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Public willingness to pay for CO_2 mitigation and the determinants under climate change: A case study of Suzhou, China

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ABSTRACT

This study explored the factors that influence respondents' willingness to pay (WTP) for CO_2 mitigation under climate change. A questionnaire survey combined with contingent valuation and psychometric paradigm methods were conducted in the city of Suzhou, Jiangsu Province in China. Respondents' traditional demographic attributes, risk perception of greenhouse gas (GHG), and attitude toward the government's risk management practices were established using a Tobit model to analyze the determinants. The results showed that about 55% of the respondents refused to pay for CO_2 mitigation, respondent's WTP increased with increasing CO_2 mitigation percentage. Important factors influencing WTP include people's feeling of dread of GHGs, confidence in policy, the timeliness of governmental information disclosure, age, education and income level.

1. Introduction

Climate change is one of the most predominant global challenges that pose potential risks to human beings. According to the fourth assessment report from the Intergovernmental Panel on Climate Change (IPCC, 2007), the observed increase in global average temperatures since the mid-20th century is highly likely due to the observed increase in anthropogenic greenhouse gas (GHG) concentrations. The reduction of GHG emissions has become a scientific consensus. CO_2 is considered to be the main source of increased greenhouse effect, both developed and developing countries are faced with the dilemma of CO_2 mitigation, and efforts in tackling climate change are in progress. During one of the fringe meetings of the COP18 held in Doha, representatives from the United States, Switzerland, China, and other countries highlighted the need to promote better public participation in addressing climate change issues. The need to adapt to climate change impacts, while simultaneously limiting GHG emissions, requires the combined efforts of the government and the public (Bichard and Kazmierczak, 2012). During the executive meetings of the State Council in 2009, China committed to reduce its CO_2 emission intensity (i.e., per unit GDP) by 40%–45% from its 2005 levels. On the one hand, for policy makers the costs implicitly given by the commitment to reduce CO_2 emissions must be accepted by the citizens who will ultimately bear the costs of the reduction (Beetham, 1991). On the other hand, the public has an unshirkable responsibility for CO_2 emission reduction. Wei et al. (2007) have found that approximately 26% of total energy consumption and 30% of CO_2 emission every year are a consequence of residents' lifestyles, and the economic activities to support these demands in China. Since people serve different roles in society, if they are able to bring the consciousness into life and work, CO_2 mitigation will be probably improved by individual-level actions. Since then, understanding the public afford ability and their cognition level about their responsibility for CO_2 mitigation is distinctly important to achieve the national mitigation targets. Due to the external characteristics, the value of CO_2 mitigation cannot be got directly in the market through exchange. The contingent valuation method (CVM) is usually used to elicit an individual's willingness to pay (WTP) for CO_2 mitigation. WTP is the maximum amount an individual willing to sacrifice to procure a good or avoid something undesirable. The value of CO_2 mitigation will be any point between an individual's willingness to pay and a government's willingness to accept. The net difference between WTP and WTA is the social surplus created by the trading of CO_2 mitigation.

Studies on WTP estimation for GHG mitigation and avoidance of the climate change impacts are substantial but quite diverse.

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Different underlying scenarios have been used to detect specific problems, such as green electricity generation (Zorić and Hrovatin, 2012), labeling policies for energy saving (Ward et al., 2011) and forest carbon sequestration services (Wang et al., 2010). A considerable part of these studies focused on people's WTP for CO_2 mitigation, such as air travelers' WTP for CO_2 mitigation (Brouwer et al., 2008) or their voluntary carbon offsets in an aviation context (MacKerron et al., 2009), urban households' WTP for CO_2 emission reductions in Turkey (Adaman et al., 2011) and in China (Zeng, 2011), car buyers' consideration on CO_2 emission performance of a car in car choices (Achtnicht, 2012), how citizen's WTP for reducing CO_2 emissions differs among and within countries (Carlsson et al., 2012), and air travelers' WTP for a carbon travel tax to offset carbon emissions from flying (Akter et al., 2009). According to the results of previous studies, respondents' WTP may depend on various factors such as their gender (Akter and Bennett, 2011), age (Lo and Jim, 2010), education level (Bhandari and Heshmati, 2010), economic status (Ezebilo and Animasaun, 2011) and other demographic characteristics. Most previous studies considered people's risk perception and attitude toward government influencing factors of WTP for climate change mitigation. O'Connor et al. (1999) examined the relationship between risk perceptions and willingness to address climate change. Hidalgo and Pisano (2010) noted risk perception regarding climate change is associated with the willingness to perform individual actions to mitigate the harmful effects of climate change on the environment. The effect of risk perception on citizens' willingness to absorb the costs of climate change adaptation and mitigation policies is far more robust (Zahran et al., 2006). Environmental initiatives that require the voluntary participation of citizens should either be led by institutions people trust or first be preceded by trust-building actions (Adaman et al., 2011). Public attitude toward government competence is related to willingness to address climate change (O'Connor et al., 1999), and a negative relationship exists between respondents' WTP for mitigation and their degree of disbelief in the effectiveness of policies (Akter and Bennett, 2011). In summary, studies are numerous on people's willingness to show concern, adapt to, or act on climate change as well as the determinants. Little work had been done to estimate the effects of people's risk perception of GHGs and attitude toward government's risk management practices on WTP for CO_2 mitigation.

Suzhou is one of the most developed cities in China and a very important financial, cultural, artistic, and educational center and transport hub city of Jiangsu Province. Suzhou is in the second batch of pilot cities for the national low-carbon scheme, and efforts from previous studies on the construction of low-carbon cities are limited. Although some existing studies revealed the willingness of industrial enterprises to participate in low-carbon production (Zheng, 2012), most of these studies were macroscopic and gave an overview of the approaches (Zhang, 2011) or patterns (Meng and Chen, 2011) for low-carbon development of Suzhou. Conclusions from these studies were also quite similar, such as industrial structure optimization, public transport development, and construction of low-carbon buildings. Suzhou is a developed city facing with high per capita carbon emissions and great mitigation pressure. Based on calculations on permanent population, Suzhou's per capita carbon emissions reaches 11.8 tons, which is beyond the world average level and is roughly equivalent to 1.7 times that in Hong Kong (Yan, 2013). The mandatory CO_2 mitigation requirements put a “carbon constraint” on the macroscopic economy, which will increase the running cost of economy. Whether consumers could accept the CO_2 mitigation cost, how about their WTP and what are the influencing factors are crucial for the formulation and implementation of CO_2 mitigation policies and will affect the future development of low carbon economy in Suzhou.

This study examines public WTP for CO_2 mitigation in Suzhou and determines the influencing factors using the CVM and Tobit model. The rest of the paper is organized as follows: Section 2 describes the research design, including the questionnaire description, sampling and specification of the Tobit model; Section 3 presents the WTP measurements and the Tobit regression results; Section 4 provides discussion of the results; and Section 5 presents the conclusions.

2. Research design

2.1. Questionnaire description and sampling

The questionnaire structure and measurement items are shown in Fig. 1. The questionnaire contained four sections. The questions and corresponding options for each question are presented in Appendix A.

In the first section, a set of questions on the individual's information and their knowledge about GHG were asked. The first question referred to the respondent's gender. Both respondent's age and education level were divided into three intervals. Respondent's monthly income fell into four groups and their living location was divided by urban and rural. The final question was designed to examine respondent's knowledge about GHG risk using a five-point Likert-type scale ranging from “1 = hardly know” to “5 = know very well”. The second section investigated the respondent's risk perception of the increasing GHG emissions. Three questions included in this section inquired into the respondent's feeling of dread, risk duration and risk influence of GHG risk. Respondent's attitude toward government's risk management practices was investigated in the third section. Three items corresponding to public confidence in policy trust in information and the timeliness of government information disclosure. All the questions in Sections 2 and 3 were asked using a five-point Likert-type scale ranging from “1 = strongly disagree” to “5 = strongly agree.” The final section covered the WTP questions, in which respondents were asked about their monthly WTP to reduce CO_2 emission by 20%, 30%, 40%, and 45% per unit GDP, respectively. The WTP values were obtained using the payment card shown in Appendix B. The WTP was divided into 27 levels, which ranged from 0 CNY to over 600 CNY. Respondents chose a number from a matrix, representing their maximum WTP for a certain percentage in CO_2 mitigation. The questionnaire ended with the zero-bid reasons offering 11 options.

The survey was conducted in five districts (Xiangcheng, Huqiu, Gusu, Wuzhong, and Suzhou Industrial Park) in Suzhou. Overall, the questionnaire was face-to-face administered to 900 respondents using stratified sampling. A total of 870 questionnaires were finally recycled, and 840 questionnaires were screened as effective, out of which 591 were drawn from urban areas and 249 from rural areas. The effectiveness rate of the questionnaire was 96.55%. The sampling size meets the requirements for a sampling error of 3.5% at a 95% confidence level (Feng, 2005).

2.2. Tobit model specification

In economic surveys using the CVM, the valuation of many dependent variables will be censored at times. Censored data occurs when you know that a measurement exceeds or falls below some threshold, but you don't know by how much. Tobin originally developed a hybrid of probit analysis and multiple regressions in the study of household expenditures; this hybrid, the Tobit model, is suitable for variables that have a lower or upper limit and take on the limiting value for a substantial number of respondents (Tobin, 1958).