9.46E+02

Table13. Marginal (per each unit increase in pollutants per day) health damages cost of the symptoms (Rial 2002)*

Symptom	Pollutant	Upper Limit	Lower Limit	Mean
Efficacy	PM10	47335186.8	14583062.6	30839591.4
Nausea	SO_2	6961195.54	1367636.13	4160797.75
Eye Irritation	SO_2	17610053.4	1843124.76	8348807.7
	PM10	30110454	5328637.92	17701297.2
Headache	SO_2	28884727.4	5716517.18	17282493.8
	PM10	75051948.6	22721040.8	48826066.4
Sputum	NO_2	11199691.3	2149505.97	6685033.13
Cough	NO_2	15299779	1754974.65	8513877.02

*1 US$= 9200 Rials

Table14. Total annual health damages cost of the symptoms in Tehran based on Maximum %1 of days when the level of pollutants has exceeded the standard level of Japan (Rial 2002)*

Symptom	Pollutant	Upper Limit	Lower Limit	Mean
Efficacy	PM10	1330182625000	409803746200	866634151800
Nausea	SO_2	34606194280	6798931664	20684577470
Eye Irritation	SO_2	73936849380	9162729769	41504423160
	PM10	846144406500	149741915600	497430348100
Headache	SO_2	143594645300	28418523070	85916461430
	PM10	2109061070000	638491919900	1372078381000
Sputum	NO_2	235176161300	45136293290	140375337800
Cough	NO_2	321271644300	36849949720	178778223600
Total				3203401904000

*1 US$= 9200 Rials

The number of the symptoms was estimated in such a way that in maximum 1 percent of days the level of pollutants would exceed the Standard Level of Japan. In order to calculate the above points, the corresponding Z for each of the above probabilities was extracted from the related standard tables, and was then multiplied by the standard deviation. The result of the multiplication was deducted from the mean of the pollutants in the year 2002, and the resulting figure was adopted

as the feasible limit of the air pollution reduction. The number of the avoidable symptoms was calculated by multipying the "feasible limit of the air pollution reduction" by the related coefficients for each consequence (Yunesian 2002).

In this study except V.S.L we used Impact pathway approach for assessment of health damage cost in Tehran. For V.S.L an alternative approach, transfer economic values from other countries was used. Transferring economic values to other countries typically relies on a simple scaling based on national per capita output (or income) rations between the country of intrest and the developed counteries. Such a procedure contains many drawbacks; the most obvious is the implicit assumption that preferences for averted morbidity and mortality are similar between the countries. That they are also determined largely by income. Use of such a simple transfer procedure also assumes that the income elasticity of willingness-to- pay (α - WTP) for improved health (or death avoided) is equal to 1.0 (or that treating it as 1.0 captures all Other factors that may influence the WTP). This, of course, ignores the potential importance of other factors. At the current time, we have very little data on how these difference might affect preferences and how these relate to willingness-to- pay. Some recent valuation studies have begun to address the issue of income and preferences in a developing country.

CONCLUSIONS

Considering the estimation of the health damage costs caused by Tehran air pollution in three categories of symptoms, mortality, and morbidity. The total daily health damage costs of the air pollution in Great Tehran area per each unit increase of each pollutant has been estimated in Table 15.

Table 15. Marginal health damage costs caused by air pollution in Tehran (US$ 2002)

Pollutant	US$
SO_2	7739
NO_2	1927
PM_{10}	16224
CO	28816

In Table 16, The total annual health damage costs, considering the reduction of pollutants in such a way that the level of pollutants would be higher than the standard level of Japan in maximum %1 of the days in a year has been estimated to be US$ 663776376. It goes without saying that this figure in this study is the Lower Limit or the minimum estimation of the health effects caused by the air pollution in Tehran. If the indirect effects and chronic effects are added to the above figure, the total costs will become significantly higher.

Table 16. Total annual health damages cost caused by air pollution in Tehran (US$ 2002)

Pollutant	US$
SO_2	38462277
NO_2	40469556
PM_{10}	483453481
CO	101390962
Total	663776276

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