Natural disasters and participation in volunteer activities: A case study of the Great Hanshin-Awaji earthquake.

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Abstract

The Great Hanshin-Awaji (Kobe) earthquake in 1995 has had a significant detrimental effect on the economic conditions of southern-central Japan. However, the earthquake also led people to acknowledge the importance of the many volunteer activities in Japan at that time. Using a large sample of individual-level data from 1991 and 1996, this study investigates how and the extent to which the earthquake increased the participation of students and house-workers in volunteer activities. After controlling for various individual characteristics, a Heckman-Tobit model was used and the following key findings were obtained: (1) the probability of students' participating in volunteer activities was 2% higher after the earthquake than before, and (2) the number of days that students spent participating in volunteer activities was 4.38 days longer after the earthquake than before. However, the same did not hold true for house-workers.

JEL classification: N35, Q54, Z13

Keywords: Natural disasters, social capital, volunteer activities.

1. Introduction

A growing number of works have focused on natural disasters, and a popular issue now in social science is how to cope with unforeseen events (e.g., Albala-Bertrand, 1993; Tol and Leek, 1999; Congleton, 2006; Shughart, 2006; Skidmore and Toya, 2002; Toya and Skidmore, 2007, 2010; Cavallo et al., 2010). For instance, the Great Hanshin-Awaji (Kobe) earthquake occurred in 1995, and in response to the earthquake, economic researchers analyzed the outcomes of the earthquake and suggested various policy implications (e.g., Horwich, 2000; Sawada, 2007; Sawada and Shimizutani, 2007; 2008;). The function of the market and the role of government are considered important in disaster prevention and in coping with disaster. In addition, the level of damage caused by disasters obviously depends on institutional conditions (Kahn, 2005). Hence, social capital such as social networks and community participation appear to contribute to the prevention of and resilience to natural disasters (Chamlee-Wright, 2010; Yamamura, 2010).

In the wake of the Great Hanshin-Awaji earthquake, many people, especially young people (generally students), arrived in Kobe to participate in volunteer activities. This was the first time in Japan that such a large number of people had come forward as volunteer workers. Therefore, 1995 is regarded as "the first year of volunteer activity" in Japan. The earthquake has resulted in Japanese residents acknowledging the importance of the role played by volunteer activities (Waseda University Social Science Institute, 1996). This may be a reason why so many people without question joined the volunteer activities in response to the eastern Japan earthquake in 2011. Thus, unforeseen disastrous events have triggered cooperation and collective action for disaster-prevention and resilience.[1] After the Hanshin-Awaji earthquake, students and house-workers were especially encouraged to take action. From an economic viewpoint, this may have been because their opportunity cost was relatively smaller than workers in paid employment. However, the argument that the Hanshin-Awaji earthquake became the catalyst for volunteer participation has not been assessed based using close

[1] In Japan, homeownership and neighbors influence the degree of participation in community activities (Yamamura 2011a, 2011b).

statistical analysis.[2] Hence, this paper used a "Survey of Time Use and Leisure Activities" (STULA) to explore how and the extent to which the Hanshin-Awaji earthquake impacted on individuals' volunteer activities. This survey provided individual-level data and consisted of 375,676 observations. This paper's analysis has the advantage of using a rich data set.

The remainder of this paper is organized as follows. Section 2 provides an overview of the Great Hanshin-Awaji earthquake. Section 3 explains the data set and the empirical method used. Section 3 provides the estimation results. The final section offers some conclusions.

2. Overview of the Great Hanshin-Awaji earthquake

On January 17, 1995 an unprecedented devastating earthquake occurred in southern-central Japan (the Hanshin-Awaji area). Kobe, a densely populated city and an important hub port in western Japan, suffered the greatest damage above all other areas. Figure 1 shows Kobe's location in the south-eastern area of the Hyogo Prefecture, Hanshin-Awaji. Japan's earthquake scale ranges from level 1 (weak) to level 7 (devastation)—most of Kobe was categorized as level 7 in the Great Hanshin-Awaji earthquake (Ministry of Land, Infrastructure, Transport and Tourism 1996, p. 3). As a consequence of the earthquake, the death toll reached 6,308. Further, approximately 100,000 homes were destroyed and 33,000 suffered partial destruction. The loss of housing was valued at more than US$60 billion, and that of capital stock exceeded US$100 billion (Horwich, 2000; Sawada and Shimizutani, 2007, 2008). The government's initial response was slow, and this later drew criticism. In contrast, young people came to Kobe from various parts of Japan to serve as volunteer workers. It is widely acknowledged that informal volunteer activities are more flexible than formal institutions and can make considerable contributions in the event of natural disasters.

[2] Fukushige (2010) used individual-level data to ascertain the determinants of participation in volunteer activities for middle-aged and advanced-age respondents. However, that data was limited to people over 40 years old and in selected areas. Furthermore, the sample size was smaller than 1,000 in each area. In addition, Fukushige (2010) used aggregated-level data for examination purposes, and was constructed using whole generations in Japan. However, because of data limitations, individual characteristics were not controlled.

3. Data and Methods

3.1. Data

In this paper, I used individual-level data sourced from STULA. Based on the data provided, I constructed various variables to be used for statistical estimations. The Japanese Government (Ministry of Internal Affairs and Communications, Statistical Bureau in Japan) began conducting STULA in 1976. These surveys are held every 5 years. The survey includes observations randomly chosen from almost all regions throughout Japan. Surveys have been conducted in 1991, 1996, 2001, 2006, and 2011,[3] when STULA was limited to the period after 1990s. The survey is conducted in October of the survey year, and in 1996 STULA was conducted approximately 18 months after the earthquake. With the aim of assessing the impact of the earthquake on individuals' behavior, this paper compares participation rates in volunteer activities before and after the Great Hanshin-Awaji earthquake. Hence, STULA data from 1991 and 1996 are used in this paper. In addition to issues regarding social activities, STULA asks standard questions concerning individuals' characteristics. The data includes information relating to marital status, age, gender, annual household income, and education level. Combined data from 1991 and 1996 were gathered from approximately 396,332 respondents aged over 15 years old. However, not all respondents answered all of the survey questions. Inevitably, data regarding some variables used in the estimations were not available. As a consequence, the number of samples used in the regression estimations was reduced to 375,676.

The key variable, the proxy for the degree of participation in volunteer activities, is defined as follows: in the STULA questionnaire respondents were asked "Did you participate in any volunteer work within a year?" The possible responses to this question were "Yes" or "No". If respondents choose "Yes", they were asked "How many days did you participate in volunteer activities within a year?" There were 7 possible responses to this question: "1–4 days", "5–9 days", "10–19 days", "20–39 days", "40–99 days", "100–199 days" and "more than 200 days". The interval of the responses differed according to the various categories. The distribution of the

[3] Individual-level data could only be accessed for 1991, 1996, and 2001.

participation in volunteer activities is presented in Table 1. Table 1 shows that 77.8% of respondents did not take part in volunteer activities. Further, 14.6% of respondents participated in activities from 1 to 4 days. Hence, the share of those who participated in activities for more than 5 days was less than 10%. Based on the interval data of the volunteer activities, I constructed a proxy for the degree of volunteer activities as follows: I assumed that the days in which everyone in each category participated in the activities as the midpoint value. For instance, a value of 2.5 days was assigned for those in the "1–4 days" category. In the case that respondents did not participate at all, a value of 0 was assigned. In contrast, the "more than 200 days" category results in the problem of top-coding. I solved that problem as follows: one can participate in the activities for 365 days at best within a year. Hence, for the "more than 200 days" category, I assigned a value of 282.5, which is the mid-value of 200 and 365.

In the original data set, as illustrated in Figure 2, the various ages were grouped into 15 categories. The groups representing respondents in their 40s are the largest. In addition to those aged 40–44, 45–49, and 35–39 (the three largest age groups), the 15–19 year age group is also large, with a distribution of more than 0.08. The 15–19 age group basically represents students. Hence, the 15–19 age group is sufficiently large to justify analysis. Further, as illustrated in Figure 3, annual earnings were grouped into 12 categories. In the estimations reported in Tables 4(1) and (2), dummies for age group and household income groups were included.[4] The other variables used in the regression estimations are shown in Table 2. With the exception of *Volunteer*, which is the number of days spent participating in volunteer activities, the variables in Table 2 are dummy variables. Definitions and the share of each dummy variable are presented in Table 2. With regard to social position, such as *Student* and *House* (house-workers), the original data set showed 6 categories: workers (those who have full-time jobs), student (without job), student (with part-time job), house-workers (without jobs), house-workers (with part-time jobs), others (without jobs). *Student* consists of both student (without job) and student (with part-time job). *House* consists of house-workers (without jobs) and

[4] Education level was grouped into 9 groups, including current students at junior high school, high school, junior college, university, and graduates from junior high school, high school, junior college, university, and others. Their dummies are also included as independent variables in the estimations.

house-workers (with part-time jobs). *Workers* are workers (those who have full-time jobs).

Table 3 compares *Volunteer* between 1991 and 1996. With respect to the results based on the whole sample, Table 3(1) shows 2.23 days for 1991 and 2.25 days for 1996. The difference is not statistically significant. As for the sub-sample of students, Table 3(2) shows 0.43 and 0.59 for 1991 and 1996, respectively. This suggests that the number of days that students spent doing volunteer activities is distinctly less than those for the whole sample. However, *Volunteer* for student is 0.16 days more in 1996 than in 1991 and statistically significant at the 5% level. It follows then that students are less likely to participate in volunteer activities than other groups but the Hanshin-Awaji earthquake increased students' volunteer participation rate. Further, concerning house-workers, Table 3(3) shows 2.76 and 2.95 for 1991 and 1996, respectively. This suggests that the number of days that house-workers spent doing volunteer activities is slightly more than those for the whole sample. In addition, *Volunteer* for house-workers is 0.19 more in 1996 than in 1991 and statistically significant at the 10% level. The combined results of Tables 3(1), (2) and (3) suggest that overall the participation rates in volunteer activities did not differ before and after the earthquake. However, when focusing only on students and house-workers, whose opportunity cost was relatively smaller than workers, those two groups were more likely to participate in volunteer activities after the earthquake than before.

4.2. Econometric framework and estimation strategy

The estimated function of the baseline model takes the following form:

$$Volunteer_i = \alpha_0 + \alpha_1 Student_i * 1996\ dummy_i + \alpha_2 House_i * 1996\ dummy_i + \alpha_3 Student_i + \alpha_4 House_i + \alpha_5 1996\ dummy_i + \alpha_6 Marry_i + \alpha_7 Male_i + \alpha_8 Urban_i + \alpha_9 Owner_i + u_i,$$

where $Volunteer_i$ represents the dependent variable in individual i. Regression parameters are represented by α. The error term is represented by u_i. As shown in Table 1, $Volunteer_i$ takes 0 for approximately 80% of observations. An individual's decision-making is considered in two-steps. First, an individual will participate in volunteer activities or not. Second, an individual will consider the degree to which he/she will participate. In such a situation, selection bias will occur if a simple OLS model is used. Hence, the Heckman Tobit model is more appropriate to control for selection bias. Using the Heckman Tobit model, in the first step, a Probit estimation is used to estimate the decision to participate or not. In the second step, the OLS model is used to examine the number of days spent doing volunteer activities for those who decided to participate.

A cross term including the key variables of $Student_i$ **1996 dummy* and $House_i$ **1996 dummy* $_i$ was incorporated to capture the effect of the Hanshin-Awaji earthquake on participation rates in volunteer activities for students and house-workers, respectively. If their coefficient signs are positive, then they are more likely to participate in volunteer activities after the earthquake than before. In addition, there are a number of factors that may affect an individual's propensity to engage in volunteer activities. Married people seem to be more integrated into the community and social networks, and hence, *Marry* is expected to take the positive sign. In urban areas, the opportunity cost of residents engaging in volunteer activities is higher because there are opportunities to obtain higher earnings. Hence, *Urban* is predicted to take the negative sign. *Owner* represents house ownership, and is included because people who own their homes are more inclined to be "good citizens" and participate in community activities (DiPasquale and Glaeser, 1999; Yamamura, 2011a). The expected sign of *Owner* is positive.

The opportunity cost for full-time workers participating in volunteer activities is very high. Full-time workers work weekdays, which impose severe time constraints on volunteer activities. Hence, full-time workers are less likely to participate in volunteer activities. In addition to *Student* and *House,* in the first stage of the Heckman Tobit model, *Workers* is included as an independent variable whereas *Workers was* excluded from the second-stage estimation. Hence, in the first stage, "Others (without job)" is used as the reference group.

4. Estimation Results

In Table 4(1), the results of the simple OLS model are shown in column (1), and the results of the second-stage estimation using the Heckman Tobit model are reported in column (2). Table 4(2) shows the results of the first-stage estimation of the Heckman Tobit model.

Column (1) of Table 4(1) shows that the cross term of *Student*1996 dummy* yields the positive sign and is statistically significant at the 5% level. In addition, the absolute value is 0.22, which implies that the number of days spent participating in volunteer activities in 1996 is 0.22 days longer than in 1991. However, this result is likely to be influenced by selection bias and therefore care should be called for when interpreting these results. In contrast, *House*1996 dummy* is not statistically significant although it yields the predicted positive sign. This implies then that there was no difference in the number of days spent by house-workers participating in volunteer activities between 1991 and 1996.

As discussed earlier, the OLS regression results appear to suffer from selection bias. Hence, the bias was controlled for and the second-stage results of the Heckman Tobit estimation are shown in column (2) of Table 4(1). The cross term of *Student*1996 dummy* yields the positive sign and is statistically significant at the 1% level. What is more, the absolute value is 4.38, which implies that the number of days spent participating in volunteer activities in 1996 is 4.38 days longer than in 1991. This means that result for *Student*1996 dummy* in the simple OLS estimation suffered a downwards bias. *House*1996 dummy* is not statistically significant and takes an unpredicted negative positive sign. The other control variables exhibited statistical significance in all columns. In line with the prediction, *Marry* and *Owner* yield the positive sign. The absolute value of *Marry* is 9.40, and can be interpreted as meaning that married people are more inclined to participate in volunteer activities for a further 9.40 days than others. The absolute value for *Owner*, 3.53, means that home owners will participate in volunteer activities for an extra 3.53 days. In contrast, *Urban* yields the predicted negative sign. The absolute value for *Urban* is 5.35, and suggests that residents of urban areas are less likely to participate in volunteer activities, volunteering 5.35 days less than others. Turning to results of the first-stage estimation using the Heckman Tobit model, in Table 4(2), the cross term for *Student*1996 dummy* yields the positive sign and is statistically significant at the 1% level. Further, its absolute value shows a marginal effect of 0.02, thus, the probability of students' participating in volunteer activities was 2% higher in 1996 than in 1991. Contrary to the estimation, *House*1996 dummy* yields the negative sign and is statistically significant at the 1% level. Considering Tables 4(1) and (2) jointly shows that the earthquake promoted the participation of students in volunteer activities. However, the earthquake did not promote house-workers' participation in such activities.

5. Conclusions

Unforeseen and uncontrolled events such as natural disasters have a significant impact on socio-economic conditions. This inevitably results in economic loss, which is considered a negative outcome. However, in the case of the Great Hanshin-Awaji (Kobe) earthquake in 1995, many young people arrived in Kobe to participate in volunteer activities. The earthquake led people to acknowledge the importance of volunteer activities in Japan. However, the issues surrounding the volunteer response have not been examined using detailed statistical analysis based on individual-level data.

This paper used a large sample of individual-level data to explore how and the extent to which the Great Hanshin-Awaji earthquake increased the participation of students and house-workers in volunteer activities. As suggested in the descriptive analysis, students are characterized as being less active in volunteer activities whereas house-workers are considered active. I found, however, via the Heckman-Tobit model that students were more likely to participate in volunteer activities immediately after an earthquake than before. Furthermore, the number of days that students spent participating in volunteer activities was greater immediately after the earthquake than before. However, this does not hold true for house-workers. This suggests that the earthquake promoted the less active students to participate in volunteer activities but did not influence the active house-workers' participation level although their opportunity cost for the volunteer activities is lower than workers.

The results of the estimations in this paper can be interpreted differently: the macro-economic shock or institutional change between 1991 and 1996 influenced the behavior of people causing an increase in participation in volunteer activities. For instance, in Japan, Japanese people enjoyed a business boom, "the bubble economy" from the mid-1980s to the early 1990s. "The prolonged period asset inflation showed initial signs of collapse in 1991. By October, stock prices had fallen 50 percent from their 1989 peak" (Moriguchi and Ono, 2006, p. 165). After the boom period, Japan entered a long-term economic recession, considered to have begun in 1991. Such a change of economic condition possibly influenced individuals' behavior such as participation in volunteer activities. If this holds true, then the effect of the Hanshin-Awaji earthquake on participation in volunteer activities is spurious. It is necessary to engage in a closer examination of the effect of the earthquake. For instance, the Gini coefficient and unemployment rate in each prefecture could be used to capture the influence of changes to the macro-economic conditions. However, due to a limitation of data, information regarding the prefecture where respondents reside was not available. Furthermore, it seems plausible that the impact of the earthquake on individuals' behavior differs between victims of the earthquake and non-victims. Information regarding residence is necessary to identify victims of the earthquake. Hence, the data limitation did not allow me to investigate how and the extent to which the behavior of the earthquake victims differs from non-victims. This information is necessary to identify the respondents' residence, and then these issues can be addressed in future studies.

References

Albala-Bertrand, J. (1993). *Political Economy of Large Natural Disasters*, Oxford University Press, Inc., New York.

Cavallo, E., Powell, A., and Becerra,O. (2010). Estimating the direct economic damages of the earthquake in Haiti. *Economic Journal,120(546)*, F298-F312.

Chamlee-Wright, E. (2010). *The Cultural and Political Economy of Recovery: Social Learning in a Post-Disaster Environment.* Routledge: New York.

DiPasquale D., Glaeser, E.L. (1999). Incentives and social capital: Are homeowners better citizens?. *Journal of Urban Economics* 45(2), 354-384.

Fukushige, M. (2010).*Econometric Analysis of Social Activities.* (in Japanese),(Kakei ni Yoru Syakai-teki Katsudo no Keiryo Bunseki). Mineruva Shobo: Kyoto.

Horwich, George. (2000). Economic lessons from Kobe Earthquake. *Economic Development and Cultural Change 48*. 521-542.

Kahn, M. (2005). The death toll from natural disasters: The role of income, geography and institutions. *Review of Economics and Statistics 87(2),* 271-284.

Ministry of Land, Infrastructure, Transport and Tourism (1996). *White Paper on Disaster Management 1996*. Ministry of Land, Infrastructure, Transport and Tourism: Tokyo.

Moriguchi, C., Ono, H. (2006). Japanese lifetime employment: a century's perspective. Blomstrom, M and La Croix, S (eds). *Institutional Change in Japan.* Routledge: New York.

Sawada, Y. (2007). The impact of natural and manmade disasters on household welfare. *Agricultural Economics 37,* 59–73.

Sawada, Y., & Shimizutani, S. (2007). Consumption insurance against natural disasters: evidence from the Great Hanshin-Awaji (Kobe) earthquake. *Applied Economics Letters 14(4–6)*, 303–306.

Sawada, Y., & Shimizutani, S. (2008). How do people cope with natural disasters? Evidence from the great Hanshin-Awaji (Kobe) earthquake in 1995. *Journal of Money, Credit and Banking 40(2–3)*, 463–488.

Skidmore, M., & Toya, H., 2002. Do natural disasters promote long-run growth?

Economic Inquiry 40 (4), 664–687.

Tol, R., Leek, F. (1999). Economic analysis of natural disasters. in T. Downing, A. Olsthoorn, and R. Tol, eds, *Climate Change and Risk*, Routledge, London.

Toya, H., Skidmore, M. (2007). Economic development and the impacts of natural disasters. *Economics Letters 94(1)*, 20-25.

Toya, H., Skidmore, M. (2010). Natural disaster impacts and fiscal decentralization. *CESifo Forum 11(2),* 43-55.

Waseda University Social Science Institute (1996). *Volunteer Activities in the Great Hanshin-Awasji Tarthquake*. (in Japanese),(Hanshin-Awaji Daishinsai ni Okeru Saigai Volunteer Katsudo). Waseda University Social Science Institute: Tokyo.

Yamamura, E. (2010). Effects of interactions among social capital, income and learning from experiences of natural disasters : A case study from Japan. *Regional Studies 44 (8),* 1019-1032.

Yamamura,E. (2011 a). "Comparison of the effects of homeownership by individuals and their neighbors on social capital formation: Evidence from Japanese General Social Surveys," *Journal of Socio-Economics*, 40 (5), 637-644.

Yamamura,E. (2011 b). "How do neighbors influence investment in social capital? : Homeownership and length of residence," *International Advances in Economic Research*, 17(4), 451-464.

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Figure 1. Map of Japan showing Kobe's location (the area suffering the most damage in the 1995 earthquake)

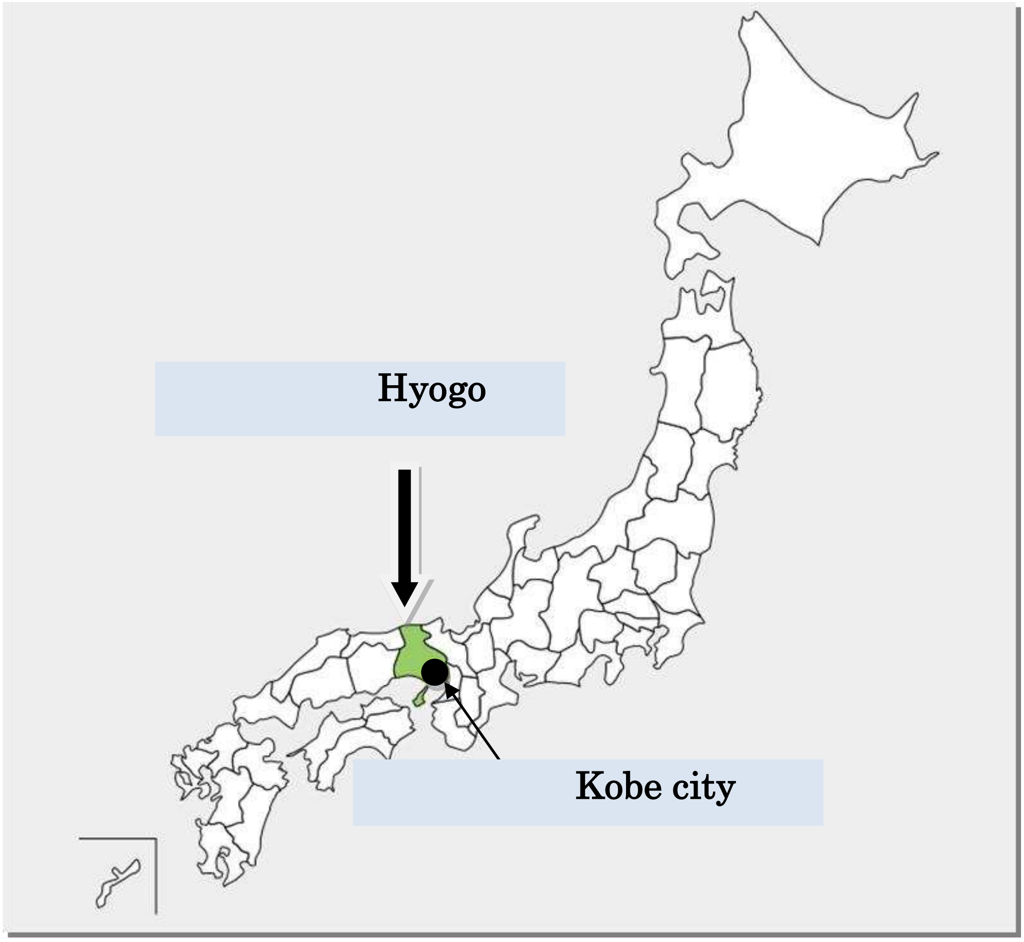

Figure 2. Distribution of ages

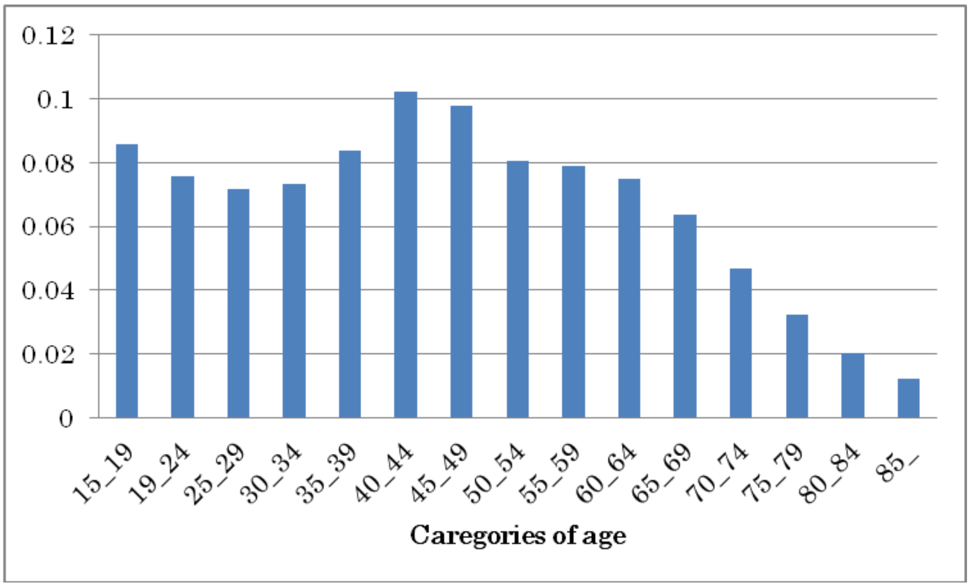

Figure 3. Distribution of household income

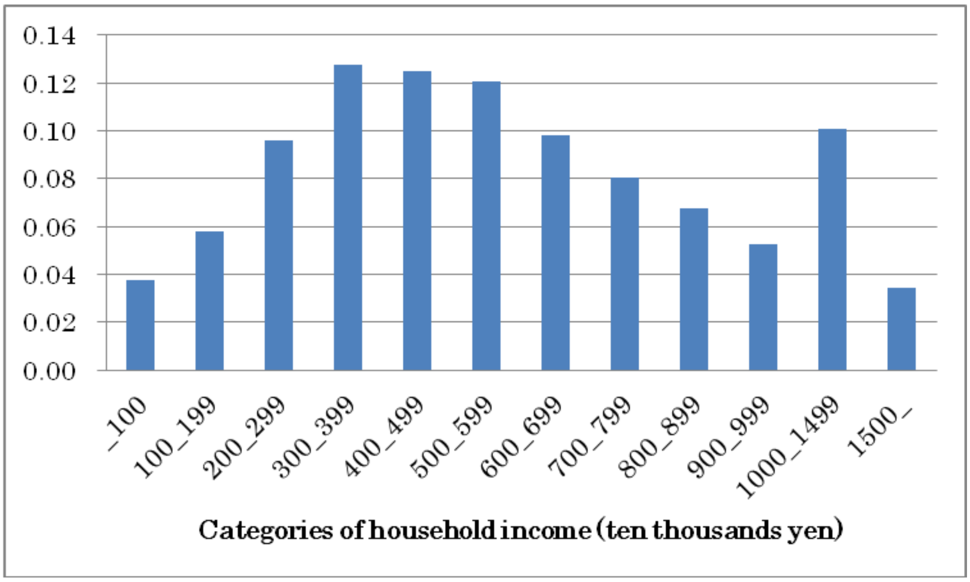

Table 1.
Distribution of days spent participating in volunteer activities

Days	%
0	77.8
1–4	14.6
5–9	3.3
10–19	2.7
20–39	0.9
40–99	0.4
100–199	0.2
200–	0.2

Table 2.
Definition of variables used for estimation and basic statistics

	Definitions	
Volunteer	Number of days spent participating in volunteer activities	2.2
Student	A value of 1 is given if respondent is a student, otherwise 1 (%)	8.8
House	A value of 1 is given if respondent is a house-worker, otherwise 1 (%)	26.9
Marry	A value of 1 is given if respondent is married, otherwise 1 (%)	63.7
Male	A value of 1 is given if respondent is male, otherwise 1 (%)	47.4
Urban	A value of 1 is given if respondent resides in an urban area, otherwise 1 (%)	28.7
Owner	A value of 1 is given if respondent resides in own home, otherwise 1 (%)	76.7
Observations		375,676

Note: Numbers are mean values for *Volunteer*. The percentage of respondents taking 1 is also reported.

Table 3.
Comparison of mean values of days spent participating in volunteer activities

(1) Whole sample

1991	1996	t-statistics
2.23	2.25	0.41

(2) Sample restricted to students

1991	1996	t-statistics
0.43	0.59	2.16**

(3) Sample restricted to house-workers

1991	1996	t-statistics
2.76	2.95	1.89*

Note: * and ** indicate statistical significance at the 10% and 5% levels, respectively.

Table 4(1). Determinants of *Volunteer*

	(1) OLS	(2) Heckman
*Student*1996 dummy*	0.22** (2.32)	4.38*** (3.21)
*House*1996 dummy*	0.09 (0.80)	–0.11 (–0.21)
Student	–0.69** (–2.07)	–10.1*** (–3.24)
House	0.65*** (7.75)	5.86*** (7.75)
1996 dummy	-–.06 (–1.07)	–1.34*** (–3.78)
Marry	0.66*** (9.72)	9.40*** (9.41)
Male	0.84*** (15.8)	5.25*** (12.3)
Urban	–0.08 (–1.51)	–5.35*** (–5.89)
Owner	0.03 (0.66)	3.53*** (5.03)
Constant	0.64* (1.70)	–59.9*** (–8.19)
R-square	0.01	
Wald chi-square		1,319
Censored observations		293,045
Uncensored observations		83,631
Observations	375,676	375,676

Note: Numbers in parentheses are t-statistics calculated using robust standard errors. ** and *** indicate significance at the 5% and 1% levels, respectively. In all estimations, age group dummies, household income dummies, and education level dummies are included as independent variables but are not reported because of space limitations.

Table 4(2). First-stage analysis of column (2) of Table 4(1)

	Heckman (first-stage Probit)
*Student*1996 dummy*	0.02***
	(3.09)
*House*1996 dummy*	–0.01***
	(–2.89)
Student	–0.003
	(–0.28)
House	0.09***
	(25.1)
1996 dummy	–0.01***
	(–7.58)
Marry	0.07***
	(41.9)
Male	0.02***
	(12.9)
Urban	–0.07***
	(–48.2)
Workers	0.05***
	(17.9)
Owner	0.05***
	(30.3)
Constant	–1.22***
	(–20.6)
Observations	375,676

Note: Values are marginal effects. Numbers in parentheses are z-statistics calculated using robust standard errors. ** and *** indicate significance at the 5% and 1% levels, respectively. In all estimations, age group dummies, household income dummies, and education level dummies are included as independent variables but are not reported because of space limitations.