



The Socioeconomic Determinants of Individual Environmental Concern: Evidence from Shanghai Data

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【要約】 This study examines the influence of socioeconomic characteristics on eleven measures of environmental concern by applying a pooled sample of 1200 individuals in Shanghai, China. Previous studies, which made efforts to explain environmental concern as a function of social structure, suggest that there are traditionally five hypotheses (the age, gender, social class, residence, and political hypotheses) for socioeconomic determinants, which are associated with individual environmental concerns. Unlike those methodologies adopted in many previous studies, we apply an ordered probit model to test three hypotheses (the age, gender, and social class hypotheses) in this study. As a result, high income and high education level are found to be positively related to environmental concern as expected. However, we find that in contrast to most of the existing studies, the marginal effect of age on the probability of being environmentally concerned is positive in several measures, implying that the older are more concerned about the environment than the younger. In addition, weak evidences indicate that women are less concerned about the environment than men. Other socioeconomic characteristics such as employment status and household size are not significant in most of the environmental concern measures we defined.

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1. Introduction

Over the past three decades, it has been indicated that the protection of the natural environment has become not only a major social and political issue but also an important assignment in academic research. For many years, both the environmental conservation professionals and the social science academics with interests in environmental conservation have commonly recognized that personal and social awareness, and subsequent concern regarding the quality of the natural environment, are at the heart of environmental protection (Hackett 1993). Although several researchers have attempted to document the changing levels of environmental concern among the general public, the central issue these researchers increasingly addressed has been to determine the social bases of concern for environmental quality (Van Liere and Dunlap 1980). The link between socioeconomic characteristics and environmental concern has been explored by several researchers. Of interest with respect to the present study, the following studies examined the relationships of environmental concern with: the gender (Arcury and Christianson 1990; Davidson and Freudenburg 1996; Dietz et al. 2002; Hunter et al. 2004; Mohai 1992; Schahn and Hotzer 1990; Stern and Dietz 1993); age (Eagly and Kulesa 1997; Howell and Laska 1992; Lyons and Breakwell 1994; Nord et al. 1998); income (Adeola 1994; Antil 1984; Arcury and Christianson 1990; Buttel and Flinn 1974; Koenig 1975; Newell and Green 1997; Samdahl and Robertson 1989); education (Arcury and Christianson 1990; Howell and Laska 1992; Jones and Dunlap 1992; Schahn and Hotzer 1990; Scott and Willits 1994); and household size (Oskamp et al. 1991; Poortinga et al. 2004). They are to identify what type of individual is most concerned about environmental issues. However, the previous studies have not exhibited a consistent result in explaining socioeconomic determinants of individual environmental concern. Given the large number of past studies, the reasons of such mixed results seem to be their sample survey techniques, empirical methodologies, and measures of environmental concern.

The present study aims to investigate the socioeconomic determinants of individual environmental concern in more details. The main contribution of this study is threefold. First, we define eleven environmental concern indices covering general environmental problem as well as specific environmental issues and pro-environmental behaviors. We believe that rather than examining solely the environmental concern in general, adding concern about some specific issues and attitude measures also in the present study would certainly help us learn more about a respondent's true preference towards environmental protection. Second, we apply the data from a recent survey in Shanghai, China. The previous studies focus mainly those individuals in developed countries especially in the U.S. Considering the well known fact of huge differences between China and most western countries, not only on political institutions but also on people's views in various social problems, it is worthwhile and necessary to study the social

bases of individual environmental concern in this country. However, there has been no literature published to date that has examined this issue on Chinese. This blank space must be filled. In addition, we believe that our study based on Chinese individuals would make international comparison between Chinese and their western counterparts possible, which as a result enhances the studies in this field. Third, different from most previous studies which applied analysis of variance (ANOVA), correlation analysis or factor analysis, we adopt an ordered probit model (ORM) in our empirical study due to the characteristics of our measures for environmental concern. Through the ordered probit model, we are able to not only identify which socioeconomic factor determines individual environmental concern, but also discern which factor plays the most important role through predicting each factor's marginal effect on the probability being the most and/or least environmentally concerned individual.

Our empirical results are somewhat different from several previous evidences, especially in terms of *the age hypothesis* (discussed below). We find that in some measures the age is negatively related to the choice of concern as seen in previous studies, however, in some other measures associated with living environmental issues the younger seems to concern less about the environment than the older. In addition, strong evidences indicate that income and education level significantly affect the degree of individual environmental concern. Meanwhile, although the evidence may be somewhat weak, men seem to be more environmentally concerned than women. Other socioeconomic factors such as employment status and household size are not significant in most of the measures.

The rest of the paper proceeds as follows. In Section 2, we review the hypotheses presented in the previous studies. In Section 3, we describe the data issue. We introduce the model specification in Section 4, and report empirical results in Section 5. The limitations of this study, future implication as well as concluding comments are provided in the final section.

2. Review of Hypotheses

Van Liere and Dunlap (1980) and Fransson and Gärling (1999) provide detailed review on five hypotheses (the age, gender, social class, residence, and political hypotheses) about socioeconomic determinants of individual environmental concern. In this section, a brief outline of these hypotheses as well as related empirical findings is presented.

The age hypothesis

The age hypothesis suggested by Van Liere and Dunlap (1980) and Fransson and Gärling (1999) states that younger people tend to concern more about environmental

quality than elders. The majority of previous studies report that the age is negatively correlated with different environmental concern measures they applied, which could be viewed as supportive of the age hypothesis.

The gender hypothesis

The previous studies have been inconclusive about the effects of gender on individual environmental concern. Some studies such as Arbuthnot and Lingg (1975) and Arcury and Christianson (1990) indicate that women are less environmentally concerned than men, while other studies, for example Schahn and Holzer (1990), Mohai (1992) and Hunter et al. (2004), suggest that women do express greater concern for environment than men. These mixed results imply that there is no agreement on the direction of the relationship between gender and individual environmental concern.

The social class hypothesis

The social class hypothesis states that education and income is positively correlated with environmental concern. One explanation for this hypothesis is based on Maslow's hierarchy of needs theory (Maslow 1970). This hypothesis rests on the assumption that concern about environmental quality has the property of luxury goods which can be indulged only after more basic material needs such as adequate food, shelter, and economic security are met (Van Liere and Dunlap 1980). Support for a positive correlation between education and environmental concern has been found in several studies (e.g. Arcury and Christianson 1990; Howell and Laska 1992; Schahn and Hotzer 1990; Scott and Willits 1994). However, concerning the relationship between income and environmental concern, the findings are mixed. For example, one study reports that income is negatively related to the perceptions of environmental problems, as well as the support for environmental regulations and ecological behavior (i.e. Samdahl and Robertson 1989), while another study suggests that income may be positively related to concern about the environment (i.e. Buttel and Flinn 1974). Moreover, most studies indicate that income is not predictive of environmental concern (e.g. Adeola 1994; Antil 1984; Koenig 1975, etc.).

The residence hypothesis

The residence hypothesis states that urban residents are more likely to be environmentally concerned than rural residents. A possible explanation for this difference is given in Fransson and Gärling (1999) that urban residents are more exposed to the signs of environmental deterioration such as air pollution. This hypothesis receives support in several studies (e.g. Arcury and Christianson 1990;

Buttel and Flinn 1974; Howell and Laska 1992, etc.).

The political hypothesis

The political hypothesis assumes that in the U.S., liberals are more environmentally concerned than conservatives. Three possible reasons for this assumption are noted in Dunlap (1975). First, environmental reforms generally are opposed by business and industry which typically support conservatives. Second, an extension of government activities and regulations entailed by environmental reforms is generally opposed by conservatives. Third, environmental reforms often require innovative action which is opposed by conservatives. The evidences supporting this hypothesis can be found in several studies such as Dunlap (1975), Hine and Gifford (1991), Samdahl and Robertson (1989), Howell and Laska (1992), and Daneshvary et al. (1998). However, it has been shown that the relationship between environmental concern and political ideology decreased in the 1980s (Howell and Laska 1992).

3. The Data

Data Collection

The data used in this study are drawn from a field survey on individual's environmental concern in Shanghai, China. The survey was conducted by two professional marketing firms at the beginning of November 2006. One firm called Nikkei Research was in charge of collecting 600 observations from randomly selected Shanghai residents through face-to-face interviews, while another firm called Searchina Research conducted the survey through Internet and collected another 600 valid samples. Both data sets had the same contents, which comprised of a series of questions on different environmental concern measures, attitudes towards tradeoff between environmental consideration and other factors, and information on most common socioeconomic characteristics such as gender, age, education level, occupation, annual household income, and household size. Table 1 summarizes the socioeconomic characteristics of these two samples and pooled sample. Since our main purpose is to examine the socioeconomic determinants of environmental concern, we pool these two data sets in the present study despite slight differences found in between the results of the interviews and Internet samples as shown in the table.

Measures of environmental concern indices

A number of questions are used in the questionnaire to illustrate the different measures

Table 1 Socioeconomic characteristics of the sample

Characteristics	Pooled		Interview		Internet	
	n	%	n	%	n	%
Gender						
Male	583	48.58	300	50.00	283	47.17
Female	617	51.42	300	50.00	317	52.83
Age (years)						
Below 20	22	1.83	0	0.00	22	3.67
20-29	521	43.42	120	20.00	401	66.83
30-39	245	20.42	120	20.00	125	20.83
40-49	140	11.67	120	20.00	20	3.33
50-59	145	12.08	120	20.00	25	4.17
Over 60	127	10.58	120	20.00	7	1.17
Education level						
Elementary school	8	0.67	8	1.33	0	0.00
Junior high school	97	8.08	93	15.50	4	0.67
Senior high school	202	16.83	168	28.00	34	5.67
Technical degree	78	6.50	43	7.17	35	5.83
Undergraduate degree	761	63.42	273	45.50	488	81.33
Graduate degree	54	4.50	15	2.50	39	6.50
Household annual income						
< 30,000 RMB	143	11.92	99	16.50	44	7.33
30,000-49,999 RMB	240	20.00	163	27.17	77	12.83
50,000-69,999 RMB	244	20.33	129	21.50	115	19.17
70,000-99,999 RMB	246	20.50	100	16.67	146	24.33
100,000-149,999 RMB	191	15.92	70	11.67	121	20.17
150,000-199,999 RMB	76	6.33	21	3.50	55	9.17
>200,000 RMB	60	5.00	18	3.00	42	7.00
Household size						
1 person	57	4.75	30	5.00	27	4.50
2 persons	239	19.92	117	19.50	122	20.33
3 persons	635	52.92	313	52.17	322	53.67
4 persons	149	12.42	87	14.50	62	10.33
5 persons	103	8.58	42	7.00	61	10.17
Above 6 persons	17	1.42	11	1.83	6	1.00
Occupation						
Fulltime-employed	872	72.67	350	58.33	522	87.00
Self-employed	43	3.58	42	7.00	1	0.17
Part time	26	2.17	20	3.33	6	1.00
Retired	147	12.25	145	24.17	2	0.33
Student	98	8.17	36	6.00	62	10.33
Unemployed	14	1.17	7	1.17	7	1.17
Total observations	1200	100	600	100	600	100

of individual environmental concern (see Table 2). We gauge three types of measures. The first type is to examine the level of the respondent's concern about general environmental issue (marked as A in Table 2), which is measured with a single question:

Table 2 Summary of environmental concern indices

Description	Mean	S.D.
A. Concern about general environmental problem: 4= concern; 3=somewhat concern; 2=neither concern nor unconcern; 1=not quite concern; 0=not concern	3.468	0.675
B. Concern about global warming problem: 4= concern; 3=somewhat concern; 2=neither concern nor unconcern; 1=not quite concern; 0=not concern	3.219	0.858
C. Concern about cross-boundary pollution and acid rain problem: 4= concern; 3=somewhat concern; 2=neither concern nor unconcern; 1=not quite concern; 0=not concern	3.003	0.995
D. Concern about air/water/soil pollution problem: 4=concern; 3=somewhat concern; 2=neither concern nor unconcern; 1=not quite concern; 0=not concern at all	3.228	0.868
E. Concern about urban energy problem: 4= concern; 3=somewhat concern; 2=neither concern nor unconcern; 1=not quite concern; 0=not concern	3.113	0.899
F. Concern about green land and ecological problems: 4= concern; 3=somewhat concern; 2=neither concern nor unconcern; 1=not quite concern; 0=not concern	3.361	0.821
G. Concern about the effect of harmful substances on health: 4= concern; 3=somewhat concern; 2=neither concern nor unconcern; 1=not quite concern; 0=not concern	3.557	0.761
H. Concern about disposal, reduction and recycling of waste: 4= concern; 3=somewhat concern; 2=neither concern nor unconcern; 1=not quite concern; 0=not concern	3.343	0.795
I. Concern about living environmental problems such as noise/odor: 4= concern; 3=somewhat concern; 2=neither concern nor unconcern; 1=not quite concern; 0=not concern	3.578	0.714
J. Tradeoff between life convenience and environmental conservation: 3=environmental conservation always weighs more; 2=conserve the environment even if sacrificing life convenience to some extent; 1=conserve the environment without sacrificing life convenience; 0=life convenience always has higher priority	1.753	0.787
K. Rank of environmental consideration when buying electronics: 4=Regard its environmental impact as the first issue to consider; 3=Regard its environmental impact as the second issue to consider; 2=Regard its environmental impact as the third issue to consider; 1=Regard its environmental impact as the fourth issue to consider; 0=Consider its environmental impact out of the first four issues	1.810	0.791

“Do you care about the environmental problems”. The answers for this question are coded as five scale points (‘concern’ (1), ‘somewhat concern’ (2), ‘neither concern nor unconcern’ (3), ‘not quite concern’ (4) and ‘not concern’ (5)).¹

¹ In our empirical analysis, we manipulate the answers chosen by the respondents as 4 denoting ‘concern’, 3 denoting ‘somewhat concern’, 2 denoting ‘neither concern nor unconcern’, 1 denoting ‘not quite concern’ and 0 denoting ‘not concern’. Note that this

The second type of measures, which includes eight indices (from B to I in Table 2), aims to indicate individual's concern about specific environmental issues ranged from local pollution problem to global warming. Five scale points that are coded as same as those for general environmental issue is also provided as the answers for these specific environmental issues. One previous study (i.e. Wall 1995) compares two measures of environmental concern (concern about the environment in general and concern about a specific, local environmental issue) and reports that measuring reaction to a specific, local environmental issue and posing economic tradeoffs as a consequence do not result in substantially improved explanatory ability, or more pronounced class differences. In contrast, a recent study (Poortinga et al. 2004) suggests that concern about different specific environmental issues is found to have correlation with different socioeconomic characteristics. In the present study, we believe that it will be more helpful to examine not only the concern about the environment in general, but also to add concern about some specific issues in order to learn more about the respondent's true preference towards environmental protection.

The third type of measures, which comprises of two indices, is the attitude towards pro-environmental behavior (see J and K in table 2). The first index of this type is termed as tradeoff between life convenience and environmental conservation, while the second one is measured by ranking the consideration about environmental impacts when purchasing electronics. The former is asked as a simple question: "How do you consider the issue on environmental conservation in comparison with life convenience". The answers for this question are valued by four scale points ('environmental conservation weighs more' (1), 'conserve environment even if sacrificing life convenience to some extent' (2), 'conserve the environment without sacrificing life convenience' (3), 'life convenience always has higher priority' (4)).² The latter index is asked through four questions and rearranged by the authors. The four questions are stated as: "What is the most important issue you consider firstly when purchasing electronics", "What is the most important issue you consider secondly when purchasing electronics", "What is the most important issue you consider thirdly when purchasing electronics", "What is the most important issue you consider fourthly when purchasing electronics". We provide nine choices including price, daily running cost, design, function, material used, production method, environmental impact, health impact, and other factors for the respondents to select. We mark those who chose environmental impact as the first issue of concern as 4, the second issue of concern as 3, the third issue of concern as 2, the fourth issue of concern as 1, and not chose it as the first four issues of concern as 0. The

manipulation does not alter the estimation results and interpretations.

² The answers are manipulated as 3 for 'environmental conservation weighs more', 2 for 'conserve the environment even if sacrificing life convenience to some extent', 1 for 'conserve the environment without sacrificing life convenience', and 0 for 'life convenience always has higher priority'.

Table 3 Summary of independent variables

Variable name	Description	Mean	S. D.
Female	=1 if female	0.514	0.500
Age	actual age of the respondent	36.133	14.412
High_inc	=1 if household annual income of the respondent is larger than 100,000 RMB	0.273	0.445
Middle_inc	=1 if household annual income of the respondent is between 50,000 and 99,999 RMB	0.408	0.492
High_edu	=1 if the respondent's education level is above undergraduate degree	0.679	0.467
Full-time-employed	=1 if the respondent is full-time-employed	0.726	0.446
Self-employed	=1 if the respondent is self-employed	0.036	0.186
Part-time-employed	=1 if the respondent is part-time employed	0.022	0.146
Household_size	Actual household size	3.044	0.991

above two indices are generated in order to measure the individual's pro-environmental attitude, which in turn indicates environmental concern.

As a summary of the above discussions, we develop eleven indices to measure the degree of individual environmental concern. These measures are to serve as the dependent variables in our empirical analysis conducted below.

Socioeconomic determinants

We provide the description of all the associated socioeconomic characteristics as the independent variables of our empirical model in Table 3. As introduced in Section 2, in order to test the age, gender, and social class hypotheses, we include female, age, household annual income, and education level in the model.³ In addition, we also examine another two socioeconomic factors (employment status and household size) as in Witzke and Urfei (2001), to capture other direct and indirect effects of social factors on the respondent's degree of environmental concern.

A possible problem on whether there is any co-linearity among the independent variables is examined by correlations among these socioeconomic characteristics. Table 4 provides the correlation matrix. Due to the low correlation between any two variables as shown in the table, we believe that the possibility of co-linearity is not a problem in the present study.

³ Since the sample in the present study is strictly urban, therefore, we cannot test *the residence hypothesis* in our empirical analysis. Moreover, due to the political institution in China, *the political hypothesis* is also impossible to be tested.

Table 4 Correlation matrix of independent variables

	Female	Age	High_inc	Middle_inc	High_edu	Full time	Self-employed	Part time	Household size
Female	1.000								
Age	-0.076	1.000							
High_inc	0.011	-0.118	1.000						
Middle_inc	0.017	-0.066	-0.208	1.000					
High_edu	0.018	-0.228	0.256	0.099	1.000				
Full time	-0.014	-0.260	0.145	0.032	0.222	1.000			
Self-employed	-0.073	0.051	0.003	-0.023	-0.117	-0.314	1.000		
Part-time	-0.016	0.025	-0.078	-0.031	-0.143	-0.242	-0.029	1.000	
Household size	0.033	0.030	0.097	0.030	-0.090	-0.008	-0.022	0.057	1.000

4. Model Specification

As mentioned in the previous section, the respondent's choice of concern scenario in the survey is measured on an ordinal scale. Thus, we may describe the choices of concern as a discrete variable y_i . Following our classification, this variable can take one of the following five values

$y_i = 0$, if the degree of concern is chosen as 'Not concern'

$y_i = 1$, if the degree of concern is chosen as 'Not quite concern'

$y_i = 2$, if the degree of concern is chosen as 'Neither concern nor unconcern'

$y_i = 3$, if the degree of concern is chosen as 'Somewhat concern'

$y_i = 4$, if the degree of concern is chosen as 'Concern' ⁴

Then, we assume that the choice of concern is based on a continuous and latent variable y_i^* . This latent variable is assumed to be a linear function of all the socioeconomic variables and given as

$$y_i^* = \beta'X_i + \varepsilon_i \quad \text{for } i = 1, 2, \dots, N \quad (1)$$

where X_i is a vector of independent variables, N is the number of respondents, and ε_i

⁴ Measure J (tradeoff between life convenience and environmental conservation) takes four values as $y_i = 0$ if the answer chosen as 'life convenience always has higher priority', $y_i = 1$ if the answer chosen as 'conserve the environment without sacrificing life convenience', $y_i = 2$ if the answer chosen as 'conserve the environment even if sacrificing life convenience to some extent', and $y_i = 3$ if the answer chosen as 'environmental conservation always weighs more'. Moreover, measure H (ranks of environmental consideration when buying electronics) takes five values as $y_i = 0$ if the electronics' environmental impact is not considered as the first four important issues, $y_i = 1$ if the electronics' environmental impact is considered as the fourth important issue, $y_i = 2$ if the electronics' environmental impact is considered as the third important issue, $y_i = 3$ if the electronics' environmental impact is considered as the second important issue, and $y_i = 4$ if the electronics' environmental impact is considered as the first important issue.

is the error term. Let $\kappa_1 < \kappa_2 < \kappa_3 < \kappa_4$ be unknown cut points or threshold parameters, and define

$$y_i = 0, \text{ if } y_i^* \leq \kappa_1 \quad (2)$$

$$y_i = 1, \text{ if } \kappa_1 < y_i^* \leq \kappa_2 \quad (3)$$

$$y_i = 2, \text{ if } \kappa_2 < y_i^* \leq \kappa_3 \quad (4)$$

$$y_i = 3, \text{ if } \kappa_3 < y_i^* \leq \kappa_4 \quad (5)$$

$$y_i = 4, \text{ if } y_i^* > \kappa_4 \quad (6)$$

Note that the four cut points are estimated along with the coefficients of the independent variables of vector X_i . Consequently, the probabilities of y_i being classified as ‘not concern’, ‘not quite concern’, ‘neither concern nor unconcern’, ‘somewhat concern’, and ‘concern’ are given by

$$\Pr(y_i = 0) = \Pr(\beta'X_i + \varepsilon_i \leq \kappa_1) \quad (7)$$

$$\Pr(y_i = 1) = \Pr(\kappa_1 < \beta'X_i + \varepsilon_i \leq \kappa_2) \quad (8)$$

$$\Pr(y_i = 2) = \Pr(\kappa_2 < \beta'X_i + \varepsilon_i \leq \kappa_3) \quad (9)$$

$$\Pr(y_i = 3) = \Pr(\kappa_3 < \beta'X_i + \varepsilon_i \leq \kappa_4) \quad (10)$$

$$\Pr(y_i = 4) = \Pr(\beta'X_i + \varepsilon_i > \kappa_4) \quad (11)$$

If we assume that the error term ε_i in Eqs. (7) - (11) follows normal distribution, the cut points κ and coefficients β can be estimated as an ordered probit model (ORM) by maximum likelihood method (Greene, 2003; Long, 1997; Wooldridge, 2002). However, it should be noted that when the dependent variable is ordered, estimated parameters do not reflect the marginal effects of an independent variable on probability. Thus, the interpretation of the estimated coefficients in the ordered probit model is unclear. For the sake of this issue, we calculate the associated marginal effects and examine in what direction those effects are exerted.⁵

5. Empirical Results

In this section, we report the empirical results concerning the socioeconomic determinants of individual environmental concern. We estimate the specification for general environmental problem (one index), specific environmental issues (eight indices), and attitude towards pro-environmental behavior (two indices) by using the ordered probit model discussed in the previous section. The results are reported in Tables 5 - 15.⁶

First, concerning the socioeconomic determinants of general environmental concern

⁵ For detailed issues on how to calculate the marginal effects on probability in an ordered probit model, see Greene (2003), Long (1997), and Wooldridge (2002).

⁶ The cut points are estimated but not reported here for the sake of saving space. They are available upon request.

Table 5 Determinants of concern about general environmental problem

Variable	Coefficient	Marginal effects on probabilities				
		y=4	y=3	y=2	y=1	y=0
Female	-0.153(-2.21)**	-0.060	0.039	0.018	0.004	0.000
Age	0.007(2.42)**	0.003	-0.002	-0.001	0.000	0.000
High_inc	0.273(2.80)***	0.106	-0.071	-0.029	-0.006	0.000
Middle_inc	0.062(0.76)	0.025	-0.016	-0.007	-0.001	0.000
High_edu	0.323(3.82)***	0.128	-0.078	-0.040	-0.009	-0.001
Full-time-employed	-0.136(-1.41)	-0.053	0.035	0.015	0.003	0.000
Self-employed	-0.223(-1.16)	-0.089	0.053	0.029	0.007	0.001
Part-time-employed	-0.060(-0.25)	-0.024	0.015	0.007	0.002	0.000
Household_size	-0.051(-1.42)	-0.020	0.013	0.006	0.001	0.000
Log likelihood	-1092.381					
Count R ²	0.613					
Observations	1200					

Note: *z* statistics are in the parentheses. Cut points are not reported here for the sake of saving space. Due to its meaninglessness for Pseudo R² in the ordered probit model, we report Count R², which is the proportion of outcomes correctly predicted by the model. ***, ** and * indicate 1%, 5%, and 10% significance level, respectively.

as shown in Table 5, we find that gender, age, high income, and high education level are significant in the choice of different degrees of environmental concern, while middle income class, employment status, and household size are exhibited to be irrelative to concern about general environmental problem. We note that the model correctly predicts 61.3 percent of the choice even though only four of eleven variables have significant coefficients. In regards to the hypotheses reviewed in Section 2, social class hypothesis is supported in our model, as expected, in which education and income is positively correlated with environmental concern. However, this correlation is only with the outcome of $y = 4$ and not including $y = 3$, i.e. including only ‘concern’ but not ‘somewhat concern’ (see the results of marginal effects on probability in Table 5). Age is found to be positively related to the choice of ‘concern’, which is not supportive of the age hypothesis. A possible reason for this may be due to the fact that we categorize the degree of concern into five levels, which is seldom done by the previous studies. Therefore, it cannot be distinguished whether a respondent measured as an environmentally concerned individual in previous studies actually concerns about the environment entirely or just somewhat. Indeed, our results indicate that for general environmental issue, a one-year increase in age increases the probability of choosing ‘concern’ by 0.003 but decreases the probability of choosing ‘somewhat concern’ by 0.002, holding all other independent variables at their means. In addition, comparing to male, female is found to be relatively less concerned about the environment. As for the issue on which factor is more contributed to individual environmental concern, we compare

Table 6 Determinants of concern about global warming

Variable	Coefficient	Marginal effects on probabilities				
		y=4	y=3	y=2	y=1	y=0
Female	-0.197(-3.00)***	-0.077	0.030	0.029	0.014	0.004
Age	0.003(2.03)**	0.002	-0.001	-0.001	0.000	0.000
High_inc	0.113(2.22)**	0.045	-0.018	-0.017	-0.008	-0.002
Middle_inc	0.024(0.30)	0.010	-0.004	-0.004	-0.002	0.000
High_edu	0.269(3.25)***	0.105	-0.037	-0.041	-0.020	-0.007
Full-time-employed	-0.141(-1.68)*	-0.056	0.023	0.020	0.009	0.003
Self-employed	-0.308(-1.54)	-0.117	0.032	0.048	0.027	0.010
Part-time-employed	0.253(0.96)	0.101	-0.047	-0.035	-0.015	-0.004
Household_size	0.013(0.37)	0.005	-0.002	-0.002	-0.001	0.000
Log likelihood	-1356.595					
Count R ²	0.606					
Observations	1200					

Note: See Table 5.

Table 7 Determinants of concern about cross-boundary pollution and acid rain problem

Variable	Coefficient	Marginal effects on probabilities				
		y=4	y=3	y=2	y=1	y=0
Female	-0.101(-1.99)**	-0.038	0.006	0.016	0.011	0.005
Age	-0.003(-1.04)	-0.001	0.000	0.000	0.000	0.000
High_inc	0.213(2.33)**	0.081	-0.017	-0.033	-0.022	-0.009
Middle_inc	0.084(1.06)	0.031	-0.005	-0.013	-0.009	-0.004
High_edu	0.353(4.25)***	0.128	-0.014	-0.055	-0.041	-0.019
Full-time-employed	-0.018(-0.19)	-0.006	0.001	0.003	0.002	0.000
Self-employed	-0.088(-0.49)	-0.032	0.004	0.014	0.010	0.004
Part-time-employed	0.489(1.86)*	0.191	-0.066	-0.071	-0.040	-0.014
Household_size	0.002(0.06)	0.001	0.000	0.000	0.000	0.000
Log likelihood	-1522.830					
Count R ²	0.611					
Observations	1200					

Note: See Table 5.

the magnitude of marginal effects of each significant variable on the probability of choosing category 4, i.e. 'concern'. We find that education with at least an undergraduate degree, of which the marginal effect's magnitude is about 20% and 410% larger than those of high income and age, plays the most important role in determining individual concern about general environmental problem in Shanghai.

Turning to the issue on concern about specific environmental issues, a number of results are found to be inconsistent with those in concern about general environmental

Table 8 Determinants of concern about air/water/soil pollution problem

Variable	Coefficient	Marginal effects on probabilities				
		y=4	y=3	y=2	y=1	y=0
Female	-0.059(-1.90)*	-0.023	0.009	0.009	0.004	0.001
Age	0.005(2.10)**	0.001	0.000	0.000	0.000	0.000
High_inc	0.126(2.06)**	0.050	-0.019	-0.020	-0.009	-0.003
Middle_inc	-0.043(-0.54)	-0.017	0.006	0.007	0.003	0.002
High_edu	0.245(3.08)***	0.096	-0.032	-0.040	-0.019	-0.006
Full-time-employed	-0.060(-0.62)	-0.024	0.009	0.009	0.004	0.001
Self_employed	-0.103(-0.54)	-0.041	0.013	0.017	0.008	0.003
Part-time-employed	-0.001(-0.00)	0.000	0.000	0.000	0.000	0.000
Household_size	0.016(0.47)	0.006	-0.002	-0.002	-0.001	0.000
Log likelihood	-1371.048					
Count R ²	0.609					
Observations	1200					

Note: See Table 5.

Table 9 Determinants of concern about urban energy problem

Variable	Coefficient	Marginal effects on probabilities				
		y=4	y=3	y=2	y=1	y=0
Female	-0.111(-1.62)	-0.043	0.011	0.020	0.009	0.003
Age	-0.003(-2.30)**	-0.002	0.001	0.001	0.000	0.000
High_inc	0.153(1.67)*	0.059	-0.017	-0.026	-0.012	-0.003
Middle_inc	0.076(0.97)	0.029	-0.008	-0.013	-0.006	-0.002
High_edu	0.192(2.41)**	0.073	-0.016	-0.034	-0.017	-0.005
Full-time-employed	0.016(0.18)	0.006	-0.002	-0.003	-0.001	0.000
Self_employed	-0.186(-0.97)	-0.069	0.012	0.033	0.018	0.006
Part-time-employed	0.057(0.27)	0.022	-0.006	-0.010	-0.005	-0.001
Household_size	0.050(1.94)*	0.019	-0.005	-0.009	-0.004	-0.001
Log likelihood	-1440.691					
Count R ²	0.577					
Observations	1200					

Note: See Table 5.

problem (see the estimated results in Tables 6 - 13). First, there is no effect of gender on individual environmental concern in such issues as urban energy problem, green land and ecological problems, the effect of harmful substances on health, disposal/reduction/recycling of waste, and living environment problems. It may be true that male and female are almost same in these local and personal environmental issues. Additionally, men are found to be more concerned about some 'purely' environmental problems (global warming, cross-boundary pollution and acid rain, and air/water/soil pollution). Second, age is a significant and negative factor for choosing 'concern' in

Table 10 Determinants of concern about green land and ecological problems

Variable	Coefficient	Marginal effects on probabilities				
		y=4	y=3	y=2	y=1	y=0
Female	0.001(0.02)	0.001	0.000	0.000	0.000	0.000
Age	0.007(3.42)***	0.003	-0.002	-0.001	0.000	0.000
High_inc	0.117(1.85)*	0.046	-0.023	-0.014	-0.007	-0.002
Middle_inc	-0.007(-0.09)	-0.003	0.001	0.001	0.000	0.000
High_edu	0.226(2.69)***	0.089	-0.041	-0.029	-0.016	-0.004
Full-time-employed	-0.085(-1.84)*	-0.034	0.016	0.011	0.005	0.001
Self-employed	-0.189(-1.75)*	-0.075	0.032	0.025	0.014	0.004
Part-time-employed	-0.246(-1.00)	-0.098	0.041	0.033	0.019	0.005
Household_size	-0.035(-0.97)	-0.014	0.007	0.004	0.002	0.001
Log likelihood	-1262.282					
Count R ²	0.590					
Observations	1200					

Note: See Table 5.

Table 11 Determinants of concern about the effect of harmful substances on health

Variable	Coefficient	Marginal effects on probabilities				
		y=4	y=3	y=2	y=1	y=0
Female	0.015(0.21)	0.005	-0.003	-0.002	-0.001	0.000
Age	0.006(1.91)*	0.002	-0.001	-0.001	0.000	0.000
High_inc	0.099(2.94)***	0.035	-0.019	-0.010	-0.004	-0.001
Middle_inc	-0.033(-0.36)	-0.012	0.006	0.003	0.002	0.001
High_edu	0.253(2.78)***	0.091	-0.047	-0.028	-0.013	-0.004
Full-time-employed	0.049(0.49)	0.017	-0.009	-0.005	-0.002	-0.001
Self-employed	0.460(1.92)*	0.143	-0.086	-0.039	-0.015	-0.004
Part-time-employed	-0.090(-0.34)	-0.032	0.017	0.010	0.005	0.001
Household_size	-0.085(-2.28)**	-0.030	0.016	0.009	0.004	0.001
Log likelihood	-1053.016					
Count R ²	0.735					
Observations	1200					

Note: See Table 5.

urban energy problem, waste problem, and living environment problems, while it is positively contributed to concern about global warming issue, air/water/soil pollution, green land and ecological problems, and the effect of harmful substances on health. It seems that the younger generation in Shanghai pays more attention to environmental problems closely associated with living, while the older generation concerns more about 'purely' environmental problems and some issues affecting their health. Third, compared to the result in general environmental problem model, employment status

Table 12 Determinants of concern about disposal, reduction, and recycling of waste

Variable	Coefficient	Marginal effects on probabilities				
		y=4	y=3	y=2	y=1	y=0
Female	-0.014(-0.21)	-0.006	0.003	0.002	0.001	0.000
Age	-0.006(2.17)**	0.002	-0.001	-0.001	0.000	0.000
High_inc	0.197(2.09)**	0.078	-0.041	-0.027	-0.008	-0.004
Middle_inc	0.095(1.16)	0.038	-0.019	-0.013	-0.004	-0.002
High_edu	0.147(2.02)**	0.059	-0.028	-0.021	-0.006	-0.003
Full-time-employed	-0.090(-0.95)	-0.036	0.018	0.013	0.004	0.002
Self-employed	-0.031(-0.15)	-0.012	0.006	0.004	0.001	0.001
Part-time-employed	0.022(0.08)	0.009	-0.004	-0.003	-0.001	0.000
Household_size	0.014(0.41)	0.006	-0.003	-0.002	-0.001	0.000
Log likelihood	-1259.860					
Count R ²	0.557					
Observations	1200					

Note: See Table 5.

Table 13 Determinants of concern about living environmental problems

Variable	Coefficient	Marginal effects on probabilities				
		y=4	y=3	y=2	y=1	y=0
Female	-0.020(-0.28)	-0.007	0.004	0.002	0.001	0.000
Age	-0.007(2.39)**	0.003	-0.002	-0.001	0.000	0.000
High_inc	0.047(2.18)**	0.017	-0.010	-0.004	-0.001	-0.001
Middle_inc	0.008(0.12)	0.004	-0.002	-0.001	0.000	0.000
High_edu	0.117(2.30)**	0.042	-0.026	-0.011	-0.004	-0.002
Full-time-employed	-0.166(-1.62)	-0.058	0.037	0.014	0.005	0.002
Self-employed	0.332(1.32)	0.108	-0.072	-0.025	-0.008	-0.004
Part-time-employed	-0.194(-0.74)	-0.072	0.041	0.020	0.007	0.004
Household_size	-0.021(-0.55)	-0.007	0.005	0.002	0.000	0.000
Log likelihood	-1020.927					
Count R ²	0.728					
Observations	1200					

Note: See Table 5.

and household size are found to be significant in several cases. For example, the self-employed respondents concern more about the effect of harmful substances on health (see Table 11), an one-person increase in household significantly increases the probability of choosing 'concern' about urban energy problem by 0.019 (see Table 9), and respondents are found to be less concerned about green land and ecological problems if they are employed full-time or self-employed (see Table 10).

In addition, in all eight models for specific environmental problems, other two socioeconomic characteristics (high income and high education) show consistent results

Table 14 Determinants of tradeoff between life convenience and environmental conservation

Variable	Coefficient	Marginal effects on probabilities			
		y=3	y=2	y=1	y=0
Female	-0.187(-2.85)**	-0.053	-0.021	0.071	0.003
Age	-0.005(-1.99)**	-0.001	-0.001	0.002	0.000
High_inc	0.478(5.03)***	0.145	0.038	-0.177	-0.007
Middle_inc	0.362(4.41)***	0.104	0.038	-0.136	-0.006
High_edu	0.059(2.22)**	0.016	0.007	-0.022	-0.001
Full-time-employed	-0.225(-2.61)***	-0.066	-0.022	0.084	0.004
Self-employed	-0.620(-3.25)***	-0.131	-0.109	0.217	0.023
Part-time-employed	-0.328(-1.08)	-0.080	-0.051	0.121	0.009
Household_size	-0.055(-1.59)	-0.015	-0.006	0.021	0.001
Log likelihood	-1282.672				
Count R ²	0.616				
Observations	1200				

Note: See Table 5.

Table 15 Determinants of ranks of environmental consideration when buying electronics

Variable	Coefficient	Marginal effects on probabilities				
		y=4	y=3	y=2	y=1	y=0
Female	-0.090(-1.32)	-0.008	-0.010	-0.010	-0.006	0.034
Age	-0.003(-0.91)	0.000	0.000	0.000	0.000	0.001
High_inc	0.168(1.71)*	0.016	0.020	0.018	0.011	-0.065
Middle_inc	0.095(1.08)	0.009	0.011	0.010	0.007	-0.036
High_edu	0.097(3.59)***	0.009	0.011	0.010	0.007	-0.037
Full-time-employed	-0.133(-1.48)	-0.013	-0.016	-0.014	-0.009	0.052
Self-employed	-0.505(-2.53)**	-0.031	-0.048	-0.053	-0.044	0.176
Part-time-employed	-0.347(-1.23)	-0.024	-0.035	-0.037	-0.029	-0.125
Household_size	0.005(0.14)	0.000	0.001	0.001	0.000	-0.002
Log likelihood	-1412.001					
Count R ²	0.658					
Observations	1200					

Note: See Table 5.

with those in concern about general environmental issue. Meanwhile, the predictive power indices (Count R²) of all the models are from 55.7 percent to 73.5 percent, which are within a statistically acceptable range. Moreover, as in the case of general environmental issue, education level is also found to be the most influential factor in choosing 'concern' among all the significant variables in most of the cases.⁷

⁷ Exceptions can be found in model C (Table 7), model G (Table 11), and model H (Table 12), which the magnitude of marginal effect of high education on probability of choosing

Let us examine our third type of measure: attitude towards pro-environmental behavior. The estimated results are presented in Tables 14 and 15. Concerning the first index (i.e. tradeoff between life convenience and environmental conservation), we find that although the magnitude is small, both the estimated marginal effects of age on probabilities of choosing 'environmental conservation always weighs more' and 'conserve the environment even if sacrificing life convenience to some extent' are consistent with the age hypothesis proposed by Van Liere and Dunlap (1980) and Fransson and Gärling (1999). Meanwhile, besides high income and high education, the respondents belonging to middle income class also indicate that, compared with the low income group, they are more likely to conserve the environment than considering life's convenience. The significantly negative marginal effects of female, full-time employed, and self-employed on probabilities of choosing 'environmental conservation always weighs more' or 'conserve the environment even if sacrificing life convenience to some extent' indicate that female or full-time employed or self-employed respondents are relatively less willing to sacrifice their life's convenience. Turning to the second index (i.e. rank of environmental consideration when buying electronics), only high income, high education, and self-employed are estimated as significant determinants. It should be noted that unlike the case of other environmental concern measures, the marginal effect of income on choice probability is larger than that of education level in the cases of the above two 'attitude' measures. This difference implies that when facing a tradeoff between environmentally friendly behavior and other factors, income, rather than education, plays a relatively more important role.

As a summary of the above empirical results, we find that income and education level are the two consistent determinants of each environmental concern measure defined in the present study. Age is a significant factor in most of the measures with either positive or negative signs. The mixed results of age factor imply that the effect of age on environmental concern depends heavily on which measure is used. Additionally, men are found to be more concerned about environment than women in five of eleven indices. Other socioeconomic characteristics such as employment status and household size hardly exhibit any significant roles in determining the degree of concern.

6. Conclusion

In this study, we present an empirical analysis on examining what the roles of different socioeconomic characteristics are in determining individual environmental concern, by applying data recently collected in Shanghai. A part of the results of this study seems to complement previous results, which indicate that individuals with high education

'concern' is the second largest one, comparing to other significant variables.

and/or high income are more concerned about the environment as a group. These two socioeconomic characteristics of high education and high income are especially consistent and robust in all the environmental concern measures defined in the present study. In addition, the results of testing the gender hypothesis weakly support that men in Shanghai are more concerned about the environment than woman in several measures. One finding of this study, which is contrary to most previous studies, is that in five of the measures, the marginal effects of age on the probability of choosing 'concern' are estimated as significant with positive signs, implying that the older generation is more concerned about the environment. Although a number of socioeconomic characteristics such as gender, age, income, and education level are found to be important determinants of individual environmental concern, other factors such as employment status and household size are almost irrelative.

It should be noted that the results and findings of this study are mainly based on the environmental concern measures applied. Therefore, future studies should employ more multiple measures of environmental concern to help ensure the validity of the findings. In addition, because the current sample is strictly urban and only drawn from Shanghai, it cannot be viewed as a representative of all Chinese, considering the large differences among different provinces in China. Consequently, to examine the socioeconomic determinants of environmental concern for entire Chinese population will require the collection of samples from other urban and rural areas. Finally, concerning an econometric technique issue, we treat the eleven environmental concern measures separately by applying the ordered probit model in this study. With the possible correlations among these measures, it may be more appropriate to use a multivariate ordered probit model with eleven equations being simultaneously estimated. This modeling, however, cannot be run by today's most statistical software. We leave the programming of this model as our future task to be solved.

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