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Article

Influencing factors and paths of public support for carbon emission reduction policies—An integration model

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Abstract: Research has shown that understanding the fundamental of public support for carbon emission reduction policies may undermine policy formulation and implementation, yet the direction of influence and the transmission mechanism remain unclear. Using data from using data from 1482 questionnaires conducted in Hangzhou, China, this paper has examined a comprehensive model of the factors and paths influencing public support for carbon emission reduction policies, and evaluated the determinants and predictors of policy support regarding individual psychological perceptions, social-contextual perceptions, and perceptions of policy features. The results show that the variables in both the individual psychological perception and social contextual perception dimensions have no significant effect on carbon tax, however, be important constructure in carbon trading; in the policy characteristics perception dimension, both variables have a significant positive effect on both carbon tax and carbon trading, and are also the strongest predictors of policy support for carbon policies. Further evidence suggests that future policies could be more acceptable to residents by strengthening their environmental values, social norms can further arouse residents' social responsibility to care about climate, and whether the policy is effective or fair to help residents realize the importance of the policy as well as the need for their participation and willingness to dedicate themselves to the mitigation of climate change.

Keywords: carbon trading; carbon tax; carbon emission reduction; public support; integration modelling

1. Introduction

As global warming becomes more and more serious, such as heavy rains, droughts and El Niño are occurring all over the world, posing a serious threat to human lives, exacerbating food insecurity and undermining socio-economic stability and development. Climate change mitigation has therefore become an urgent issue.

Human activities are the main cause of global warming. Today, reducing carbon emissions is an effective measure to mitigate climate change, and carbon tax and carbon trading are two types of policy designs that are highly concerned with the key directions. Carbon tax has been implemented in several countries, with the International Monetary Fund (2019) calling for carbon tax. However, France, Canada, and Australia are also opposed to carbon tax. In US, neither the federal government nor state governments has enacted the carbon tax. This is exemplified by the repeal of carbon tax in Australia through a general election (Crowley, 2017); the rejection of carbon tax in Washington, USA through a direct referendum (Reed et al., 2019); and the social movements such as the protests against the tax on carbon-containing fuels in France in 2018 (Douenne and Fabre, 2020).

Public support for policies is an important fundamental for their successful implementation (Long et al., 2021). Lack of public support is a barrier to climate

change mitigation (Geels, 2013). For example, while economists often suggest that carbon tax is the most effective way to curb emissions industry-wide, public opposition has prevented most jurisdictions from implementing rigorous carbon tax policies (Carettini et al., 2018; World Bank, 2019). Policy support needs to be related to people attitudes, psychology and behavior towards the policy, social acceptance of the government and whether the context in which the society develops on how to take root in societies and become a mature policy.

This study assessed the public support for carbon tax and carbon trading in Hangzhou, China. It extends previous research in two ways. First, despite the growing evidence of influencing factors of carbon reduction policies, the empirical results are more fragmented and no prior work has explicitly examined the causal mechanisms. To fill this gap, we tested three pathways that may explain model including perception of policy features, individual psychological perception and social-contextual perception. Second, in Western countries, a number of studies have been conducted especially on public support for carbon tax, but there is less literature on carbon trading in social cognition, such as financial incentives. Domestically, there are fewer studies on public support for carbon emission reduction, and research on participation in social governance as well as policy development needs to be increasingly focused on. As such, our study contributes to an advanced understanding of how the two types of policies are influenced during implementation, which not only contributes to the understanding of the generation mechanism of low-carbon policy support and compliance among Chinese residents, but also provides a scientific rationale for the practice sector to improve the legitimacy and effectiveness of carbon emission reduction policies.

The remainder of this paper is organized as follows. Section 2 reviews the relevant literature and illustrates our hypotheses regarding the causal mechanisms and boundary conditions of crowding out. Section 3 briefly describes the incentive program and the experimental design. The results are presented in Section 4 and discussed in Section 5. Section 6 concludes the study with a summary of the findings and their implications.

2. Literature background

2.1. Policy characteristics perception

Public attitudes towards policies depend on its specific characteristics. Policy characteristics are mainly assessed by perceived policy effectiveness and perceived policy fairness. Perceived policy effectiveness refers to whether people perceive that policies achieved the intended purposes (Bolderdijk et al., 2017). When people have a stronger effectiveness perception, the more they will support the policy. At the same time, when focusing on the effectiveness of policies, perceived fairness of policies is also a major factor for the public to determine whether they support the policy or not. Supporting a policy represents citizens need to sacrifice their self-interests in order to conformity, the fairness of the policy becomes a matter for the public in such a costly environment. Perceived policy fairness is categorized into individual fairness and distributive fairness (Maestre-Andrés et al., 2019), where individual fairness refers to whether it is fair to oneself when bearing the cost of policies, and distributive fairness

refers to whether it is fair to those who bear it, such as whether the industry and the public are fair in paying and whether the cost of the policy is borne the same between different people.

The public is the target of most environmental policies. People have to pay for their pollution (e.g., solid waste charges or environmental taxes) or change their behavior (e.g., mandatory recycling) in order to obtain a better environment (Stern et al., 1999). Thus, in environmental policy context, individuals will bear some burden and responsibility, whether financial cost or non-financial sacrifice. With this in mind, there is a great deal of concern about the way in which policy decisions are made and the outcomes that affect them. Individuals' attitudes and support for policy are influenced to some extent by perceived justice (Kals and Russell, 2001), which consists of two dimensions of fairness, procedural fairness and distributive fairness (Clayton, 1998, 2000; Reese and Jacob, 2015). Lind and Tyler (1988) defined procedural fairness as the fairness of the process used to determine outcomes. According to Tyler and Bies (1990), procedural fairness includes consistency in the law, respect for the individuals, adequate representation of citizens, and effective channels for citizens' voices. Distributive equity is considered to be a framework, the shared responsibilities and cost-effectiveness of each resident should be distributed according to the principle of equity, with no group or individual being disadvantaged (Folger, 1996; Kim et al., 2013; MacCoun, 2005).

These concepts are discussed in emerging researches that examined the acceptability of environmental policies. Rasinski et al. (1994) proposed equity as one of the motivations for supporting environmental expenditure. The study concluded that equity was a guiding principle for whether people support government spending on the environment. More recent studies have investigated these relationships by focusing on urban environmental policies. For example, Kim et al. (2013) found that individuals' perceptions of fairness were the most important direct determinants of public acceptability of road pricing and environmental tax policies in New Jersey, USA and London, UK. In addition, Chung et al. (2011) presented a model to test price fairness and tourists' willingness to pay for nature conservation in the United States. These results supported the idea that fair user charging policies are positively related to willingness to pay. These studies show that fairness is positively associated with individual support for policies (Börjesson et al., 2016, 2012, 2015; Kim et al., 2013).

Hypothesis 1a: There is a positive association between perceived policy effectiveness and public support for climate change policies.

Hypothesis 1b: there is a positive association between perceived policy fairness and public support for climate change policies.

Hypothesis 2: Perceived policy fairness is positively associated with perceived policy effectiveness.

2.2. Social contextual perception

Social norms likewise belong to the external environment, in interdisciplinary dimension, social norms have been identified as one of the strongest predictors of pro-environmental behaviors (Farrow et al., 2017; Thøgersen, 2006). Social norms are divided into descriptive norms and injunctive norms, where descriptive norm

demonstrate the prevalence of a behavior in population (Cialdini et al., 1990; Deutsch and Gerard, 1955). Indicating the extent to which the choices of members within a group are perceived as the prevalence of a certain behavior, e.g., most people support the carbon reduction policies, which guides individual through the perception of the majority's choices (Nyborg, 2018). Injunctive norm indicates the degree to which group members approval of a behavior or expectations of a specific behavior (Cialdini et al., 1990; Deutsch and Gerard, 1955). That is, the majority of people around think it is important to support carbon reduction policies or the majority of residents around expect me to be a person who possesses pro-environmental preferences and supports carbon reduction policies. Research suggests that social norms enhance disclosure to some extent, and social norms disclosure and interventions generally predict positive results (Cialdini and Jacobson, 2021; for meta-analyses, see: Abrahamse and Steg (2013); Bergquist et al. (2019); Farrow et al. (2017)). Those who regard the support for carbon reduction policies as pervasive in society are more likely to support policies together from it than those who do not. Therefore, when people feel that those around them are supporting the carbon reduction policy and feel that the policy is the right direction in society, then people will follow the group to support the carbon reduction policy so as not to be ostracized.

Hypothesis 3a: There is a positive association between descriptive norms and public support for carbon reduction policies.

Hypothesis 3b: There is a positive association between directive norms and public support for carbon reduction policies.

Providing information on social norms enhances disclosure to some extent and helps to correct common misconceptions about climate issues and policy support. Descriptive norm does not always have a positive effect. When people receive information about descriptive norm, the individual will believe that group members hold an acceptable attitude towards a certain behavior, and then drive to be consistent with others, the individual will choose to carry out the same behaviors as one of the group members. Alternatively, the individual will receive information that the group members expect to carry out the same behavior as they do, and that the same people who share pro-environmental beliefs, therefore, disclosure of descriptive norm will also have an effect on injunctive norm.

Hypothesis 4: Descriptive norm is positively associated with injunctive norm.

2.3. Individual psychological perception

Public support for climate change policies can be influenced by individual psychological factors, which consist of ecological value, personal norms, climate change risk perceptions and self-efficacy.

Ecological value reflects the extent of people attach importance to the ecological environment, and climate change is regarded as a necessity for human survival, ecological value affects attitudes towards climate change policies. Environmental self-efficacy is a subjective belief about one's ability to achieve environmental goals (Bandura, 1977). Its positive effects can be explained by Social Cognitive Theory (SCT) motivation (Bandura, 1986, 2006), which suggests that self-efficacy can increase environmental goals, long-term persistence, and effort, representing the

awareness and motivation used to carry out environmental behavior. Hutchinson, Sherman, Martinovic, and Tenenbaum (2008) found that individuals with high self-efficacy showed greater perseverance on goals than individuals with low self-efficacy. In addition, Locke et al. (1984) showed that higher self-efficacy increased commitment to goals and also would encourage individuals to create more ideas. These findings suggest that when people have greater self-efficacy for environmental behaviors, people will be motivated to engage in these behaviors more diligently and consistently. Bandura (2004) argues that behavior change is facilitated by an individual's sense of control. If people believe that they can take action to solve a problem, i.e., if they have a sense of self-efficacy, they will be more inclined to do and be more committed to the action. Therefore, if people believe that they 'have the power to support policies', which may lead them to believe that 'I can mitigate climate change more effectively by supporting policies. Climate risk perception refers to people's perceptions of the severity of the negative impacts of climate change that threaten humanity. Realizing the threats of climate change is an important factor during people's support for carbon mitigation policies.

Hypothesis 5a: There is a positive association between ecological value and public support for carbon reduction policies.

Hypothesis 5b: There is a positive association between environmental self-efficacy and public support for carbon reduction policies.

Hypothesis 5c: there is a positive association between climate change risk perception and public support for carbon reduction policies.

Self-efficacy shapes individual's problem-solving attitude by activating cognitive responses (Makki et al., 2016), which affects responsibility cognitive responses. Whereas, personal norm is a type of cognitive response of an individual which generates beliefs of ethical responsibility. Grazzini et al. (2018) stated that self-efficacy beliefs influence responsibility cognitive responses. Personal norms are individual cognitive responses that generate beliefs of ethical responsibility for pro-environmental behavior (Eid et al., 2021; Juvan and Dolnicar, 2017). The obligation influences the self-efficacy beliefs (Majeed et al., 2023). Personal self-efficacy beliefs affect environmental knowledge and ethical behavior to protect the environment (Kornilaki et al., 2019; Yan and Chai, 2021), i.e., personal norm (Kiatkawsin and Han, 2017; Han et al., 2017). Therefore, when individuals feel that they have the ability to achieve their environmental goals, they believe that they are a person who value environment and motivate environmental protection as their moral responsibility.

Hypothesis 6: There is a positive association between environmental self-efficacy and personal norms.

Value-Belief-Norm Theory (VBN) is based on the Norm Activation Model (NAM), which examines 1) when individuals realize a threat to others becomes awareness of the consequences that occur by ignoring the risk; and 2) when individuals blame themselves for these actions to address the threat. Whether or not either of these two psychological conditions occur, it triggers a sense of moral obligation (i.e., moral or personal norm) to help others, classifies environmental behavior as altruistic behavior then helping others (Schwartz, 1977).

Hypothesis 7: There is a positive association between ecological value and personal norm.

Personal norm refers to the moral obligation of individuals to perform pro-environmental behavior (Stern, 2000). The New Ecological Paradigm proposes that environmental behavior is influenced by awareness of the adverse consequences of actions on environment (awareness of consequences or AC) and one person's perceived ability to avoid these threats (attribution of responsibility or AR), arguing that a sense of moral obligation (personal norm or PN) is created in favour of environment. According to the theory, both the perception of consequences and the attribution of responsibility contribute to the activation of one person's sense of moral obligation to protect the environment (Schwartz, 1992; Stern et al., 1999). However, it is also theorized that individual's sense of moral obligation can vary through the influence of personal experience, risk perception, and social-contextual factors. When faced a risky choice, the clearer and stronger perception of the consequence, the more they realize that the risk will affect human and social stability, the individual will change their prior moral sense and more actively support carbon reduction policies to reduce the negative consequences of climate change.

Hypothesis 8: There is a positive association between personal norm and climate risk perception.

2.4. Hypothesis

The hypothesis diagram is shown in **Figure 1**.

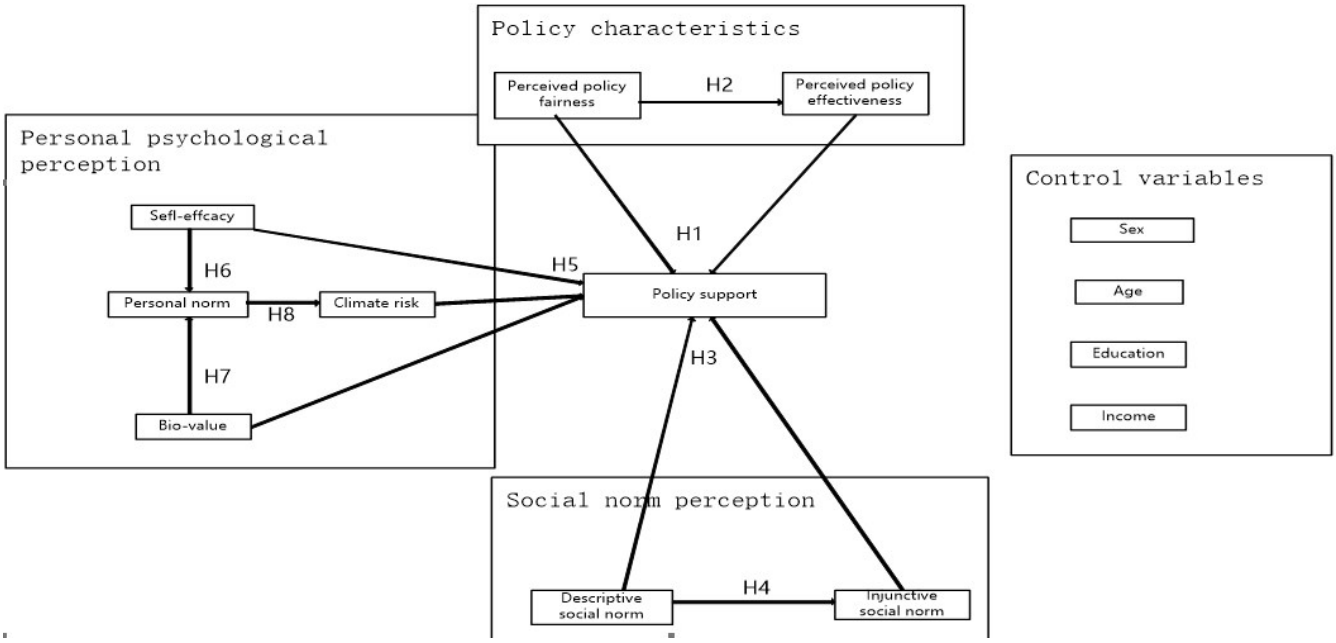

Figure 1. The conceptual model tested in this study.

3. Method

3.1. Experimental design and participants

The data were evaluated using a questionnaire survey conducted in December 2022 on three streets in the main city of Hangzhou of China's Zhejiang Province. To explore attitudes of local residents, the Hangzhou City government had promoted the

survey in housing estate of the urban district (Gongshu) from November 2022 to January 2023, in partnership with volunteers. These estates were chosen based on infrastructure facilities and population size. Based on the theoretical assumptions of the integration model, 20 local households were pre-survey. In the formal survey stage, the group selected the sample through stratified sampling method. First of all, we randomly chose 50% in three streets under the community, and then exclude the selected community to be demolished and scattered households; a total of 14 communities 56 neighborhoods. Specifically, within each estate, we randomly chose 5% households. For the selected households, the research team commissioned local voluntary organizations to go to their homes to fill in the questionnaire. In order to increase the response rate, gifts were given to the residents. A total of 1508 households participated in the survey. After eliminating a large number of questionnaires with unfilled questions, similar notes, similar answers, and ticking the "yes" box throughout, 1482 valid questionnaires were obtained.

3.2. Measures

3.2.1. Dependent variables

The dependent variables of this study are carbon trading policy support and carbon tax policy support, and residents are invited to evaluate the two types of policies. Currently, several provinces in China have piloted carbon trading programs that reward residents with points for participating in daily pro-environmental behaviors. Therefore, the questionnaire describes the Carbon Trading Policy as follows: This policy encourages the public to participate in various pro-environmental behaviors such as waste separation, green travelling, household energy saving and so on, by means of 'rewarding point'. Although it may be time-consuming and labor-intensive to implement, they will be rewarded with 'carbon point'. The points will be deposited into their 'carbon account'. Residents can use the points to exchange for daily necessities, buy tickets to scenic spots, or enjoy other preferential services.

Based on references, the Carbon Tax Policy is described as follows: In order to reduce fossil fuel and promote clean energy, the government may impose carbon tax on energy, transport and industries. The higher the carbon emissions exhaust, the more tax they pay. This will indirectly lead to an increase in residential water, electricity, gas and oil prices. It is estimated that if this policy is implemented, each family will have to spend an additional 295 RMB a year on average.

Drews and van den Bergh (2016) point out that public support measurement for low-carbon policies always give a general description without disclosing the costs to the audience, which does not accurately reflect the public attitudes when confronted with the actual policy, and therefore may lead to measurement error.

3.2.2. Independent variables

The questionnaire measured three dimensions: policy characteristic perception, social contextual perception, and individual psychological perception.

For policy characteristic perception, regarding the effectiveness and fairness of each policy, according to Welfel (2017), we measured the degree of residents' perceptions of whether the policy is effective in reducing carbon emissions and whether it is fair. A five-point Likert scale was used to assign values, (effectiveness

perception: 1 = very ineffective, 5 = very effective; fairness perception: 1 = very unfair, 5 = very fair).

For social contextual perception, following the example of Chan et al. (2022) study, four questions were designed to ask respondents whether they thought most people in their neighborhood were participating in low climate change, and whether they thought most people wanted them to support climate change policies. We measured respondents' perceptions of the prevalence of pro-environmental people and the social influence of their neighbors on their recycling decisions. The social norms were categorized into descriptive norm and injunctive norm. Both scales were created by averaging the corresponding items. With the descriptive norm statement, we measured the extent to which respondents viewed their neighbors as persons who cared about the environment. Namely 'People surrounded who implement energy-saving and emission-reduction such as sorting rubbish, green travelling, and saving energy at home.' and 'People surrounded who support energy-saving and emission reduction.' For injunctive norm, we measured the extent to what others think affect respondents who cared about the environment. Injunctive norm describes 'I believe other people want me to save energy and reduce emissions.' and 'I believe others regard me as someone who support for energy conservation and emission reduction policies.' Participants rated their agreement with each item (1 = strongly disagree, 5 = strongly agree).

For Individual psychological perception, the Ecological and Environmental Protection Values Scale developed by Steg et al. (2014) was used to set up four questions to examine residents' perceptions of the importance of the goals of respecting the earth, living in harmony with nature, protecting the environment, and environmental tidiness. For personal norm, four items from Steinhorst et al. (2015) were used to measure the participants' feelings of moral obligation to act pro-environmentally. We asked residents four questions about their feelings of moral obligation to policy support, namely 'Regardless of what others believe, I should persist in participating in energy conservation.', 'Based on my values and principles, I have a responsibility and obligation to save energy and reduce emissions.', 'I feel ashamed when I fail to save energy and emission reduction.' and 'I feel guilty when I think of my past energy wasting behavior.' The moral obligation and perceived morale scales were created by averaging the corresponding items. For self-efficacy, three items to measure perceived self-efficacy in achieving environmental goals. We adopted three items from Van der Werff et al. (2013a) to measure the extent to which participants' beliefs about their ability to achieve pro-environmental goals. 'I believe that I can contribute to energy-saving and emission reduction.', 'I have the ability to reduce carbon emissions and protect the environment.', 'I definitely practice energy saving and emission reduction behaviors in my daily life.' Participants rated their agreement with each item (1 = strongly disagree, 5 = strongly agree). Both scales were created by averaging the corresponding items. In the climate change risk dimension, the perceived risk of environmental issues was measured with a single item, which stated that 'How much do you think climate change will negatively affect human life', from established measurement systems (Fairbrother et al., 2019; Kácha et al., 2022). Respondents assigned a seven-point Likert scale to the ecological value (1 = least

important, 7 = most important), and a five-point scale to the personal norm, self-efficacy, and climate change risk (1 = strongly disagree, 5 = strongly agree).

The questionnaire concluded with a survey of the demographic attributes of the respondents, including gender (0 = male, 1 = female), age, education level (1 = uneducated, 7 = graduate and above), monthly household income level (1 = below 5000 CN¥, 6 = above 25,000 CN¥), and political affiliation (0 = other, 1 = member of the Chinese Communist Party). Due to respondents' omissions, there are a few missing values in the questionnaire data for variables, with the degree of missingness ranging from 0.07% to 1.62%. In this research, multivariate imputation by chained equations (van Buuren, 2018) was used to complete the minor missing survey.

3.3. Research methodology

Using SmartPLS4.0 and Stata17.0 statistical analysis software, we conducted descriptive statistical analyses of the influencing factors through the 1482 questionnaires, and then carried out correlation analyses, partial least squares, regression analyses and comparisons of the effects, identified the paths between the factors, and completed the testing various hypotheses in the Mediation model. On this basis, the demographic variables are further incorporated into the test model by combining the questionnaire data, constituting sub-models under different demographic variables, and systematically examining how various factors affect the potential role of public support for climate change policies.

4. Results

4.1. Descriptive statistics

The basic demographic profile of the study sample is shown in **Table 1**. Females and those younger than 40 years accounted for 27.7% and 37.7% of the sample, respectively. Respondents ranged in age from 27 to 75 years, with the middle group of 41 to 60 years accounting for 39.3%. In addition, 29% of the respondents were at the tertiary education level (university), 44.9% had household incomes exceeding the average Hangzhou salary of 10,000 yuan, and 47.9%were retired.

Table 1. Demographic profile.

Demographic variables	Number	Percentage (%)
Sex		
Male	649	43.8
Female	833	56.2
Age		
20–30	86	5.8
31–40	326	21.9
41–50	268	18.1
51–60	313	21.2
>60	489	33.0

Table 1. (*Continued*).

Demographic variables	Number	Percentage (%)
Education		
Never	9	0.6
Primary school	78	5.3
Junior school	258	17.4
High school	373	25.2
Junior college	319	21.5
Bachelor degree	392	26.4
Master or Doctor degree	53	2.6
Occupation		
Government organizations	25	1.7
Enterprises	350	23.6
Public institutions	94	6.4
Social organizations	75	5.1
Self-employment	175	11.8
Army	0	0
Retired	710	47.9
Students	13	0.9
Others	38	2.6
Income (CN¥)		
<5000	277	18.7
5000–10,000	539	36.4
10,001–15,000	352	23.7
15,001–20,000	158	10.7
20,000–25,000	79	5.3
>25,000	77	5.2

Table 2. Descriptive statistics.

VarName	Mean	SD	Min	Max
tax_effe	3.44	0.93	1	5
offset_effe	3.55	0.86	1	5
tax_fair	3.31	0.96	1	5
offset_fair	3.53	0.84	1	5
dnorm	4.11	0.79	1	5
inorm	4.11	0.83	1	5
biovalue	5.46	0.83	1.8	7
efficacy	4.14	0.75	1	5
climate_glo	3.93	0.80	1	5
pnorm	4.07	0.75	1	5
female	0.56	0.50	0	1
age	52.46	14.67	20	91
income	2.63	1.33	1	6
educ	4.55	1.31	1	7

$N = 1482$.

Table 2 shows the descriptive statistical analyses for each independent variable. The means of all the independent variables are relatively high, indicating that the majority of residents responded positively to the policy support. In addition, the standard errors for all variables are relatively small, indicating that the mean is reasonably close to the true mean for the sample. All variables are relatively clustered around the mean because their standard errors are less than 1. The negative skewness of all variables explains an asymmetric distribution in which the data declines towards the higher side of the scale with few lower values.

4.2. The measurement model

4.2.1. Construct reliability and validity

In order to assess the structural reliability and validity of the PLS-SEM measurement model, convergent validity and composite reliability tested the association between indicators belonging to the same construct, ensuring that all items measuring the same construct should be highly correlated. The internal reliability of the measurement model was tested by following a standardized process based on Cronbach's alpha coefficient and Fornell's composite reliability measure.

As can be seen in **Tables 3** and **4**, the factor loadings for all constructs are greater than the standard value of 0.5. The Cronbach's alpha coefficients for all variable constructs exceeded the standard value of 0.7, ranging from 0.702 to 0.880, indicating high internal consistency. Similarly, all composite reliabilities exceeded 0.7, ranging from 0.708 to 0.884, indicating that all variable constructs were reliable. The average variance extracted (AVE) for all variable constructs was greater than 0.5, confirming that all constructs had satisfactory convergent validity.

Table 3. The measurement model (carbon trade).

Constructs	Indicators	Factor loading	Cronbach's Alpha	AVE	CR
Discriptive norm (DN)	SN1	0.909	0.824	0.850	0.838
	SN2	0.934			
Injunction norm (IN)	SN3	0.945	0.880	0.893	0.880
	SN4	0.945			
Biovalue (BV)	BV1	0.767	0.702	0.528	0.708
	BV2	0.761			
	BV3	0.720			
	BV4	0.653			
Self-efficacy (SE)	SE1	0.899	0.871	0.795	0.872
	SE2	0.891			
	SE3	0.884			
Personal norm (PN)	PN1	0.862	0.857	0.695	0.884
	PN2	0.880			
	PN3	0.818			
	PN4	0.771			

AVE: average variance extracted; CR: composite reliability.

Table 4. The measurement model (carbon tax).

Constructs	Indicators	Factor loading	Cronbach's Alpha	AVE	CR
Discriptive norm (DN)	SN1	0.909	0.824	0.850	0.839
	SN2	0.934			
Injunction norm (IN)	SN3	0.946	0.880	0.893	0.881
	SN4	0.945			
Biovalue (BV)	BV1	0.768	0.702	0.528	0.708
	BV2	0.757			
	BV3	0.721			
	BV4	0.654			
Self-efficacy (SE)	SE1	0.898	0.871	0.795	0.872
	SE2	0.892			
	SE3	0.884			
Personal norm (PN)	PN1	0.862	0.857	0.695	0.884
	PN2	0.880			
	PN3	0.818			
	PN4	0.771			

AVE: average variance extracted; CR: composite reliability.

4.2.2. Discriminant validity

Discriminant validity of variables is tested to ensure that variables in different constructs are not correlated, i.e., items measuring different constructs should not be correlated with each other. One piece of evidence for assessing discriminant validity is to check whether the square root of the AVE should be greater than the correlation between that construct and any other factor in the model. As shown in **Tables 5** and **6**, the values of the square root of the AVE for the constructs in the diagonal are both greater than the correlations between the constructs below the diagonal. Therefore, the results pass the discriminant validity test.

Table 5. Square root of AVE (carbon trade).

	bio value	climate_glo	dnorm	efficacy	inorm	offset_effe	offset_fair	pnorm	policy support
bio value	**0.727**								
climate_glo	0.213	**1**							
dnorm	0.185	0.181	**0.922**						
efficacy	0.237	0.262	0.546	**0.891**					
inorm	0.224	0.206	0.735	0.561	**0.945**				
offset_effe	0.126	0.169	0.211	0.255	0.235	**1**			
offset_fair	0.125	0.128	0.152	0.19	0.218	0.585	**1**		
pnorm	0.235	0.253	0.611	0.717	0.656	0.23	0.198	**0.834**	
policy support	0.156	0.185	0.175	0.225	0.186	0.541	0.549	0.195	**1**

Table 6. Square root of AVE (carbon tax).

	bio value	climate_glo	dnorm	efficacy	inorm	pnorm	policy support	tax_effe	tax_fair
bio value	**0.727**								
climate_glo	0.213	**1**							
dnorm	0.186	0.181	**0.922**						
efficacy	0.237	0.262	0.546	**0.891**					
inorm	0.224	0.206	0.735	0.561	**0.945**				
pnorm	0.235	0.253	0.611	0.717	0.656	**0.834**			
policy support	0.102	0.115	0.132	0.143	0.124	0.134	**1**		
tax_effe	0.086	0.157	0.174	0.188	0.206	0.191	0.593	**1**	
tax_fair	0.061	0.084	0.144	0.138	0.164	0.167	0.581	0.563	**1**

4.3. The structure model

The study develops a structural model to detect the correlation between each factor, as well as factors and carbon reduction policy support. The importance of the estimated path coefficients is shown as all the requirements are positively reliable. The estimated path coefficients of the structure are expressed in standardized form. Results of PLS estimation are shown in **Figures 2** and **3** respectively.

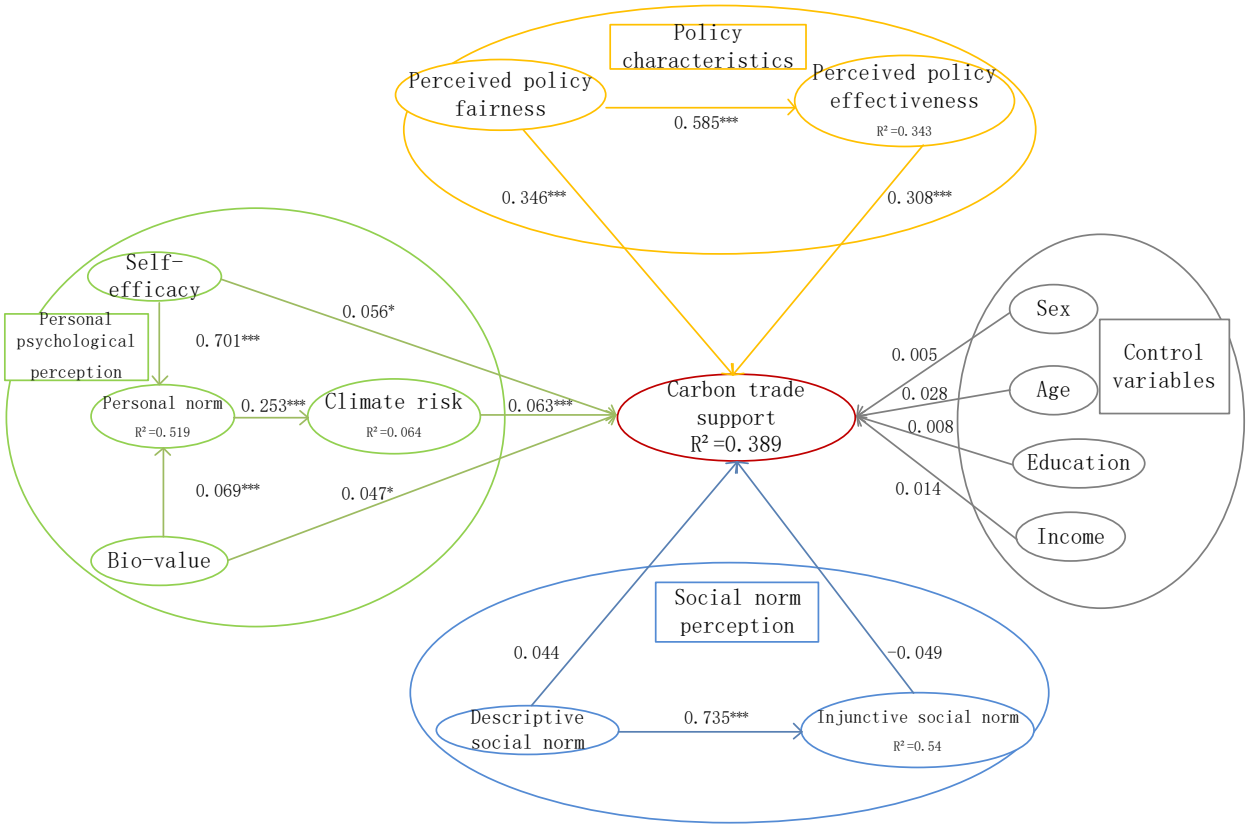

Figure 2. The conceptual model tested with coefficients on carbon trading.

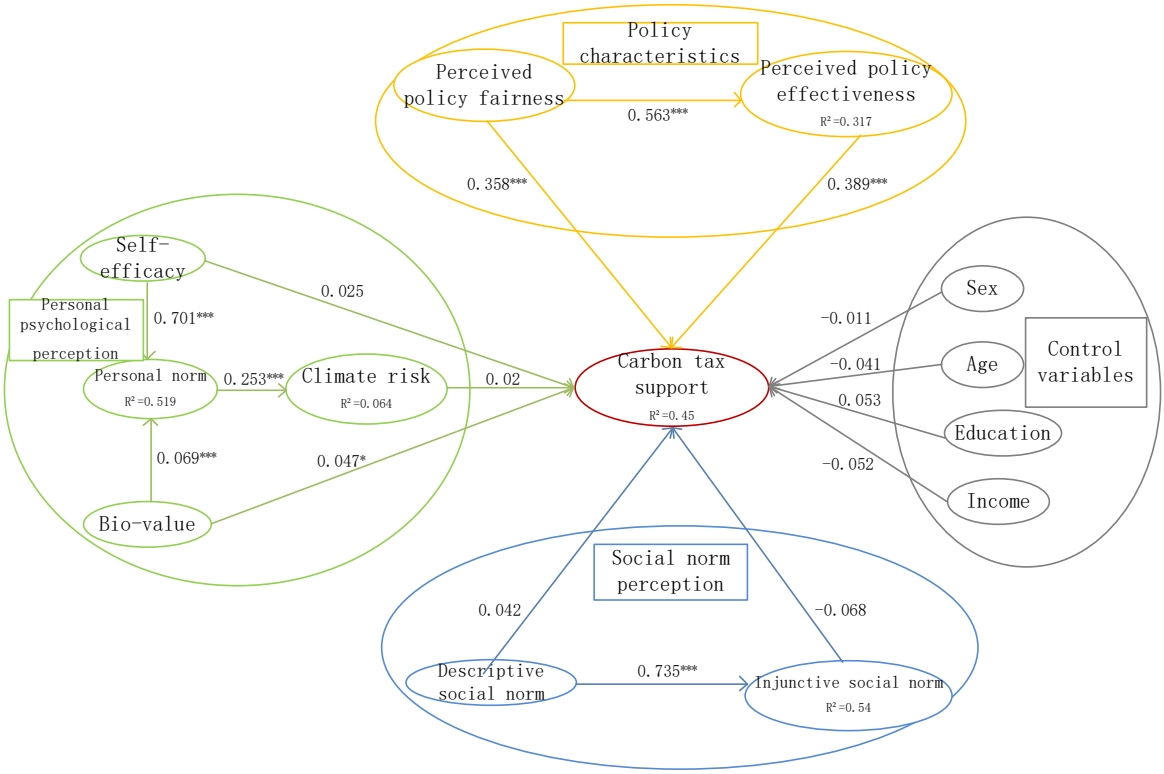

Figure 3. The conceptual model tested with coefficients on carbon tax.

As can be seen from **Table 7**, regarding personal norm, ecological value and self-efficacy have a positive effect on personal norm, confirming H6 and H7 and personal norm have a positive effect on climate risk perception, confirming H8. Meanwhile ecological values, self-efficacy and climate risk perception all have a positive effect on carbon trading support, confirming H5.

Table 7. Standardised path coefficients (carbon trade).

Path	Hypothesis	Path coefficients (β)	Result of hypothesis test
offset_effe → policy support	H1a	0.308***	Accept
offset_fair → policy support	H1a	0.346***	Accept
offset_fair → offset_effe	H2	0.585***	Accept
dnorm → policy support	H3a	0.044	Reject
inorm → policy support	H3b	−0.049	Reject
dnorm → inorm	H4	0.735***	Accept
bio value → policy support	H5a	0.047*	Accept
efficacy → policy support	H5b	0.056*	Accept
climate_risk → policy support	H5c	0.063**	Accept
efficacy → pnorm	H6	0.701***	Accept
bio value → pnorm	H7	0.069***	Accept
pnorm → climate_risk	H8	0.253***	Accept

In terms of social norms, the effect of descriptive norm and injunctive norm on carbon trading policy support is not statistically significant at the 0.05 level, although we find that descriptive norm have a significant effect on injunctive norm, therefore,

hypothesis H3 is invalid and H4 is valid. It suggests that when people see others around doing the same, individuals will assume that group members hold an approving attitude towards a certain behavior and will engage in the same behavior by themselves. However, for rewarding policies such as the carbon trading policy, there will be spontaneous motivation for residents, and they will actively support for the policy, so group normative behaviors will have little effect on individuals.

In terms of policy characteristics, perceived fairness and effectiveness of carbon trading policy both have a significantly positive impact on carbon trading support, and policy perceived fairness also has a significant positive impact on perceived effectiveness, confirming H1 and H2, which indicates that the top factors of residents' support for and perception of the policy are effectiveness and fairness, also demonstrates that the determining factor in the process of policy formulation is the effectiveness and fairness among residents.

The results also indicate that perceived policy effectiveness and fairness are the strongest predictors of carbon trading support. The path coefficients of these two predictors are the largest in structural model, which is consistent with the results presented and suggests that the perceived effectiveness of policy can significantly predict residents support for carbon trading policies. In other words, residents tend to favor the direct impact of the policy characteristics itself or their attitude towards the policy can directly predict whether they support the policy. Residents will support the policy if they perceive it to be an effective solution to the target when the sacrifices are the same for everyone. Perceived effectiveness is enhanced when residents perceive the policy to be fair.

Table 8. Standardised path coefficients (carbon tax).

Path	Hypothesis	Path coefficients (β)	Result of hypothesis test
offset_effe → policy support	H1a	0.389***	Accept
offset_fair → policy support	H1a	0.358***	Accept
offset_fair → offset_effe	H2	0.563***	Accept
dnorm → policy support	H3a	0.042	Reject
inorm → policy support	H3b	−0.068*	Accept
dnorm → inorm	H4	0.735***	Accept
bio value → policy support	H5a	0.047*	Accept
efficacy → policy support	H5b	0.025	Reject
climate_risk → policy support	H5c	0.020	Reject
efficacy → pnorm	H6	0.701***	Accept
bio value → pnorm	H7	0.069***	Accept
pnorm → climate_risk	H8	0.253***	Accept

As can be seen from **Table 8**, for the carbon tax, regarding personal norm, ecological value and self-efficacy have a positive effect on personal norm, confirming H6 and H7. Ecological value has a positive effect on carbon tax support, partially confirming H5. Whereas, self-efficacy and climate risk perception are not statistically significant at the 0.05 level on carbon tax support, therefore partially H5 is not supported. It indicates that people with strong ecological value do not hinder the

impact of residents who support either incentive policies or punitive policies. However, people with strong self-efficacy and climate risk perception are indifferent to punitive policies, suggesting that residents are unwilling to pay for climate risks even though they have strong self-efficacy or perception.

In terms of social norms, the effect of descriptive norm on carbon trading policy support is not statistically significant at the 0.05 level, but we find injunctive norm has significantly influence, also positively influence carbon tax support. That is, H3 partially is valid and H4 is valid. It indicates that when people see others around doing the same individuals will think that group members hold approval for a certain behavior and will engage in the same behavior themselves. However, for the carbon tax policy, which requires residents to cost, the popularity cannot influence residents' willingness to pay for it, but descriptive norm will affect perceived injunctive norm, when residents perceive that everyone wants me to engage in a certain behavior, subjective norm believe what the society wants me to do, they will still support the carbon tax policy.

In terms of policy characteristics, both carbon tax policy perceived fairness and effectiveness have a significantly positive impact on carbon tax, in which policy perceived fairness also has a significantly positive impact on policy perceived effectiveness, thus confirming H1 and H2. It indicates that the primary factors of residents support for and perception of policy, and also demonstrates that the determining factors in the process of policy formulation are policy effectiveness and fairness among residents.

The results also display that perceived policy effectiveness and fairness are the strongest predictors of carbon tax support. The path coefficients of these two predictors are the largest in structural model, which is consistent with the results presented and suggests that the perceived effectiveness of policy can significantly predict residents' support for carbon tax policy. In other words, the direct impact of the characteristics of the policy or the attitude towards the policy that residents can directly predict whether residents will support the policy. Residents will support the policy if they perceive the policy is effective in solving problems and fair for each person. Perceived effectiveness is enhanced when residents perceive the policy to be fair.

5. Discussion

5.1. Theoretical contributions

Joining a collective effort to investigate the interaction between the economic and social determinants of sustainable actions, this study applied a survey to evaluate the factors and paths of public support for carbon emission reduction policies. The main contribution of this study consists of the factors influencing support for carbon reduction policies cannot be viewed in isolation from each other, but need to be linked between the dimensions to interact with each other so that support for the two carbon reduction policies occurs. Specifically:

(1) The nature of the policies have an impact on whether or not residents support carbon reduction. Carbon trading and carbon tax policy are very typical incentive policy and penalty policy. In the study on the carbon trading policy, we see that neither

descriptive norm nor injunctive norm can positively influence residents support for the carbon tax. In other words, in the face of rewarding policy, residents are not willing to follow the trend of carbon reduction, even when they perceive that others want them to engage in specific behaviors, they still stick to their own views. This is consistent with the results of individual psychological perceptions of behavior: ecological values, perceived climate risk and self-efficacy all positively affect the degree of support for carbon policy. Residents support for carbon trading policies is related to individual psychology, they will be willing to support incentive policies only when they have spontaneous intrinsic motivation, regardless of social effects, and social norms cannot drive residents' choices, which occurs when intrinsic personal factors are stronger than social influences. In the carbon tax, the results show that neither climate risk perception nor self-efficacy can positively influence residents' approval of carbon tax policies. This suggests that when residents perceive climate change is getting worse, it has nothing to do with paying taxes to the government, and although levy to businesses and other industries to promote clean energy is a punitive measure, it is an additional expense for residents and cannot mitigate climate change; when residents believe that they have the ability to practice carbon reduction behaviors, they have no need to share the tax with businesses. However, it is worth noting that descriptive norm have no significant effect on carbon tax policy, while injunctive norm has a positive effect on support for carbon tax policy. At the same time, the herd mentality of descriptive norm will make residents believe that everyone wants them to engage in the same behavior, i.e., when residents perceive themselves expected to support the carbon tax policy, they will also support the carbon reduction policy due to social pressure.

(2) In the study of carbon tax support, the influence factors and influence paths of individual psychological perceptions are significantly different. Ecological values show a positive influence on both personal norm and carbon tax support variables, i.e., when residents have positive ecological values, they will be willing to bear the tax with the society; at the same time, such values will be internalized as their own responsibility, and they will regard the protection of ecology, carbon reduction and emission reduction as their responsibility and obligation, they will be concerned about climate change when their sense of responsibility is stronger, however, there is a non-significant effect with the carbon tax policy support. This suggests that when residents realize that the climate change risk is getting more serious and uncontrollable, they believe that bearing the tax cannot solve the problem of climate.

Another contribution of this study is to the scant research on the boundary conditions of individual psychology. As hypothesized in H6 and H7, we expected personal norm to be more likely among people with high levels of environmental self-efficacy or ecological value. Our reasoning makes intuitive sense: because these people possess strong prior beliefs about the importance of environmental issues, moral obligation, the environmental morale of others and perception of risk, there is much more room for the mechanisms to happen. As expected, all the proposed mechanisms were more pronounced when personal norm and perception of climate change risk was strong, and as a result, policy support occurred only when the mediator were strong rather than weak. These findings provide valuable insights into the personal norm and perception of the policy support.

5.2. Practical implications

A central implication of our findings is that policy formulation considers environmental policies based on individual psychological perceptions, social contextual perceptions, and perceptions of policy characteristics will be more comprehensive and more accepted. As a crucial social institution for sustainable development, individual psychological recognition will make people more proactive in complying with rules and supporting policies. Social norms play a vital role in nurturing interpersonal cooperation and motivating individuals' voluntary contributions to environmental public goods. The fairness and effectiveness of the policy is to give the residents a more intuitive feeling of the purpose of the policy. Therefore, when designing and evaluating policies, both the subject and the object as well as the external environment need to be taken into account.

Moreover, since the negative influences of support for carbon tax regarding the perception of climate change risk, moral obligation, the environmental morale of others and social norms, a systematic examination of changes in these beliefs helps predict the residents' attitudes towards cost in penalty policy support. This pre-assessment should be an integral part before the implementation of policies, and it can be achieved through stakeholder interviews, surveys, experiments, and mixed methods.

5.3. Limitations and future directions

Given that, in many cases, individuals adjust their behavior to increase the likelihood of policy support in response to changes in values, perceived competence, people's behaviors and expectations, and policy features (Farrow et al., 2017), we measured whether participants would engage with a carbon reduction policy by asking them if they would do in the three dimensions. However, as individual psychological perceptions change in response to other events and socio-environmental change is sometimes an automatic mimicry process (Bergquist et al., 2019), this measure may not comprehensively reveal an individual's response to social norms. Therefore, future research could benefit from doing field-experiments that are less prone to potential measurement bias than intention indicators.

Our study extends the current literature by validating the three influencing factors and pathways concerning the carbon reduction policies of individual psychological perception, social contextual perception and perceived policy characteristics in explaining support for incentive policies and punish policies. Nevertheless, there are additional mechanisms that need further examination. For example, one prominent explanation for conformity to prosocial norms is that people desire social approval and a good reputation (Gross and Vostroknutov 2022). However, confronted with an incentive policy such as carbon trading, other members may attribute individuals' conformity behavior to the motivation to obtain monetary rewards, which may reduce the level of consistency towards a specific policy on carbon reduction (Ling et.al., 2023). Similarly, future research should continue to explore the role of other influences in supporting carbon abatement policies, as well as the spillover effects resulting from the sequential implementation of incentive and punish policies, or the effects of policies when they are implemented at the same time.

6. Conclusions

Our findings arguably provide many avenues for future research. Testing additional policy frameworks and exploring more details of policy attributes could help increase public acceptance and willingness to participate in climate adaptation financing. The latter seems particularly important and also need further exploring support, as well as the trade-offs between allocation principles, which may guide how funding is mobilized. In addition, given the range of ways in which different pro-environmental projects may protect development and livelihoods in recipient countries, our focus on mortality reduction - exploring the 'effectiveness' of interventions as an attribute may be said to have been climate adaptation, albeit arguably in the context of climate change. While arguably focused on climate adaptation, it is not necessarily comprehensive. As climate impacts erode these outcomes, the need for adaptation becomes more apparent, it is increasingly important to better understand public support for international action.

By identifying the causal mechanism between individuals' behavioral decisions, we integrate the factors at three dimensions to explore their influence pathways, provide a window to understand the microecology of individual complexity, stimulate the positive influence of people's internal perception of individuals, the influence of the social context, and the combination of their perceptions of policy features. Avoiding the behavioral blockage caused by their antagonistic effects, exploring the comparison of the implementation of incentive-based policies such as 'carbon trading' and penalty-based policies such as 'carbon tax'. In addition, the study compares which brings policy ideas and experiences for promoting residents' participation in carbon reduction and mitigation. The key question is, what are the key factors that influence residents to support carbon reduction policies? How does the nature of the policy affect residents' behavioral decisions of support? How does the path of influence of these factors go? If these three basic questions are not effectively addressed, then the implementation of carbon reduction policies will remain a "great idea that never got off the ground". Although previous studies have conducted many empirical studies on residents' support for environmental policies and developed various types of influencing factors and possible paths, the theoretical explanations are fragmented and contradictory, and there is still a lack of systematic review of influencing factors.

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