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Natural Disasters, Social Isolation and Alcohol Consumption in the Long Run: Evidence from the Great East Japan Earthquake

Taiki Kakimoto

Former student at the Faculty of Economics, Nagoya City University

Shinsuke Uchida

Graduate School of Economics, Nagoya City University

Policy Design Lab, Tohoku University

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Natural Disasters, Social Isolation and Alcohol Consumption in the Long Run: Evidence from the Great East Japan Earthquake

Taiki Kakimoto[†] Shinsuke Uchida[‡]

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Abstract

Large-scale natural disasters are known to increase disaster victims' risk-taking behavior such as alcohol consumption, but the potentially prolonged phenomenon has rarely been tracked. This study examines the long-term causal effect of the Great East Japan Earthquake and the subsequent Fukushima nuclear accident on alcohol consumption by using the monthly expenditure data of representative households in 47 prefecture capitals in Japan in 2000-2019. We use the seismic intensity (Shindo) of each city to identify the causal relationship between the earthquake and alcohol consumption. The results reveal a persistent increase in alcohol consumption in cities with a seismic intensity of 6 or higher. This trend is particularly pronounced for non-employed (retired) households. We also find that the long-term increase in alcohol consumption is associated with the persistent decline of spending on things that maintain social connections.

Keywords: Natural Disasters, Alcohol Consumption, Long-Term Causal Effects, Social Isolation, Great East Japan Earthquake, Difference-in-Differences

JEL codes: D12, I12, Q54

Background

[†] Former student at the Faculty of Economics, Nagoya City University.

[‡] Corresponding author: Graduate School of Economics, Nagoya City University and Policy Design Lab, Tohoku University. Email: suchida@econ.nagoya-cu.ac.jp. We thank Kazuki Kagohashi, Yutaro Sakai, Kenji Takeuchi, and other participants at the 24th Annual Meeting of the Society of Environmental Economics and Policy Studies for their helpful comments. We also acknowledge financial support from the Environment Research and Technology Development Fund (JPMEERF20S11821) of the Environmental Restoration and Conservation Agency of Japan, and JSPS KAKENHI Grant Number JP19K01632.

An earthquake of magnitude 9 occurred off the east coast of Tohoku region in Japan at 14:46 on March 11, 2011. Coastal areas in Miyagi and adjacent prefectures were destroyed by the subsequent tsunami. Many residents in the neighborhood were forced to evacuate because of these disasters as well as the calamitous accident at the Fukushima Daiichi Nuclear Power Station. Even eight years after the earthquake, reconstruction of the disaster-stricken areas has not progressed as projected. The Japan Broadcasting Corporation (2017) conducted a survey in the most affected three prefectures (Fukushima, Iwate, and Miyagi) six years after the earthquake, and reported that more than 60% of survey respondents felt that the reconstruction was "delayed," 36.4% responded that the reconstruction status of their residential areas was "behind schedule," and 26.8% responded that there was "no sense of progress."[1] In addition, more than 60% of respondents still felt the effect of the earthquake on their mind and body, and 75% felt anxious about their future.

The situation caused by the earthquake and the Fukushima accident has put long-term stress on victims who are unable to live the same life as before the incidents. People tend to be more socially isolated (e.g., Hikichi et al. 2017; Murakami et al. 2017; Sone et al. 2016), more risk tolerant (Hanaoka et al. 2018), or more present-biased (Kuroishi and Sawada 2019). As a result, the undesired effects on their physical and mental health are likely to be prolonged and possibly increased risk-taking behaviors such as alcohol consumption. Solving alcohol-related problems for large-scale disaster victims has been recognized as an important issue in post-disaster health care (Matsushita and Higuchi 2013). Nevertheless, most studies have examined the effects of the immediate aftermath of disasters on alcohol consumption. The effects of medium- to long-term stresses have been rarely examined.[2]

In addition, causal evidence of such disaster effects has rarely been provided. The majority of previous studies fail to properly establish a control group to quantify the treatment effect of

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[1] They conducted a survey between November 2016 and February 2017, with 5,000 victims in three prefectures and evacuees from the nuclear power plant accident. There were 1,437 respondents (response rate: 28.7%).

[2] Most studies have only examined effects for 1-2 years after disaster events (e.g., Fergusson et al. 2014; Kanehara et al. 2016; Murakami et al. 2017; Nordlokken, Pape, and Heir 2016; Shimizu et al. 2000). Exceptions are Matsushita and Ozaki (2015) and Filipski et al. (2019), who analyze devastating earthquake effects on risk-taking behaviors three years after the earthquake.

disaster shocks.[3] Hanaoka et al. (2018) and Filipski et al. (2019) are exceptions; they use the difference-in-differences (DID) method in an attempt to quantify causal earthquake effects on alcohol consumption. Individual/household panel survey data enable them to observe the change in risk-taking behaviors before and after the disaster. However, data limitation allows them to use only two/three data points in time, which cannot uncover consecutive disaster effects or control for potential confounding factors.[4] Furthermore, these two-period DID analyses fail to validate the key assumption of parallel pre-event trend in outcomes between treatment and control groups.[5]

We examine the long-term causal effect of the Great East Japan Earthquake (GEJE) and the subsequent Fukushima Daiichi Nuclear Power Plant accident on alcohol consumption. We use the monthly average alcohol expenditure data from the Family Income and Expenditure Survey of capital cities in 47 prefectures from January 2000 to March 2019. In the 47 prefecture capital cities, we can utilize exogenous variations in seismic intensities ("Shindo" in Japanese) at the time of the GEJE. This natural experiment enables us to employ the DID method to provide the causal evidence of the long-run and consecutive disaster effects on alcohol consumption. By controlling for demographic, socioeconomic, and weather factors that affect alcohol consumption, our estimate can indicate the disaster effect of stress factors such as social isolation and anxiety about the future. Further analysis compares the disaster effects among different types of households. We explore who is more likely to be influenced by natural disasters among employed and non-employed (mostly retired) household groups. We also use the ambient radioactivity level to segregate the Fukushima accident effect from the earthquake effect on alcohol consumption. Quantifying the effects of different disaster types on different household types can help with future policy formation in disaster recovery.

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[3] Moreover, medical studies focus on field surveys with the emphasis on respondent's demographic status that may affect alcohol consumption. Alcohol consumption is further influenced by socioeconomic conditions: household income and employment status, market drivers of alcoholic beverages, and macroeconomic trends (e.g., Dee 2001).

[4] Moreover, Filipski et al. (2019) use data collected in different seasons over sample years, which may contaminate estimates by seasonal confounding factors.

[5] Hanaoka et al. (2018) showed the pre-event trend of risk preferences, but not of risk-taking behaviors.

The next chapter describes the data used in the econometric analysis. We then introduce our econometric model and discuss estimation results. Finally, we conclude.

Data

We construct our key variables of earthquake damages by using seismic intensity (SI) data across cities (see Table 1 and Appendix Figure A1). Four dummy variables are constructed based on intensity levels in Table 1–SIs of 6, 5, 4, and 3 or less at the GEJE.[6] These SI dummy variables take the value of 1 after March 2011 when the GEJE occurred, and 0 before March 2011. We also collected the monthly average ambient radioactivity level (Gy/h) data from the environmental monitoring data of the Nuclear Regulation Authority.[7] A set of the SI dummies and the ambient radioactivity level are used to disentangle the effects of the GEJE and the Fukushima nuclear accident on alcohol consumption.

Our dependent variable is the share of monthly expenditure on alcohol consumption. It is computed by dividing the monthly city-average expenditure on alcoholic beverages by monthly city-average total expenditure. The total expenditure and the expenditure on alcoholic beverages are obtained from the Family Income and Expenditure Survey of capital cities in 47 prefectures from January 2000 to March 2019. The survey is periodically conducted by the Statistics Bureau of the Ministry of Internal Affairs and Communications to collect information from sample households with two or more household members on monthly household expenditure on various consumption goods including alcoholic beverages as well as on their household characteristics. Approximately 100 sample households are randomly selected from the stratified Census tracts in each survey city and asked to record their accounts for six consecutive months. In each month, one-sixth of the sample households are replaced by new observations to maintain the repeated panel status. Collected monthly records are then averaged at the city level.

The Family Income and Expenditure Survey also allows us to control for the following rich set

[6] Other possible specification would use quantitative information on actual damage to houses and aftershocks. These may better capture the effect of the disaster, but monthly data are not fully available. Nevertheless, they should be highly correlated with the SI level.

[7] See Appendix Figure A2 for how the ambient radioactivity level changes over time.

of average household characteristics in estimation: the number of persons per household, percentage of persons under 18 years of age, percentage of persons aged 65 years or older, age of household head, percentage of earners per household, percentage of employed female spouses of household heads, percentage of owned dwellings, monthly expenditure on total consumption and percentage of fixed costs in monthly expenditures. Our fixed costs are defined as the sum of rental fees/mortgage and property tax payments, loan payments for automobile purchases, and transfer payments of gifts and remittances.

Besides, we control for two economic factors: the consumer price index for alcoholic beverages (2015 basis) from the Statistics Bureau, Ministry of Internal Affairs and Communications; and the ratio of job openings to job seekers in each prefecture from the Ministry of Health, Labour and Welfare. We also control for weather variables: the monthly average temperature (°C), total sunlight time, and monthly average precipitation (mm) obtained from the Japan Meteorological Agency. Finally, we included the year-by-month fixed effects and the city-by-month fixed effects to account for macroeconomic effects and city-specific seasonality of alcohol consumption, respectively. By controlling for all the possible demographic, socioeconomic, and meteorological factors that affect alcohol consumption, the effects captured by the earthquake SI dummies can indicate the causal mechanism through psychological and physical stress factors such as social isolation and anxiety about the future.

The summary statistics on the proportion of expenditure on alcohol consumption are shown by SI groups in Table 2. The proportion increases significantly after the earthquake only in capital cities with an SI of 6. Figure 1 depicts the annual average expenditure share of alcohol consumption (2010=100) by SI groups in 2000-2019. Before the disaster, the trend appears similar among SI groups, despite the fluctuation of the index in cities of SI6. The evidence of this pre-event parallel trend validates our DID approach. After the disaster, the expenditure proportion of the SI6 cities starts to increase whereas the proportion in the other two groups rarely changes. The gap has remained constant since then. In addition, descriptive statistics on the other explanatory variables are provided in Table 3.

Our data separates the sample households by household head's job status--"employed" and "non-employed." Panels A and B of Appendix Table A2 show that the proportion of expenditure on alcohol consumption in highly affected cities increases more significantly for non-employed households. Despite the definition of "non-employed" households including self-employed and jobless households by definition, household characteristics in Appendix Table A3 indicate that the majority of non-employed household samples are retired households.

Econometric Model and Estimation Results

Econometric model

Our main specification to examine the disaster effects on alcohol consumption is given by

$$Y_{cym} = \alpha + \sum_{j=4}^{6} \beta_j \, SI_{cym}^{j} + \gamma R_{cym} + \mathbf{X}_{cym}\boldsymbol{\delta} + \theta_{cm} + \rho_{ym} + \varepsilon_{cym}, \qquad (1)$$

where Y_{cym} represents the share of household spending on alcoholic beverages (%) in city c, year y, and month m; SI_{cym}^{j} is a dummy variable for the SI level ($j = 4,5,6$), where an SI of 3 or less is the base[8]; R_{cym} is the ambient radioactivity level; and $\mathbf{X}_{cym}$ denotes a vector of explanatory variables of a variety of socioeconomic and market factors described above. We also introduce a set of fixed effects to reduce the effect of unobservable factors: θ_{cm} represents city-by-month fixed effects to control for city-specific seasonal factors such as migration, seasonal employment, and special events that may change the alcohol consumption of household members; and ρ_{ym} represents year-by-month fixed effects to account for macroeconomic monthly shocks on alcohol consumption such as business climate and tax policy changes as well as calendar differences in days of the week and the number of days in each month. By controlling for both the observable and unobservable confounding factors, our parameters of interest, $\beta_j's$ and γ, can capture the differential physio-psychological influences on alcohol consumption from the disastrous incidences. Finally, ε_{cyn} is the i.i.d. error term. Regressions of our econometric model is weighted by the number of households in each city. The standard errors are clustered at the city level because the error terms within cities might be correlated over time.

[8] I define cities with an SI of 3 or less as the control group according to the degree of human perception and reaction to SI, borrowed from Hanaoka et al. (2018) in Appendix Table A1. Results are similar with different definitions of the control group (an SI of 2 or less; an SI of 4 or less).

Estimation Results and Discussion

Columns (1)-(4) in Table 4 provide parameter estimates for all households in our sample period of 2000-2019. The size and statistical significance of our parameter of interest, $\beta_j's$, changes with different combination of fixed effects and explanatory variables, indicating that city- and time-specific unobservables are likely to bias the estimates. Our preferred model in column (4) shows that the monthly expenditure share of household spending on alcoholic beverages increases significantly by 0.07 percentage points (about 6.5 percent) in the cities with an SI of 6 as compared with the share in the cities with an SI of 3 or less.[9][10] When we separate the sample into the employed and non-employed household groups in columns (5) and (6), we observe the same effect in larger magnitude (0.12 percentage points) for non-employed households. By contrast, an increment in the ambient radioactivity level decreases the monthly expenditure share of alcohol beverage consumption for non-employed households significantly.

Results for the remaining explanatory variables are not inconsistent with theoretical prediction. Specifically, monthly fixed costs and monthly total expenditure (income proxy) have significant negative effects on the share of alcohol expenditure. By contrast, a significant positive effect appears with the larger proportion of households with employed spouse. It is interesting to note that the spouse effect is much larger for non-employed households in column (6) than in column (5).

Next, we examine the dynamic cumulative effect of the earthquake at different points of time after the earthquake in 3 months, 6 months, 1 year, 2 years, 3 years ... and 8 years. Figure 2 plots the point estimates and the 95 percent confidence intervals of coefficients $\beta_j's$ by SI levels in each period.[11] This figure shows the percentage change in the share of alcohol expenditure for cities with different earthquake damage when compared with areas with little or no damage (an

[9] An increase in the proportion of alcohol expenditure likely indicates an increase in alcohol consumption, rather than a decrease in the total expenditure. We use the monthly household expenditure as a dependent variable to estimate the quake effects, and find that the total expenditure in the cities with SI6 dropped significantly shortly after the quake; a stark contrast with that in the other less damaged cities, but quickly recovered to the same level.

[10] Inclusion of Kumamoto (hit by the devastating earthquake recorded SI7 in April 2016) in the group of SI6 does not significantly change the result.

[11] Table A4 in Appendix provides parameter estimates of all the explanatory variables.

SI of 3 or less). We observe that the proportion of alcoholic beverage expenditure in cities with an SI of 6 becomes statistically significant around 2 years after the earthquake. This finding is similar to previous studies examining the shot-term effect. Our results further show that this phenomenon becomes more pronounced as time develops. It peaks 5 years after the earthquake and then starts to decline. By contrast, no statistically significant trends are detected in cities with an SI of 4 or 5.

We also find in Table A4 that ambient radiation concentration has significantly negative and long-lasting effects on the alcohol beverage expenditure share after the earthquake and the Fukushima accident. The coefficient is slightly larger in magnitude for the first 3 months after the Fukushima accident. This is consistent with the period when the actual ambient radioactivity level remained unusually high in regions relatively close to the Fukushima nuclear power station,[12] although the government announced that it did not harm our health. Earthquake (actual risk) and ambient radiation concentration (perceived risk) reveal contrasting behavioral responses. In either direction, both disastrous events cause long-lasting effects on risk-taking behavior.

We gain more insights from panels A and B of Figure 3 displaying the same figure as in Figure 2 for the employed and non-employed households, respectively (Appendix Tables A5 and A6 provide corresponding parameter estimates). Effects of the earthquake and ambient radiation concentration for employed households are rarely significant from both statistical and economic perspectives (panel A of Figure 3 and Table A5). Nevertheless, the alcohol expenditure share tends to increase over time. For non-employed (retired) households we find in panel B of Figure 3 that quake effects are larger and more persistent than for employed households. We also find that the effect of ambient radiation concentration on alcohol consumption is larger for unemployed households in Table A5.

Increasing alcohol consumption in the long run can result from more anxiety about the slow recovery of local economy and/or weaker social network. This supposition is supported by the dynamic trend of household expenses that maintain social connections. Figure 4 shows the point estimates and the 95 percent confidence intervals of coefficients by SI levels when a dependent

[12] Dynamics in ambient radioactivity level refer to Figure A2.

variable is replaced by the monthly share of household spending on social activities, vacation, and spa and beauty salon services. An observation common to the three figures is the persistent decline of spending on things that potentially strengthen social bonds.[13]

We show more evidence of increasing risk-taking behavior by using tobacco expenditure share as a dependent variable. Figure 5 depicts the quake effect on the percentage change in the expenditure share of tobacco products. We observe that the proportion of tobacco product expenditure in cities with SI6 has remained higher than that in the base group (SI3 or less). Similar to alcohol consumption, it peaks a little earlier at 3 months after the GEJE and then declines slowly.

The expenditure share of other daily consumption goods such as food, beverages (other than alcohol), clothes, and other daily merchandise fell much more sharply in cities with SI6 in the month of the GEJE and/or the subsequent few months than in the base group, but such contrasts disappear in the mid- to long-term.[14]

Conclusion

This study analyzes the long-term effect of earthquake and ambient radiation concentration on monthly alcohol consumption for representative households located in Japanese 47 prefecture capitals during the period of 2000-2019. Using the information on seismic intensity (SI) level and ambient radiation concentration across cities, we quantify the causal physio-psychological effect on alcohol consumption in the long-term. We also separate the sample households into employed and non-employed (retired) households to examine the heterogeneous effects of the earthquake and radiation.

We find that the proportion spent on alcoholic beverages by average households in severely damaged cities (an SI of 6) increased significantly by 0.07 percentage points (about 6.5 percent) as compared with households in areas with no damage (an SI of 3 or less). This phenomenon

[13] The expenditure for social activities potentially includes alcohol spending outside the home. Nevertheless, adding this expenditure share to our dependent variable in equation (1) does not change our result qualitatively.

[14] Estimation results of these items are available upon request.

appears more pronounced and persistent for non-employed households over the study period. By contrast, radiation has a lasting negative effect on alcohol consumption.

We also find that the long-term increase in alcohol consumption is associated with the persistent decline of spending on things that maintain social connections. This indicates that alcohol consumption has increased in the long run because of stresses caused by social isolation, anxiety about the future, and/or disappointment in the slow recovery of the local economy. Such stresses particularly overwhelm non-employed households. Public or private assistance programs need to consider appropriate timing, space, and socioeconomic status to help design effective support.

Our data does not cover areas other than prefecture capitals. For some local towns where the damage was larger, the physical and mental conditions of household members would be more strongly affected.

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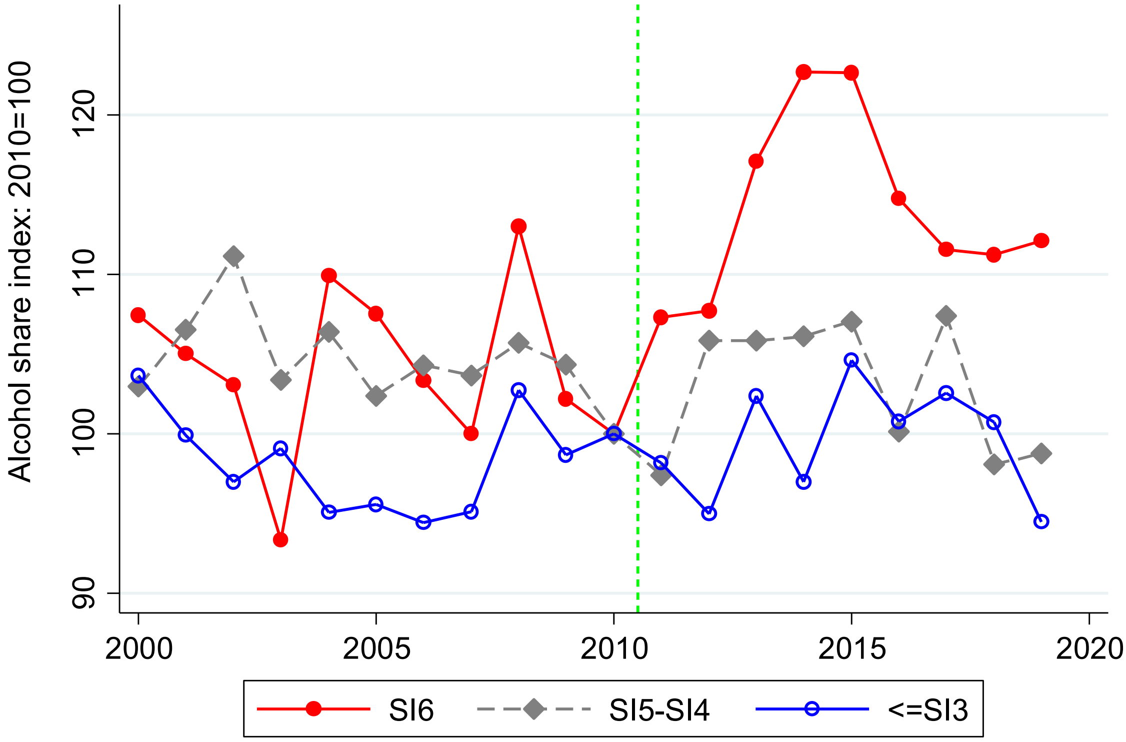


Figure 1 Dynamics of the expenditure share of alcoholic beverages by seismic intensity in 2000-2019

Notes: An alcohol share index represents the annual average expenditure share of alcoholic beverages with the base year in 2010. This index is calculated by taking an adjusted annual average of the monthly share of household spending on alcoholic beverages (%) in each city with the total number of households as weight, where I define the year starting from March to February to be adjusted for the GEJE event in March 2011 (a dashed vertical line). The alcohol share index is then plotted for three groups of cities split by the level of seismic intensity larger than 6, between 5 and 4, and 3 or less.

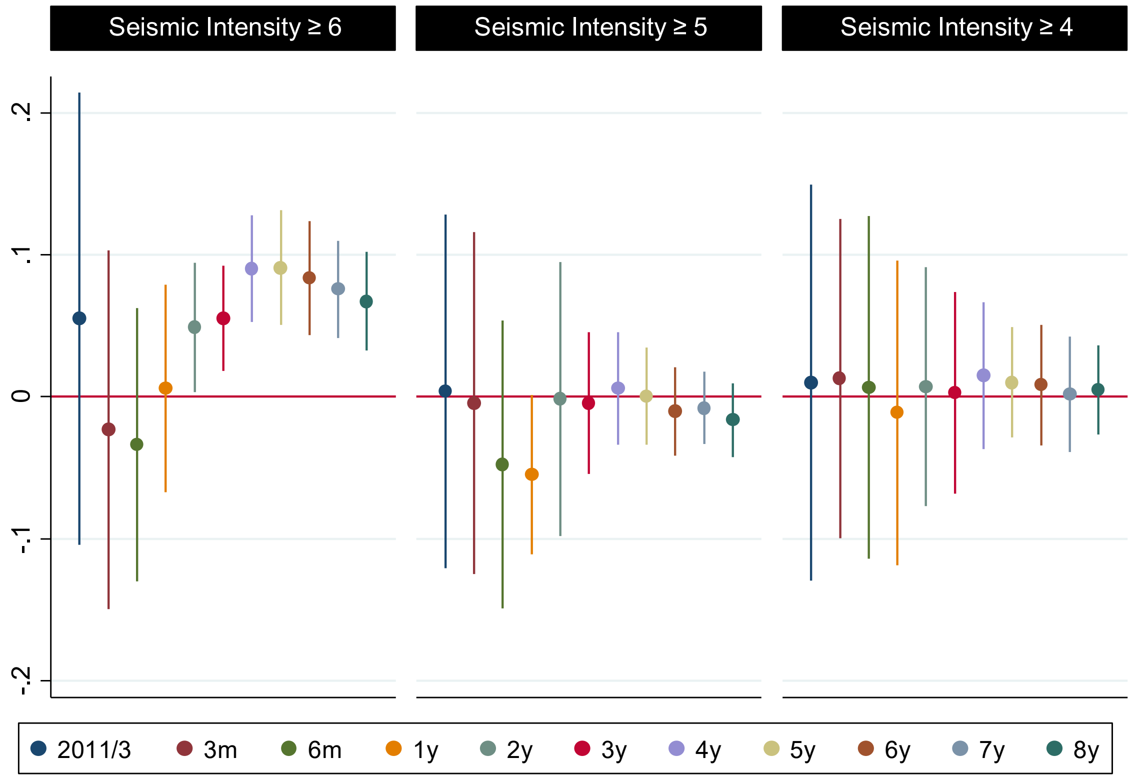
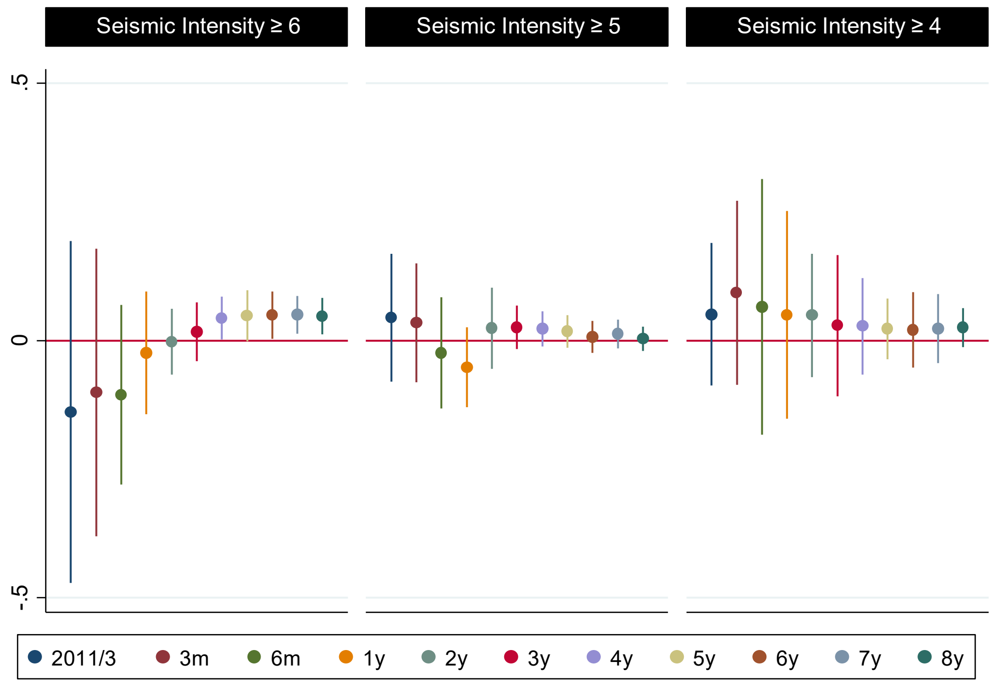


Figure 2 Cumulative changes in the proportion of alcoholic beverages spent by households after the GEJE by seismic intensity

Notes: The dependent variable is the monthly share of household spending on alcoholic beverages (%) in each city. The figure plots the point estimates and the 95 percent confidence intervals of the temperature coefficients β obtained by fitting equation (1). The excluded category is the intensity of less than 3. Each of the plotted estimates is estimated by using different sample periods of 1 month, 3months, 6 months, and 1-8 years since March 2011. Regressions are weighted by the number of households in each city. Standard errors are clustered at the city level.

A. Employed households



B. Non-employed households

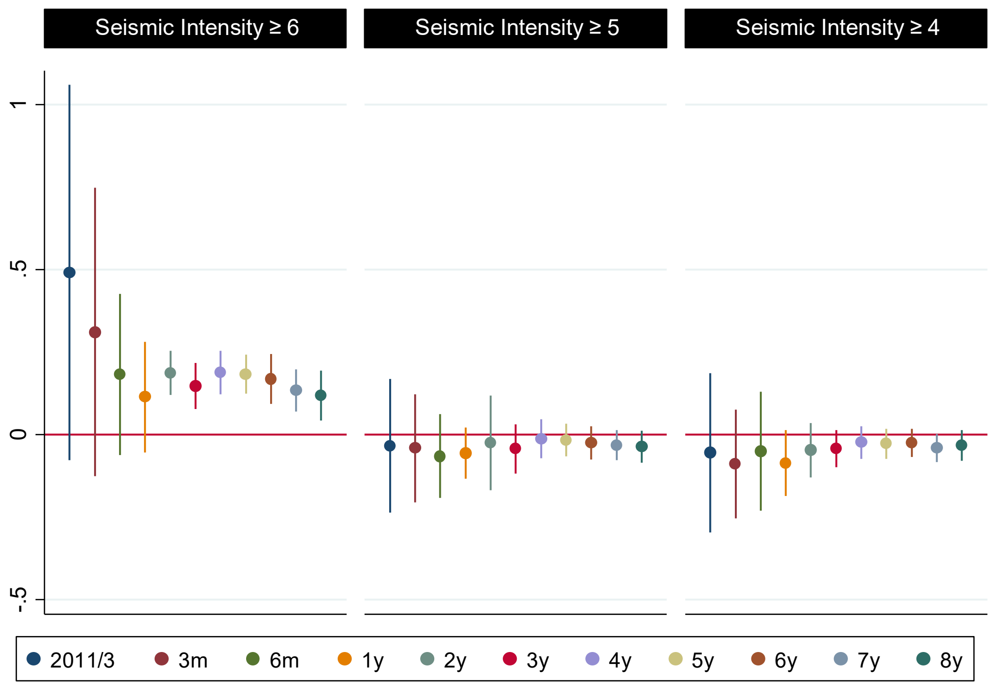
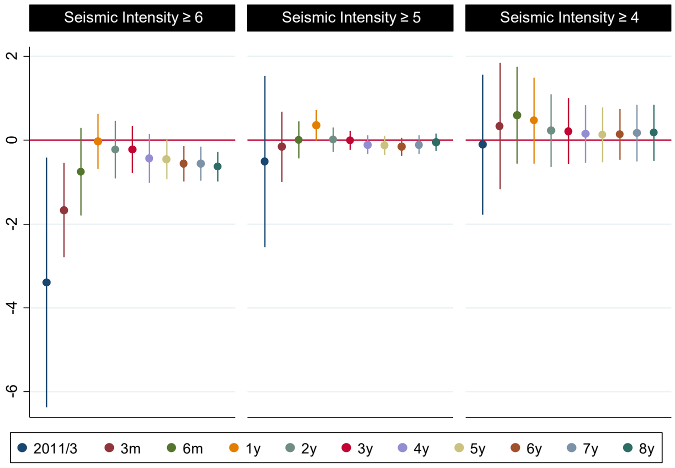


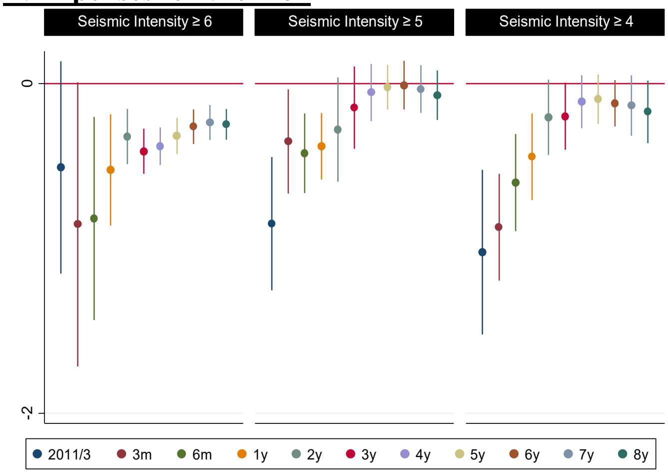
Figure 3 Cumulative changes in the proportion of alcoholic beverages spent by households after the GEJE by seismic intensity and household type

Notes: See the notes in Figure 3.

A. Expenses for social activities



B. Expenses for vacation



C. Expenses for spa and beauty salon

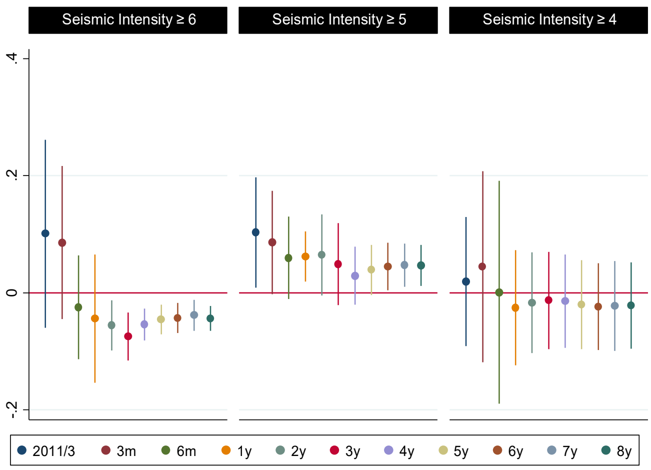


Figure 4 Cumulative changes in the proportion of social activities, vacation, and spa and beauty salon services spent by households after the GEJE by seismic intensity

Notes: See the notes in Figure 3. The dependent variables for panels A, B, and C are replaced respectively by the monthly share of household spending on social activities, vacation, and spa and beauty salon services (%) in each city.

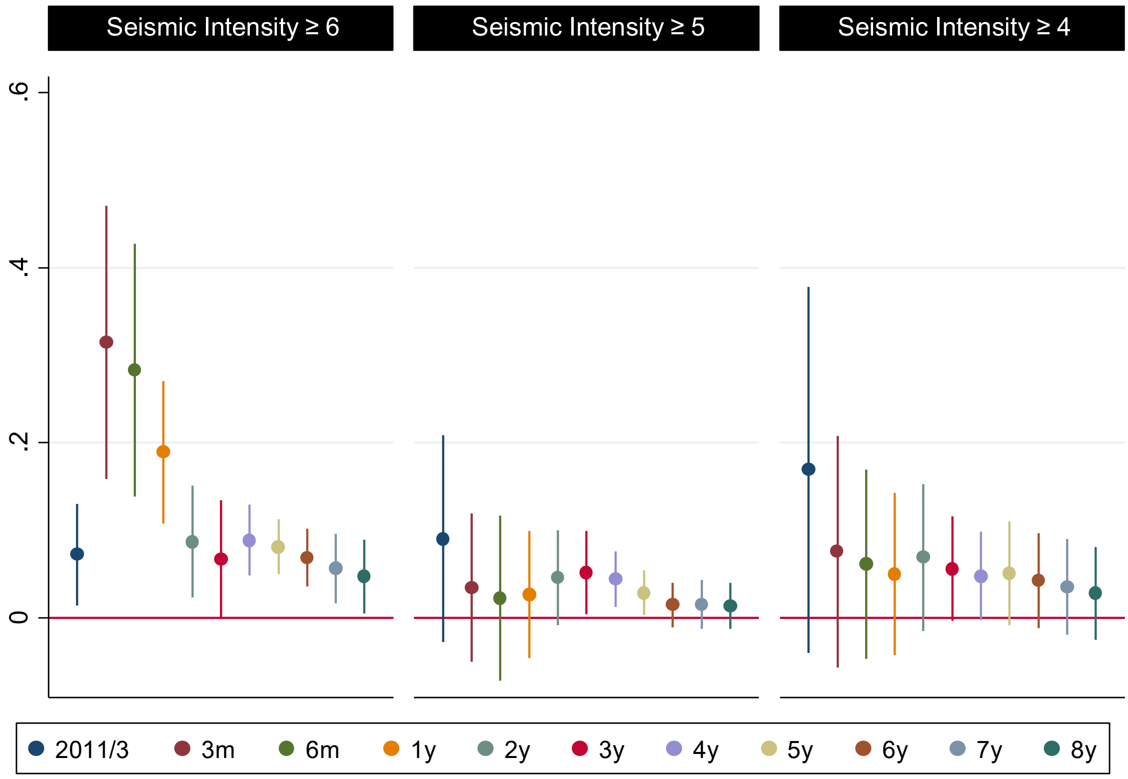


Figure 5 Cumulative changes in the proportion of tobacco products spent by households after the GEJE by seismic intensity

Notes: See the notes in Figure 3. The dependent variable is replaced by the monthly share of household spending on tobacco products (%) in each city.

Table 1 Distribution of seismic intensities in capital cities in 47 prefectures

Seismic intensity	Cities
6.5	Sendai*, Utsunomiya
6	Fukushima, Mito*
5.5	Morioka, Akita, Maebashi, Saitama, Chiba, Tokyo, Yokohama
5	Kofu
4	Aomori, Yamagata, Niigata, Nagano, Shizuoka
3 or less	Other 30 cities

Source: Japan Meteorological Agency
Notes: * indicates cities damaged by tsunami.

Table 2 Change in the expenditure share of alcohol beverages by seismic intensity

Share of expenditures of alcoholic beverages (%):	Means (standard deviation)			Difference before/after 2011.3
	ALL PERIOD (1)	2000.1-2011.2 (2)	2011.3-2019.3 (3)	Column (3)–(2)
(1) ALL CITIES	1.103	1.098	1.110	0.013**
	(0.239)	(0.232)	(0.247)	(0.005)
(2) Cities with SI6	1.106	1.057	1.165	0.108***
	(0.25)	(0.24)	(0.251)	(0.016)
(3) Cities with SI5	1.077	1.083	1.071	-0.012
	(0.186)	(0.179)	(0.195)	(0.009)
(4) Cities with SI4	1.229	1.214	1.247	0.033
	(0.321)	(0.32)	(0.321)	(0.019)
(5) Cities with SI3 or less	1.111	1.102	1.122	0.020**
	(0.26)	(0.254)	(0.267)	(0.006)
Differences in seismic intensity				
Row (2)–(5)	-0.005	-0.045***	0.043**	0.088***
	(0.010)	(0.013)	(0.016)	(0.021)
Row (3)–(5)	-0.034***	-0.019**	-0.051***	-0.032**
	(0.005)	(0.006)	(0.008)	(0.010)
Row (4)–(5)	0.118***	0.112***	0.125***	0.013
	(0.010)	(0.013)	(0.016)	(0.021)

Notes: Each statistic is calculated with the number of households in each city as weight. ***, ** and * indicate significant difference in the mean values in different periods (columns) or at different seismic intensities (rows) at the 0.1%, 1% and 5% level, respectively.

Table 3 Descriptive statistics by seismic intensity in 2001-2019

	Means (Standard deviation)			
	SI6	SI5	SI4	SI3 or less
	4 cities	8 cities	5 cities	30 cities
	N=922	N=1848	N=1155	N=6930
Explanatory variables	(1)	(2)	(3)	(4)
Ambient radiation level (Gy/h)	56.8	35.8	38.2	40.2
	(130.7)	(7.4)	(8.7)	(9.4)
Number of persons per household	3.1	3.0	3.2	3.1
	(0.2)	(0.1)	(0.2)	(0.2)
Percentage of persons under 18 years old per household	21.0	19.2	20.6	20.9
	(3.7)	(2.3)	(3.4)	(3.6)
Percentage of persons over 65 years old per household	22.6	22.3	22.8	21.7
	(5.7)	(4.7)	(5.1)	(5.3)
Age of household head	56.0	56.6	56.6	56.1
	(3.2)	(2.5)	(3.1)	(2.8)
Percentage of earners per household	41.9	44.2	45.2	42.9
	(4.0)	(3.0)	(3.8)	(3.8)
Percentage of employed female spouses of household heads	30.3	31.1	38.1	32.3
	(7.3)	(4.4)	(7.1)	(7.2)
Percentage of owned dwellings	74.7	76.2	80.3	74.7
	(9.9)	(7.3)	(7.5)	(10.2)
Percentage of fixed costs in monthly expenditure	14.5	13.2	14.7	14.1
	(5.0)	(3.4)	(5.0)	(4.9)
Logged monthly expenditure on total consumption (1,000 Yen)	12.6	12.7	12.6	12.6
	(0.1)	(0.1)	(0.1)	(0.1)
Price index of alcoholic beverages	103.0	103.9	103.8	102.7
	(4.4)	(3.5)	(5.3)	(3.9)
Ratio of job openings to job seekers	1.0	1.1	0.9	0.9
	(0.4)	(0.5)	(0.4)	(0.4)
Monthly average temperature (°C)	13.3	16.1	13.8	15.9
	(8.1)	(7.6)	(8.6)	(8.5)
Monthly total daylight hours	159.1	165.1	153.7	164.1
	(38.2)	(40.2)	(53.8)	(43.3)
Monthly average precipitation (mm)	3.6	4.4	4.7	4.4
	(2.8)	(3.3)	(3.4)	(3.6)

Notes: Each statistic is calculated with the number of households in each city as weight.

Table 4 Estimation results of cumulative quake effects on the proportion of alcoholic beverages spent by households

	All households (1)	All households (2)	All households (3)	All households (4)	Employed households (5)	Non-employed households (6)
Cities with seismic intensity 6	0.077	0.087	0.084***	0.067***	0.047*	0.118**
	(0.086)	(0.068)	(0.015)	(0.017)	(0.018)	(0.038)
Cities with seismic intensity 5	-0.034	-0.020	-0.010	-0.016	0.004	-0.036
	(0.022)	(0.028)	(0.012)	(0.013)	(0.012)	(0.024)
Cities with seismic intensity 4	0.142	0.125	0.012	0.005	0.025	-0.032
	(0.102)	(0.087)	(0.014)	(0.016)	(0.019)	(0.023)
Ambient radiation level (Gy/h)	-0.034	-0.038	-0.026***	-0.019***	-0.006	-0.035***
	(0.026)	(0.024)	(0.007)	(0.004)	(0.003)	(0.005)
Number of persons per household		0.036	0.105*	0.029	0.014	0.053
		(0.105)	(0.052)	(0.044)	(0.033)	(0.067)
Percentage of persons under 18		-0.005	-0.007*	-0.005	0.002	-0.008*
years old per household		(0.004)	(0.003)	(0.002)	(0.002)	(0.003)
Percentage of persons over 65		-0.002	-0.002	-0.004	0.003	-0.004*
years old per household		(0.004)	(0.003)	(0.003)	(0.002)	(0.002)
Age of household head		0.011	0.000	0.006	0.011*	-0.002
		(0.009)	(0.008)	(0.007)	(0.005)	(0.006)
Percentage of earners per household		0.002	0.000	-0.001	0.004	-0.003
		(0.004)	(0.002)	(0.002)	(0.003)	(0.002)
Percentage of employed female		0.001	0.002*	0.003**	-0.000	0.003*
spouses of household heads		(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Percentage of owned dwellings		-0.001	0.001	0.001	0.001	0.000
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Percentage of fixed costs in		-0.012***	-0.005***	-0.005***	-0.004***	-0.005***
monthly expenditure		(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Logged monthly expenditure on		-0.310***	-0.658***	-0.729***	-0.637***	-0.810***
total consumption (1,000 Yen)		(0.060)	(0.049)	(0.044)	(0.043)	(0.039)
Price index of alchoholic beverages		0.004	0.005*	0.003	0.005	0.001
		(0.003)	(0.002)	(0.003)	(0.003)	(0.004)
Ratio of job openings to job seekers		-0.057*	-0.013	0.010	0.019	0.009
		(0.024)	(0.015)	(0.024)	(0.028)	(0.034)
Monthly average temperature (℃)		0.003***	0.008***	0.009	0.013	0.001
		(0.001)	(0.002)	(0.007)	(0.008)	(0.008)
Monthly total daylight hours		-0.000*	0.000*	0.000	0.000	0.000
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Monthly average precipitation (mm)		-0.002	0.001	-0.001	-0.000	-0.003
		(0.002)	(0.001)	(0.001)	(0.001)	(0.002)
City-by-month fixed effects	N	N	Y	Y	Y	Y
Year-by-month fixed effects	N	N	N	Y	Y	Y
Observation	10855	10855	10855	10855	10854	10854
Asjusted R^2	0.01	0.15	0.50	0.54	0.42	0.40

Notes: The dependent variable is the monthly share of household spending on alcoholic beverages (%) in each city. For seismic intensity dummies, the excluded category is the intensity of less than 3. The estimated coefficient of ambient radiation level is multiplied by 100 for readability. Results in columns (1)-(4) are estimated using all households with different sets of fixed effects and explanatory variables, and columns (5) and (6) are results from the same specification as column (4) for the subsample of employed and non-employed households, respectively. Regressions are weighted by the number of households in each city. Standard errors clustered at the city level are presented in parentheses. Data refer to the period 2008-2014. ***, **, and * indicate significance at the 0.1%, 1%, and 5% level, respectively.

APPENDIX

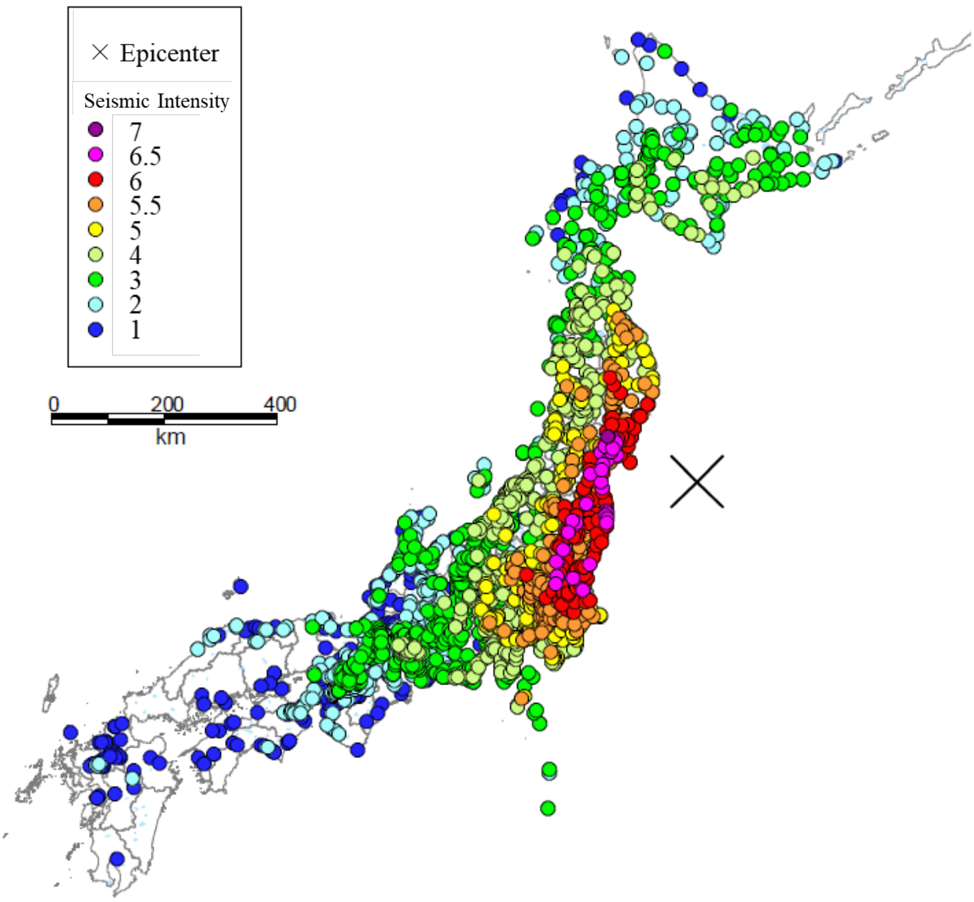
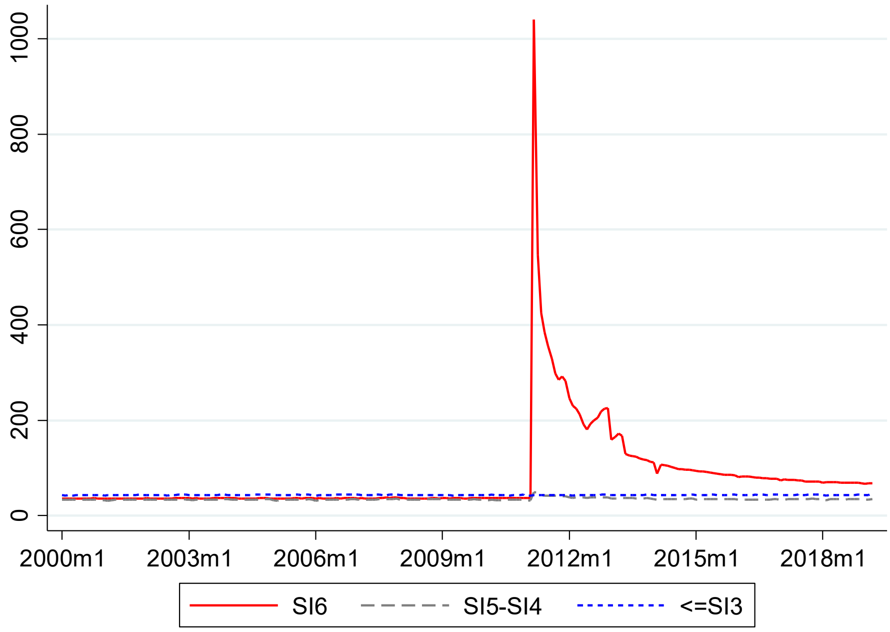


Figure A1 Distribution of seismic intensities in Japan

Source: Headquarters for Earthquake Research Promotion

https://www.jishin.go.jp/main/oshirase/20110311_sanriku-oki.htm

Fukushima City (SI6) included



Fukushima City (SI6) excluded

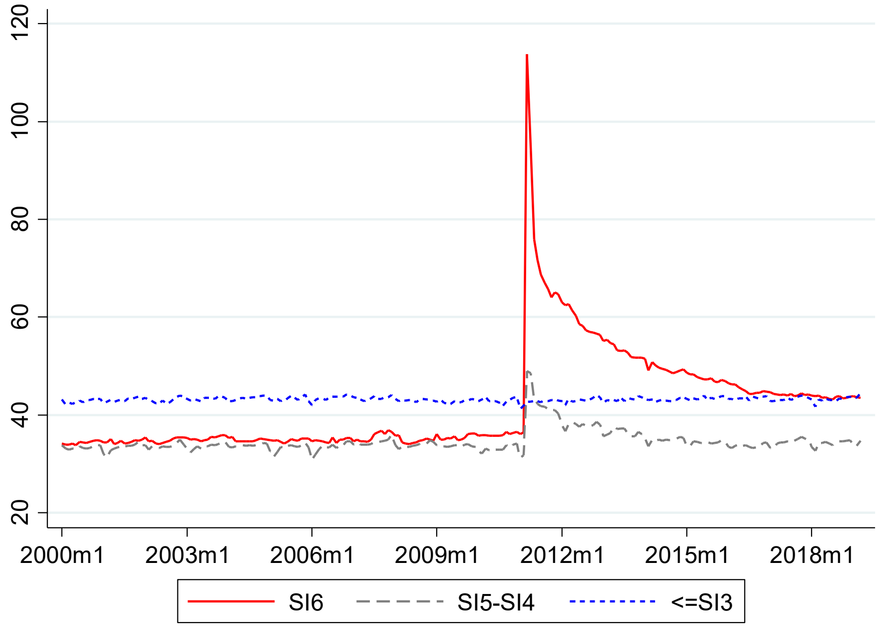


Figure A2 Monthly average ambient radioactivity level (nGy/hour) by seismic intensity in 2000-2018

Notes: Figures display monthly average ambient radioactivity level among cities in each of the three SI categories (SI6, SI5-SI4, SI3 or less). Ambient radioactivity level usually ranges in 15-50nGy/h depending on weather and geologic characters (e.g., Higher level after the rain, at high altitude, nearby volcanos, etc.).

Table A1 JMA seismic intensity scale (Shindo) from Hanaoka et al. (2018)

Seismic intensity	Human perception and reaction	Indoor situation
0	Imperceptible to people, but recorded by seismometers.	–
1	Felt slightly by some people keeping quiet in buildings.	–
2	Felt by many people keeping quiet in buildings. Some people may be awoken.	Hanging objects such as lamps swing slightly.
3	Felt by most people in buildings. Felt by some people walking. Many people are awoken.	Dishes in cupboards may rattle.
4	Most people are startled. Felt by most people walking. Most people are awoken.	Hanging objects such as lamps swing significantly, and dishes in cupboards rattle. Unstable ornaments may fall.
5 lower (4.5–5)	Many people are frightened and feel the need to hold onto something stable.	Hanging objects such as lamps swing violently. Dishes in cupboards and items on bookshelves may fall. Many unstable ornaments fall. Unsecured furniture may move, and unstable furniture may topple over.
5 upper (5–5.5)	Many people find it hard to move; walking is difficult without holding onto something stable.	Dishes in cupboards and items on bookshelves are more likely to fall. TVs may fall from their stands, and unsecured furniture may topple over.
6 lower (5.5–6)	It is difficult to remain standing.	Many items of unsecured furniture move and may topple over. Doors may become wedged shut.
6 upper (6–6.5)	It is impossible to remain standing or move without crawling. People may be thrown through the air.	Most items of unsecured furniture move and are more likely to topple over.
7		Most items of unsecured furniture move and topple over or may even be thrown through the air.

Notes: The seismic intensity scale (*Shindo*) is used to measure the degree of shaking at a specific location in Japan. It is computed using acceleration data for each monitoring station by the Japan Meteorological Agency (JMA). After adjusting the raw digital acceleration data to the adjusted acceleration (a gal), the JMA seismic intensity scale (I) can be obtained by $I = 2\log10a + 0.94$. Thus, the measure can be considered essentially as the logarithm of the acceleration. In other words, an increase of the JMA intensity scale corresponds to an exponential increase in acceleration. Approximately, an increase of JMA seismic intensity scale by two means tenfold of acceleration. This table comes from JMA's descriptions on seismic intensity for human perception and reaction as well as indoor situations (Japan Meteorological Agency 2015).

Table A2 Change in the expenditure share of alcohol beverages by seismic intensity and household type in 2001-2019

A. Employed Households

Share of expenditures of alcoholic beverages (%):	Means (standard deviation) ALL PERIOD (1)	2000.1-2011.2 (2)	2011.3-2019.3 (3)	Difference before/after 2011.3 Column (3)–(2)
1. ALL CITIES	1.011	1.013	1.009	-0.004
	(0.263)	(0.253)	(0.275)	(0.005)
2. Cities with SI6	1.029	1.000	1.066	0.066***
	(0.277)	(0.277)	(0.272)	(0.018)
3. Cities with SI5	1.003	1.013	0.991	-0.021*
	(0.216)	(0.206)	(0.228)	(0.010)
4. Cities with SI4	1.118	1.100	1.139	0.039
	(0.349)	(0.335)	(0.364)	(0.021)
5. Cities with SI3 or less	1.005	1.005	1.004	-0.001
	(0.282)	(0.273)	(0.293)	(0.007)
Differences in seismic intensity				
Row (2)–(5)	0.025*	-0.006	0.062***	0.068**
	(0.011)	(0.014)	(0.018)	(0.023)
Row (3)–(5)	-0.002	0.007	-0.013	-0.020
	(0.005)	(0.007)	(0.009)	(0.011)
Row (4)–(5)	0.113***	0.094***	0.135***	0.041
	(0.011)	(0.014)	(0.018)	(0.022)

B. Non-Employed Households

Share of expenditures of alcoholic beverages (%):	Means (standard deviation) ALL PERIOD (1)	2000.1-2011.2 (2)	2011.3-2019.3 (3)	Difference before/after 2011.3 Column (3)–(2)
1. ALL CITIES	1.244	1.239	1.249	0.010
	(0.345)	(0.346)	(0.344)	(0.007)
2. Cities with SI6	1.240	1.175	1.320	0.145***
	(0.362)	(0.339)	(0.374)	(0.023)
3. Cities with SI5	1.189	1.199	1.176	-0.023
	(0.255)	(0.262)	(0.245)	(0.012)
4. Cities with SI4	1.403	1.410	1.393	-0.017
	(0.437)	(0.456)	(0.414)	(0.026)
5. Cities with SI3 or less	1.271	1.260	1.285	0.025**
	(0.384)	(0.383)	(0.386)	(0.009)
Differences in seismic intensity				
Row (2)–(5)	-0.031*	-0.085***	0.035	0.120***
	(0.015)	(0.020)	(0.024)	(0.031)
Row (3)–(5)	-0.082***	-0.061***	-0.109***	-0.048***
	(0.007)	(0.009)	(0.011)	(0.014)
Row (4)–(5)	0.131***	0.150***	0.109***	-0.042
	(0.015)	(0.020)	(0.023)	(0.030)

Notes: See the notes in Table 2.

Table A3 Descriptive statistics by seismic intensity and household type in 2001-2019

A. Employed Households

	Means (Standard deviation)			
	SI6	SI5	SI4	SI3 or less
	4 cities	8 cities	5 cities	30 cities
	N=921	N=1848	N=1155	N=6930
Explanatory variables	(1)	(2)	(3)	(4)
Number of persons per household	3.4	3.3	3.5	3.4
	(0.2)	(0.1)	(0.2)	(0.2)
Percentage of persons under 18	28.5	26.9	28.5	28.8
years old per household	(4.2)	(2.6)	(4.0)	(4.1)
Percentage of persons over 65	7.0	5.9	7.2	5.8
years old per household	(3.2)	(1.8)	(2.6)	(2.8)
Age of household head	47.2	47.6	47.5	47.1
	(2.4)	(1.7)	(2.4)	(2.3)
Percentage of earners per	47.3	48.5	50.7	47.9
household	(4.8)	(3.1)	(5.1)	(4.4)
Percentage of employed female	37.6	37.2	48.2	38.7
spouses of household heads	(10.0)	(7.2)	(10.7)	(10.0)
Percentage of owned dwellings	65.1	67.4	70.7	66.5
	(12.4)	(9.3)	(10.4)	(13.3)
Percentage of fixed costs in	14.3	12.7	15.0	14.0
monthly expenditure	(6.1)	(4.2)	(6.2)	(5.9)
Logged monthly expenditure on	12.7	12.8	12.7	12.6
total consumption (1,000 Yen)	(0.1)	(0.1)	(0.1)	(0.1)

B. Non-Employed Households

	Means (Standard deviation)			
	SI6	SI5	SI4	SI3 or less
	4 cities	8 cities	5 cities	30 cities
	N=921	N=1848	N=1155	N=6930
Explanatory variables	(1)	(2)	(3)	(4)
Number of persons per household	2.7	2.7	2.9	2.7
	(0.2)	(0.1)	(0.2)	(0.2)
Percentage of persons under 18	8.4	8.0	9.5	9.1
years old per household	(4.2)	(3.1)	(3.9)	(4.0)
Percentage of persons over 65	48.3	45.6	44.3	44.7
years old per household	(9.3)	(8.6)	(8.4)	(9.2)
Age of household head	67.6	66.9	67.0	66.3
	(3.0)	(2.6)	(2.9)	(3.0)
Percentage of earners per	33.2	38.0	37.9	35.6
household	(6.9)	(6.1)	(6.1)	(6.9)
Percentage of employed female	21.4	24.3	26.9	25.2
spouses of household heads	(9.1)	(6.3)	(8.2)	(8.7)
Percentage of owned dwellings	88.4	86.4	92.0	84.7
	(6.7)	(5.9)	(5.0)	(8.3)
Percentage of fixed costs in	14.3	13.6	13.9	13.9
monthly expenditure	(6.7)	(4.8)	(6.7)	(6.7)
Logged monthly expenditure on	12.5	12.6	12.5	12.5
total consumption (1,000 Yen)	(0.2)	(0.1)	(0.2)	(0.2)

Notes: See the notes in Table 3.

Table A4 Estimation results of cumulative quake effects on the proportion of alcoholic beverages spent by households in different time periods after the earthquake

	March 2011	3 months	6 months	1 year	2 years	4 years	6 years	8 years
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cities with seismic intensity 6	0.055	-0.023	-0.034	0.006	0.049*	0.090***	0.084***	0.067***
	(0.079)	(0.063)	(0.048)	(0.036)	(0.023)	(0.019)	(0.020)	(0.017)
Cities with seismic intensity 5	0.004	-0.004	-0.048	-0.055	-0.002	0.006	-0.010	-0.016
	(0.062)	(0.060)	(0.050)	(0.028)	(0.048)	(0.020)	(0.015)	(0.013)
Cities with seismic intensity 4	0.010	0.013	0.007	-0.011	0.007	0.015	0.008	0.005
	(0.069)	(0.056)	(0.060)	(0.053)	(0.042)	(0.026)	(0.021)	(0.016)
Ambient radiation level (Gy/h)	-0.024***	-0.023***	-0.014***	-0.012***	-0.017***	-0.022***	-0.020***	-0.019***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.004)	(0.003)	(0.004)
Number of persons per household	0.061	0.068	0.062	0.066	0.001	-0.012	0.043	0.029
	(0.059)	(0.060)	(0.060)	(0.058)	(0.045)	(0.039)	(0.049)	(0.044)
Percentage of persons under 18	-0.007*	-0.008*	-0.007*	-0.007*	-0.007*	-0.006	-0.005*	-0.005
years old per household	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)
Percentage of persons over 65	-0.011**	-0.011**	-0.011**	-0.011**	-0.010*	-0.007	-0.005	-0.004
years old per household	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)
Age of household head	0.015*	0.016*	0.016*	0.016*	0.012	0.009	0.008	0.006
	(0.007)	(0.007)	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)
Percentage of earners per household	-0.003	-0.004	-0.004	-0.004	-0.004	-0.005	-0.002	-0.001
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.002)
Percentage of employed female	0.003*	0.003*	0.003*	0.003*	0.003**	0.005***	0.003**	0.003**
spouses of household heads	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Percentage of owned dwellings	0.001	0.001	0.001	0.001	0.002*	0.001*	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Percentage of fixed costs in	-0.006***	-0.006***	-0.006***	-0.005***	-0.006***	-0.006***	-0.005***	-0.005***
monthly expenditure	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Logged monthly expenditure on	-0.643***	-0.638***	-0.638***	-0.649***	-0.643***	-0.668***	-0.724***	-0.729***
total consumption (1,000 Yen)	(0.050)	(0.050)	(0.050)	(0.051)	(0.050)	(0.052)	(0.049)	(0.044)
Price index of alchoholic beverages	0.002	0.002	0.001	0.002	0.001	0.003	0.003	0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Ratio of job openings to job seekers	0.064	0.061	0.060	0.061	0.093*	0.062*	0.030	0.010
	(0.038)	(0.038)	(0.038)	(0.036)	(0.042)	(0.027)	(0.023)	(0.024)
Monthly average temperature (°C)	0.008	0.008	0.007	0.008	0.008	0.008	0.007	0.009
	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.004)	(0.007)	(0.007)
Monthly total daylight hours	0.000	0.000	0.000	0.000	0.000	0.000*	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Monthly average precipitation (mm)	-0.000	-0.000	-0.000	0.000	-0.001	-0.001	-0.002	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Observation	6345	6484	6625	6907	7471	8599	9727	10855
Asjusted R^2	0.53	0.53	0.53	0.54	0.54	0.53	0.53	0.54

Notes: The dependent variable is the monthly share of household spending on alcoholic beverages (%) in each city. For seismic intensity dummies, the excluded category is the intensity of less than 3. The estimated coefficient of ambient radiation level is multiplied by 100 for readability. Columns (1)-(7) are estimated by using different sample periods of 1 month, 3months, 6 months, 1 year, 2 years, 4 years, 6 years, and 8 years since March 2011. Regressions are weighted by the number of households in each city. Standard errors are clustered at the city level. ***, **, and * indicate significance at the 0.1%, 1%, and 5% level, respectively.

Table A5 Estimation results of cumulative quake effects on the proportion of alcoholic beverages spent by employed households in different time periods after the earthquake

	March 2011	3 months	6 months	1 year	2 years	4 years	6 years	8 years
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cities with seismic intensity 6	-0.139	-0.101	-0.106	-0.024	-0.003	0.043*	0.049*	0.047*
	(0.165)	(0.139)	(0.087)	(0.059)	(0.032)	(0.021)	(0.023)	(0.018)
Cities with seismic intensity 5	0.044	0.034	-0.024	-0.053	0.024	0.023	0.007	0.004
	(0.061)	(0.057)	(0.054)	(0.039)	(0.039)	(0.017)	(0.016)	(0.012)
Cities with seismic intensity 4	0.051	0.093	0.065	0.050	0.049	0.027	0.020	0.025
	(0.069)	(0.089)	(0.124)	(0.100)	(0.060)	(0.047)	(0.036)	(0.019)
Ambient radiation level (Gy/h)	-0.001	-0.004	-0.003	-0.003	-0.004	-0.008	-0.008*	-0.006
	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)
Number of persons per household	0.030	0.031	0.026	0.036	-0.010	-0.011	0.033	0.014
	(0.044)	(0.043)	(0.043)	(0.042)	(0.033)	(0.031)	(0.035)	(0.033)
Percentage of persons under 18	-0.003	-0.003	-0.003	-0.002	-0.002	0.002	0.001	0.002
years old per household	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)
Percentage of persons over 65	-0.007	-0.007	-0.007	-0.006	-0.004	0.001	0.003	0.003
years old per household	(0.004)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.002)
Age of household head	0.019**	0.020**	0.020**	0.019**	0.016**	0.014*	0.014*	0.011*
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)
Percentage of earners per household	-0.002	-0.002	-0.002	-0.001	-0.000	0.001	0.003	0.004
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)
Percentage of employed female	0.002	0.002	0.002	0.002	0.002	0.002	0.001	-0.000
spouses of household heads	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Percentage of owned dwellings	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Percentage of fixed costs in	-0.006***	-0.006***	-0.006***	-0.006***	-0.005***	-0.006***	-0.005***	-0.004***
monthly expenditure	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Logged monthly expenditure on	-0.611***	-0.605***	-0.604***	-0.610***	-0.625***	-0.599***	-0.646***	-0.637***
total consumption (1,000 Yen)	(0.064)	(0.061)	(0.057)	(0.061)	(0.066)	(0.046)	(0.050)	(0.043)
Price index of alchoholic beverages	0.002	0.002	0.003	0.003	0.004	0.005	0.006	0.005
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)
Ratio of job openings to job seekers	0.086**	0.083**	0.082*	0.077*	0.110**	0.075*	0.057*	0.019
	(0.029)	(0.030)	(0.031)	(0.030)	(0.033)	(0.028)	(0.024)	(0.028)
Monthly average temperature (°C)	0.016*	0.017*	0.016	0.016	0.019*	0.016*	0.013	0.013
	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)	(0.006)	(0.008)	(0.008)
Monthly total daylight hours	0.000	0.000	0.000	0.000	0.000	0.000*	0.000*	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Monthly average precipitation (mm)	0.001	0.001	0.002	0.002	0.001	-0.001	-0.001	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Observation	6345	6483	6624	6906	7470	8598	9726	10854
Asjusted R^2	0.42	0.42	0.42	0.42	0.42	0.41	0.41	0.42

Notes: See the notes in Table A4.

Table A6 Estimation results of cumulative quake effects on the proportion of alcoholic beverages spent by non-employed households in different time periods after the earthquake

	March 2011	3 months	6 months	1 year	2 years	4 years	6 years	8 years
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cities with seismic intensity 6	0.491	0.311	0.182	0.115	0.187***	0.188***	0.169***	0.118**
	(0.283)	(0.218)	(0.122)	(0.083)	(0.034)	(0.032)	(0.038)	(0.038)
Cities with seismic intensity 5	-0.034	-0.041	-0.065	-0.056	-0.024	-0.013	-0.025	-0.036
	(0.101)	(0.081)	(0.063)	(0.038)	(0.071)	(0.029)	(0.025)	(0.024)
Cities with seismic intensity 4	-0.054	-0.089	-0.050	-0.086	-0.047	-0.023	-0.025	-0.032
	(0.120)	(0.082)	(0.090)	(0.050)	(0.041)	(0.025)	(0.021)	(0.023)
Ambient radiation level (Gy/h)	-0.055***	-0.052***	-0.032***	-0.026***	-0.039***	-0.042***	-0.038***	-0.035***
	(0.008)	(0.007)	(0.005)	(0.005)	(0.003)	(0.005)	(0.005)	(0.005)
Number of persons per household	0.016	0.030	0.029	0.045	0.023	0.010	0.052	0.053
	(0.080)	(0.079)	(0.079)	(0.080)	(0.073)	(0.079)	(0.068)	(0.067)
Percentage of persons under 18	-0.008*	-0.009*	-0.009**	-0.009**	-0.009*	-0.007*	-0.007**	-0.008*
years old per household	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Percentage of persons over 65	-0.008***	-0.008***	-0.008***	-0.007**	-0.006**	-0.005**	-0.003*	-0.004*
years old per household	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)
Age of household head	0.006	0.006	0.006	0.003	0.001	-0.000	-0.003	-0.002
	(0.008)	(0.008)	(0.008)	(0.007)	(0.007)	(0.006)	(0.006)	(0.006)
Percentage of earners per household	-0.004	-0.004	-0.004	-0.004	-0.004	-0.003	-0.002	-0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
Percentage of employed female	0.004*	0.004*	0.004*	0.003	0.003	0.004**	0.002	0.003*
spouses of household heads	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Percentage of owned dwellings	-0.000	-0.000	-0.000	-0.000	0.001	-0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Percentage of fixed costs in	-0.004***	-0.004***	-0.004***	-0.004***	-0.005***	-0.005***	-0.005***	-0.005***
monthly expenditure	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Logged monthly expenditure on	-0.777***	-0.783***	-0.786***	-0.797***	-0.784***	-0.779***	-0.801***	-0.810***
total consumption (1,000 Yen)	(0.050)	(0.050)	(0.050)	(0.050)	(0.040)	(0.044)	(0.043)	(0.039)
Price index of alchoholic beverages	0.000	-0.000	-0.001	-0.001	-0.003	-0.001	0.000	0.001
	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
Ratio of job openings to job seekers	0.034	0.033	0.032	0.035	0.064	0.035	-0.003	0.009
	(0.072)	(0.071)	(0.071)	(0.069)	(0.074)	(0.056)	(0.042)	(0.034)
Monthly average temperature (°C)	-0.010	-0.010	-0.010	-0.007	-0.010	-0.005	-0.003	0.001
	(0.009)	(0.009)	(0.009)	(0.009)	(0.011)	(0.008)	(0.008)	(0.008)
Monthly total daylight hours	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Monthly average precipitation (mm)	-0.003	-0.004	-0.004	-0.003	-0.004	-0.003	-0.003	-0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)
Observation	6345	6483	6624	6906	7470	8598	9726	10854
Asjusted R^2	0.381	0.382	0.383	0.388	0.389	0.388	0.393	0.397