How does information affect willingness to pay for green power?

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Background

- In 2015, there are more than 80 mild air pollution and above days in Shanghai.
- In Northeast China, the air pollution situation is even more serious, especially in winter.
- According to the researches, more than half of the air pollution are due to coal-burning.
- Among all the coals used in Shanghai, more than half of them are used in fire power plants.

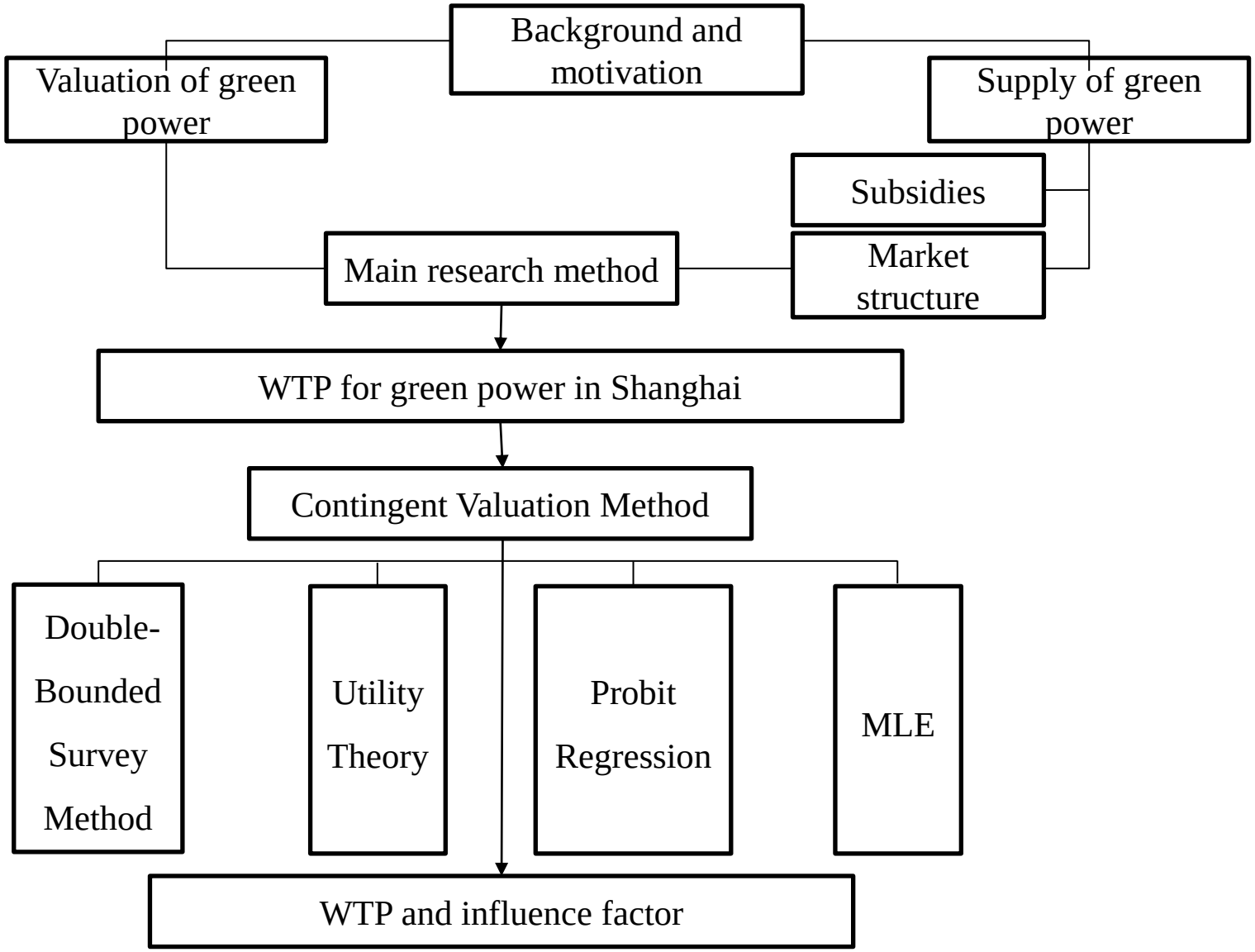
Motivation

- Policy change
  - Electricity market reform and Promote market competition
- The survival problem for Green Power
  - A deeper understanding for the competitiveness of green power
  - Subsidies are not enough for the high-speed development of green power
  - Need more support from demand side
  - WTP for green power is the basement for related policy
- Value of Green Power = Direct value + Indirect value
  - Green power is a impure public goods
  - The indirect value of green power can not be priced because of its public character
- In most researches, the basic assumption is perfect information

Hypothesis

- Households have perfect information on green power, and giving them any information will not change their WTP.
- Household do not have perfect information.
  - If we give them the cost information that is higher than we they think it was, their WTP will decrease and vice versa.
  - If we give them the emission advantage that is higher than we they think it was, their WTP will decrease and vice versa.
  - If we give them the environment benefit that is higher than we they think it was, their WTP will increase and vice versa.

Research Structure



Literature review

- Main factors that will influence WTP for green power
  - Population character, including gender, age, health situation, education etc.
  - Resource structure
  - National fixed character
  - Knowledge about green power

Literature review

- Stated preference method
  - Contingent valuation
    - Single-bounded the simplest method
    - Double-bounded more efficient than single-bounded
    - Payment card approach more subjective to the question
    - Opening question limited information
  - Choice experiment
    - Virtual contracts sometimes can be confused
  - Based on the education level and population structure in shanghai, we use the simplest way in contingent valuation method for the research.

Literature review

- Contingent Valuation Method (CVM)
  - Single bounded CVM application for valuation estimation (Bishop and Heberlein, 1979)
  - Earliest research on green power using CVM in 1996 (Farhar and Houston, 1996)
  - Weakness of lower efficiency for SBDC method
  - Double bounded CVM for WTP research (Hanemann ,1991)
  - Anchoring effect or starting-point bias and modified model on DBDC (Herriges and Shogren 1996, Alberini et al. 1997)
  - We use the modified double-bounded CVM for the research

Model

WTP

Willingness to pay and the selection of the respondents

$$W = X\beta + \varepsilon$$

For people answered to the bid price

$$choice_{ti} = 1 \; if \; W_1 \geq b_{ti} \; or \; \varepsilon \geq b_{ti} - X\beta$$

$$= 0 \; if \; W_1 \leq b_{ti} \; or \; \varepsilon \leq b_{ti} - X\beta$$

Model

For people whose answer to both bid price is yes,

$$P_i^{11} = prob(choice_1 = 1, choice_2 = 1) = 1 - \Phi\left(\frac{b_2 - X\beta}{\sigma}\right)$$

$$P_i^{10} = prob(choice_1 = 1, choice_2 = 0) = \Phi\left(\frac{b_2 - X\beta}{\sigma}\right) - \Phi\left(\frac{b_1 - X\beta}{\sigma}\right)$$

$$P_i^{01} = prob(choice_1 = 0, choice_2 = 1) = \Phi\left(\frac{b_1 - X\beta}{\sigma}\right) - \Phi\left(\frac{b_2 - X\beta}{\sigma}\right)$$

$$P_i^{00} = prob(choice_1 = 0, choice_2 = 0 | y_i = 1) = \Phi\left(\frac{b_2 - X\beta}{\sigma}\right)$$

Model

So, the Log-likelihood function to maximize is,

$$lnL = \sum_{\substack{choice1=1 \\ choice2=1}} \ln[1 - \Phi(\frac{b_2 - X\beta}{\sigma})]$$

$$+ \sum_{\substack{choice1=1 \\ choice2=0}} \ln[\Phi(\frac{b_2 - X\beta}{\sigma}) - \Phi(\frac{b_1 - X\beta}{\sigma})]$$

$$+ \sum_{\substack{choice1=0 \\ choice2=1}} \ln[\Phi(\frac{b_1 - X\beta}{\sigma}) - \Phi(\frac{b_2 - X\beta}{\sigma})]$$

$$+ \sum_{\substack{choice1=0 \\ choice2=0}} \ln\left[1 - \Phi\left(\frac{b_2 - X\beta}{\sigma}\right)\right]$$

Anchoring effect and starting-point bias

Anchoring effect (Herriges and Shogren, 1996)

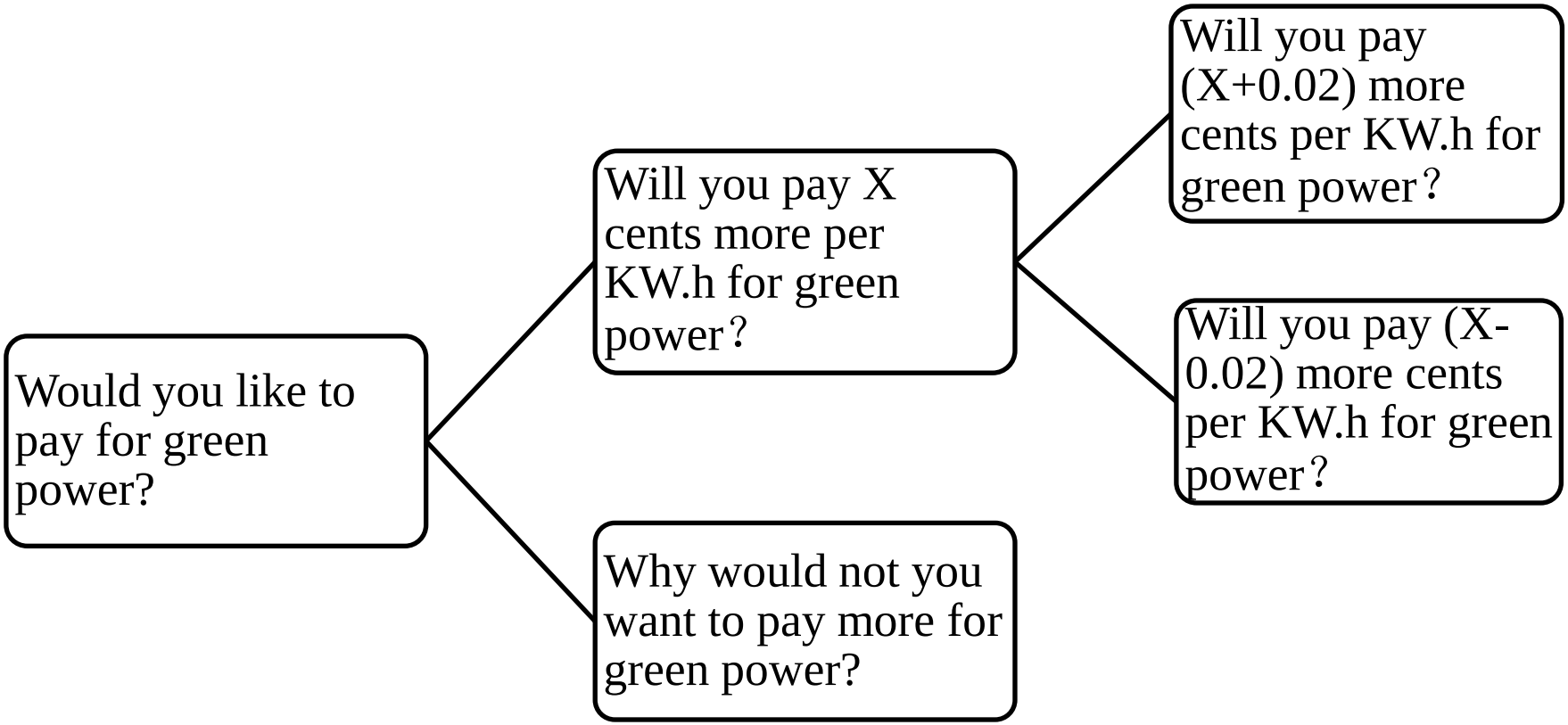
$$W_2 = \gamma b_1 + (1-\gamma)W$$

Starting-point bias (Chien et al., 2005)

$$W_2 = X\beta + \delta_i START_i + \varepsilon$$

Using the new W_2 for the estimation in the log-likelihood function

Question design of double-bounded CVM



Based on the preliminary research, we set the beginning bid price set as {4, 6, 8, 10, 12, 14, 16 and 18 cents/kw.h} and randomly assign them to respondents.

Totally there are 2751 effective respondents.

Summary Statistic

	Sample	Pudong	Shanghai
Gender	46.55%	51.66%	49.62%
Age	47.63	46.54	47.62
Education level			
junior school	36.33%	54.51%	35.60%
high school	19.71%	19.01%	24.00%
community college	12.94%	9.44%	18.10%
university	23.70%	10.36%	22.30%
graduate	7.33%	2.09%	
Unemployment	10.99%		
Self-owned	82.40%		
House space	26.24	27.97	27.25
Income	5347.88		4798.30

Definition of variables

Variables	Definition
LN(income)	Natural log of average monthly home income (yuan)
Education	Education level
Employment	If the respondents is employed, if not it's 1, if employed it's 0.
Rental	if the house is rental, this variable will be 1
Space	The house square of the respondent
House age	The house year in use of the respondent
Pollution days	The pollution days in respondent's memory during 2016
Pollution level	The pollution level the respondents feel in 2016
Anti -pollution	The anti-pollution devices the respondent bought.
Knowledge	The knowledge level about the electricity price in Shanghai
Cost	If the respondents was given the cost information about green power
Emission	If the respondents was given the emission benefit information about green power
Environment	If the respondents was given the environment benefit information about green power

Basic Results

Variables	Basic model	With information source	Starting-point bias	Anchoring effect
	Estimate	Estimate	Estimate	Estimate
Gender	0.65**	0.704**	0.434**	0.886**
	(0.322)	(0.311)	(0.206)	(0.418)
Age	-0.017	-0.021*	-0.007	-0.023
	(0.013)	(0.012)	(0.008)	(0.016)
LN(income)	1.039***	0.967***	0.956***	1.073***
	(0.104)	(0.097)	(0.074)	(0.13)
Education	1.201***	1.122***	0.882***	1.594***
	(0.152)	(0.151)	(0.102)	(0.199)
Employment	-0.347	-0.442	-0.27	-0.504
	(0.331)	(0.342)	(0.221)	(0.456)
Rental	-4.326***	-4.299***	-2.879***	-5.646***
	(0.578)	(0.482)	(0.328)	(0.632)
Space	0.018***	0.018***	0.011***	0.022***
	(0.006)	(0.006)	(0.004)	(0.007)
Knowledge	0.475***	0.525***	0.356***	0.577***
	(0.171)	(0.172)	(0.113)	(0.215)
Houseage	0.129***	0.13***	0.09***	0.158***
	(0.02)	(0.019)	(0.013)	(0.025)
Sigma(σ)	5.567***	5.539***	3.781***	7.28***
	(0.155)	(0.156)	(0.138)	(0.327)

Anchoring and Starting-point bias

Gamma(γ)		0.484*** (0.027)
Starting 0.04	-2.902*** (0.409)	
Starting 0.06	-1.197*** (0.456)	
Starting 0.08	0.425 (0.554)	
Starting 0.12	1.616*** (0.431)	
Starting 0.14	1.943*** (0.37)	
Starting 0.16	2.676*** (0.443)	
Starting 0.18	4.907*** (0.463)	

Environment knowledge

Variables	Basic model	With information source	Starting-point bias	Anchoring effect
	Estimate	Estimate	Estimate	Estimate
Pollution days	0.015*** (0.004)	0.015*** (0.004)	0.011*** (0.002)	0.021*** (0.005)
Pollution level	1.19*** (0.245)	1.127*** (0.251)	0.856*** (0.166)	1.566*** (0.34)
Anti-pollution	0.573 (0.355)	0.554 (0.339)	0.237 (0.22)	0.569 (0.435)
TV		0.854*** (0.177)		
Domestic		1.538*** (0.239)		
International		1.63** (0.789)		
Monitor		1.345*** (0.383)		

Information effect

Variables	Basic model	With information source	Starting-point bias	Anchoring effect
	Estimate	Estimate	Estimate	Estimate
Cost	-0.935* (0.487)	-0.932** (0.448)	-0.688** (0.306)	-1.259* (0.678)
Emission	0.591 (0.509)	0.65 (0.466)	0.392 (0.335)	0.748 (0.668)
Environment	-1.363** (0.419)	-1.288*** (0.381)	-0.78*** (0.275)	-1.458** (0.632)

Conclusion and Innovation

- We adopted the Double bounded CVM method for WTP research.
  - The main individual character that will influence household's WTP for green power are Income, Gender, Age, Education level and knowledge of the resource and pollution.
  - In the research, there truly exists an anchoring effect and starting-point bias. Based on the modified DB CVM model, we calculated a higher WTP, which also consists with other literatures.
  - In our sample, the estimated total willing payment for the indirect value of green power in Shanghai is about 3.06 billion Yuan RMB per year.
  - The government should set up channels to the access of funds from the households for a better development chance of green power.

Conclusion and Innovation

- Information may influence households' willingness to pay for green power.
  - The more knowledge about the environmental problems, the higher willing payment for green power.
  - Household did not have perfect information on Green power.
  - Household think that the cost and benefit of Green power is better than it truly is.
  - If the advantages of green power do not meet households' expectation, this kind of information would lower households' willingness to pay for green power.
  - It is suggested that the government should improve the relevant information disclosure mechanism, disclose the ecological environment status to residents in a timely and multi way.

Thank you!

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