

A Study on Residents Willingness to Pay for Personal Carbon Trading and Relevant Factors

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The study

In a backdrop of climate change, efficient ways for carbon emission reduction has become widespread concerns for governments and the public. This study suggests installing a personal trading system in the exist Carbon trading platform to encourage public participation in emission reduction activities. As one of the basic studies, individuals WTP/WTA for per-unit of CO₂ emission are observed under the suggested trading conditions.

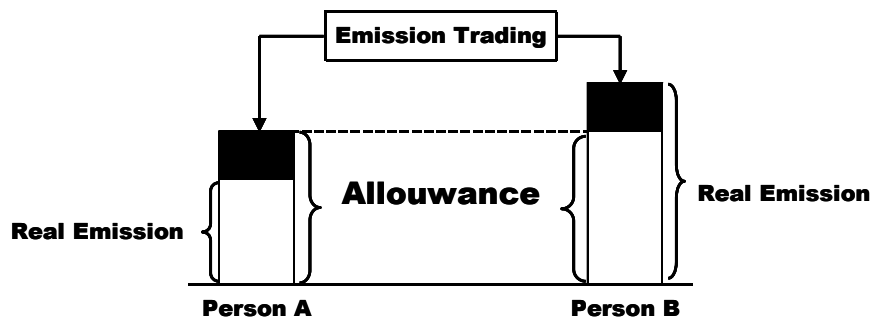


Figure 1: Mechanism of Personal Carbon Trading (PCT) System

The mechanism of the proposed personal carbon trading (PCT) system is illustrated as Figure 1. First, personal carbon emission allowance is set at a certain amount, and then individual's real emission is measured in a given period. As figure 1 shows, When an individual, Person A's real emission is lower than the given allowance, the rest of his (or hers) emission credits (shown as the black part on the left bar) is tradable with Person B's overtopped part than the given allowance (shown as the black part on the right bar). In this case, Person A would gain benefit because of his or her efforts on emission reduction while Person B would cover the cost to purchase his or her right for the over released carbon emission. Furthermore, we suppose individuals behavior is influenced by individual benefit maximization, Person A would continue doing effort on emission reduction, while, to reduce economy lose, Person B would also do effort to reduce emission until reach a standard level, such as the carbon allowance.

Based on a residents' questionnaire survey, we analyze individuals' WTP (Willingness to pay, here means how much people would like to pay for their over released carbon emission.) and WTA (Willingness to accept, here means how much people would like to accept for their lower carbon emission.). According to our research purpose, the contents are designed from flowing three parts:

- i. Descriptive analysis on the state of residents' environmental awareness and clarifying the distribution of their WTP/WTA for emission reduction;
- ii. Difference analysis on WTP/WTA according to demographic variables (Method: Non parameter test method), to find out the effect of demographic variables on WTP/WTA;
- iii. Relevant factors analysis on residents WTP/WTA (Method: chi-square test of independence).

As residents WTP/WTA for PCT (personal carbon trading) and the relevant factors are the primary investigation, the WTP/WTA are set as dependent variables, and other related independent variables are set for observation. Furthermore, as this research need to observe the effect of residents' environmental awareness on their participation in emission reduction, thus when designing dependent variables, we focus on the variable of residents' environmental awareness and related effect variables, including: i. Demographic variables; ii. environmental awareness variables. Based on literature review, the primary variables selected in this research are shown as table 1.

Table 1: Selected Variables

Variables	Latent Variables	Observed Variables	
Dependent Variables	WTP / WTA	WTP for per-unit of CO ₂ when over emission than standard WTA for per-unit of CO ₂ when less emission than standard	
Independent Variables	Demographic Variables	gender, age, education, occupation, income	
	Environmental Awareness Variable	Knowledge	understanding on greenhouse effect, garbage classification and access to propagate of environmental protection
		Behavior	Green products shopping, garbage classification
		Attitude on Environmental policy	Willingness for reduction; Willingness for agree with emission reduction policy; Willingness for cooperate with policy and the implementation

Using Non parametric statistical method, the diversity on WTP/WTA is studied based on 2592 survey data which is random sampled in Dec. 2012 in Chengdu city in China (Shown as figure 2). Further more, using Chi-square test method, the influential level for each variable are measured based on the analysis on the main factors which would affect WTP/WTA. Variance analysis on WTP /WTA by demographic variables as well as the Correlation between individuals WTP/WTA and other variables are shown as table 2 and table 3 respectively.



Figure 2: Location of the Survey

Table 2: Variance Analysis on WTP /WTA by Demographic Variables

variable	group	WTP	WTA
gender	Male	3.534	4.190
	Female	3.422	4.196
	P value	0.301	0.760
	Significance	No	No
age	Under 20	3.866	4.224
	21-30	3.701	4.244
	31-40	3.440	4.273
	41-50	3.461	4.134
	51-60	3.476	4.199
	61-	3.133	4.037
	P value	0.005	0.608
	Significance	Yes	No
education	Bachelor degree and above	3.986	4.628
	junior college	3.605	4.316
	school for professional training/ high school	3.439	4.214
	Middle school	3.303	3.964
	Primary school and below	2.931	3.759
	P value	0.000	0.002
	Significance	Yes	Yes
	Occupation	office worker	4.183
institution staff member		3.356	4.197
enterprise staff		3.413	4.202
retired		3.329	4.149
Nonemployees		3.481	4.051
School students		3.789	4.175
migrant workers		3.539	4.238
professional worker		3.722	4.294
others		3.302	4.003
P value		0.026	0.270
Significance		Yes	No
monthly Income (Chinese Yuan)	no income	3.694	4.000
	1000 and below	3.323	4.095
	1000-2000	3.419	4.233
	2000-3000	3.679	4.237
	3000-4000	3.769	4.560
	4000-5000	3.333	4.030
	5000-6000	3.941	4.529
	6000 and above	4.273	5.000
	P value	0.167	0.552
	Significance	No	No

Table 3: Correlation between Individuals WTP/WTA and other Variables

Variable	Correlation	
	WTP (P value)	WTA (P value)
Gender	0.287	0.098
Age	0.000**	0.125
Education	0.004**	0.056
Occupation	0.000**	0.008**
Income	0.127	0.786
Understanding on greenhouse effect	0.010**	0.081
Frequency of connect to environmental propaganda	0.000**	0.001**
Understanding on garbage classification	0.004**	0.131
Whether do green shopping	0.000**	0.001**
Whether do garbage classification	0.189	0.005**
Whether agree with emission reduction policy	0.000**	0.000**
Will of reduce personal carbon emission	0.000**	0.000**
Whether feel inconvenient on new environmental policy	0.000**	0.001**
Whether cooperate with emission reduction policy	0.000**	0.036**
WTP for inconvenience free (consider to support new environmental policy might cause inconvenience)	0.000**	0.000**

In this research, individuals WTP/WTA for unit of carbon emission is observed under the suggested personal carbon trading market by using CVM method. The survey data are analyzed statistically from 3 aspects. The main findings are:

- i. The average WTP for emission is 59.7yuan/t, while WTA is 66.9yuan/t, which means residents are much more willing to accept incentives;
- ii. Demographic variables, such as age, education level and occupation showed significantly high relevance to WTP;
- iii. Variables of environmental awareness, environmental behavior and attitude for environment policies are also significantly relevant to WTP.

The study provided a variety of information for government to formulate relevant environment policies.

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