Can an Economic Structural Model Support Hypothetical and Experimental Evidence? Preference Parameters Before and After the Great East Japan Earthquake

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Abstract

This study proposes the measurement error robust Euler equation approaches to estimate households' preference parameters before and after a large-scale disaster, namely the Great East Japan Earthquake of 2011. By using household consumption and asset allocation data, we find that a large-scale disaster affects households facing different future risks of similar disasters differently even if they are not physically damaged by the disaster. Our finding supports other studies using hypothetical and experimental data that suggest experiencing a large-scale disaster changes individuals' risk preferences. Simultaneously, our results also reveal imperfection of experimental and hypothetical designs.

Introduction

A growing body of literature finds that an individual's preference parameters such as risk and time preferences change after experiencing an unexpected natural disaster.
In the literature, two main approaches elicit preference parameters:
Field experiments Eckel El-Gamal, and Wilson (2009) Cameron and Shah (2015) and **hypothetical questions** Callen (2015) Hanaoka Shigeoka Watanabe (2017).
However,
(1) since experiments and hypothetical questions target individuals' decisions rather than those of households, whether and how natural disasters affect households' preference parameters are not evident.
(2) No clear lines exist between identifying those affected and not affected by a disaster, which makes the definition of the treatment controversial.
This study empirically investigates how preference parameters such as relative risk aversion and the time discount factor have been affected by the Great East Japan Earthquake that occurred in March 2011.
We adopt life-cycle consumption models, in which risk and time preferences determine consumption, saving, and the other asset allocation plans of economic agents.

Model and Data

We use Japanese household panel survey (JHPS-KHPS) data that contain actual households' consumption C and saving and asset Q.
We assume **a** household's expected utility maximization problem is

$$\max E\left[\sum_{t=0}^{\infty}\beta^t U(C_{i,t},\omega_i,\gamma)\,\middle|\,I_{i,t}\right]$$

$$C_{i,t+1} \le Q_{i,t}(1+R_{i,t}) + L_{i,t} - C_{i,t}$$

$0<\beta<1$ Discount factor; ω_i Household fixed effect
$0<\gamma<\infty$ Utility curvature parameter; $R_{i,t}$ Household's returns at time t
$L_{i,t}$ Labor income at time t.; $I_{i,t}$ Information set at time t.

Specifically, we assume the utility function to be the constant relative risk aversion (CRRA) type:

$$U(C_{i,t},\omega_i,\gamma) = (1-\gamma)^{-1}(C_{i,t}{}^{-\gamma}-1)exp(\omega_i)$$

The utility maximization problem yields the Euler equation:

$$E\left\{\beta(w)(1+R_{i,t})\left(C_{i,t+1}/C_{i,t}\right)^{-\gamma(w)} - 1\,\middle|\,Z_{i,t}, W_{i,t}=w\right\} = 0$$

$W_{i,t}$ Earthquake risk of the household (**Figure 1**)
$Z_{i,t}$ Instrumental variables
The localized moment condition enables us to identify heterogeneous effect of the disaster on β and γ. We apply local GMM developed by Lewbel (2007).

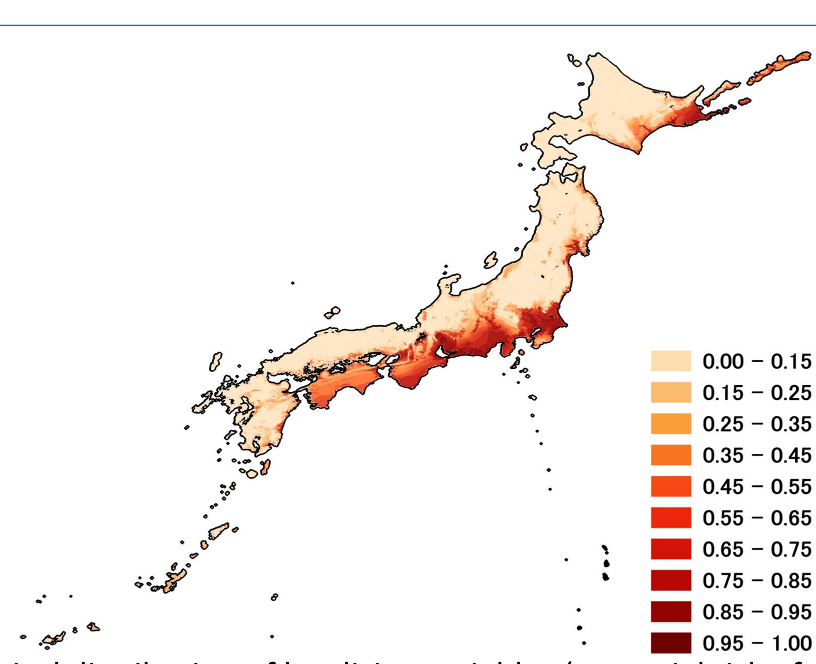

Figure 1. Geographical distribution of localizing variables (potential risk of severe earthquake).

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Results

To observe the effect of the earthquake, we compare $(\beta(w),\gamma(w))$ before and after the earthquake.

We adopt measurement error robust estimators GMM-D and GMM-LN developed by Alan, Attanasio, & Browning (2009) because JHPS-KHPS consumption data are reported consumption. Additionally, we test whether GMM-D and GMM-LN results satisfy moment inequality:

$$E\{[\log\beta(w) + \log(1+R_{i,t+1}) - \gamma(w)\log(C^{obs}_{i,t+1}/C^{obs}_{i,t})]g(Z_{i,t})|W_{i,t}=w\} \le 0$$

The inequality is derived under a weak distributional assumption on measurement error. When $w \in [0.50, 0.99]$, both GMM-D and GMM-LN satisfy the inequality.

For the risk aversion parameters of GMM-D in the right-hand panel of **Figure 2**, households whose future earthquake risk is above 0.5 become risk averse after the earthquake. **Figure 2** shows that the 95% confidence intervals in 2009 and 2012 do not overlap for most households. In particular, in 2012, households whose earthquake risk runs from 0.8 to 0.9 had high $\hat{\gamma}(w)$ values compared with households whose risk is outside this interval. Households facing a higher risk of earthquakes became more risk averse than other households.

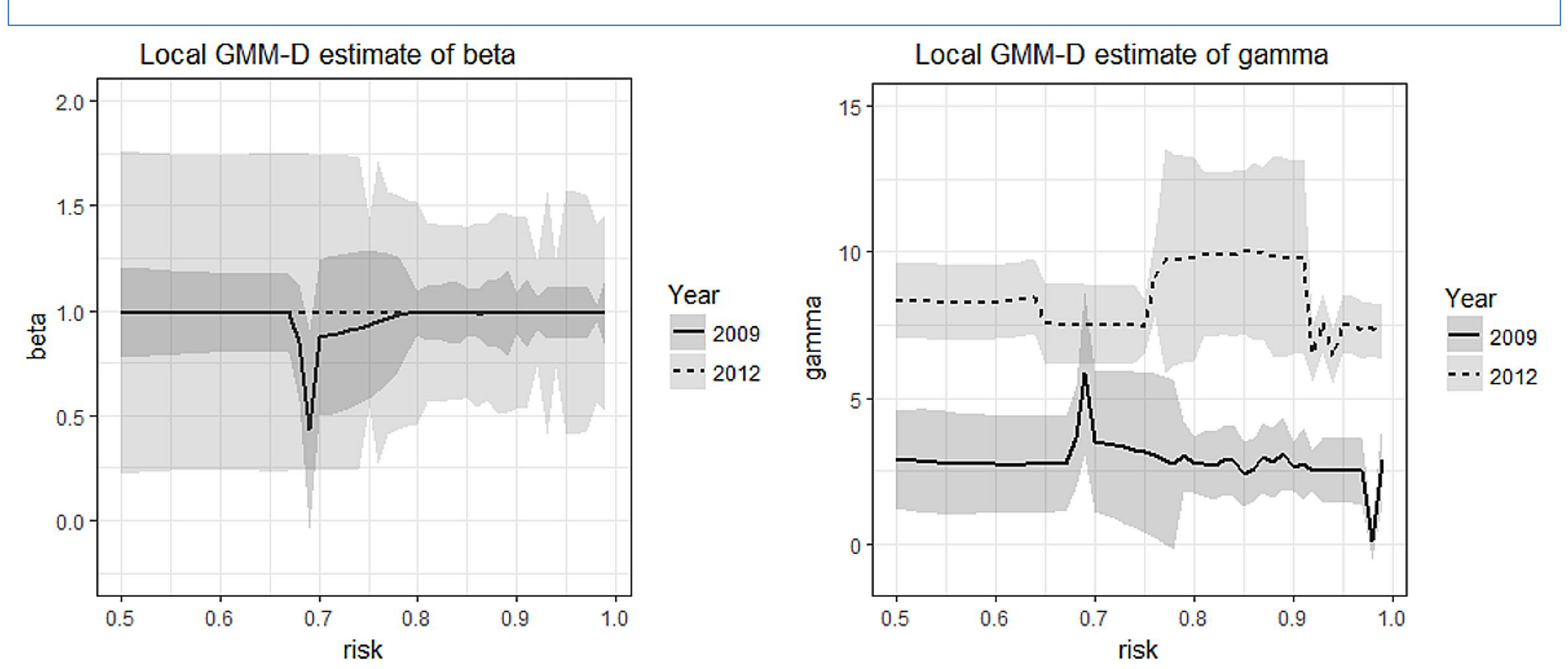

Figure 2. Local GMM-D estimate of $(\beta(w),\gamma(w))$.

Discussion

The varying coefficients model reveals the heterogeneous effects of the disaster on households' parameters. The estimated values suggest that the parameter changes of some subpopulations are larger than others.

The estimated parameter change suggests that households living in regions at risk of a severe earthquake are more risk averse than those living in safer areas. In other words, households facing a relatively high earthquake risk are more affected by earthquakes compared with others. The observed parameter change is consistent with other empirical results. For example, Goebel, Krekel, Tiefenbach & Ziebarth (2015) show that the earthquake and Fukushima nuclear accident affect German attitudes regarding nuclear power plants. Hence, our results support the findings of studies that report a change in the time or risk preference parameters.

While other unexpected events occurring in 2011 could have made households risk averse, the observed heterogeneity of the risk preference change, which was also observed in Germany, suggests that the disaster did affect risk preferences to some extent.

Conclusions

We observed preference parameter changes after the disaster, which is consistent with existing works. Therefore, hypothetical questions or experiments are useful when researchers are interested in whether a large-scale disaster affects respondents' minds. However, we observed differences between our results and existing works. The differences suggest that the effect of the disaster on questionnaire responses and behavior in experiments is not always the same as real-life economic behavior. Additional evidence would thus be required.

The policy implications of our findings are clear. Since preference parameters can change after a large-scale disaster even if the disaster does not damage households' lives or property directly, policymakers must consider preference changes after a large-scale disaster when evaluating the effect of a policy implemented after its occurrence.

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