

Effects of the Great East Japan Earthquake  
on Subjective Well-Being

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# “Effects of the Great East Japan Earthquake on Subjective Well-Being”

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## Abstract

Using a large panel data set that samples over 4000 Japanese, we analyze changes in people’s subjective well-being (happiness) and altruistic worldview before and after the Great East Japan Earthquake. As a result we find that 1) more people replied that their happiness improved after the earthquake than said it worsened, and also that 2) many more Japanese people became more altruistic since the earthquake, even in the most affected areas. One possible interpretation of these results is that an increase in altruism due to the earthquake spurred people to give to charity, which in turn increased their happiness. Our regression analysis yields results that are consistent with this story.

JEL classification numbers: I18, I31, I38

Keywords: subjective well-being, happiness, altruism, the Great East Japan Earthquake, disasters.

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## Introduction

In this paper, we study changes in Japanese people's subjective well-being (happiness) and feelings of altruism before and after the Great East Japan Earthquake of March 2011. We use a panel data set compiled by a group of researchers mainly from Keio University. Although the questionnaire is large, we focus on a question about people's altruism. We are interested in altruism because, according to a Japanese Statistics Bureau report on expenditure by Japanese households, charitable donations increased by over 850 percent in March 2011 compared to one year earlier (in both nominal and real terms). This increase is especially striking when we compare it to increases in spending on other goods; for example, expenditure on mineral water went up by only 148.8 percent in nominal terms and 161.3 percent in real terms.

Using a large panel survey consisting of responses from over 4000 households all over Japan, we analyzed changes in people's happiness and altruism before and after the earthquake. We found that many Japanese people reported more feelings of altruism following the earthquake, even in the most affected areas; this is consistent with the rise in charitable giving. We also found that a large number of people reported an *increase* in happiness after the earthquake, in fact, as the number who reported a drop in happiness. An interpretation of this finding is suggested by a recent experiment by Dunn et al. (2008), who find that spending money on others promotes happiness; according to this story, many Japanese people became more altruistic after the earthquake, inducing them to make charitable donations, which in turn made them happier.

We are interested in seeing how changes in altruism affect changes in happiness. However, both variables are subjective, so their measurement errors are likely to be correlated. Therefore, we use a two-step procedure, first identifying the effect of altruism on an objective variable, charitable giving, and then measuring the effect of charitable giving on happiness. We call this the "Subjective-Objective-Subjective" method ("S-O-S" for short). In each step of the analysis, we run a two-stage logit regression, which controls for reverse causality. This S-O-S analysis, which deals effectively with the aforementioned problem of correlated measurement errors, yields results that are consistent with our story.

As for the Great East Japan Earthquake, Tiefenbach and Kohlbacher (2014) show that those living closer to the Fukushima were less happy after the disaster, using nationwide survey in Japan, the National Survey on Lifestyle Preferences<sup>1</sup>. Aldrich and

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<sup>1</sup> Kitamura and Hirai (2012) also show the changes in Japanese people's subjective well-being and their health condition before and after the Great East Japan

Sawada (2014) find that tsunami height, stocks of social capital, and level of political support strongly influenced mortality rates, using original data set from the Pacific Ocean side of the Tohoku region. Goebel et al (2013) studies the impact of the Great East Japan Earthquake on German population and find that the meltdown significantly increased their environmental concerns.

As for other literatures on disasters, in economics, Kimball et al. (2006) studied changes in happiness before and after Hurricane Katrina which struck southeast Louisiana on August 29, 2005. They found that the subjective happiness of representative U.S. adults dipped significantly in the first week following the hurricane. The dip was especially strong in the South Central region, closest to the devastation of Katrina. In the non-economics literature on effects of disasters on happiness, surveyed by Phifer and Norris (1989), whether the effects are positive or negative, and whether the size of the effects is substantial or negligible have both been shown to depend on many factors such as the person's and her community's situations before and after the disaster, age, and the time since the disaster.

A few other researchers have studied the links between social behavior and happiness. Clark and Senik (2011) try to understand the differences between cognitive, hedonic and "eudaimonic"<sup>2</sup> measures of well-being reflect different aspects of quality of life, and find that individuals with high "hedonic" well-being (happiness or life satisfaction) are likely to have high eudaimonic well-being (flourishing, functioning, etc.) as well. (See also Huppert and So (2009), Huppert et al (2009), and Deci, and Ryan (2006).) Eudaimonic measures of well-being focus on functioning and the realization of people's potential; this is similar to Amartya Sen's notion of "capabilities." Our results indicates that one of the important element of eudaimonic well-being, altruism, improves people's subjective sense of happiness, since we find that people who made charitable donations experienced a rise in happiness.

The next section describes our data, and provides summary of the basic statistics. In section 2, we propose our methodology that enables us to see the relation between two subjective variables accounting for reverse causality. In section 3, we show our results indicating that many Japanese people became more altruistic after the Great East Japan Earthquake, made charitable donations, and as a result experienced an increase in happiness, applying our methodology. Section 4 concludes the paper.

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Earthquake.

<sup>2</sup> "Eudaimonia" is Aristotle's concept of happiness as a "good life" defined by the acquisition and use of virtue. This is one of the three concepts of happiness listed by Frey (2008, p.5)

## 1. Data

Our analysis was conducted using a Japanese household panel survey data set compiled by a group of researchers mainly from Keio University. The survey sampled over 4,000 respondents from all over Japan, and includes residence information. The data set begins in 2004, but in June 2011 an extra survey was added to measure responses to the Great East Japan Earthquake. Our data on altruism and happiness come from this extra survey and from questions asked by the regular panel surveys.

The “extra” questionnaires conducted in June 2011 asked respondents to what extent they believed themselves to be happy at the time, on a scale of 0 to 100.<sup>3</sup> The June questionnaire also asked the respondents to what extent they thought they had been happy in February 2011, also on a 0-100 scale.<sup>4</sup> Prior to the extra survey, the regular panel survey asked in January 2011 the respondents to score the degree of their happiness between 0 (totally unhappy) and 10 (totally happy) considering their whole life. To measure altruism, the survey asked to what extent people “try to act in the interest of strangers”<sup>5</sup> at the time of the survey, again on a 0-100 scale. The questionnaire also asked how altruistic people remembered feeling in February 2011. *It is important to note that throughout this paper, when we use the word “altruism,” we refer specifically to the answer to this survey question, not to altruistic actions such as charitable giving.*

Table 1 shows the distribution of changes in Japanese people’s self-reported happiness before and after the earthquake. Since there is continuing debate about the appropriateness of inter-personal comparisons when using subjective data, we focused on the direction of the change in each individual’s happiness before and after the earthquake.

Panel A of table 1 is for changes in happiness between February 2011 (before the earthquake, for retrospective evaluation of happiness) and June 2011 (after the earthquake.) The table shows the numbers of respondents and relative frequency for each class of changes in happiness. The percentage of respondents who answered that their happiness had improved, worsened, or remained unchanged were 27.9 percent, 4.5 percent, and 67.6 percent, respectively. One surprising result was that there were many more people – over six times as many! – who replied that their happiness level *improved*

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<sup>3</sup> In increments of 10.

<sup>4</sup> We calculated correlation coefficients between the retrospective replies regarding happiness and the replies we collected earlier in 2011 before the earthquake (real time happiness) to check the reliability of our retrospective data. The correlation was 0.4, meaning that our retrospective data probably contains sufficient information to make our analysis reliable.

after the earthquake compared to the number who said their happiness level worsened. This result, of course, is probably subject to some degree of selection bias, especially in the most affected areas (Iwate, Miyagi and Fukushima); many of those who were severely affected by the earthquake were probably not able to answer our survey due to their situation. Thus, we think the true level of well-being in the most affected areas was probably lower than the figure given in the table. The results in table 1 are summarized in figure 1 by classifying the data into three categories, corresponding to the sign of the reported happiness change.

Panel B of table 1 is for changes in happiness between January 2011 (real time data before the earthquake) and June 2011 (after the earthquake). As in Panel A, more people report that they are happier after the tragedy.<sup>6</sup>

We also tried to assess whether or not Japanese people's worldviews had changed since the disaster. We paid special attention to the question about altruism, since according to a Japanese Statistics Bureau report on expenditure by Japanese households, the most affected expenditure as March 2011 was charitable donations. Households' donations increased by over 850% year/year in March 2011 in both nominal and real terms, whereas the increase in expenditure on, for example, mineral water was only 149% in nominal terms and 161% in real terms. The table shows that a large fraction of Japanese people began to feel more altruistic after the earthquake, even in the most affected areas. We should note that there was a higher percentage of people who said they had become less altruistic in Miyagi than in other parts of Japan; we think it is likely that since Miyagi was the area that was most seriously affected by the direct effect of the earthquake and tsunami, that there were a number of people there who were simply not in any condition to help others. The results of table 2 are summarized in figure 2 by classifying the data into three categories, corresponding to the sign of the reported happiness change

The results shown in tables 1 and 2 (and figures 1 and 2) are quite striking, since Kimball et. al (2006) showed that the average US citizen felt "unhappy" after Hurricane Katrina, and that this unhappiness continued for two or three weeks for people living in the most affected area (the South Central region of the United States). Our results suggest the opposite – that Japanese people's well-being improved following a major natural disaster. Kimball's analysis on Hurricane Katrina concluded that in the regions of the US outside the affected zone, happiness returned to normal levels in a few

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<sup>6</sup> Using internet survey data replied by young adults living in unafflicted areas, Uchida et al (2014) also found that there were improvement in happiness for those who thought of earthquake when they were answering to their questionnaire.

weeks, but we found that both Japanese people's well-being and also their altruism continued to be affected even several months after the earthquake. The Great East Japan Earthquake may thus have had a much greater impact on the happiness of the average Japanese citizen than Hurricane Katrina had on the average citizen in the US.

## 2. Methodology

Our interpretation of the data is that many Japanese people became more altruistic as a result of the Great East Japan Earthquake, made charitable donations, and as a result experienced an increase in happiness. In order to test this story, we need two subjective variables: a change in altruistic feelings after the earthquake, and a change in self-reported happiness. Because the measurement errors in these subjective variables are likely to be correlated, we avoid using these two variables in the same regression, and instead use the S-O-S method explained in the introduction. This method involves two steps. In the first step we analyze the effect of a subjective variable (altruism) on an objective variable (donations), and in the second step we analyze the effect of this objective variable on a second subjective variable (happiness). In each step, we must also consider the possibility of reverse causality; people who become happier may give more to charity, and making donations may cause people to report more feelings of altruism. In order to control for reverse causality, we use a two-stage logit analysis in each of the two steps.

In Step 1, we want to see how changes in altruism affect the probability of making a charitable donation. We use a two-stage multinomial logit analysis to measure this effect. In the first stage, the dependent variable is a dummy variable representing the sign of the change in altruism from February 2011 to June 2011, while the independent variables include two instrumental variables and a number of covariates. The probability  $P_{ij}$  that individual  $i$  chooses the  $j$ th alternative for altruism is given by

$$(1) P_{ij} = F(z_i' \gamma_{1j} + x_i' \beta_{1j}), \quad j = \text{downward, unchanged, upward},$$

Where  $F$  is the logistic distribution function,  $x$  is a vector of covariates, and  $z$  is a vector of instrumental variables. The vector  $z$  includes A) a dummy variable for whether or not any acquaintances (including the respondent's family) were struck by the earthquake, and B) a dummy variable about whether or not the respondent subscribed to life insurance before the earthquake. We think that subscription to life insurance did not affect the amount of charitable donations before the earthquake, and the subscription

increased donation only through the changes in altruism after the earthquake. Japanese people did not usually donate much before the earthquake compared with other developed countries. Increase in the amount of charitable donations after experiencing any acquaintances being struck by the earthquake should be due to the changes in respondents' altruism. The covariates  $x$  include A) a dummy variable representing whether or not the respondent was personally affected by the earthquake, and B) other socio-economic control variables such as household income, wealth, owner-occupier of the house, age, age squared, and region of residence. Note that none of these independent variables includes quantitative measures of subjective variables; when data are subjective, we use only dummy variables.

In the second stage, we run a binominal logit regression to explain the dummy variable for charitable giving after the earthquake, using the fitted values of the altruism-change dummy predicted in the first stage. The probability  $P_{ik}$  that individual  $i$  chooses the  $k$ th alternative for charitable giving is represented by:

$$(2) P_{ik} = F(\hat{P}_{ij}\gamma_2 + x_i'\beta_2), \quad k = \text{giving donation, not giving donation}$$

where  $F$  is the logistic distribution function, and  $\hat{P}_{ij}$  is the value of the altruism-change dummy predicted in the first stage. The covariate vector  $x$  is the same as in the first stage. We compute the standard errors by bootstrap with 3000 replications.

For Step 2 of our analysis, we conduct a two-stage multi-nominal logit analysis explaining Japanese people's changes in happiness as a function of their charitable giving. In the first stage, we run a binominal logit regression of the dummy variable for charitable giving on the same two instrumental variables used in Step 1, and on our vector of covariates:

$$(3) P_{ik} = F(z_i'\gamma_3 + x_i'\beta_3), \quad k = \text{giving donation, not giving donation}$$

where again  $F$  is the logistic distribution function. The covariate vector  $x$  is the same as in previous regressions. We think that these two instrumental variables can be used for our analysis in Step 2 also, since Dunn et al. (2008) show that making donations improves happiness.

In the second stage, the dependent variable is the dummy representing the sign of the happiness change from February 2011 to June 2011. We run a multinomial logit regression of the happiness change dummy on the amount of charitable donations predicted in the first stage:

$$(4) P_{il} = F(\hat{P}_{ik}\gamma_{4l} + x_i\beta_{4l}), \quad l = \text{downward, unchanged, upward},$$

where  $F$  is the logistic distribution function,  $\hat{P}_{ik}$  is the amount of donations predicted in the first stage, and  $x$  is the same vector of covariates. We compute the standard errors by bootstrap with 3000 replications.<sup>7</sup>

### 3. Results

For the sake of brevity, we here discuss only those results that were significant at the 10% level.

Table 4 shows the multinomial logit regression results when the dummy variable for making donations is taken as the dependent variable. These are the results for the second stage of Step 1 in which we examine how changes in altruism affect donations. (The S-O part of the S-O-S method).<sup>8</sup> For changes in altruism, the base dummy is taken to be a positive change in altruism. The coefficients for predicted values of “altruism changed downward” and “altruism unchanged” have the expected negative sign. Both coefficients were significant at the 5% level with the one-sided test.<sup>9</sup> For other variables, an increase in income has a positive effect on the probability of making donations (significant at the 5% level). Men were less likely than women to make donations (significant at the 5% level). Respondents with one or more children were more likely to make donations (significant at the 10% level). Respondents with more family members living together were less likely to make donations (significant at the 5% level.)

Table 5 shows the multinomial logit regression results when the dummy variable for making changes in happiness from February (in the retrospective question) to June is taken as the dependent variable. These are the results for the second stage of Step 2 in which we examine how changes in donation affect changes in happiness. (The O-S part of the S-O-S method).<sup>10</sup> The predicted value of the donation dummy has the expected positive coefficient for the upward change in happiness (significant at the 5% level) and the expected negative coefficient for the no change in happiness (significant

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<sup>8</sup> The first stage results are reported in the Appendix.

<sup>9</sup> We use the one-sided test for the dummy variables for the changes in altruism because our story to explain changes in happiness is that an increase in altruism caused an increase in donation, which in turn caused an increase in happiness.

<sup>10</sup> The first stage results are reported in the Appendix.

at the 10% level).<sup>11</sup> Combined with the results in Table 4, we found evidence for our story that increased altruism caused people to make donations for earthquake victims, and the act of making donations improved happiness.

Table 5 also report results for other variables that affected changes in happiness. For household income, the coefficients for the upward and downward changes in happiness were significant at the 5% level. For household income squared, the coefficient for the upward change in happiness was significant at the 10% level and that for the downward change in happiness was significant at the 5% level. From the point estimates of these coefficients, people with more income were more likely to report downward changes in happiness up to income of about 13, 160,000 yen. If household income is more than 21, 180, 000 yen, then people with more income were more likely to report upward changes in happiness. However, respondents with more than 13,160,000 yen are about 7% and those with income more than 21, 180,000 yen were only about 1% of all the respondents. Hence, for typical households, people with more household income tended to become unhappier. For age and age squared, the coefficient for “unchanged” is significant at the 10% level. The point estimates for “unchanged” imply that older respondents were more likely to report that happiness was unchanged until the age reached 27 years old. Men were more likely to show no change and less likely to show upward changes in happiness (significant at the 10% level). Respondents with more family members living together were more likely to report upward changes in happiness (significant at the 1% level), and less likely to report no or downward changes (significant at the 10% level).

Table 6 shows the multinomial logit regression results when the dummy variable for making changes in happiness from January (in the real time data) to June is taken as the dependent variable. Just as in Table 5, in which we used data on retrospective evaluation of happiness for February 2011, just before the earthquake, the predicted value of the donation dummy has the expected positive coefficient for the upward change in happiness (significant at the 5% level) and the expected negative coefficient for no change in happiness. For the results of the predicted value of the donation dummy, the only difference is that the coefficient for not change in happiness is not significant at the 10% level when real time data are used.

For the other explanatory variables, there are two cases in which the coefficients in both Tables 5 and 6 are significant at least at the 10% level: the coefficient for the sex variable for “upward” and the coefficient for the number of family members living apart variable for “upward.” In both cases, the signs of the coefficients are the same in both

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<sup>11</sup> As in the change in altruism variables in Table 4, we use the one-sided test for donations in Tables 5 and 6.

tables.

Thus, except for changes in significance levels for some coefficients, our results are robust when only real time data for happiness are used instead of data involving retrospective evaluation in happiness.

#### **4. .Concluding Remarks**

We studied changes in Japanese people's altruistic feelings, charitable giving, and happiness following the Great East Japan Earthquake, using a large panel data set of over four thousand respondents. We found that the number of people reporting an increase in happiness after the earthquake far exceeded the number who said it worsened. These results, which allow for reverse causality, suggest that many Japanese people became more altruistic as a result of the Great East Japan Earthquake, made charitable donations, and experienced an increase in happiness as a result of their charitable behavior.

As we have explained before, some of the recent literature on happiness has tried to understand whether cognitive, hedonic, and eudaimonic measures of well-being reflect different aspects of quality of life. Eudaimonic measures of well-being focus on functioning and the realization of people's potential. Our results indicate that altruism, one of the important elements of eudaimonic well-being, improves people's sense of happiness. We think that people's worldviews are very much related to eudaimonic well-being, and that these affect people's happiness or life evaluation. We sometimes observe social disorder or violence after large disasters, but we did not experience any riot or serious violence after the Great East Japan Earthquake in Japan. It is possible that Japanese people's culture or worldview promoted resilience or economic recovery after the disaster. Our analysis on people's worldview and happiness may thus give us a hint as to how to better cope with natural or/and man-made disasters.

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Figure 1. Japanese people's happiness before and after 3.11

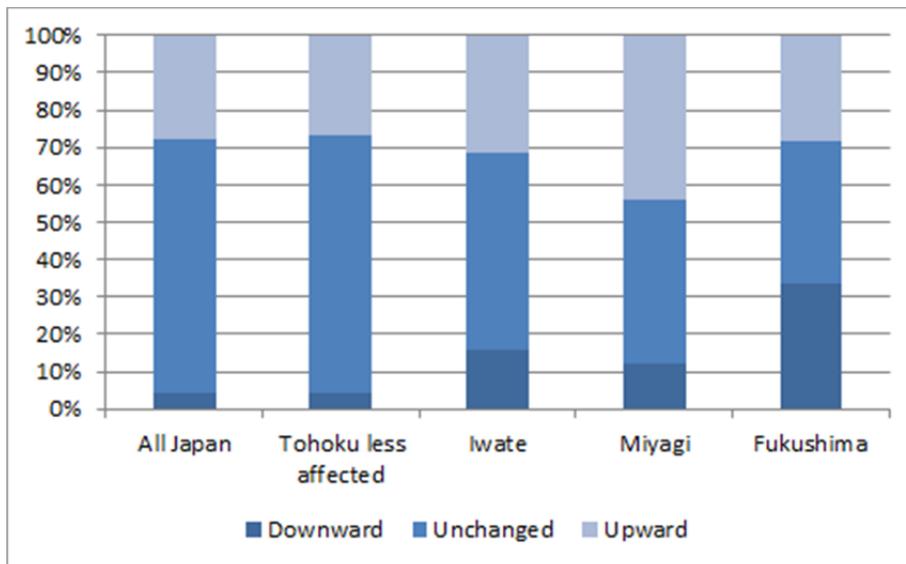


Figure 2. Japanese people's altruism before and after 3.11

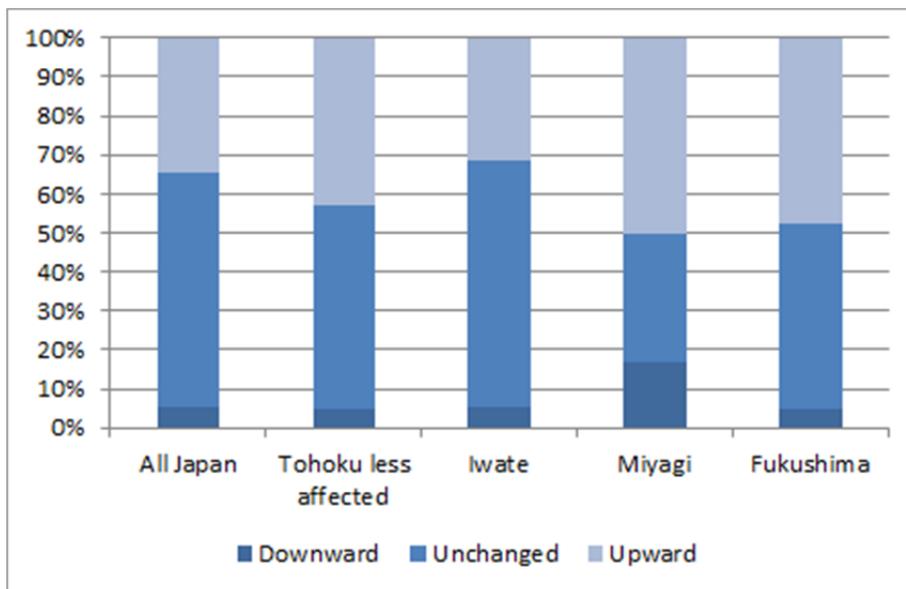


Table 1 Regional distribution of changes in well-being

Panel A: Changes in well-being From February to June				
Region	Relative frequency of changes in well-being (%)			N
	Downward	Unchanged	Upward	
Hokkaido	3.09	69.59	27.32	194
Tohoku less affected area (Aomori, Akita and Yamagata)	4.03	69.35	26.61	124
Tohoku most affected area				
Iwate	15.79	52.63	31.58	19
Miyagi	12.00	44.00	44.00	25
Fukushima	33.33	38.10	28.57	21
Kanto	6.00	65.91	28.09	1,367
Chubu	3.91	66.62	29.47	767
Kinki	3.42	72.80	23.78	761
Chugoku	2.77	69.57	27.67	253
Shikoku	3.82	65.65	30.53	131
Kyushu	2.48	66.59	30.93	443
All Japan	4.51	67.55	27.94	4,105

Panel B: Changes in well-being From January to June				
Region	Relative frequency of changes in well-being (%)			N
	Downward	Unchanged	Upward	
Hokkaido	27.84	23.71	48.45	194
Tohoku less affected area (Aomori, Akita and Yamagata)	25.00	24.19	50.81	124
Tohoku most affected area				
Iwate	31.58	15.79	52.63	19
Miyagi	25.00	16.67	58.33	24
Fukushima	33.33	38.10	28.57	21
Kanto	26.06	27.09	46.84	1,362
Chubu	23.14	22.88	53.99	765
Kinki	27.00	22.28	50.72	763
Chugoku	25.50	21.12	53.39	251
Shikoku	26.52	25.76	47.73	132
Kyushu	25.23	22.52	52.25	444
All Japan	25.69	24.20	50.11	4,099

Table 2 Regional distribution of changes in altruism (From February to June)

Region	Relative frequency of changes in altruism (%)			N
	Downward	Unchanged	Upward	
Hokkaido	5.82	65.08	29.10	189
Tohoku less affected area (Aomori, Akita and Yamagata)	4.88	52.03	43.09	123
Tohoku most affected area				
Iwate	5.26	63.16	31.58	19
Miyagi	16.67	33.33	50.00	24
Fukushima	4.76	47.62	47.62	21
Kanto	6.71	58.48	34.81	1,356
Chubu	4.23	60.71	35.05	756
Kinki	3.85	65.38	30.77	754
Chugoku	2.00	60.40	37.60	250
Shikoku	3.88	50.39	45.74	129
Kyushu	6.62	60.50	32.88	438
All Japan	5.27	60.19	34.54	4,059

Table 3 Descriptive Statistics

	N	Mean	S.D.
Well-being in January	6161	64.28	20.46
Well-being in February	4144	66.71	22.11
Well-being in June	4114	71.80	21.94
Altruism in february	4108	44.92	21.64
Altruism in June	4070	51.48	22.28
Made donations regarding the earthquake	4210	0.74	0.44
Respondent was struck by the earthquake	4210	0.02	0.12
Any acquaintances (include R's family) were struck by the earthquake	4138	0.36	0.48
Subscribe life insurance	4078	0.82	0.39
Living in the region affected by rolling brackouts	3704	0.25	0.43
Household annual income (in 10thousands JPY)	3883	678.75	476.45
Household wealth (in 10thousands JPY)	3953	1201.44	2197.84
Household debt (in 10thousands JPY)	4120	504.41	1176.10
Owner-occupier	4170	0.83	0.38
Subscribe earthquake insurance	3964	0.40	0.49
Age	4210	53.19	14.29
Sex (1 if male)	4210	0.47	0.50
Marital status (1 if married)	4210	0.79	0.41
Any child(ren) in the household	4210	0.63	0.48
Number of family members living together	4210	3.19	1.39
Number of family members living apart	4109	0.21	0.58
JHPS (1 if respondents of JHPS)	4210	0.49	0.50
Living in Hokkaido (Base dummy is living in Kyushu)	4210	0.05	0.21
Living in Aomori, Akita or Yamagata pref.	4210	0.03	0.17
Living in Iwate, Miyagi or Fukushima pref.	4210	0.02	0.13
Living in Kanto	4210	0.33	0.47
Living in Chubu	4210	0.19	0.39
Living in Kinki	4210	0.19	0.39
Living in Chugoku	4210	0.06	0.24
Living in Shikoku	4210	0.03	0.18
Living in Kyushu	4210	0.11	0.31
Living in designated city	4210	0.30	0.46
Living in municipal	4210	0.61	0.49
Living in village or town	4210	0.09	0.28

Table 4: Estimation result of Making donations (Structural Form)

	Structural Form	
	Marginal Effect	(S.E.)
Altruism changed downward (Predicted value. Base dummy is Upward)	-1.3214	(0.7663) **
Altruism were unchanged (Predicted value. Base dummy is Upward)	-1.4241	(0.7927) **
Respondent was struck by the earthquake	-0.0702	(0.1702)
Living in the region affected by rolling brackouts	0.0727	(0.0544)
Household annual income (in million JPY)	0.0165	(0.0077) **
(Household annual income) <sup>2</sup> /10	-0.0020	(0.0023)
Household wealth (in 10million JPY)	0.0166	(0.0109)
Household debt (in 10million JPY)	0.0067	(0.0155)
Owner-occupier	0.0490	(0.0458)
Subscribe earthquake insurance	0.0274	(0.0338)
Age	0.0020	(0.0096)
(Age) <sup>2</sup> /1000	-0.0281	(0.0973)
Sex (1 if male)	-0.0716	(0.0354) **
Marital status (1 if married)	-0.0271	(0.0582)
Any child(ren) in the household	0.1125	(0.0623) *
Number of family members living together	-0.0379	(0.0171) **
Number of family members living apart	-0.0428	(0.0305)
Log likelihood	-1446.12	
N	2725	

Notes: \*\*\*, \*\* and \* indicate that the estimated marginal effects are significant at 1%, 5% and 10% levels, respectively. For the dummy variables for changing altruism, the significance level is based on the one sided test. For the other variables, the significance level is on the two sided test. Dummy variables for city-sizes, regions and data sets are also controlled but are omitted from the results. Standard errors are in the parentheses.

Table 5 Estimation result of changes in well-being (From February to June)

	Upward		Unchanged		Downward	
	Marginal Effect	(S.E.)	Marginal Effect	(S.E.)	Marginal Effect	(S.E.)
Donation (Predicted value)	0.5793	(0.2641) **	-0.4078	(0.2681) *	-0.1714	(0.1341)
Respondent was struck by the earthquake	0.0075	(0.1075)	-0.0333	(0.1051)	0.0258	(0.0357)
Living in the region affected by rolling brackouts	-0.0197	(0.0308)	0.0032	(0.0306)	0.0165	(0.0130)
Household annual income (in million JPY)	-0.0161	(0.0067) **	0.0062	(0.0069)	0.0100	(0.0045) **
(Household annual income) <sup>2</sup> /10	0.0036	(0.0019) *	0.0002	(0.0021)	-0.0038	(0.0020) **
Household wealth (in 10million JPY)	0.0005	(0.0051)	-0.0003	(0.0055)	-0.0003	(0.0034)
Household debt (in 10million JPY)	0.0085	(0.0096)	-0.0105	(0.0095)	0.0020	(0.0039)
Owner-occupier	-0.0431	(0.0391)	0.0307	(0.0398)	0.0125	(0.0183)
Subscribe earthquake insurance	-0.0066	(0.0214)	0.0012	(0.0214)	0.0054	(0.0096)
Age	0.0052	(0.0061)	-0.0061	(0.0060)	0.0009	(0.0028)
(Age) <sup>2</sup> /100	-0.0097	(0.0059)	0.0112	(0.0059) *	-0.0015	(0.0027)
Sex (1 if male)	-0.0463	(0.0269) *	0.0475	(0.0268) *	-0.0012	(0.0129)
Marital status (1 if married)	0.0227	(0.0319)	-0.0212	(0.0308)	-0.0015	(0.0142)
Any child(ren) in the household	-0.0348	(0.0299)	0.0208	(0.0304)	0.0140	(0.0148)
Number of family members living together	0.0313	(0.0114) ***	-0.0209	(0.0114) *	-0.0104	(0.0059) *
Number of family members living apart	0.0361	(0.0180) **	-0.0371	(0.0181) **	0.0010	(0.0089)
Log likelihood			-1999.96			
N			2622			

Notes: \*\*\*, \*\* and \* indicate that the estimated marginal effects are significant at 1%, 5% and 10% levels, respectively. For the donation variable, the significance level is based on the one sided test because of Dunn et al (2008). For the other variables, the significance level is on the two sided test. Dummy variables for city-sizes, regions and data sets are also controlled but are omitted from the results. Standard errors are in the parentheses.

Table 6 Estimation result of changes in well-being (From January to June)

	Upward		Unchanged		Downward	
	Marginal Effect	(S.E.)	Marginal Effect	(S.E.)	Marginal Effect	(S.E.)
Donation (Predicted value)	0.4381	(0.2342) **	-0.2149	(0.1956)	-0.2233	(0.2073)
Respondent was struck by the earthquake	-0.2029	(0.1125) *	0.0898	(0.0798)	0.1131	(0.0978)
Living in the region affected by rolling brackouts	-0.0267	(0.0313)	0.0259	(0.0241)	0.0008	(0.0269)
Household annual income (in million JPY)	-0.0080	(0.0064)	0.0030	(0.0058)	0.0050	(0.0055)
(Household annual income) <sup>2</sup> /10	0.0016	(0.0018)	-0.0003	(0.0019)	-0.0013	(0.0015)
Household wealth (in 10million JPY)	-0.0155	(0.0061) **	0.0082	(0.0043) *	0.0073	(0.0047)
Household debt (in 10million JPY)	0.0212	(0.0090) **	-0.0172	(0.0080) **	-0.0040	(0.0078)
Owner-occupier	-0.0396	(0.0366)	0.0003	(0.0311)	0.0393	(0.0330)
Subscribe earthquake insurance	-0.0367	(0.0207) *	0.0319	(0.0172) *	0.0047	(0.0181)
Age	-0.0075	(0.0057)	0.0084	(0.0049) *	-0.0009	(0.0048)
(Age) <sup>2</sup> /100	0.0070	(0.0055)	-0.0073	(0.0048)	0.0003	(0.0047)
Sex (1 if male)	-0.0779	(0.0251) ***	0.0046	(0.0212)	0.0733	(0.0223) ***
Marital status (1 if married)	-0.0232	(0.0296)	0.0135	(0.0249)	0.0097	(0.0264)
Any child(ren) in the household	-0.0324	(0.0275)	0.0290	(0.0226)	0.0034	(0.0238)
Number of family members living together	0.0130	(0.0113)	-0.0077	(0.0092)	-0.0053	(0.0100)
Number of family members living apart	0.0477	(0.0200) **	-0.0208	(0.0170)	-0.0269	(0.0177)
Log likelihood			-3021.10			
N			2956			

Notes: \*\*\*, \*\* and \* indicate that the estimated marginal effects are significant at 1%, 5% and 10% levels, respectively. For the donation variable, the significance level is based on the one sided test because of Dunn et al (2008). For the other variables, the significance level is on the two sided test. We use one sided test for the marginal effect of donation. Dummy variables for city-sizes, regions and data sets are also controlled but are omitted from the results. Standard errors are in the parentheses.

**Appendix** This appendix explains the first stage results in each step.

Table A.1 shows the first stage results in Step 1 for changes in altruism. The table indicates that the altruism of people who subscribed to life insurance before the earthquake tended to increase (5% significance level). Men were less likely than women to show downward changes in altruism.

Table A. 1: Estimation result of changes in altruism (From February to June)

	Upward		Unchanged		Downward	
	Marginal Effect	(S.E.)	Marginal Effect	(S.E.)	Marginal Effect	(S.E.)
Subscribe life insurance	0.0552	(0.0264) **	-0.0542	(0.0269) **	-0.0010	(0.0117)
Any acquaintances were struck by the earthquake	0.0187	(0.0193)	-0.0118	(0.0198)	-0.0069	(0.0091)
Respondent was struck by the earthquake	-0.0065	(0.0869)	-0.0461	(0.0893)	0.0526	(0.0285) *
Living in the region affected by rolling brackouts	-0.0354	(0.0275)	0.0297	(0.0282)	0.0057	(0.0119)
Household annual income (in million JPY)	-0.0004	(0.0044)	-0.0007	(0.0045)	0.0011	(0.0022)
(Household annual income) <sup>2</sup> /10	-0.0005	(0.0012)	0.0008	(0.0013)	-0.0003	(0.0007)
Household wealth (in 10million JPY)	-0.0023	(0.0043)	0.0043	(0.0044)	-0.0020	(0.0024)
Household debt (in 10million JPY)	-0.0101	(0.0091)	0.0058	(0.0090)	0.0043	(0.0031)
Owner-occupier	0.0044	(0.0275)	0.0039	(0.0281)	-0.0083	(0.0128)
Subscribe earthquake insurance	-0.0039	(0.0199)	0.0173	(0.0205)	-0.0134	(0.0095)
Age	-0.0028	(0.0053)	0.0050	(0.0054)	-0.0022	(0.0024)
(Age) <sup>2</sup> /100	0.0031	(0.0051)	-0.0065	(0.0053)	0.0034	(0.0023)
Sex (1 if male)	0.0100	(0.0184)	0.0154	(0.0189)	-0.0254	(0.0089) ***
Marital status (1 if married)	0.0397	(0.0263)	-0.0460	(0.0269) *	0.0063	(0.0122)
Any child(ren) in the household	-0.0561	(0.0250) **	0.0693	(0.0256) ***	-0.0132	(0.0114)
Number of family members living together	0.0103	(0.0090)	-0.0130	(0.0092)	0.0027	(0.0041)
Number of family members living apart	0.0099	(0.0172)	-0.0197	(0.0176)	0.0098	(0.0074)
Log likelihood			-2218.47			
N			2725			

Notes: \*\*\*, \*\* and \* indicate that the estimated marginal effects are significant at 1%, 5% and 10% levels, respectively. Dummy variables for city-sizes, regions and data sets are also controlled but are omitted from the results. Standard errors are in the parentheses.

Table A.2 shows the first stage results in Step 2 for making donations. The two instrumental variables are significant at the 1% level and have the expected positive sign.

Table A. 2: Estimation result of Making donations (Reduced Form)

	Reduced Form		
	Marginal Effect	(S.E.)	
Any acquaintances (include R's family) were struck by the earthquake	0.0803	(0.0202)	***
Subscribe life insurance	0.0497	(0.0167)	***
Respondent was struck by the earthquake	-0.1482	(0.0667)	**
Living in the region affected by rolling brackouts	0.0295	(0.0229)	
Household annual income (in million JPY)	0.0153	(0.0036)	***
(Household annual income) <sup>2</sup> /10	-0.0025	(0.0009)	***
Household wealth (in 10million JPY)	0.0114	(0.0050)	**
Household debt (in 10million JPY)	-0.0100	(0.0065)	
Owner-occupier	0.0661	(0.0216)	***
Subscribe earthquake insurance	0.0028	(0.0172)	
Age	-0.0004	(0.0043)	
(Age) <sup>2</sup> /1000	0.0005	(0.0421)	
Sex (1 if male)	-0.0632	(0.0155)	***
Marital status (1 if married)	0.0338	(0.0215)	
Any child(ren) in the household	0.0288	(0.0212)	
Number of family members living together	-0.0229	(0.0074)	***
Number of family members living apart	-0.0236	(0.0146)	
Log likelihood		-1616.58	
N		3019	

Notes: \*\*\*, \*\* and \* indicate that the estimated marginal effects are significant at 1%, 5% and 10% levels, respectively. Dummy variables for city-sizes, regions and data sets are also controlled but are omitted from the results. Standard errors are in the parentheses.