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Environmental ideology and household energy conservation in Beijing

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ABSTRACT

During a period of extraordinary urban growth, China's per-capita carbon footprint could soar. A growth in households' willingness to purchase "green" products and to engage in voluntary restraint could help offset this pollution increase as the free market will design products to cater to this group of consumers. We study whether Chinese urbanites who label themselves as environmentalists consume fewer resources than the average urbanite. Based on a sample of Beijing's micro data drawn from the household survey on energy consumption in China, we document the association between a household's environmental ideology and its energy conservation behavior. Our findings imply that government's demand-side efforts such as environmental education and persuasion may help to bring about more sustainable behaviors.

1. Introduction

During the past decades, China has experienced rapid urbanization and economic development, accompanied by burgeoning energy consumption. According to the China National Bureau of Statistics, the total residential energy consumption of China has increased from 145.52 million tons standard coal in 2000 to 455.30 million tons in 2014, more than tripling in fifteen years. One calculation by Auffhammer et al. (2016) similarly shows that the total carbon emissions of Chinese cities increased by about 180% during the first decade of the 21st century. However, carbon emissions per household in China is low. According to Zheng et al. (2011), who rank 74 major Chinese cities with respect to their household carbon emissions, even in the dirtiest city in China, a standardized household's carbon emissions is only one-fifth of that in America's greenest city. This implies a huge potential increase in energy consumption as China's development continues at a rapid pace. Environmentalists have significant concerns about this.

Chinese households' energy conservation behavior could have a large impact on global carbon emissions. Anticipating that aggregate energy demand in China will rise sharply, the Chinese government wants to be proactive in changing the current situation. Since 2007, the Chinese government has put forward a number of measures to promote energy savings and emission reductions. For example, the Ministry of Housing and Urban-Rural Development in China set up the "China Green Building Evaluation Label" program in 2007, which came to fruition in 2008. From 2007 to 2011, the Ministry of Finance spent 31.6 billion RMB yuan to encourage the purchase of energy-saving appliances through subsidies, including lighting products, home appliances, automobiles, and electrical machines[1]. The Beijing municipal government first promoted advanced energy-saving technology and rail transit equipment, and the application of electric vehicles through subsidies, differential pricing, permits and other preferential policies[2]. To make those supply side efforts achieve the desired purpose, cooperation from demand side is necessary. In 2007 the Chinese government has launched the "National Action on Energy Conservation and Emissions Reduction" to promote people's awareness of environmental protection and reduce energy consumption[3]. However, due to the lack of a supervision mechanism, the demand-side work was mainly carried out by means of publicity and education, in an attempt to raise people's awareness of the issue of environmental

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[1] Detailed information see: http://finance.sina.com.cn/chanjing/cyxw/20120525/015212142629.shtml.
[2] Detailed information see: http://zhengwu.beijing.gov.cn/ghxx/qtgh/t1359600.htm.
[3] Detailed information see: http://www.gov.cn/zwgk/2012-02/07/content_2059923.htm.

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protection, so it is important to understand whether the improvement of environmental ideology could contribute to energy consumption behavior.

In the United States today, there are large differences in energy consumption for households that pay similar prices and have comparable income and demographics. A recent area of research has worked on this, finding that environmental ideology plays an important role, which means people who reveal themselves to be environmentalists exhibit more energy conservation behaviors (Kahn, 2007; Costa and Kahn, 2013; Egbue and Long, 2012). Another area of research, on strategies to promote household energy conservation, also points out that interventions are more effective to the extent that they target determinants of energy use and energy savings (e.g. attitudes, knowledge) (Abrahamse et al., 2005). Specifically, psychological strategies aiming at changing people's knowledge, perceptions, motivation, cognitions and norms related to energy use and conservation can be followed by changes in behavior, and consequently by energy savings (Steg, 2008). However, the existing studies mainly focus on the case of the U.S.. Understanding whether Chinese people exhibit the same behaviors is important but has been less studied to date.

In this paper, we use people's attitudes towards using energy efficient appliances and volunteer activities to identify Chinese urbanites' environmental ideology based on micro survey data—a household survey on energy consumption. Then we document the association between a household's lifestyle, ideology and its energy conservation behaviors to investigate whether those who reveal themselves to be environmentalists consume less energy. Our results show that environmentalist households do not own fewer appliances than average; however, they are more likely to use energy efficient appliances and consume less water and electricity, controlling for other factors. As for transportation choices, environmental ideology does not influence the probability of owning a vehicle or the choice of vehicle's engine size but it does influence gas consumption–the pro-environment cohort consumes less gasoline. Overall, our study represents the first empirical study documenting consumers' environmental ideology and its implications for “nascent” green markets in a major developing country. Our findings indicate that the Chinese government should make more efforts to change households' attitudes to energy conversation and perceptions of the importance of energy efficient appliances.

The rest of the paper is organized as follows. Section 2 reviews related literature; Section 3 introduces the micro-survey data and key variables. Section 4 and Section 5 present our empirical method and results. Section 6 concludes.

2. Literature review

Factors that influence residents' energy conservation behaviors have been studied by environmentalists for decades. Becker et al. (1981) investigate homeowners' energy-related attitudes and connected their attitudes to winter gas consumption, finding that more energy-conserving attitudes have a negative effect on household energy consumption. Similar conclusions have been drawn in the environmental psychology literature (Heberlein and Keith Warriner, 1983; Stern, 1992; Brandon and Lewis, 1999). Thøgersen (1995) suggests the MOA-model, in which he argues that the determinants of consumer behavior with an environmental impact can be defined as **M**otivation, **O**pportunity, and **A**bility, where motivational factors include preferences and attitudes. Beyond this, more and more studies focus on the role of environmental ideology. Lindenberg and Steg (2007) conclude that behavioral choices are based on evaluations about what is right or wrong and environmental concerns play a key role in environmental behavior. Other scholars empirically examined the relationship between attitudes and energy use (Gadenne et al., 2011; Martinsson et al., 2011; Gilg and Barr, 2006). They all find a strong positive association between environmental attitudes and energy saving behaviors, although the effect is generally not as great as that of socio-economic factors on energy saving behaviors. Brounen, Kok and Quigley (2013) use a detailed survey of 1721 Dutch households and documente that consumer's attitudes towards energy conservation have direct effects on behavior regarding heating and cooling of the home.

Recent studies on the carbon footprint also find that environmental ideology has a significant impact on consumers' choices about energy use. To specify, Kahn and Vaughn (2009) find that environmentalist communities in California tend to have more hybrid vehicles as well as LEED registered buildings. Jansson (2011) finds that people who exhibit a higher level of environmentally-related personal norms (i.e. feel a moral obligation to conserve oil/petrol/diesel no matter what other people do) are more likely to adopt alternative fuel vehicles. Kahn and Morris (2009) point out that green ideology can cause green travel behavior as residents living in green communities engage in more sustainable travel than residents of other communities. To specify, they are more likely to commute to work by non-auto modes, to drive fewer miles, and to consume fewer gallons of gasoline. Costa and Kahn (2013) make an empirical test and find that households that pay for electricity from renewable sources and donate to environmental groups are more likely to reduce their energy consumption more than others in the face of energy conversation “nudges”. Cragg et al. (2013) also find that liberals tend to vote for carbon mitigation legislation; this is in opposition to findings for conservatives, indicating an ideology effect exists in the promotion of environmental legislation. Using data from Spain, Ramos et al. (2016) show that households with eco-friendly behaviors are more likely to investment in well-differentiated energy efficient measures as well as to steer daily habits towards energy savings. That is to say, households that reveal themselves to be “liberal-environmentalist” through surveys or political markets are shown to live a smaller carbon footprint lifestyle. In other words, such environmentalists in the United States and some other Western countries are “walking the walk”.

New research from emergent countries, such as China, have gained increased attention. For example, Wang and Wu (2016), examining data from Hangzhou, test the impacts of emotions on the intention of sustainable consumption choices. Liu et al. (2012), after designing a questionnaire survey about green purchasing behaviors of urban residents in Suzhou, find environmental attitudes greatly influence intention of green purchasing behaviors. Geng, Liu and Zhu (2017) empirically examine Chinese adolescents' sustainable consumption behaviors. In their study, one influencing factor of sustainable consumption behaviors is sustainable awareness and attitude: they find Chinese adolescents know little about sustainable consumption, which demotivates their sustainable consumption behaviors. Zhao et al. (2014), who conduct a questionnaire survey in Qingdao, find that attitudes are the most significant predictor of green purchasing behaviors. As is clear, most of the conclusions are obtained based on data collected from questionnaire surveys, which may be not consistent with the actual consumption behaviors of those surveyed. In addition, the measure of the consumption behaviors mainly focuses on people's purchase and use of green products including energy efficient appliances, green furniture, recycled paper products and so on. Very few mention participation in eco-tourism. And, due to the limited availability of data, none examine whether environmental attitudes

or ideology impact household energy consumption, such as consumption of electricity, water, or gas.

Earlier studies have defined environmentalists according to two factors. The most frequently adopted indicator is attitude towards green behavior, especially attitude towards green products (Chen et al., 2010; Ek, 2005; Mills and Schleich, 2012). Other literature has sought to identify which subgroups of the population reveal themselves as environmentalists. Volunteer activities have also been used as proxies for pro-environment "public" behaviors (Hunter et al., 2004; Turaga et al., 2010). People who are willing to invest time in activities that benefit the community but do not offer explicit compensation are public goods providers who are likely to take private actions that offer social benefits. In this paper we define environmentalist using two proxies: first, people's attitudes towards using energy efficient appliances; second, volunteer activities.

3. Data and variables

3.1. Survey

The data employed in this paper is derived from the Urban Household Survey of 2010. UHS is a regular nationwide sample survey conducted every three years by the National Bureau of Statistics of China. Households are randomly selected from all cities; then officers from local statistics authorities are sent to visit the sampled households and help them answer the questionnaires. The questionnaire covers all key demographics, employment, income, wealth, consumption information for each household member, as well as the major features of the household's current residence.

In addition to such basic information, in the 2010 UHS, a supplemental questionnaire focusing on household energy consumption was also included in surveys distributed in Beijing. In total, 1000 households (consisting of 2907 household members) were sampled in this supplemental survey. Their spatial distribution in the city is shown in Fig. 1.

The questionnaire is divided into three major divisions: (1) work and travel, (2) quality of life, and (3) energy consumption. In the first part, we mainly asked the respondents about their daily traffic behaviors, including commuting frequency (number of commuting each week), average commuting distance and time, as well as the main modes of transportation such as walking, self-driving, public transport and so on. Here we mainly focus on households owning cars since gasoline consumption is the main source of daily transportation energy consumption. Therefore, in the questionnaire, for households with cars, we asked about cars' engine size which may reflect the households' preference for energy-saving behavior to some extent, and monthly consumption of gasoline (in RMB yuan). After controlling for other factors, including cars' engine size and commuting distance, as well as income, demographics, housing and neighborhood attributes, gasoline consumption reflects households' preference for energy use. In addition, we also asked the respondents "whether (at least part of) the commuting cost can be reimbursed?"[4] which also affects households' car use behaviors.

In the second part of the quality of life survey, we mainly asked respondents about their satisfaction with their current living conditions. Of these questions, two are related to this study: first, "Do any people in the household stay at home during the day on weekdays?" and second, "Has any household member participated

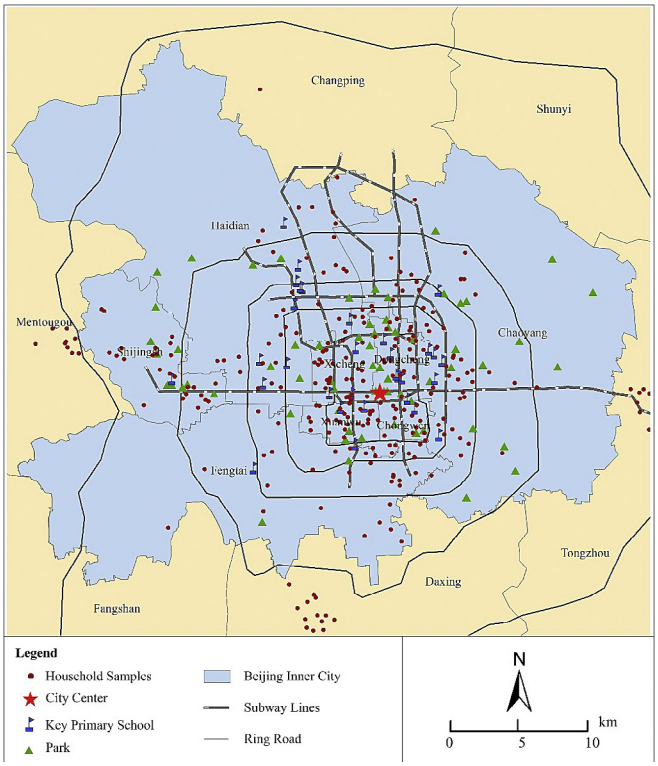

Fig. 1. Distribution of households samples in Beijing.

in a volunteer activity?" The first question may affect household energy consumption during week days. The second question, regarding volunteer behaviors, can be used to measure whether the household is environmentally friendly (Hunter et al., 2004; Turaga et al., 2010).

In the third part of the questionnaire on energy consumption, on one hand, we asked the household members how many appliances they owned, including television, refrigerator, air conditioning, washing machine, microwave oven and so on; on the other hand, we directly asked the household about their annual expenditures on electricity and water (in RMB yuan). Responses to both of these questions can help us more accurately measure daily household energy consumption behaviors. In addition, we also asked about their usage of and attitudes toward energy efficient appliances (EEAs). (1) "Do you use any energy efficient appliances?" captures their energy-saving behavior. (2) "Do you think using EEAs is an important way to contribute to a green society?" is another measure to reflect the household's environmental ideology.

The definition and descriptive statistics of major variables from the survey are listed in Table 1.

3.2. Key variables and preliminary analysis

3.2.1. Proxy for environmental ideology

This research employs two variables derived from the survey as proxies of households' environmentalist ideology. The first is the household's attitude towards using EEAs (*LOVEGREEN*). In the survey, 74.8% of the respondents believe using EEAs is "very important". They are more likely to be pro-environment than others. The second is whether any household member has participated in volunteer activities (*VOLUNTEER*). Since volunteer activities in China have only emerged recently, we believe that current volunteers should be more concerned about social affairs including environmental protection, and hence are more likely to be

[4] In China, many government agencies provide official consumption reimbursement for their employees (that is to say the employers will cover a part of commuting fees such car gasoline fees and taxi fees for their employees), and enterprises have transportation subsidies.

Table 1
Variable definitions and summary statistics.

Variable	Definition	No. Of Obs.	Mean	Std. Dev.
LOVEGREEN	Attitude towards using energy efficient appliances; 1 = very important, 0 = otherwise.	1000	0.75	0.43
VOLUNTEER	Any household member as a volunteer; 1 = yes, 0 = otherwise.	1000	0.75	0.43
ENVIRONMENTALIST	*VOLUNTEER* × *LOVEGREEN*	1000	0.57	0.49
INCOME	Total household income in 2009; in RMB yuan.	1000	102699.6	62680.5
EDU	Household heads' education level, measured as years of schooling.	998	12.78	2.83
AGE	Household head's age.	998	48.19	10.44
HUKOU	Whether has Beijing registration permit: 1 = yes, 0 = no.	1000	0.95	0.22
CLASS	Self-evaluation of social class status; 1 = low, 2 = medium low, 3 = medium, 4 = medium high, 5 = high.	1000	2.32	0.82
HHSIZE	Household size.	1000	2.91	0.71
AIRCON	Number of air conditioners owned.	1000	1.74	0.88
OVEN	Number of microwaves/electric ovens owned.	1000	1.13	0.50
HEATER	Number of electric heaters owned.	1000	0.29	0.72
WASHING	Number of washing machines owned.	1000	1.02	0.26
EEA	Using any energy efficient appliances (EEAs); 1 = yes, 0 = otherwise.	1000	0.63	0.48
WASHING_STYPE	Whether the house has a private water system; 1 = yes, 0 = otherwise (public).	1000	0.99	0.09
ELECQ	Expenditure on electricity per person in Jan to Jun 2010; in RMB yuan.	644	261.69	250.72
WATERCQ	Expenditure on water per person from Jan to Jun 2010; in RMB yuan.	792	67.74	68.74
CAR	Owning at least one car; 1 = yes, 0 = otherwise.	1000	0.34	0.48
ESIZE	Engine size of car; in liters.	344	1.65	0.30
GASOLINE	Average expenditure on gasoline for car use each month; in RMB yuan.	344	581.89	314.52
DAYTIME	Any people stay at home during daytime on weekdays; 1 = yes, 0 = otherwise.	1000	0.45	0.50
HSIZE	Housing size; in square meters.	1000	68.10	26.17
HAGE	House age (in years)	1000	21.91	17.95
DISTANCE	Distance from resident to householder's workplace; in kilometers.	967	10.37	14.50
D_CENTER	Distance city center; in kilometers.	1000	5.26	5.71
D_SUBWAY	Distance to nearest subway station; in kilometers.	1000	2.04	2.85
D_PARK	Distance to nearest park; in kilometers.	1000	2.56	2.86
D_SCHOOL	Distance to nearest primary school; in kilometers.	1000	3.05	3.19
REIMBURSE	At least part of the commuting cost can be reimbursed; 1 = yes, 0 = otherwise.	1000	0.06	0.23

environmentalists compared to non-volunteers. Roughly 74.9% of the respondent households have volunteer members, a ratio higher than we expected, which may reflect the influence of the 2008 Olympic Games in Beijing[5].

In this paper, we define environmentalists using the interaction of the two proxies, which is to say households that volunteer and also highly value the importance of EEAs are labeled as environmentalists. For this definition, 57.3% of the respondents are environmentalists. Table 2 reports a comparison of mean values of the demographic attributes of both environmentalist householders and non-environmentalist householders.

Our data shows that age and *hukou* condition[6] are significantly different between environmentalists and non-environmentalists. The average age of environmentalist householders is 49.16, more than two years older than non-environmentalist householders. People with more abundant living experience are more likely to be environmentalists. Among the households defined as environmentalist about 96% are of this city registered permanent address, which for non-environmentalists the rate is somewhat lower at 93.44%. The significant t statistic indicates that local residents are more likely to be environmentalists. The differences in age and *hukou* condition between environmentalists and non-environmentalists may imply that stability in both residence and job is one precondition for environmental ideology and behavior. However, household income, gender and education level of the household head are similar between the two groups.

We also look into employment status for the two groups. The results show that people who work in collective enterprises and private enterprises are more likely to be non-environmentalists, which is significantly different at the 1% level. However, we find that 12.91% of environmentalists are retired, which is about twice the ratio for non-environmentalists. Whether the heads are members of labor unions, which is endogenously affected by occupation, does not influence environmental ideology or behaviors for households in Beijing.

3.2.2. Energy consumption behaviors

Households' energy consumption behavior is measured using two indicators. The first is a household's choice of appliances and whether the household is using an EEA. Overall, 63% of the respondent households have at least one EEA. Preliminary analysis suggests a strong relationship between the environmental ideology proxy discussed above and the usage of EEA(s) (see Table 3). 68% of the environmentalist households owned at least one EEA, while 57% of the non-environmentalist households owned EEA(s).

Using the micro data, we can also examine differences in household electricity and water consumption. As depicted in Table 3, there is little difference between the two groups by comparing total energy consumptions. Average electricity consumption for environmentalist households is only 2.8% less than non-environmentalist households.

The second aspect of households' energy consumption behavior is their choice of cars. Only 34.4% respondents own cars, and no significant relationship exists between car ownership and environmental ideology. We instead prefer to focus on differences in engine size (*ESIZE*) and gasoline expenditures (*GASOLINE*). The effect of ideology on households' car choice seems limited. Differences between groups holding various attitudes towards environment is trivial, while average engine size for households with environmentalists is slightly larger than those owned by households without environmentalists. However, the effect of

[5] In other major Chinese cities, the ratios of households with volunteer members are much lower, for example the ratios of Shanghai, Shenzhen, and Chengdu are 55.2%, 37%, and 39%, respectively.

[6] *Hukou* is a resident permit issued to households by the Chinese government. Rural Chinese who migrate to cities are often ineligible for basic urban welfare and social services due to the lack of a local urban *hukou* status.

Table 2
Comparison of environmentalists and non-environmentalists for demographic Attributes.

	(1) Environmentalists	(2) Non-environmentalists	(3) *t*-test for difference between (1) and (2)
INCOME (*RMB yuan*)	103268.0 (55526.8)	101936.8 (69143.6)	0.337
MALE (*percent*)	50.35 (50.04)	52.82 (49.98)	−0.771
EDU (*year*)	12.85 (2.81)	12.69 (2.85)	0.865
AGE (*year*)	49.16 (10.65)	46.88 (10.02)	3.424***
HUKOU (*percent*)	95.81 (20.05)	93.44 (24.78)	1.700**
EMPLOYMENT (*percent*)			
State owned enterprise	42.58 (49.49)	45.43 (49.85)	−0.898
Collective enterprise	12.74 (33.37)	15.93 (36.63)	−1.432*
Private enterprise	6.98 (25.50)	9.60 (29.50)	−1.503**
Retired	12.91 (33.57)	6.56 (24.78)	3.300***
Other employment	0.70 (8.33)	0.23 (4.84)	1.028
Not employed	24.08 (42.80)	22.25 (41.64)	0.679
LABOUR UNION (*percent*)	55.40 (49.76)	56.33 (49.67)	−0.255

Notes: (1) standard deviations are reported in parentheses.
(2) ***: significant at the 1% level; **: significant at the 5% level; *: significant at the 10% level.
(3) See Table 1 for variable definitions.

Table 3
Comparison of environmentalists and non-environmentalists for energy consumption behaviors.

	(1) Environmentalists	(2) Non-environmentalists	(3) *t*-test for difference between (1) and (2)
Usage of EEA	67.5% (0.47)	56.9% (0.50)	−3.43***
Expenditure on electricity (*RMB yuan*)	258.43 (239.63)	265.90 (264.73)	−0.37
Expenditure on water (*RMB yuan*)	67.68 (70.90)	67.82 (65.79)	0.03
Whether own a car	34.0% (0.47)	34.9% (0.48)	0.28
Engine size (*Liters*)	1.65 (0.29)	1.64 (0.32)	−0.27
Average expenditure on gasoline (*RMB yuan*)	566.65 (260.85)	623.48 (286.87)	−1.82*

Notes: (1) standard deviations are reported in parentheses.
(2) ***: significant at the 1% level; **: significant at the 5% level; *: significant at the 10% level.
(3) See Table 1 for variable definitions.

ideology on households' expenditures for car gasoline is significant and important. Average gasoline expenditures for households with environmentalists is 9.1% lower than for households without environmentalists.

4. Empirical strategy

Here we employ econometric models to investigate the relationship between households' environmental ideology and their energy consumption behaviors conditional on demographics. The estimation specification is as follows:

$$Y_i = \alpha \cdot \text{Environmentalist}_i + \mathbf{X_i} \cdot \beta + \mathbf{Z_i} \cdot \gamma + \varepsilon_i \quad (1)$$

where Y_i is the measurement of energy consumption related behaviors of household *i*. As discussed in Section 3, we construct three variable sets based on the survey data to measure households' energy consumption behaviors.

(1) **Choice of appliances**. Households' choice of appliances is explored via two steps. First we focus on the link between numbers of appliances owned by the household and its demographics as well as ideology. Four kinds of the most energy-intensive appliances are investigated here: air-conditioner (*AIRCON*), microwave/electric oven (*OVEN*), electric heater (*HEATER*), and washing machine (*WASHING*). We employ a count regression model–negative binomial regression[7] to estimate the coefficients. Secondly we estimate a binary discrete choice model (Probit model) to examine the association between EEA use and household ideology.

(2) **Expenditures for energy consumption**, which includes expenditures for electricity per person (*ELECQ*) and expenditures for water per person (*WATERCQ*). We use a log-linear regression model to estimate these effects.

(3) **Choice of cars and gasoline consumption**. First we focus on the determinants of car ownership; a binary discrete choice model (Probit model) is employed for this estimation. Then for car owners, we use a log-linear regression model to test the impacts of environmental ideology on their choice of engine size (*ESIZE*) and gasoline consumption (*GASOLINE*). While the choice of engine size and gasoline consumption may be simultaneously determined when households choose whether to buy a car, there may be some unobservable factors that simultaneously impact whether or not to purchase a car and how to use the car, which is a typical sample selection issue. To mitigate the potential selection bias, we estimate a Heckman two-step model to simultaneously model the probability that a household owns a car and its engine choice as well as gasoline consumption conditional on ownership. We use self-evaluation of social class status (*CLASS*) to proxy car ownership in the first step.

On the right side of Equation (1), $Environmentalist_i$ is the key independent variable we focus on. It indicates whether any one of household *i* has environmental ideology which is defined using the interaction of *LOVEGREEN* and *VOLUNTEER*. The coefficient α then measures the average difference in energy consumption between environmentalists and non-environmentalists on average. $\mathbf{X_i}$ is the vector of demographics, including total household income (*INCOME*), household heads' education level (measured using years of schooling (*EDU*)), household heads' age (*AGE*), *hukou* conditions

[7] Likelihood Ratio Tests indicate that Negative Binomial Regression is more suitable than Poisson Regression.

(*HUKOU*), household size (*HHSIZE*), and employment status dummies. $\mathbf{Z_i}$ is the vector of other potential factors that may impact households' energy consumption behaviors, which includes the households' working conditions such as whether staying at home during the day on weekdays (*DAYTIME*), distance from residence to each householder's workplace (*DISTANCE*), and whether the commuting cost can be reimbursed (*REIMBURSE*); housing size (*HSIZ*) and age (*HAGE*), as well as some location attributes of the house such as distance to city center (*D_CENTER*), distance to the nearest subway station (*D_SUBWAY*), park (*D_PARK*) and primary school (*D_SCHOOL*). To deal with potential problems of serial correlation, we adopt a conservative approach in estimating standard errors and allow the disturbance terms ε_i to be clustered by township (or *Jiedao*) throughout.

5. Empirical findings

5.1. Choice of appliances

Table 4 first reports the negative binomial regression results for the four energy-intensive appliances. The coefficients of the environmentalist dummy are positive and insignificant in all four of these specifications, implying that households that label themselves as environmentalist tend to own more such appliances. According to these findings, there is no evidence that the pro-environment cohort consumes fewer appliances; instead such choice is still dominated by conventional household demographics: the effects of the major demographics are significant and consistent with expectations. Generally, households with higher income, higher education level, or older household members and more household members are more likely to own, and own more of these energy-intensive appliances. And households with a bigger house prefer to own more air-conditioners, microwave/electric ovens, and washing machines. Besides, the significantly positive coefficient of log (*HAGE*) indicates that households living in older houses likely use more electric heaters. This is reasonable as most of newly-built residential buildings in Beijing enjoy collective heating but the heating in old houses is not that good.

Then we estimate a binary discrete choice model to examine the association between EEA use and household demographics and ideology. The results are reported in Table 5. The coefficient of the proxy of environmentalist ideology is significantly positive in the model, which implies that environmentalist households are indeed more likely to use EEAs, even controlling for household demographics. Specifically, environmentalist households have a 10% higher probability to own EEAs than non-environmentalist households. Households with higher total income are significantly more likely to choose EEAs. Respondents with higher education attainment also tend to use EEAs, but this effect is not statistically significant.

There are two points with the research as we have described it so far needed to be note. First, there may exist a gap between an individual's ideology and behavior, so even though we use household's attitude towards using EEAs as one of two proxies for environmentalist ideology, it doesn't necessarily mean that they will use EEAs. Our result instead empirically tests whether households that believe using EEAs is important for a green society will indeed have a higher probability of owning EEAs. Second, using EEAs doesn't necessarily lead to lower electricity consumption as the appliance and electricity consumption are not always highly correlated. Specifically, households that use EEAs may pay less attention to their energy conservation behavior as their appliances are naturally more energy efficient and will result in reduced cost per use. Therefore, they may have even higher actual energy consumption than households with no EEAs. As a result, we should also further test whether pro-environmentalists consume less energy, as this provides more direct evidence of their energy conservation behaviors.

Table 5
Determinants of using EEAs.

	(1)
ENVIRONMENTALIST	0.100*** (3.17)
log (*INCOME*)	0.139*** (3.46)
log (*EDU*)	0.0319 (0.45)
log (*AGE*)	−0.0742 (−0.85)
HUKOU	0.0277 (0.34)
HHSIZE	0.00298 (0.12)
log (*HSIZE*)	0.0126 (0.27)
log (*HAGE*)	−0.00822 (−0.21)
DAYTIME	−0.0292 (−0.84)
Employment status dummies	Yes
Observations	998
Pseudo R^2	0.029
chi2	35.11

Notes: (1) Marginal effects are mainly reported, t-statistics are reported in parentheses, standard errors are clustered at *Jiedao* level.
(2) ***: significant at the 1% level; **: significant at the 5% level; *: significant at the 10% level.
(3) See Table 1 for variable definitions.

Table 4
Determinants of number of appliances.

	(1) *AIRCON*	(2) *MICROWAVE*	(3) *HEATER*	(4) *WASHING*
ENVIRONMENTALIST	0.0228 (0.73)	0.0132 (0.44)	0.236 (1.54)	0.0231 (1.44)
log (*INCOME*)	0.208*** (6.76)	0.128*** (4.17)	0.362*** (2.79)	0.0792*** (3.47)
log (*EDU*)	0.100 (1.23)	0.0969 (1.31)	0.523 (1.42)	−0.0327 (−0.79)
log (*AGE*)	0.188** (2.29)	0.202** (2.53)	0.168 (0.39)	0.00654 (0.15)
HUKOU	0.123 (1.48)	0.144*** (2.86)	−0.00369 (-0.01)	−0.0165 (−0.41)
HHSIZE	0.0600*** (2.73)	0.0139 (0.67)	0.113 (1.32)	0.00982 (0.83)
log (*HSIZE*)	0.487*** (9.20)	0.0895** (2.21)	−0.460 (−1.37)	0.0906*** (3.50)
log (*HAGE*)	−0.00110 (−0.03)	−0.0256 (−0.95)	0.575** (2.30)	0.0163 (1.52)
DAYTIME	0.00999 (0.31)	−0.0126 (-0.39)	0.238* (1.67)	0.0320 (1.61)
Employment status dummies	Yes	Yes	Yes	Yes
Constant	−5.209*** (−9.49)	−2.887*** (−5.84)	−8.087*** (−3.53)	−1.309*** (−4.12)
Observations	998	998	998	998
Pseudo R^2	0.042	0.007	0.067	0.002
chi2	376.7	71.59	90.76	27.71

Notes: (1) t-statistics are reported in parentheses, standard errors are clustered at *Jiedao* level.
(2) ***: significant at the 1% level; **: significant at the 5% level; *: significant at the 10% level.
(3) See Table 1 for variable definitions.

5.2. Electricity and water consumption

Our next empirical objective is to measure electricity and water consumption differentials across households. For this purpose, we regress expenditure on electricity and water per capita on a number of household attributes, and we also control for some variables that may affect electricity and water consumption. Table 6 reports regression results. In Column (1) the dependent variable is the logarithm of expenditure on electricity per capita. The environmentalist variable is negative and significant at the 90% confidence level, implying that environmentalists consume less electricity. Electricity conservation by environmentalists is about 18.4% compared to non-environmentalist, even though environmentalists do not own fewer appliances (see Table 4). The effects of other household and housing characteristics are as expected. Households with higher incomes consume more electricity, and when there are more household members, it leads to less consumption of electricity per capita. Use of air-conditioning and electric heater contributes to more electricity consumption. Housing size and housing age, however, does not increase electricity consumption.

Table 6
Determinants of electricity and water consumption.

	(1) log (*ELECQ*)	(2) log (*WATERCQ*)
ENVIRONMENTALIST	−0.184** (−2.17)	−0.124** (−2.16)
log (*INCOME*)	0.234*** (2.99)	0.212*** (3.52)
log (*EDU*)	0.0943 (0.38)	0.201 (1.49)
log (*AGE*)	0.0408 (0.17)	0.175 (1.18)
HHSIZE	−0.287*** (−5.16)	−0.246*** (−6.34)
log (*HSIZE*)	−0.120 (−0.76)	0.356*** (4.09)
log (*HAGE*)	−0.102 (−1.31)	0.115** (2.55)
DAYTIME	0.0597 (0.52)	0.0500 (0.82)
AIRCON	0.112** (2.37)	
MICROWAVE	−0.0660 (−0.78)	
HEATER	0.220*** (3.81)	
WASHING	0.116 (0.79)	0.0966 (0.90)
WATER_STYPE		−0.521 (−1.25)
Employment status dummies	Yes	Yes
Constant	3.523** (2.39)	−0.324 (−0.33)
Observations	642	790
Adjusted R^2	0.075	0.106

Notes: (1) t-statistics are reported in parentheses, standard errors are clustered at *Jiedao* level.
(2) ***: significant at the 1% level; **: significant at the 5% level; *: significant at the 10% level.
(3) See Table 1 for variable definitions.

A similar model for water consumption is regressed in Column (2) of Table 6. Most results are consistent with the results from Column (1): environmentalists consume less water, while households with more income and fewer members consume more. However, the housing size and housing age both positively correlated with water consumption, which is intuitive as larger and older houses need more water for cleaning.

5.3. Choice of cars and gasoline consumption

Now we examine households' propensity to own a car and how much gasoline to consume conditional on owning a vehicle. First, we focus on determinants of car ownership. Results of the probit model are listed in Table 7. In Column (1) we only include households' demographics as well as environmental ideology; in Column (2) we include commuting distance (*DISTANCE*), and in Column (3) we include other locational attributes that may affect households' car ownership. Results are robust and consistent with expectations: households' decision on whether to own a car is dominated by a series of household characteristics and commuting distance. Car owners tend to be richer, more educated, have a larger household size, and are younger than non-car owners. Households that believe they have higher social class status are more likely to own car(s). And households that have long distance commute are also more likely to own car(s). Holding these factors constant, we cannot reject the hypothesis that there is no association between environmentalist status and car ownership. But after controlling for commuting distance, the other locational attributes (such as distance to city center, subway station, park and school) do not affect households' car-owning decision, which implies distance has the central role in households' choice of commuting mode.

For car owners, we then focus on their choice of engine size (*ESIZE*). We estimate a Heckman two-step model to simultaneously model the probability that a household owns a car (using the same specification that was used in Column (3) of Table 7) and its engine choice, conditional on ownership. As shown in Column (1) of Table 8, being an environmentalist seems to have no effect on households' choice of size of car engine. Other factors, including whether the householders' work units reimburse the household for gasoline expenditures (*REIMBURSE*), have no significant effect.

Finally, determinants of car owners' gasoline expenditures are investigated. Again, we use a Heckman two-stage technique (Column (2) and Column (3), Table 8). Controlling for other factors

Table 7
Determinants of car ownership.

	(1) *CAR*	(2) *CAR*	(3) *CAR*
ENVIRONMENTALIST	−0.00425 (−0.13)	−0.00847 (−0.26)	−0.00741 (−0.23)
log (*INCOME*)	0.368*** (8.19)	0.364*** (7.74)	0.365*** (7.66)
log (*EDU*)	0.143* (1.80)	0.131 (1.53)	0.131 (1.59)
log (*AGE*)	−0.0708 (−0.68)	−0.0573 (−0.53)	−0.0542 (−0.50)
CLASS	0.0667*** (3.55)	0.0656*** (3.40)	0.0659*** (3.41)
HHSIZE	0.0581** (2.41)	0.0537** (2.15)	0.0529** (2.10)
HUKOU	0.109 (1.63)	0.0933 (1.34)	0.0949 (1.38)
log (*DISTANCE*)		0.0336** (2.47)	0.0331** (2.43)
log (*D_CENTER*)			−0.00626 (−0.28)
log (*D_SUBWAY*)			0.000222 (0.01)
log (*D_PARK*)			0.0136 (0.54)
log (*D_SCHOOL*)			0.00661 (0.18)
Employment status dummies	Yes	Yes	Yes
Observations	998	964	964
Pseudo R^2	0.155	0.151	0.151
chi2	128.9	126.6	131.2

Notes: (1) Marginal effects are mainly reported, t-statistics are reported in parentheses, standard errors are clustered at *Jiedao* level.
(2) ***: significant at the 1% level; **: significant at the 5% level; *: significant at the 10% level.
(3) See Table 1 for variable definitions.

Table 8
Determinants of engine size and gasoline consumption.

	(1) *ESIZE*	(2) log (*GASOLINE*)	(3) log (*GASOLINE*)
ENVIRONMENTALIST	0.00110 (0.06)	−0.107* (−1.92)	−0.108** (−1.99)
log (*INCOME*)	0.0666 (1.38)	0.0503 (0.33)	0.00294 (0.02)
log (*EDU*)	0.0449 (0.84)	−0.109 (−0.65)	−0.141 (−0.86)
log (*AGE*)	0.0297 (0.61)	−0.117 (−0.78)	−0.138 (−0.94)
HHSIZE	−0.00344 (−0.24)	0.0244 (0.55)	0.0269 (0.62)
HUKOU	0.0219 (0.48)	−0.113 (−0.79)	−0.129 (−0.93)
REIMBURSE	0.0101 (0.39)	0.0400 (0.49)	0.0328 (0.41)
log (*DISTANCE)*	−0.0177* (−1.95)	0.0875*** (3.09)	0.100*** (3.62)
log (*D_CENTER)*	−0.0159 (−1.32)	−0.00769 (−0.21)	0.00363 (0.10)
log (*D_SUBWAY*)	0.00275 (0.21)	0.0797** (1.98)	0.0778** (1.98)
log (*D_PARK*)	0.00971 (0.83)	−0.0365 (−1.00)	−0.0434 (−1.23)
log (*D_SCHOOL*)	0.00317 (0.21)	0.00301 (0.06)	0.000753 (0.02)
ESIZE			0.712*** (4.17)
Employment status dummies	Yes	Yes	Yes
Mills Lambda	−0.0356 (−0.49)	−0.0706 (−0.31)	−0.0452 (−0.21)
Observations	318	318	318
chi2	18.98	26.67	45.61

Notes: (1) Marginal effects are mainly reported, t-statistics are reported in parentheses, standard errors are clustered at *Jiedao* level.
(2) ***: significant at the 1% level; **: significant at the 5% level; *: significant at the 10% level.
(3) See Table 1 for variable definitions.

(especially distance for daily commute and engine size), environmentalist households use about 11% less gasoline than those without environmentalists, which is significant at 10% level. We conclude that although the pro-environment cohort does not reject owning and using cars (with bigger engine size), they still prefer to consume less gasoline. For other controls, we find that commuting distance and distance between residence and the nearest subway station are positively correlated with households' gasoline consumption.

6. Conclusion

In this paper, we first investigate whether Chinese urbanites who reveal themselves to be environmentalists based on survey responses consume fewer resources than the average urbanite. In the nascent Chinese urban housing market, we have documented, using micro survey data, that there is a group of environmentalists "walking the walk". Our empirical results show that environmentalists prefer using energy efficient appliances and aim to conserve resources (electricity, water and gasoline), although they still prefer to have more electrical appliances and cars compared to non-environmentalists. Why are some Chinese households "green" while others are not? While this remains an open question, we have documented that income and education correlate with their lifestyles. Given that Chinese urbanites will continue to enjoy improvements in educational attainment and income, this suggests that the consumer "green movement" in China could take root in a similar fashion as in the United States, where we see a subset of consumers driving Prius vehicles and installing solar panels. Our findings indicate that the Chinese government should make more efforts to change households' attitudes to energy conversation and perceptions of the importance of energy efficient appliances, which may help to bring about more sustainable behaviors.

There are of course some limitations to this study. First, we follow the existing literature to construct a measurement for residents' environmental ideology using people's attitudes towards using energy efficient appliances and volunteer activities. However this is imperfect. For instance, people who use EEAs may know more about the efficiency and importance of EEA, which may bring about endogenous issue. Second, it is difficult to know how the residents' environmental ideology is formed, so there may exist omitted variables that can simultaneously influence residents' ideology and lifestyle. Third, due to data limitations, we are not able to control for all the relevant factors in determining household energy consumption, which makes the explanatory power (smaller R^2 of the regressions) of our results seem to be weak. Therefore, the findings in this paper mainly reflect the correlation between residents' environmental ideology and their energy consumption rather than causality.

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