Chinese Public’s Willingness to Pay for CO₂ Emissions Reductions: A Case Study from Four Provinces/Cities

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Abstract

Contingent Valuation Method (CVM) was used to investigate the Chinese public’s willingness to pay (WTP) for a policy to reduce CO₂ emissions. Face to face interviews were conducted to collect 1,653 valid questionnaires from Beijing, Shanghai, Shandong province, and Fujian province. A model was constructed to understand the factors that influence WTP. The results indicate that the Chinese public is willing to pay CNY201.86 annually to support the policy of reducing greenhouse gas emissions. Participants from Beijing show the highest WTP, followed by participants from Fujian and Shandong, while those from Shanghai report the lowest WTP. The findings reveal that participants with higher income, higher satisfaction with their current life, and awareness of climate issues are willing to pay more for CO₂ emissions reductions. In addition, those who are young, male and members of the Communist Party also indicate a higher WTP. The results imply that translating the public’s willingness to protect climate into actions should be taken into account in China’s low carbon policy. There is a need to consider the difference in degree of willingness, among different social groups, to pay for emissions reductions if the market-based mechanisms such as carbon tax were designed to facilitate emissions reductions.

Keywords: climate policy; Contingent Valuation Method (CVM); willingness to pay (WTP); CO₂ emissions reductions


1 Introduction

During the 11th Five-Year Plan (2005–2010), the Chinese government issued a series of powerful measures to decrease energy intensity by 19.1% compared with the 2005 level, such as shutting down small-size coal-powered electricity plants, phasing out overcapacity energy enterprises, and stimulating renewable energy development. In 2010, the Chinese government committed to reducing CO₂ emissions per unit of GDP with 40%–45% by 2020 compared with the 2005 level, increasing the share of non-fossil fuel in the primary energy consumption by 15%, and increasing carbon sink from forests while implementing forest protection action plans. Compared with the business-as-usual scenario, these targets will help China to reduce 8.5% of carbon emissions by 2020, equivalent to 11.40 Gt CO₂ emissions savings (UNFCCC, 2010). It holds true that implementing these emissions reductions policies is costly, but in the long-run, China will gain social, economic, and environmental benefits from avoiding the catastrophic consequences caused by climate change.

In the research field, very few researchers have
focused on the cost-benefit analysis when dealing with China’s climate policy, which has resulted in insufficient information to help decision-makers to fully understand the benefits of a climate mitigation policy. This research applied the Contingent Valuation Method (CVM) to value China’s CO₂ emissions reductions policy through estimating the Chinese public’s willingness to pay (WTP) for supporting the climate policy. The purpose of this research aims to introduce CVM to China’s climate policy field, understand the Chinese public’s knowledge and awareness of climate change issues and how the public can support the government’s policy in reducing CO₂ emissions, and also to provide decision-makers with first-hand information for designing an effective policy which can facilitate adaptation to climate change impacts and the transition towards a low carbon society.

2 CVM and climate policy evaluation

2.1 Application of CVM

CVM is a popularly used approach for directly evaluating non-market values, especially for estimating monetary values for the environment. Using survey techniques, CVM involves simulating a hypothetical market and asking a random sample of respondents for their WTP for clearly defined public resources. This method is characterized as simple, easy to operate, and widespread in the research field to value non-market goods. However, in the CVM literature, several biases such as hypothetical bias, information bias, and strategy bias were considered to have potential impacts on empirical results. The arguments about CVM in the academic field are focused on the reliability and validity of data gathered by using the non-market use value evaluation method and the hypothetical market (Venkatachalam, 2004; Mitchell and Carson, 1989). Although CVM has limitations, this method is still considered as a valuable approach to be applied in more than 50 countries for estimating environmental benefits and values of ecosystem protection by their governments or some international organizations.

The application of CVM for environmental evaluation in China dates back to the end of the 1990s, which is relatively late compared with the same application in western cultures. Since then, this method has been used to estimate values for the environment and natural resources, improvements of environmental quality and recovery of ecological systems, and protection of natural resources and ecological systems. Researchers in China also discussed the issues related to the reliability testing of the CVM approach (Wang and Yan, 2006; Zhang and Cai, 2005; Zhao and Yang, 2006). They outlined several principles and techniques that researchers should follow to ensure the reliability of the method when carrying out CVM research, from detailed procedures of the design of questionnaires and pre-investigation to survey implementations and data analysis processing. However, the application of CVM in China in the environmental field presents some problems that need to be resolved in future, for example, poor questionnaire design, lack of pre-investigation, small sample size, and the focus of calculating WTP without a deep analysis from theoretical perspectives (Chen et al., 2006; Fu and Ding, 2007). Yang et al. (2002) provided evidence that if researchers pay close attention to questionnaire design and data collection procedures, the estimations of CVM have a high reliability and the method is acceptable by those persons in the economically advanced regions who are aware of environmental issues.

As opposed to CVM, the Human Capital Approach (HCA) assesses environmental values through the market prices and salaries that determine people’s contribution to society, by calculating the losses caused by the impacts of ecological and environmental changes on human health. Cai (2009) used both CVM and HCA methods to estimate the benefits of improving Beijing’s air quality and found that the environmental values estimated with the two approaches were very different. The results indicated that the value of reducing air pollution by 50% in 2005 in Beijing estimated with CVM was 5 times higher than that of HCA. The author concluded that compared with HCA, CVM is more capable of assessing the comprehensive losses of human health caused by environmental pollution.

2.2 Climate policy and CVM

Climate change has become one of the emerging
development issues and CVM has been used by researchers to assess the greenhouse gas (GHG) emissions reductions policy in different countries. Berk and Fovell (1999) surveyed residents in California and found that they were willing to pay US$53–239 each year for preventing climate change (becoming dry, wet, cold or warm). Using increasing tax as a payment vehicle, Viscusi and Zeckhauser (2006) estimated that Americans were willing to pay US$1,500 in gas tax to support climate change mitigation. Solomon and Johnson (2009) found that 83% of respondents from Michigan, Minnesota, and Wisconsin were willing to pay extra money for using biomass to reduce GHG emissions. A study by Li et al. (2009) indicates that Americans were willing to pay US$137 for supporting a fund for energy research as a way to reduce the U.S.’s dependence on imported fossil fuel energy and reduce GHG emissions (2006 U.S. value). Estimates by Berrens et al. (2004) indicate that the Americans were willing to pay US$1,290–1,760 in support of the Kyoto Protocol. While Li (2006) found that the U.S. residents were willing to pay US$93 each year for the Kyoto Protocol; if developing countries would bear some of the emissions reductions burden, the Americans’ WTP for the global climate treaty would increase to US$129 each year.

Kaczan et al. (2010) applied CVM and found that Australian households were willing to bear electricity fees 65% higher than the current level in order to support actions toward climate change mitigation. If the worst scenarios caused by climate change could be avoided, the Australian households were willing to pay US$1,578–2,009 in support of the Kyoto Protocol. While Li (2006) found that the U.S. residents were willing to pay US$93 each year for the Kyoto Protocol; if developing countries would bear some of the emissions reductions burden, the Americans’ WTP for the global climate treaty would increase to US$129 each year.

Comparatively, the use of CVM in the climate change field in Asian regions is not so popular and little literature documents this method. Normura and Akai (2004) estimated that the Japanese public was willing to pay US$204 each year (medium) for using green energy to reduce GHG emissions. Lee et al. (2010) investigated residents in Seoul, Korea and found that households were willing to pay an average of W3,326 each month to prevent climate change. Zeng (2011) conducted a study in Nanning, Chongqing, and Beijing in China to investigate Chinese citizens’ WTP for CO₂ emissions reductions. They found that residents in these cities were willing to pay CNY132, CNY216, and CNY264 respectively, to reduce CO₂ emissions by 30%, 60%, and 85% before 2050.

Some researchers carried out studies to compare the public’s WTP for climate change policy among different countries and cultures. Brouwer et al. (2008) studied travelers across the world and found that all respondents were willing to pay €25 t⁻¹ CO₂-eq extra for the flight ticket to offset GHG emissions. Among them, respondents’ WTP was €41 t⁻¹ CO₂-eq for Europeans, €17.1 t⁻¹ CO₂-eq for North Americans, and €10 t⁻¹ CO₂-eq for Asians. Carlson et al. (2012) compared the public’s WTP for climate mitigation in Switzerland, China, and U.S. under three different GHG emissions reductions scenarios. As estimated, for a 30% emissions reductions, WTP (measured by PPP) was US$23.08 for the Swiss, US$5.81 for the Chinese, and US$17.27 for the Americans; for an emissions reductions target of 65%, the respondents’ WTP was US$43.87, US$9.81, and US$27.95 for the Swiss, the Chinese, and the Americans, respectively; for an 80% emissions reductions, WTP was US$61.01 for the Swiss, US$13.52 for the Chinese, and US$36.43 for the Americans.
3 Application of CVM in China’s climate change policy

3.1 Survey design

The questionnaire designed for this research included three parts. The first section asked respondents about basic personal information, such as education, age, gender, income, family status, political orientation, and participation in public activities. In addition, this part also added four items related to environmental attitudes and values, including respondents’ perceptions on China’s overall environmental quality, environmental issues surrounding their living areas, life satisfaction, and China’s future development pathway.

The second part of the questionnaire included 15 questions to address climate change issues from the perspectives of causes, impacts, and solutions. Respondents were asked to state their attitudes towards these climate change issues on a scale from 1 (completely disagree) to 5 (completely agree). Meanwhile, a choice of DO NOT KNOW was also included to reflect the reality of respondents’ knowledge about the climate change issues.

The third part of the survey asked respondents to indicate their WTP for China’s climate change policy. This research used a payment card to let respondents indicate their stated preferences. This method provides respondents with a group of monetary numbers so they would select a value they wanted to pay, without considering other numbers they did not want to pay. Compared with the open-ended questions and bidding games, the payment card method contains plenty of information and the cost of implementing the survey is relatively lower. Taking into account, the reality of huge income gaps among different regions and social groups in China, the amount of the payment is designed to cover a broad range, from the lowest level of CNY60 to the highest value of CNY3,000. The payment card includes the following information:

To avoid the catastrophic consequences of climate change, countries in the world need to commit to reducing GHG emissions in order to limit the global temperature rise below 2°C compared with pre-industrial levels. To engage in international climate actions, the Chinese government should take measures to reduce CO₂ emissions. Assume that the Chinese government will set up an emissions reductions target for energy-intensive sectors, such as electricity, chemistry, and cement industries. Implementing this climate policy means an increasing cost being passed onto consumers from the industries, resulting in an increase in living expenses for ordinary Chinese people. If this emissions reductions policy is implemented before 2010, how much are you willing to pay in order to support the government’s actions toward climate mitigation? Please select the amount of money that you would be willing to pay each year (CNY):

[0, 60, 80, 110, 130, 155, 200, 240, 290, 310, 370, 440, 500, 550, 600, 660, 720, 800, 1000, 1500, 2000, 3000].

3.2 Sampling and data collection procedures

To control potential biases and reduce their impacts on results, a group of experts who work in China’s energy and climate change field were invited to review the questionnaire designed for this research. Next, a field test on 50 college students was conducted to examine the reliability and face validity of the questionnaire. Then, a statistical analysis was carried out to test the consistency and reliability of the 15 items in measuring climate change issues. Combining the feedback and information gathered from all the procedures, the questionnaire was revised several times for language, presentation and framing of questions to ensure the quality of the questionnaire and the validity of the CVM research (Carson, 2000; Arrow et al., 1993).

Official data collection was performed in Shanghai, Beijing, Fujian and Shandong provinces from September 2009 to May 2010. Considering the fact that the general Chinese public may not be familiar with surveys and questionnaires, this research applied face-to-face interviews to ensure good communication and information exchange for gathering valid data and controlling biases during the procedures of implementing the survey (Li et al., 2009). Interviews were conducted in different locations, including parks,
tourist attractions, bus stations, commercial buildings and streets, communities, campuses, and other places where people with diverse backgrounds would show up. Interviewers randomly selected participants at the above locations and directly communicated with them by asking the designed questions. Participants’ answer to each question was documented in the questionnaire immediately on site. It should be noted that a representative sample is determined by the sampling approaches and procedures rather than the degree by which the specific characteristics of the sample are close to the overall features of a population (Feng, 2001; Li, 2006; You, 2009). In theory, the simple random sampling approach used in this research should ensure the representative of the samples surveyed in the four regions as any probability sampling methods should have good representative. However, the data gathered in this research was not meant to represent the total population of the four regions, instead the conclusions referred only to the population or groups that the samples can represent in the 4 studied regions.

In total this research collected 1,653 valid samples for data analysis. Table 1 shows the characteristics of the sample from each region as well as the total sample. Overall, more males than females participated in the research, average age for the participants was 37.8, nearly 70% of participants’ annual income was less than CNY $40,000, and about 60% of participants received college and above education. The social-economic factors have shown regional differences among the samples from the 4 surveyed areas.

Table 1 Profile of participants

<table>
<thead>
<tr>
<th>Variable</th>
<th>Fujian</th>
<th>Beijing</th>
<th>Shanghai</th>
<th>Shandong</th>
<th>Total sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations</td>
<td>534</td>
<td>394</td>
<td>296</td>
<td>429</td>
<td>1,653</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>57.5%</td>
<td>47.0%</td>
<td>49.0%</td>
<td>62.0%</td>
<td>898</td>
</tr>
<tr>
<td>Female</td>
<td>42.5%</td>
<td>53.0%</td>
<td>50.7%</td>
<td>37.8%</td>
<td>752</td>
</tr>
<tr>
<td>Age</td>
<td>33.5</td>
<td>37.0</td>
<td>41.4</td>
<td>41.4</td>
<td>37.8</td>
</tr>
<tr>
<td>Annual income (CNY$)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 10,000</td>
<td>20.4%</td>
<td>26.9%</td>
<td>13.5%</td>
<td>30.8%</td>
<td>23.4%</td>
</tr>
<tr>
<td>10,000–24,999</td>
<td>22.8%</td>
<td>16.2%</td>
<td>26.4%</td>
<td>40.3%</td>
<td>26.4%</td>
</tr>
<tr>
<td>25,000–39,999</td>
<td>18.9%</td>
<td>17.3%</td>
<td>20.3%</td>
<td>19.1%</td>
<td>18.8%</td>
</tr>
<tr>
<td>40,000–54,999</td>
<td>14.2%</td>
<td>14.0%</td>
<td>15.5%</td>
<td>5.1%</td>
<td>12.0%</td>
</tr>
<tr>
<td>55,000–75,000</td>
<td>9.9%</td>
<td>9.4%</td>
<td>15.5%</td>
<td>1.2%</td>
<td>8.5%</td>
</tr>
<tr>
<td>More than 75,000</td>
<td>9.2%</td>
<td>11.9%</td>
<td>6.8%</td>
<td>2.1%</td>
<td>7.6%</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary school</td>
<td>3.4%</td>
<td>1.5%</td>
<td>3.7%</td>
<td>5.8%</td>
<td>3.6%</td>
</tr>
<tr>
<td>Middle school</td>
<td>7.7%</td>
<td>2.3%</td>
<td>14.2%</td>
<td>26.1%</td>
<td>12.3%</td>
</tr>
<tr>
<td>High school</td>
<td>20.4%</td>
<td>13.5%</td>
<td>31.1%</td>
<td>29.1%</td>
<td>23.1%</td>
</tr>
<tr>
<td>College and above</td>
<td>68.4%</td>
<td>82.5%</td>
<td>49.7%</td>
<td>37.2%</td>
<td>59.3%</td>
</tr>
<tr>
<td>Political orientation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Member of the Communist Party</td>
<td>27.5%</td>
<td>34.3%</td>
<td>22.6%</td>
<td>25.1%</td>
<td>27.7%</td>
</tr>
<tr>
<td>Without party affiliation</td>
<td>70.6%</td>
<td>64.0%</td>
<td>75.0%</td>
<td>73.4%</td>
<td>70.6%</td>
</tr>
<tr>
<td>Member of a democratic party</td>
<td>1.7%</td>
<td>1.4%</td>
<td>2.0%</td>
<td>1.1%</td>
<td>1.7%</td>
</tr>
<tr>
<td>Member of environmental organizations</td>
<td>8.4%</td>
<td>5.8%</td>
<td>4.1%</td>
<td>5.4%</td>
<td>6.2%</td>
</tr>
<tr>
<td>Involved in environmental activities</td>
<td>48.5%</td>
<td>40.4%</td>
<td>36.1%</td>
<td>34.7%</td>
<td>40.8%</td>
</tr>
<tr>
<td>House owner</td>
<td>57.9%</td>
<td>61.4%</td>
<td>79.1%</td>
<td>81.6%</td>
<td>68.7%</td>
</tr>
<tr>
<td>Car owner</td>
<td>26.6%</td>
<td>33.0%</td>
<td>29.7%</td>
<td>22.6%</td>
<td>27.7%</td>
</tr>
</tbody>
</table>

3.3 The WTP model

This research applied the WTP model approach which was used by Cameron and Huppert (1989). This method involves directly estimating the parameters of a WTP function using maximum likelihood techniques. Then the WTP function can be written as:

$$\log y_i = X'_i \beta + \varepsilon_i,$$

where $X'_i$ is a vector of selected explanatory variables.
of respondent \( i \), and \( \beta \) and is the estimated regression coefficient of the corresponding individual respondent. The error item is denoted as \( \varepsilon_i \) which captures the unobservable factors and is normally distributed with a mean of zero and standard deviation of \( \sigma \), \( \varepsilon_i \sim N(0, \sigma^2) \).

Let the vector \( t = (t_1, t_2, \ldots, t_J) \) represent the values on the payment card, listed in increasing order, and let \( t_i \) represent the value selected by the \( i \)th respondent. According to Cameron and Huppert (1989), if an individual selects a value of CNY80 on the payment card, it reveals that the true payment \( y_i \) lies between 80 and 110, and the probability of \( t_i \) that WTP lies within interval [80, 110) is given by

\[
P(t_i) = \Phi \left( \frac{\log t_i - X_i' \beta}{\sigma} \right) - \Phi \left( \frac{\log t_i - X_i' \beta}{\sigma} \right),
\]

where \( \Phi(.) \) is the cumulative density function of the standard normal distribution and \( t_J + 1 = +\infty \). The parameters can be obtained by maximizing the following log likelihood function:

\[
\log L = \sum_{i=1}^{n} \log \left[ \Phi \left( \frac{\log t_{i+1} - X_i' \beta}{\sigma} \right) - \Phi \left( \frac{\log t_i - X_i' \beta}{\sigma} \right) \right].
\]

By using the estimated values of \( \beta \) and \( \sigma \), the values of \( \log y_i \) can be estimated. The conditional mean of \( \log y_i \) for any given vector of variables will be \( X_i' \beta \), the mean of the untransformed WTP variable is \( \exp(X_i' \beta + \sigma^2/2) \) and the median is \( \exp(X_i' \beta) \).

4 Results and discussion

4.1 Environmental attitudes and values

This research designed a scale of 1–10 to measure the participants’ life satisfaction. The mean of life satisfaction for the total sample was 6.58, indicating that overall the participants were satisfied with their current life. Regarding the local environmental issues that participants were concerned with, the answers concentrated on air pollution/poor air quality, water pollution (lakes/rivers and drinking water), solid waste from households/plants, sand storms, traffic jams in urban areas, emissions from vehicles, climate change (hot summers), deforestation, noise, and poor sanitation conditions in communities. When asking participants to evaluate overall environmental quality in China, more than 60% of respondents reported that China’s environmental quality was fine or not so bad, while the rest of the respondents thought China’s environmental quality was bad or very bad. For the questions related to China’s future development, 83% of participants answered that China should prioritize both economic development and environmental protection to balance the economy and environment.

4.2 Awareness of climate change

The results show that 85% of participants not only experienced the changing climate in their living areas, but also acknowledged that GHG emissions are mainly from burning fossil fuel. Nearly 80% of participants realized that deforestation is one of the major causes of increasing GHG emissions, while 78% understood that CO\(_2\) is the most important GHG from energy related emissions, and 70% believed that the changing climate is driven by GHG emissions related to human activities. However, 6.4% of participants reported that they did not know CO\(_2\) is the most important GHG causing climate change.

Regarding the questions related to impacts of climate change, 76% of participants thought that climate change would cause a rise in sea-level and result in flooding disasters; 75% believed that climate change would significantly impact regular Chinese people’s daily live in some regions; 69% thought that climate change would worsen the situation of water shortage in China’s northern regions and cause water availability issues; 75% believed that climate change would trigger the spreading of diseases subsequently posing threats to Chinese people’s health. Furthermore, 65% of participants thought that climate change would bring unavoidable catastrophic consequences to human beings. Participants had a relatively low knowledge level about impacts of climate change on water resources availability, people’s health, and catastrophic consequences. Around 9%–10% of participants did not know the above mentioned three issues in the questionnaires. This result might indicate that those participants’ understanding of climate change was limited. There would be a need to improve public awareness of
climate change issues, which further implies that climate policy in China should focus on helping the Chinese public prepare and adapt to impacts of climate change from not only knowledge but also a psychological perspective.

Regarding solutions to climate change issues, nearly 85% of participants strongly supported that the Chinese government should take actions immediately, to minimize the losses caused by climate change impacts, at any cost. Another 76% of participants agreed that energy saving is an effective measure to reduce GHG emissions. Although 69% of participants believed that humans could find ways to solve climate change issues, 8.5% of them chose the answer DO NOT KNOW. It seems that participants were not so sure if humans are capable of resolving climate change issues. Among the solutions, leveraging a carbon tax for individuals and increasing fuel prices were not favored by 47% and 52% of participants, respectively.

4.3 WTP for climate change policy

Figure 1 shows the WTP distribution for the total sample. It can be seen that 8% of participants did not want to pay anything for supporting the government’s emissions reductions policy. The first WTP payments peak at CNY80 and CNY200, each with 18% support from participants. The following peaks of WTP are observed at the payments of CNY110 and CNY550, with the support of 12% and 9% of participants, respectively. The overall pattern of the WTP distribution for the Chinese sample is that few participants indicate a high WTP. This result is highly consistent with another research which found similar WTP distribution patterns (Pearce et al., 2002).

Table 2 lists the estimations of WTP for the Chinese sample. Participants from different regions show a significantly different WTP for supporting China’s climate policy. The mean WTP for participants from Beijing is significantly higher than those from Shanghai and Shandong ($p < 0.0001$) and also higher than that from Fujian (not statistically significant). Participants from Shanghai report the lowest WTP among the 4 regions, even lower than participants from Shandong, where participants’ annual income is much lower than that of participants from Shanghai. Overall, the mean WTP for the total sample in this research is CNY201.86, equivalent to CNY16.82 each month for each person. Zeng (2011) estimated Chinese households’ WTP for supporting CO$_2$ emissions reductions

![Figure 1 Payment card distribution for the total sample](image)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Shanghai (285)</th>
<th>Beijing (347)</th>
<th>Shandong (400)</th>
<th>Fujian (496)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>169.18</td>
<td>225.23</td>
<td>186.39</td>
<td>214.54</td>
<td>201.86</td>
</tr>
<tr>
<td>Standard difference</td>
<td>168.24</td>
<td>182.30</td>
<td>177.06</td>
<td>178.65</td>
<td>178.18</td>
</tr>
</tbody>
</table>

Note: The samples do not include those with missing data
in China’s 4 cities. He found that urban residents were willing to pay CNY132–264 for CO2 emissions reductions, with variations in different regions. Compared with the WTPs mentioned in literature from other cultures, the mean WTP for supporting China’s climate change policy estimated in this research is relatively low. This could be explained by two reasons: 1) Although the Chinese participants were aware of climate change issues and showed positive attitudes toward supporting the government’s mitigation policy, they might think that the major actor in CO2 emissions reductions should be the government rather than the general public; 2) From 1990 to 2010, China’s economic growth reached an average rate of 10% each year, but Chinese individuals’ average income and their disposable income are far below those of developed countries in Europe and the U.S.

4.4 Determinants of WTP

Table 3 lists the estimations of the WTP model for further discussion on the social and economic determinants of the Chinese respondents’ WTP for climate policy. The results indicate that participants’ income significantly and positively impact their WTP for supporting climate change policy ($p < 0.001$). Those respondents who earned a high income were willing to pay more to support the government’s climate policy. This result is consistent with most research in literature (Solomon and Johnson, 2009; Li et al., 2009; Zeng, 2011; Carlsson et al., 2012) and it also fits the economic theory of utility.

In this research, we designed a variable of life satisfaction to reflect regular people’s life conditions. The result indicates that life satisfaction is an important factor in explaining the Chinese respondents’ WTP for climate policy. If participants were satisfied with their current life, they were more aware of climate change issues and were willing to pay higher fees to support climate change policy ($p < 0.0001$). It should be noted that it is the first time the variable of life satisfaction is introduced in the CVM research in China, and there is a need to provide more evidence to confirm the positive relationship between life satisfaction and WTP.

In this research the estimation of the Chinese WTP model indicates that participants’ awareness and knowledge about climate change issues significantly affect their WTP for climate policy. Those who understood the causes, impacts, and solutions of climate change issues were willing to pay more to support the CO2 mitigation policy. This result is supported by Zeng (2011), Li et al. (2009), Solomon and Johnson (2009), and Carlsson et al. (2012) who found that, according to samples from China, the U.S., and Switzerland, knowledge of climate change significantly impacts people’s WTP.

However, this research did not find that the Chinese participants’ environmental awareness was sig-

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>1=male; 2=female</td>
<td>-14.784*</td>
</tr>
<tr>
<td>Age</td>
<td>Overall sample 38</td>
<td>-1.009**</td>
</tr>
<tr>
<td>Education</td>
<td>1=primary school; 2=middle school; 3=high school; 4=college and above</td>
<td>8.492</td>
</tr>
<tr>
<td>Annual income (CNY)</td>
<td>1=&lt;10,000; 2=10,000–25,000; 3=25,000–40,000; 4=40,000–55,000; 5=55,000–75,000; 6=&gt;75,000</td>
<td>13.874***</td>
</tr>
<tr>
<td>Political orientation</td>
<td>0=member of the Communist Party; 1=without party affiliation/member of a democratic party</td>
<td>-25.661**</td>
</tr>
<tr>
<td>Life satisfaction</td>
<td>1 to 10 scale (very dissatisfied to very satisfied)</td>
<td>12.873***</td>
</tr>
<tr>
<td>Environmental condition</td>
<td>1 to 6 scale (1=very bad; 2=bad; 3=fair enough; 4=good enough; 5=good; 6=very good)</td>
<td>-3.116</td>
</tr>
<tr>
<td>Pathway</td>
<td>1=economic development; 2=environmental protection; 3=economy and environment the same priority</td>
<td>-2.554</td>
</tr>
<tr>
<td>Acknowledge of climate change</td>
<td>Mean of the 15 climate change items</td>
<td>32.600***</td>
</tr>
</tbody>
</table>

Note: *$p < 0.1$, **$p < 0.01$, ***$p < 0.0001$
nificantly related to their WTP for climate protection. This result is not supported by Zeng (2011) who found that Chinese participants’ environmental awareness was positively related to WTP with regards to climate change policy. Although Carlsson et al. (2012) found that environmental attitudes were positively related to WTP for participants from the U.S. and the Netherlands, they did not find a significant impact of Chinese participants’ environmental attitudes on their WTP.

The model indicates that participants’ age and gender significantly impact their WTP for climate policy. Younger participants were willing to pay more than the older ones, and male participants’ WTP was higher than that of females. This finding is consistent with the result from Carlsson et al. (2012) based on the Netherlands’ participants. Li et al. (2009) found that the U.S. males were willing to pay more for CO₂ emissions reductions than female participants, but another research with a U.S. sample found that females showed higher WTP than males (Li et al., 2004). In addition, Hsu et al. (2009) did not find that participants’ age had an impact on WTP according to their Canadian sample.

In this research, educational background was not statistically related to WTP for CO₂ emissions reductions policy. This result is in line with the study by Hsu et al. (2009) from a Canadian sample. But other researchers (Zeng, 2011; Li et al., 2004; Carlsson et al., 2012) reported that those who received more education also showed a higher WTP for supporting climate change policy, meaning education is an important factor in explaining WTP. It should be noticed that nearly 60% of the Chinese participants in this research received a college or above education, while less than 30% of participants from the U.S. and other nations held a college degree, which could be the reason why educational background does not explain Chinese respondents’ WTP for supporting climate policy.

Political orientation was added in the WTP model. The result indicates that the Chinese participants’ political orientation is significantly related to their WTP for climate policy. Those who were members of the Communist Party reported a higher WTP than those who had a membership with democratic parties or who had no political orientation.

5 Conclusions and policy recommendations

This research applied CVM to estimate the Chinese participants’ WTP for the GHG emissions reductions policy in the four regions, Beijing, Shanghai, Shandong, and Fujian. On the basis of the first-hand data and the WTP model analysis, this research found that 92% of participants were willing to pay different amounts of money to support the Chinese government’s CO₂ emissions reductions policy and that the average WTP for participants in the four regions was CNY201.86 per capita. The result implies that in the future, China’s climate policy may need to improve the public’s awareness of climate change, improve their understanding of impacts of climate change, encourage the public to change their life-style and consumption-models towards low carbon, and translate the public’s willingness to support climate policy into actual low carbon actions.

This research found that there is a significant difference in participants’ WTP for CO₂ emissions reductions policy among different social groups in the 4 regions. The result indicates that those who were satisfied with their current life and who were strongly aware of climate change issues reported a higher level of WTP. Participants who were young, male, and members of the Communist Party were willing to pay a higher WTP. Participants from Beijing showed the highest WTP for supporting climate policy, followed by participants from Fujian and Shandong, while those from Shanghai reported the lowest WTP among the 4 regions. This result implies that China’s climate policy design may need to pay close attention to the issues of policy distribution, especially the design of the market-based mechanisms for CO₂ emissions reductions such as carbon tax. The market-based system should set up a reasonable carbon price and consider how to balance the payment capability of the general public from different income and social groups and regions.

In summary, this paper has reviewed a great number of publications on CVM methodologies and case
studies both in China and other countries. It has used different approaches such as expert review, pre-testing, and statistical analysis to ensure the reliability and validity of the questionnaire and to minimize potential biases. Although the estimated WTPs for the 4 regions and the whole sample are lower than those of the estimations from other countries, the estimations made in this research still reflect the reality and opinions of Chinese people from different income levels, and the key social-economic factors significantly explain the WTP for CO₂ mitigation policy, and the results support the findings from previous research. This research confirms that if a contingent valuation study is reasonably designed and it can strictly control potential biases in the questionnaire design and survey procedures, CVM is a reliable and valid method which can be applied in China’s climate policy research fields.

It should be noted that there are some limitations to applying CVM in this research. The sampling method used in this research restricts the conclusions obtained from the data from being inferred as samples of the total population. In the future, scientific sampling approaches such as the stratified random sampling method will be introduced to select samples that represent the population of the entire nation, which is helpful for a better understanding of the Chinese public’s attitude towards climate change policy and its willingness to act. This research introduced and integrated the variable of life satisfaction in the WTP model, which is not popular in CVM research. The finding that life satisfaction affects the Chinese respondents’ WTP for climate change policy may pose uncertainty in the explanatory power of this variable. Therefore, more research is needed to confirm the power of life satisfaction in explaining WTP for climate policy. Finally, it might be necessary to test the validity of the estimations of the WTP model to improve the reliability and validity of the research results.

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