ATLANTIS PRESS
Advances in Social Science, Education and Humanities Research, volume 196
2nd International Conference on Social Science, Public Health and Education (SSPHE 2018)

Income Impact on Health and Heterogeneous Environmental Willingness to Pay

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Abstract—This paper employs comprehensive Chinese data to investigate whether household income growth contributes to alleviate health impairment caused by air pollution. Using an ordered multivariate Logit model, the paper finds that the growth of household income plays an important role in relieving health damage caused by air pollution, and the alleviation is largely dependent on residents' environmental willingness to pay (WTP). Empirical results also suggest that those with better educational background are more inclined to transform household income into health welfare.

Keywords—household income, air pollution, health welfare, environmental willingness to pay (WTP)

I. INTRODUCTION

The past decades have witnessed China's economic growth. However, with the rapid growth in economy, the environmental problems, especially air pollution which impact residents' health have become an important public issue. Undoubtedly, the living standard of Chinese people, as well as their demand for health needs, have increased substantially with the development of economy. Many people show strong desire of environmental Willingness to Pay (WTP) for clean air, in hopes of alleviating body suffering(Ito and Zhang,2016[1]; Sun and Kahn 2017[2]; Zhang and Mu, 2016[3];Zheng and Kahn, 2008[4]; Zheng and Kahn,2010[5]).

By identifying the effect of net income per capita and air pollution on self-rated health condition, this paper intends to find whether the relationship between increase in household income and decline in health suffering caused by air pollution is significant, and what the influence mechanism is. Meanwhile, the objective and subjective factors that affect residents' WTP are regional air pollution situation and individual education level respectively, hence we form two types of WTP mechanisms: active generation and passive appearance. The former estimates WTP divergence of people with different educational background, and the latter compares the regional difference. To be specific, the residents in north and south China, their different income effect on health impairment caused by air pollution.

The rest of this paper is structured as follows. Section II reviews the literature of environment pollution on people's health. Section III introduces the data and methodology employed in our empirical analysis. In section IV, the main results of empirical models are presented, as well as two heterogeneous comparisons related to WTP. Section V summarizes the main findings and discusses th e policy implications.

II. LITERATURE REVIEW

The previous studies on income and health show controversial results: some argue that income has significant positive impact on health, and health improves when income increases while other factors being held constant (Pritchett and Summers, 1996[6]; Gerftham and Johannesson, 2004[7]); others show that income and health has nonlinear relationship, sometimes even invert-U-shape, as the income expands, health condition promotes, and when it reaches a certain level, then health condition decreases (Benzeval, Judge and Shouls, 2001[8]). In addition, some researchers hold view that health also has a reverse causal effect on income (Qin, Chen and Qin , 2013[9]).

Nowadays, an increasing literature employs Chinese data to investigate the influence of air pollution on health. The main stream adopts dose-response correlation to get empirical results. For instance, Zhao et al (2014) demonstrates the damage of air contaminants in Beijing city to public health[10]. However, because of the endogenous problems, these papers are not able to eliminate the influences of other factors. To solve this problem, some scholars use empirical methods to estimate health risk of air pollution, such as Chen and Chen(2014) which adopts 3SLS empirical method to test the effect of SO_2 from coal-fired power plant on public health[11].

Both income and pollution have significant impacts on human health, and the two factors may have interaction effects. Some empirical studies include personal environmental willingness to pay(WTP) for clean air. They argue that people with higher income tend to purchase protective products like air purifier and masks to mitigate the impairment(Ito and Zhang, 2016[12]), and some even move to other cities with good air quality at the expense of higher house price (Zheng, Kahn and Liu, 2010[13]). Freeman et al (2017) find that the willingness to pay for clean air is prominently larger than the previous studies calculation by using a residential sorting model with moving disutility[14]. The papers listed above have conducted Chinese micro-level data to provide evidence to support their arguments.

This paper contributes to the literature in several ways: (i) the paper investigates the interaction effect of income and pollution on health while previous research has not paid much attention yet; (ii) the paper employs multi-dimensional pollution indicators, including objective indicators i.e. air quality, and subjective indicator i.e. self-rated health condition; (iii) the paper includes WTP into mechanism analysis, since WTP levels vary across different regions and groups with different educational background, we associate income effect on health damage with north-and-south regions and different educational groups.

III. DATA AND METHODOLOGY

A. Data Source and Variables Definition

This paper uses data from a variety of statistical yearbook, along with China Health and Nutrition Survey Data (CHNS) [15]. Our outcome variable is personal self-rated health, since it's a subjective indicator that is consistent with individual willingness to pay. We collect the dependent variable information from inhabitants' self-rated dataset. CHNS provides information of residents' last three months self-rated health condition. In line with previous studies, this paper adopts two key explanatory variables: constant price net income per resident (household income for short) and air pollution emissions per unit of area(air pollution for short).

We employ the province-level pooled cross-section data during1989-2011. Our supplement data are obtained from China Statistical Yearbook of 1999-2012[16], Compilation of 60 Years Statistical Information in New China, China Environment Yearbook of 1999-2013[17], China Environmental Statistics Yearbook of 2005-2013., China Land and Resources Almanac of 1989-2011

Control variables can separate the effect of other factors that have a predictable influence on inhabitants' health condition, three categories of control variables are employed: the paper first chooses GDP per capita, education background and age for these variables may influence personal fitness level; the paper also controls the smoking group and the group near the polluter, as these groups have higher probability of being attacked by respiratory diseases; besides, local environment regulation may alleviate the health damage of contaminant, the paper adopts removal rate of four industrial pollutants to control local environment regulation.

The main macro indicators are collected from China Statistical Yearbook, the missing data are supplemented from Compilation of 60 Years Statistical Information in New China, we adopt GDP deflator in order to match constant price of household income provided by CHNS, the GDP deflator is calculated by real GDP of 2011 and constant price of product index(set year 2011 as base year).

B. Research Method

The paper uses ordered multivariate Logit model to estimate the influence of pollution and income on self-rated health condition, we construct our basic model as follows:

$$\mathrm{H}_{ijt} = \alpha + \beta_1 I_{ijt} + \beta_2 AP_{jt} + \gamma X_{ijt} + \varphi X_{jt} + \mu_j + \eta_t + \varepsilon_{ijt} \quad (1)$$

Where H represents the self-rated health indicators, I is household income, AP denotes four types of contaminants emission amount (SO_2, dust, soot and NO_X), X_{ijt} refers to micro-level control variables, X_{jt} refers to macro-level control variables, i represents the individual , j represents the province individual i belongs to, t represents the year individual i is in, μ represents fixed effect terms that changes only by the city, η represents the fixed effect terms that changes only with the time, ε is the error terms. The coefficients, β_1 and β_2 , estimate the impact of variables income I_{ijt} and air pollution AP_{jt} on individual health H_{ijt} , respectively.

Equation (2) incorporates interaction term I×AP to estimate the interaction effect of household income and air pollution on health.

$$\mathrm{H}_{ijt} = \alpha + \beta_1 I_{ijt} + \beta_2 AP_{jt} + \beta_3 I_{ijt} \times AP_{jt} + \gamma X_{ijt} + \varphi X_{jt} + \mu_j + \eta_t + \varepsilon_{ijt} \quad (2)$$

when using ordered multivariate Logit model to test the interaction effect, the partial effect of net income per capita and air pollution on self-rated health condition are:

$$\frac{\partial P(H_i = m)}{\partial I_{ijt}} = \{g(\mu_{i-1} - X'\alpha) - g(\mu_j - X'\alpha)\}\beta_1 + \{g(\mu_{i-1} - X'\alpha) - g(\mu_j - X'\alpha)\}\beta_3 AP_{jt} \quad (3)$$

$$\frac{\partial P(H_i = m)}{\partial AP_{jt}} = \{g(\mu_{i-1} - X'\alpha) - g(\mu_j - X'\alpha)\}\beta_2 + \{g(\mu_{i-1} - X'\alpha) - g(\mu_j - X'\alpha)\}\beta_3 I_{ijt} \quad (4)$$

$\{g(\mu_{i-1} - X'\alpha) - g(\mu_j - X'\alpha)\}\beta_3$ is the transferred partial effect of β_3; and m denotes 0,1,2,3,4, representing the self-rated scores.

The negative result of $\{g(\mu_{i-1} - X'\alpha) - g(\mu_j - X'\alpha)\}\beta_3$ in model (3) indicates that air pollution can significantly reduce the income improvement on health condition. The positive result of $\{g(\mu_{i-1} - X'\alpha) - g(\mu_j - X'\alpha)\}\beta_3$ in model (4) indicates the income mitigation effect. As to the total results of model (3) and (4), the positive result of model (3) suggests the level of contaminant emission amount that counteract the impact of income on self-rated health. Moreover, the negative result of model (4) reveals the income level that counteract the impact of air pollution on self-rated health.

IV. EMPIRICAL ANALYSIS

A. Basic Regression Results

The paper employs self-rated health status to recognize the air pollution effect on household income and public health, for the reason that WTP is the subjective feeling of people, and it's consistent with self-rated health condition. Moreover, considering that there's lag-effect of disease incidence caused by air pollution, the paper includes contaminant lag period term into estimation, the regression result shows no difference with current period term estimation, hence we only adopt current period term in our research.

The result of model (1) without interaction term presents that the increase in household income could drive inhabitants to rate high when judging their health level, on contrary, increase in industrial soot emission lower the rate. Table I shows the results both from model (1) and (2).The regression(1) to (4) are the results of model (1), and regression (5) to (8) are from model (2). The results indicate that household income and four types of air pollution contaminants have no significant interaction effect on self-rated health.

TABLE I. ANALYSIS ON THE INTERACTION EFFECT ON SELF-RATED HEALTH

Self-reported health	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Household income	0.103***	0.099 6***	0.111***	0.088 0*	0.404	0.252*	0.407	1.494
	(0.037 7)	(0.038 0)	(0.038 4)	(0.049 2)	(0.495)	(0.148)	(0.339)	(1.453)
SO2	0.207**				0.231**			
	(0.083 5)				(0.097 2)			
dust		0.033 7				0.061 8		
		(0.132)				(0.146)		
soot			-0.224**				-0.176*	
			(0.113)				(0.094 6)	
NOX				0.417				0.563
				(0.314)				(0.395)
Household income*SO2					-0.045 3			
					(0.074 0)			
Household income*dust						-0.028 4		
						(0.027 9)		
Household income*soot							-0.049 9	
							(0.054 1)	
Household income*NOX								-0.224
								(0.230)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES
observations	50 762	50 762	50 762	10 995	50 762	50 762	50 762	10 995
log likelihood	-58 270	-58 259	-58 324	-13 065	-58 269	-58 257	-58 321	-13 063

Table II displays the results of partial effect transformation on the estimation results of model (2), showing that household income growth alleviates health impairment caused by air pollution.

TABLE II. ESTIMATION OF THE PARTIAL EFFECT ON PUBLIC HEALTH

Public health indicators	Partial effect	SO_2	Dust	Soot	NO_X
Respiratory morbidity	Household income	0.012 1	0.004 67	0.010 3	0.012 8
	Air pollution	0.014 6	0.005 51	0.008 78	0.003 51
	Household income*Air pollution	-0.001 54	-0.000 499	-0.00142	-0.001 34
Self-reported health scores	Household income	-0.032 0	-0.020 0	-0.032 2	-0.163
	Air pollution	-0.018 3	-0.004 89	0.013 9	-0.061 5
	Household income*Air pollution	0.003 58	0.002 25	0.003 95	0.024 5

B. Micro-mechanism of Heterogeneous Environmental WTP

1) North-and–south discrepancy: comparativeness: passive WTP mechanism The government provides central-heating system in North China but not in the South. In addition to the differences in industrial structure and weather, the air pollution impairment on public health is higher in north and lower in south(Chen, Ebenstein and Greenstone, 2013[18]). Therefore, inhabitants in the north are forced to raise WTP to alleviate health impairment caused by air pollution. As for pollution sources, unlike south region where the air pollution is from agricultural activity , the main contaminants of north region are human activity and business energy consume(Lelieveld, Evans and Fnais, 2015[19]). We expect differences between north and south in passive WTP generating mechanism. We hold the view that regional contaminant disparity can lead to “high-in-north and low-in-south” structure of personal WTP, and induce northern people to spend more income on healthcare.

Table III presents the result of model (2), that accumulation in dust and NO_x reduces household income welfare to self-rated health in north, the expectation of income welfare decreases with the environmental deterioration. On the contrary, the southern residents income increase improve their confidence on self-rated health. Hence the subjective discrepancy between north and south residents leads to discrepancy in income welfare performance.

The estimation results show that income welfare effect is more obvious in northern provinces, which means northern residents attach more importance to health protection against air pollution, choosing to purchase more protection equipments to avoid environment risk, therefore their income effect is more obvious. We now discuss the partial effect results of model (2) (presented in Table IV), where increase in northern resident household income could rectify the health impairment of industrial soot and NO_x, in contrast to southern part, where increase in industrial NO_x reduce the income welfare on health.

Based on the analysis above, income effect on health improvement varies with the north and south area, owing to air pollution structure disparity of south and north, as well as the difference in residents' health confidence. Northern residents are of more awareness on the air pollution damage, which increase the WTP of northern residents, enhancing the income welfare on northern people 's health. To sum up, the "high-in-north and low-in-south" contaminate distribution leads to the "high-in-north and low-in-south" WTP properties, enhancing income welfare for north inhabitants.

TABLE III. REGIONAL HETEROGENEITY ANALYSIS OF EFFECT ON SELF-RATED HEALTH

Self-reported health scores	**Northern area**				**Southern area**			
	reg(1)	***reg(2)***	***reg(3)***	***reg(4)***	***reg(5)***	***reg(6)***	***reg(7)***	***reg(8)***
Household income	0.609	0.490***	0.377	6.845***	-0.100	0.118	0.160	-0.016 0
	(0.428)	(0.172)	(0.512)	(0.712)	(0.616)	(0.180)	(0.389)	(1.243)
SO_2	0.297***				0.135			
	(0.041 7)				(0.126)			
dust		0.274				-0.064 2		
		(0.229)				(0.151)		
soot			-1.009				-0.268	
			(0.985)				(0.169)	
NO_X				-51.01***				0.561***
				(3.712)				(0.130)
Household income *SO_2	-0.084 5				0.040 1			
	(0.062 8)				(0.0896)			
Household income *dust		-0.079 0***				0.009 99		
		(0.027 4)				(0.031 5)		
Household income *soot			-0.053 2				0.004 23	
			(0.080 4)				(0.062 1)	
Household income *NO_X				-1.084***				0.023 1**
				(0.112)				(0.191)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES
observations	20 585	20 585	20 585	4 729	30 177	30 177	30 177	6 266
log likelihood	-24 377	-24 438	-24 491	-5 730	-33 432	-33 447	-33 415	-7 196

TABLE IV. ESTIMATION OF PARTIAL EFFECT IN NORTH AND SOUTH

Contaminants	**Partial effect**	**Northern area**		**Southern area**	
		Respiratory disease	***Self-reported health level***	***Respiratory disease***	***Self-reported health level***
SO_2	Household income	0.004 60	0.019 2	0.008 38	0.008 23
	SO_2	0.028 2	-0.016 5	0.003 95	-0.011 1
	Household income *SO_2	-0.000 213	-0.003 37	-0.001 12	-0.003 29
Dust	Household income	0.001 90	-0.036 7	0.002 56	-0.009 64
	Dust	-0.006 63	-0.020 6	0.006 45	0.005 27
	Household income *dust	0.000 361	0.005 92	-0.000 278	-0.000 819
Soot	Household income	-0.005 73	-0.028 3	0.006 05	-0.013 1
	soot	-0.030 5	0.075 7	0.004 25	0.022 0
	Household income *soot	0.001 62	0.003 99	-0.000 831	-0.000 347
NO_X	Household income	-0.058 1	-0.707	0.017 7	0.001 80
	NO_x	-0.069 9	5.270	0.031 9	-0.063 2
	Household income *NO_x	0.010 3	0.112	-0.002 32	-0.002 61

2) Comparison among different education background groups: objective WTP mechanism: Different groups may have different WTP ,which affects the health risk of air pollution. The WTP objective disparity is mainly dependent on groups' health awareness variety. It's obvious that the health awareness is related to people's educational background, for instance, after receiving healthy awareness education, people with coronary heart disease can improve their health attitude and behavior, living a healthier lifestyle (Liu,2012) [20]. In our models, we explore the income impact of various educational groups on air pollution impairment.

According to China Educational Statistics Yearbook[21], Chinese education structure changes tremendously owing to expanding enrollment policy of national entrance exam after year of 2000. In order to minimize the division error of different educational groups, we split our research period into two sub-periods of before 2003 and after 2003 : during 1989-2003, we define low-educated group as those with lower than high school degree , and high-educated group as those with high school degree or above; during 2003-2011, we define low-educated group as those with lower than bachelor degree, and high-educated group as those with bachelor and higher degree.

Low educated group may have poor health awareness and is less willingly to pay for better environment, hence the income effect in low educated group is insignificant in reducing health risk. Contrarily, high educated group have more freedom to choose career, so they can choose to work far away from pollution source to avoid the health risk. Moreover, they have strong purchase willingness to protect health. Our sample data proves that only 24% of high educated people work near the pollution source, while the number is 87% in low educated group, representing that high educated group take working environment into consideration when making career choice, and they are likely to purchase house with better environment to avoid pollution. Generally, people with higher education are willing to pay more of their income to improve their health.

Table V reports the regression result of model (2), showing that after 2003 income increase in low educated group promote more self-rated health than in high educated group, but NO_x emission significantly reduces the self-rated indicator of high educate group and soot emission reduces self-rated confidence of low educated people. More precisely, as for the age distribution of low educated people, people under 30 years old accounts for 13.54%, and over 30 accounts for 86.46%. Most of the low educated people were given birth before 1970s, they have lively experience of economic bonus resulted in reform and opening up, so they may have over-confidence on health. Compared to low educated group, people with higher education have more knowledge about the damage of environment pollution, tending to have risk aversion awareness.

The analysis above indicates that educational improvement can make people objectively viewing income health welfare and pollution health risk. In other words, people in higher educated group have strong environmental awareness, they are likely to spend more on protecting health from environment pollution even though their income are less than lower educated group, which results in promoting self-rated health level.

TABLE V. EDUCATIONAL HETEROGENEITY ANALYSIS ON THE SELF-RATED HEALTH FROM 2004-2011

Self-reported indicator	Low-educated group				High-educated group			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Household income	1.492	0.487*	1.370***	0.701	0.299	-0.0208	-0.272	4.951**
	(1.068)	(0.268)	(0.344)	(2.447)	(0.601)	(0.226)	(0.278)	(1.976)
SO_2	0.653***				0.534			
	(0.228)				(0.417)			
dust		0.350**				0.472**		
		(0.148)				(0.197)		
soot			0.874**				1.056*	
			(0.345)				(0.544)	
NO_X				0.520				1.338*
				(0.588)				(0.772)
Household income *SO_2	-0.211				-0.043 7			
	(0.158)				(0.092 3)			
Household income *dust		-0.070 5				0.005 46		
		(0.048 4)				(0.039 8)		
Household income *soot			-0.214***				0.049 7	
			(0.055 3)				(0.048 9)	
Household income *NO_X				-0.093 0				-0.783**
				(0.386)				(0.315)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES
observations	9 691	9 691	9 691	4 871	1 541	1 541	1 541	842
log likelihood	-11 448	-11 453	-11 464	-5 716	-1 785	-1 778	-1 784	-956

3) Robustness checks: In order to ensure the robustness of the results, the paper employs multivariate Probit and multivariate ordered Probit approaches to estimate the regressions of all models, the robust test result shows no difference with the results above.

The paper also incorporates slope dummy variables to test the robustness of heterogeneous analysis, we rewrite model (2) with slope dummy variable as follows:

$$H_{ijt} = \alpha + \beta_1 I_{ijt} + \beta_2 AP_{jt} + \beta_3 I_{ijt} \times AP_{jt} + \beta_4 I_{ijt} \times D_{ijt} + \beta_5 AP_{jt} \times D_{ijt} + \beta_6 I_{ijt} \times AP_{jt} \times D_{ijt} + \gamma X_{ijt} + \varphi X_{jt} + \mu_j + \eta_t + \varepsilon_{ijt}$$

In regional heterogeneous analysis, D is the regional dummy variable, D=0 when province j belongs to the North, D=1 when province j belongs to the South. In different educational background analysis, D=0 when individual i belongs to high educational group; D=1 when individual i belongs to low educational group. The results are shown in the appendix, which are both consistent with heterogeneous environmental WTP analysis.

V. Conclusions and Implications

This paper theoretically and empirically analyzes the mechanism of household income in alleviating public health impairment caused by air pollution The paper starts by estimating overall household income and air pollution interaction effect on public health, using micro household health income data; then the paper identify the subjective factors that influence personal WTP: terrain air pollution disparity and personal education disparity; finally the paper compare the different household income effect on air pollution among various WTP level .

The findings are summarized as follows: (i) generally, household income can improve people's self-rated health statues; (ii) the disparity of environment pollution between north and south leads to north and south income welfare effect difference, high-in-north and low-in-south contaminate intensity characteristics result in high-in-north and low-in-south WTP discrepancy, therefore northern households have better income welfare on health than those in the south; (iii) on one hand, the promotion of overall education level can intensify the income mitigation effect on reducing air pollution damage because health awareness improves with the increase of education level. On the other hand, people with better education background, even though they are not rich, prefer to spend their income on purchasing houses with comfortable environment and good protection equipment to promote their health level.

Based on the analysis above, the paper proposes the following policy implications:

i) Air pollution is more than a mere environmental problem, it combines with economic and social factors. With the income increase, the health impairment caused by air pollution are mitigated, so we hold the view that residents with higher income tend to spend more on protecting their health , avoiding to have respiratory disease. Therefore, it is an effective way for China to deal with environmental issues by improving citizens' income level.

ii) North and south China residents have different WTP for improving air quality due to the disparity of contaminate distribution, which sheds light on environmental policy design by implementing different environmental reforms in north and south. For instance, in order to reduce pollution and save energy in northern cities, Chinese government could conduct policy reform to replace the central heating enforcement, allowing household to control their own heat and pay for the heat they've consumed. In addition, policy makers could try some methods to improve southern inhabitants' health awareness, so that they have higher WTP to transfer the income into health protection;

iii) People with better education background tend to spend more of their income on protecting health, in light of this, it's crucial for Chinese government to expend education expenditure so as to enhance income welfare effect, especially to spend more on promoting educational level in rural areas of China.

References

[1] Ito K, Zhang S., "Willingness to pay for clean air: evidence from air purifier markets in China," NBER Working paper, no. 22367, 2016.

[2] Sun C, Kahn M E, Zheng S Q., "Self-protection investment exacerbates air pollution exposure inequality in urban China," Ecological economics, vol. 131, pp. 468-474, 2017.

[3] Zhang J, Mu Q., "Air pollution and defensive expenditures evidence from particulate-filtering facemasks," SSRN Working paper, no. 2518032, 2016.

[4] Zheng S, Kahn M E., "Land and residential property markets in a booming economy: New evidence from Beijing," Journal of urban economics, vol. 63, pp. 743-757, 2008.

[5] Zheng S, Kahn M E, Liu H., "Towards a system of open cities in China: home prices, FDI flows and air quality in 35 major cities," Regional science and urban economics, vol. 40, pp. 1-10, 2010.

[6] Pritchett L, Summers L H., "Wealthier is healthier," Journal of human resources, vol. 31, pp. 841-868, 1996.

[7] Gerftham U G, Johannesson M., "Absolute income, relative income, income inequality and mortality," Journal of human resources, vol. 39, pp. 229-247, 2004.

[8] Benzeval M, Judge K, Shouls S. "Understanding the relationship between income and health: how much can be gleaned from cross-sectional data," Social policy and administration, vol. 35, pp. 376-396, 2001.

[9] Qin Lijian, Chen Bo, Qin Xuezheng, "Analysis of the influence of health on migrant workers' income," World economic papers, vol. 06, pp. 110-120, 2013.

[10] Zhao Xiaoli, Fan Chunyang, Wang Yuxi, "Evaluation of health losses by air pollution in Beijing: A study based on corrected human capital method," China population, resources and environment, vol. 03, pp. 169-176, 2014.

[11] Chen Shuo, Chen Ting, "The rise of China's coastal areas: power of market," Economic research journal, vol. 08, pp. 158-169+183, 2014.

[12] Ito K, Zhang S., "Willingness to pay for clean air: evidence from air purifier markets in China," NBER Working paper, no. 22367, 2016.

[13] Zheng S, Cao J, Kahn M E., "Real estate valuation and cross-boundary air pollution externalities: evidence from Chinese cities," Journal of real estate finance economics, vol. 48, pp. 398-414, 2014.

[14] Richard Freeman, Wenquan Liang, Ran Song, Christopher Timmins, "Willingness to pay for clean air in China," NBER Working Paper 24157, 2017.

[15] China Health and Nutrition Survey. Available at URL http://www.cpc.unc.edu/projects/china/data/datasets

[16] China Statistical Yearbook. Available at URL http://www.stats.gov.cn/tjsj/ndsj/

[17] China Environmental Statistical Yearbook. Available at URL http://www.yearbookchina.com/navibooklist-n3018061501-1.html

[18] Chen Y, Ebenstein A, Greenstone M, "Evidence on the impact of sustained exposure to air pollution on life expectancy from China's Huai River policy," Proceedings of the national academy of sciences of the United State of America, vol. 110, pp. 12936-12941, 2013.

[19] Lelieveld J, Evans J S, Fnais M, et al, "The contribution of outdoor air pollution sources to premature mortality on a global scale," Nature, vol. 525, pp. 367-371, 2015.

[20] Liu Dandan, "The impact of belief education mode on the promotion and the self-efficacy of perceived health behavior of patient with artery disease," Journal of Qilu Nursing, vol. 21, pp. 5-7, 2012.

[21] China Educational Statistical Yearbook. Available at URL http://www.moe.gov.cn/jyb_sjzl/moe_364/