The value of natural capital and its determinants in Japan

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1. Introduction

Recently in Japan, natural capital has been gaining attention to researchers and policy makers to realize sustainability (Kumagai and Managi, 2018). Previous studies have investigated the value of various types of ecosystems that construct natural capital by meta-analysis (Costanza et al., 2014). Other studies have investigated the value of specific areas or species. Although these studies have provided information on either the global value of natural capital or the local value of specific items, there is little evidence on the exhaustive values of natural environment in a specific country, which will provide useful information for the national policy makers. We investigated Japanese individuals' perceived value of the various types of Japanese-specific natural environment.

2. Methodology

We analyzed the determinants of WTP to maintain the various types of the elements that construct natural capital using the original data collected from a Japanese nationwide survey through internet that we conducted in February 2019. We applied to contingent valuation method (CVM) to elicit individuals' WTP to maintain Japanese natural capital. Payment card method was employed. Even after deleting the protest responses from the analytical sample, approximately 20% of the respondents still showed zero WTP to most of the items.

In recent empirical studies, zero-inflated ordered probit (ZIOP) model has been applied to ordinal dependent variables (Harris and Zhao, 2007). Some studies have shown the superiority of ZIOP regression to traditional ordered probit in providing less biased estimates when an ordinal dependent variable exhibits a high fraction of observations at zero (Bagozzi et al., 2012). This model assumed two latent dependent variables through the process of estimation. The latent variable model is represented as the following equations:

$$r^* = \boldsymbol{x}'\boldsymbol{\beta} + \varepsilon, \tag{1}$$

$$y^* = \boldsymbol{z}'\boldsymbol{\gamma} + u, \tag{2}$$

$$y = \begin{cases} 0 & \text{if } r^* \le 0 \quad \text{or} \quad y^* \le 0, \\ j & \text{if } 0 < r^* \quad \text{and} \quad \mu_{j-1} < y^* \le \mu_j \ (j = 1, ..., J-1), \\ J & \text{if } 0 < r^* \quad \text{and} \quad \mu_{J-1} < y^*, \end{cases} \tag{3}$$

where r^* is a latent variable representing the propensity for participation in the WTP decision, $\boldsymbol{x}$ is a vector of determinants of the participation with unknown parameters $\boldsymbol{\beta}$, y^* is a latent variable related to an ordinal variable y taking on the values $\{0, 1, 2, \ldots, J\}$, $\boldsymbol{z}$ is a vector of determinants of y with unknown parameters $\boldsymbol{\gamma}$, ε and u are standard-normally distributed error terms, and μ_j ($j = 1, \ldots, J-1$) are unknown threshold parameters. The unknown parameters can be estimated by maximum likelihood estimation. As explanatory variables $\boldsymbol{x}$ and $\boldsymbol{z}$, we included sociodemographic variables shown in the next section.

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3. Results

Table 1 shows the results of ZIOP regression. Explanatory variables are as follows: the dummy for female (Female); respondents' age (Age); the dummy for university graduate (Graduate); the number of family members (Household size); the number of children (Child); the dummy for worker (Worker); yearly income (10,000 yen) per household (Income); the dummy for living in Tokyo 23 wards or designated cities (Urban); the frequency of visiting the targeted place (Frequency); perceived importance of maintaining the targeted place (Importance). The results show that male and younger respondents with smaller household size and higher household income are likely to show higher WTP to maintain the most of the elements of natural capital that we asked the respondents to value. The frequency of visits and perceived importance are also likely to increase WTP.

Table 1. γ estimates of ZIOP regression.

VARIABLES	Paddy field	Crop field	Orchard	Pasture	Planted forest	Natural forest	Seaside protection forest
Female	–0.133***	–0.148***	–0.146***	–0.115***	–0.0961**	–0.0788**	–0.0800**
Age	–0.00197	–0.00280*	–0.00422***	–0.00242	–0.00341**	–0.00337**	–0.00375***
Graduate	0.0467	0.0338	0.0194	0.0616	0.0618	0.0660*	0.0290
Household size	–0.0132	–0.0181	–0.0266	–0.0327*	–0.0348*	–0.0321*	–0.0327*
Child	0.00591	0.0167	0.0216	0.0389	0.0102	0.0126	0.00895
Worker	0.0146	0.0414	0.0524	0.0625	–0.0143	0.00299	–0.00981
Income	0.000448***	0.000456***	0.000460***	0.000446***	0.000418***	0.000411***	0.000450***
Urban	–0.0152	0.00744	0.000499	–0.0119	0.0141	–0.00143	0.0234
Frequency	0.143***	0.129***	0.142***	0.188***	0.0956***	0.116***	0.113***
Importance	0.174***	0.106**	–0.0570	–0.0349	0.0598	0.0788**	0.0556
Observations	4,437	4,440	4,427	4,423	4,440	4,452	4,440

Table 1. (continued)

VARIABLES	Coral reef	Mangrove	Seaweed bed	Tidal flat	Sand beach	Fishing ground	Natural environment in Japan
Female	–0.0659*	–0.102***	–0.114***	–0.135***	–0.0617	–0.144***	–0.108***
Age	–0.000566	–0.00213	–0.00390***	–0.00303**	–0.000836	–0.00241*	0.00216*
Graduate	0.0686*	0.0541	0.0470	0.0102	0.0847**	0.0528	0.0756**
Household size	–0.0392**	–0.0439**	–0.0416**	–0.0370**	–0.0503***	–0.0441**	–0.0248
Child	0.0574**	0.0235	0.0106	0.0130	0.0621**	0.0130	0.0207
Worker	–0.0151	0.0446	0.0678	0.0829*	–0.0170	0.0548	0.0275
Income	0.000407***	0.000425***	0.000461***	0.000402***	0.000427***	0.000424***	0.000536***
Urban	–0.0417	0.0120	0.0301	0.0438	–0.0318	–0.0100	–0.0316
Frequency	0.160***	0.124***	0.0931***	0.112***	0.153***	0.0841***	
Importance	0.0758*	0.143**	0.192***	0.0182	0.309***	0.0940**	
Observations	4,423	4,397	4,397	4,402	4,414	4,404	4,499

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

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