# Natural disasters and their long-term effect on happiness: the case of the great Hanshin-Awaji earthquake.

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## Abstract

The great Hanshin-Awaji (Kobe) earthquake, which occurred in 1995, resulted in tremendous economic damage to the city of Kobe. Using individual-level data of Japan during the period 2000–08, I investigated the long-term impact of the earthquake on the happiness of surviving victims. After controlling for individual characteristics and characteristics of residential areas, the following key findings were obtained: (1) victims were more likely to feel happy than non-victims; (2) this tendency disappeared with time. This suggests that the aspiration level declined following the experience of the devastating event, which led victims to feel happier. However, victims adapt to the new circumstances with time.



*JEL classification:* Q54 ,Z13
*Keywords:* Natural disasters, happiness, subjective well-being, adaptation, aspiration level.

## 1. Introduction

Coping with the unforeseen events of natural disasters is a critical issue, even in modern society (e.g., Albala-Bertrand, 1993; Tol and Leek 1999; Congleton, 2006; Shughart, 2006; Toya and Skidmore 2007; 2010). The probability of natural disasters occurring is not associated with the level of economic development (Kahn 2005). Thus, natural disasters have an impact both on developing countries (Cavallo et al. 2010; Strobl 2011b) and on developed countries (Sawada 2007; Sawada and Shimizutani 2007; 2008; Luechinger and Raschky, 2009; Strobl 2011a). This is because there is no possibility of reducing the probability of occurrence even though the extent of damage caused by natural disasters is partly dependent on income level (Kellenberg and Mobarak, A. 2008). Natural disasters do, however, affect economic growth (Skidmore and Toya 2002). Since the 2000s, economic researchers have devoted considerable attention to the issue of natural disasters, and they have generally placed the focus on the physical outcomes (e.g., Horwich 2000; Sawada 2007; Sawada and Shimizutani 2007; 2008; Yamamura 2010).

However, the psychological impact of natural disasters is a major issue in economics since psychological distress decreases the performance of workers and leads to poor productivity. Recently, the impact of natural disasters on people's subjective values and perceptions has been analyzed by economic researchers[1]. For example, the impact of Hurricane Katrina in 2005 on the level of happiness has been investigated in affected areas of the United States (Kimball et al. 2006). Based on combined cross-sectional and time-series data of 16 European countries and the United States, it has been found that floods exert a negative impact on life satisfaction (Luechinger and Raschky, 2009). For 70% of Japanese, the Great East Japan earthquake of 2011 did not change the level of happiness. However, when the sample was restricted to the rest of people, most people felt happier after the earthquake than before (Ishino et al., 2012). These studies have not sufficiently examined the long-term impact of natural disasters[2]. However, studies in psychology have been informative about the effect of traumatic disastrous events on long-term psychological patterns in children (Bolton et al., 2000). Such disasters as the Haiti earthquake, Hurricane Katrina, the Great East Japan earthquake, and the great Hanshin-Awaji earthquake cause tremendous numbers of deaths. Such events are thought to cause trauma, and the effect can be considered long term rather than temporary. It is thus important to consider the long-term psychological effect of natural disasters when the process of recovery from natural disasters is considered in terms of social welfare.

The seminal work of Easterlin (1974) suggested that economic growth is not associated with personal happiness in developed countries over time, which is contrary to standard economic theory. To explain this finding, widely known as the Easterlin Paradox, one argument maintains that experience and previous conditions change people's aspiration level via an adaptation process that reduces

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[1] Non-natural disasters, such as terrorism, war, and nuclear accidents, were found to influence people's values and perceptions (Metcalfe et al., 2011; Bozzoli et al., 2012, Yamamura 2012).

[2] On the assumption that the impact of natural disasters on life satisfaction persisted at most for 24 months, Luechinger and Raschky (2009) examined the impact of floods that occurred 18 months before their survey.

personal happiness (e.g., Frey and Stutzer. 2002a,2002b; Statzer 2004) [3]. Devastating natural disasters inevitably change people's circumstances and in turn influence their aspiration level. Accordingly, apart from the association between income and happiness, a change in aspiration seems to play a significant role in determining people's perception of happiness.

A natural disaster exerts a detrimental effect on economic conditions through the destruction of physical capital and loss of the workforce immediately after the disaster occurs. By contrast, "disasters also provide an opportunity to update the capital stock, thus encouraging the adoption of new technologies" (Skidmore and Toya, 2002; 665). Further, it is argued that natural disasters enhance investment in human capital rather than physical capital when the long-term effect of such disasters is considered (Skidmore and Toya 2002). That is, natural disasters also have a reverse impact on economic conditions. In addition, the outcome of natural disasters can be analyzed in terms of psychological factors related to economics. If the change in aspiration level is not taken into account, the terrible experience of the natural disaster inevitably results in decreased happiness. In this regard, some studies have explored the impact of disastrous events on happiness (e.g., Kimball et al., 2006; Luechinger and Raschky, 2009; Berger, 2010; Metcalfe et al., 2011). However, in the present paper, I will examine the question of how the occurrence of an unforeseen disastrous event affects the aspiration level and in turn happiness.

Field experiments are very useful in examining human values by controlling for various conditions to alleviate estimation bias. However, it is difficult for researchers to investigate the long-term effects of such events as natural disasters on happiness by means of field experiments. Hence, survey data are still very useful. This paper explores the long-term effect of the great Hanshin-Awaji earthquake, which occurred in 1995, on the happiness level of its victims using the Japanese General Social Surveys (JGSS). The JGSS data covered the period 2000–08 and included more than 10,000 observations. Hence, using these data, I can examine the long-term impact of the great Hanshin-Awaji earthquake from 5 to 13 years after it occurred. I found through the ordered probit estimation that the victims were more likely to be happy than other people. This finding is contrary to the results in other studies using European and U.S. data (Kimball et al., 2006; Luechinger and Raschky, 2009), but it is consistent with work using Japanese data (Ishino et.al., 2012). Furthermore, the positive effect of the great Hanshin-Awaji earthquake disappeared with time, which is consistent with the case of Hurricane Katrina (Kimball et al., 2006).

The remainder of this paper is organized as follows. An overview of the great Hanshin-Awaji earthquake is provided in Section 2. Testable hypotheses are proposed in Section 3. Section 4 provides an explanation regarding data and the empirical method used. Section 5 presents the estimation results and their interpretation. The final section offers some conclusions.

## 2. Overview of the great Hanshin-Awaji earthquake

On January 17, 1995, a devastating earthquake occurred in Japan. This earthquake hit the Hanshin-Awaji area, which includes the city of Kobe. As

[3] Recently, Tsutsui and Ohtake (2012) explored the Easterlin Paradox using Japanese data although most studies examining the paradox were based on Western countries (Europe and the United States).

illustrated in Figure 1, Kobe is located in the southeastern part of Hyogo Prefecture. Kobe is a densely populated area and plays a leading role as a hub port and belongs to the large industrial cluster in the southern central part of Japan. The earthquake resulted in 6,308 deaths and caused serious economic damage. For example, approximately, 100,000 houses were destroyed and 33,000 houses were partially destroyed. The housing property loss was greater than USD 60 billion, while the capital stock loss was over USD 100 billion (Horwich 2000; Sawada and Shimizutani, 2007;2008).

The Japanese earthquake scale ranges from level 1 (weak) to level 7 (devastation). In Figure 1, the shaded area, which covers the seaside area of Kobe, was level 7 at the time of the great Hanshin-Awaji earthquake (Ministry of Land, Infrastructure, Transport and Tourism 1996, 3)[4]. The damage caused by the great Hanshin-Awaji earthquake was concentrated in Kobe: 99% of the deaths caused by the earthquake occurred in Hyogo Prefecture. Furthermore, 71% of the deaths in Hyogo Prefecture occurred in Kobe. In addition, 61% of the destroyed houses were in Kobe. Therefore, the damage caused by the earthquake for Kobe residents was distinctly different from that for people living in other parts of Hyogo Prefecture. This leads me to assume that the residents of Kobe can be considered the victims of the Hanshin-Awaji earthquake even if they survived.

## 3. Hypothesis

Victims of natural disasters may become homeless if the house in which they were living is destroyed or seriously damaged. Victims are also confronted with the possibility of losing their job because the disaster can cause damage to the workplace or cause physical injury. In addition, a natural disaster can impede the transport system and damage infrastructure. These hardships inevitably cause distress to the residents of areas hit by a disaster. Based on the above and in line with other works (Kimball et al., 2006; Luechinger and Raschky, 2009), Hypothesis 1 is postulated:

*Hypothesis 1: Victims of an earthquake are less likely to feel happy.*

In contrast to the results of previous studies, Ishino et al. (2012) used recent data relating to the Great East Japan earthquake of 2011 to show that about 50% of residents in Miyagi Prefecture, which was badly hit by the earthquake and tsunami, felt happier after the disaster than they did before. In line with this, it has been found that healthy people are inclined to underestimate their happiness level compared with those who have health problems (Riis et al., 2005). Recently, economic researchers have asserted that the utility of an individual is influenced by the people around them. For example, some empirical works have supported the hypothesis that it is relative income rather than absolute income that has an effect on the degree of happiness (e.g., Clark and Oswald, 1996; McBride, 2001; Stutzer

[4] According to the Ministry of Land, Infrastructure, Transport and Tourism (1996), level 7 was observed in the following wards of Kobe: Suma, Nagata, Hyogo, Chuo, Nada, Higashi-nada, and Asiaya. In addition to these Kobe wards, level 7 was observed in the cities of Nishinomiya and Takarazuka. However, compared with Kobe, serious damage to these two cities was small.

2004; Luttmer 2005). Luttmer (2005) made it evident that "increased neighbors' earnings have the strongest negative effect on happiness for those who socialize more in their neighborhood" (Luttmer 2005, 989–990). From this, Luttmer asserted "that the negative effect of a neighbor's earnings on well-being is real and that it is most likely caused by a psychological externality" (Luttmer 2005, 990). With a devastating natural disaster, not only is the income level of one's neighbors reduced, but some of those neighbors may also be dead. Even if their income is reduced, survivors of a natural disaster are alive. Surviving or not surviving a disaster such as an earthquake seems in part to depend on luck. Compared with those who died in the community, the survivors can consider themselves lucky. Life has become a more precious commodity than before the disaster because of the number of people who died. Hence, life appears to have become more valuable for the survivors. Such externality possibly increases the happiness level of the survivors. This leads me to propose Hypothesis 2:

*Hypothesis 2: Victims of the earthquake are more likely to feel happy.*

The argument has been made that with time people seem to adapt to circumstances (Myers 1992, 2000). This can explain why the influence of a change in circumstances, such as an increase in income, does not persist over time. Such traumatic events as natural disasters and terrorist attacks have a negative effect on happiness, but this dissipates with time. The present paper focuses on the long-term effect of a devastating natural disaster on happiness, rather than the temporary effect. If a devastating disaster does have a long-term influence on the happiness of victims, I would question whether the traumatic event would influence the level of happiness throughout the victims' lives. Hence, this paper attempts to investigate the extent to which the effect of the disaster persists.

## 4. Data and Methods

### *4.1. Data*

In this paper, I used individual-level data from JGSS.[5] In the JGSS surveys, a two-stage stratified sampling method was adopted. The surveys were conducted throughout Japan in 2000, 2001, 2002, 2003, 2005, 2006, and 2008.[6] JGSS ask standard questions concerning an individual's characteristics in face-to-face interviews. The data included information related to level of happiness, marital status, age, gender, annual household income,[7] and years of schooling. In addition,

[5] Data for this secondary analysis, "Japanese General Social Surveys (JGSS), Ichiro Tanioka," was provided by the Social Science Japan Data Archive, Information Center for Social Science Research on Japan, Institute of Social Science, The University of Tokyo.

[6] Surveys were not conducted in 2004 and 2007. Surveys were conducted in 2009 and 2010, but the data were not available.

[7] In the original dataset, annual earnings were grouped into 19 categories, and I assumed that everyone in each category earned the midpoint value. For the top category of "23 million yen and above," I assumed that everybody earned 23 million yen. Of the 10,708 observations used in the regression estimations, there were only 106 cases in this category. Furthermore, there was no observation in this category when respondents were "victims". Therefore, the problem of top-coding should not be a major issue here.

the size of the place of residence, prefecture of residence, and prefecture of residence at age 15 were also provided by JGSS. A Japanese prefecture is the equivalent of a U.S. state or Canadian province, and there are 47 prefectures in Japan. Data were obtained from 22,796 adults aged 20 to 89 years. Respondents did not, however, answer all the survey questions; data regarding some variables were not available. As a consequence, the number of samples used in the regression estimations was reduced to 10,708. With respect to measurement of happiness, considered a crucial dependent variable, respondents were asked, "Are you happy?" The possible responses to this question ranged between 1 (unhappy) and 5 (happy)[8].

The advantages of the JGSS data are as follows. (1) JGSS was designed as a Japanese counterpart to the General Social Survey (GSS) of the United States. Therefore, this paper presents findings that can be compared with data in the United States. (2) In the JGSS survey between 2000 and 2008, all respondents were over 15 years old in 1995, when the great Hanshin-Awaji earthquake occurred. In addition, JGSS provides information of the place of residence at the age of 15 years, which enabled me to link the current place of residence and that at age 15[9]. I assumed that if people resided in Kobe both times, they resided in that city before and after the earthquake.

Following the method of Luechinger and Raschky (2009), happiness data and the area damaged by the earthquake are matched in this paper on the basis of administrative boundaries because the respondents' exact place of residence was not known. In Japan, cities, towns, and villages are subsumed within a prefecture. As noted above, Kobe is in Hyogo Prefecture. I obtained information about the residential prefecture of the respondents and also about the size of the urban area in which the respondents resided. In the data, urban areas were divided into large city, medium-sized city (population over 0.2 million), small city (population under 0.2 million), town, and village. In the questionnaire, a city designated as such by an ordinance was defined as a "large city". Kobe achieved city status in 1956. Hence, Kobe is considered a large city. Apart from Kobe, no cities in Hyogo Prefecture have been designated as such by ordinances. Accordingly, respondents could be identified as residents of Kobe if their residential prefecture was given as Hyogo and the urban area was given as "large city." In addition to the current place of residence, I obtained information relating to that at age 15. As explained in Section 2, the damage of the great Hanshin-Awaji earthquake was concentrated in Kobe. Therefore, current Kobe residents who resided in Hyogo Prefecture at age 15 could be defined as victims of the earthquake[10].

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[8] JGSS was also used to examine how social capital affects the happiness of Japanese people (Kuroki, 2011).

[9] GSS does not contain information on the place of origin of the respondent, either in terms of birth or in terms of previous residential location.

[10] As pointed out by Luechinger and Raschky, "some respondents will be wrongly assigned to the reference group, i.e. categorized as not being affected even though they are; others will be wrongly counted among the victims. Since natural disasters are usually of limited geographical extension and the treatment group is much smaller compared to the reference group, the second type of error carries more weight. Therefore, we prefer to err on the side of setting the boundaries to narrow"(Luechinger and Raschky 2009, 623). In the great Hanshin-Awaji earthquake, some areas apart from Kobe were seriously damaged. However, following the method of Luechinger and Raschky (2009), I limited the seriously damaged area to a narrow one (Kobe).

Variables used in the regression estimations are shown in Table 1. Definitions and mean comparisons of the earthquake victims and other Japanese are provided. Even though the whole sample was over 10,000, only 66 respondents currently residing in Kobe experienced the great Hanshin-Awaji earthquake. This indicates that the sample size of the earthquake victims was very small. Furthermore, it is self-evident that the respondents were survivors of the earthquake and were able to continue residing in Kobe. Other victims died or moved to other prefectures. This inevitably caused a selection bias in the data used in this paper. Hence, the respondents defined as "victims of the earthquake" cannot be considered to represent all people who suffered as a result of the earthquake.

If the "victims" were survivors, they were thought to be relatively rich and hence were able to live in quake-resistant buildings. In addition, the psychological harm suffered by the victims was relatively small, and so they were able to continue living in Kobe. As can be seen in Table 1, the victims' mean *Household income* was 595, which was lower than the 625 of other people in Japan. Contrary to the inference made above, the victims can be regarded as relatively poor rather than rich, although the damage caused by the earthquake possibly reduced the income of the victims. It can at least be stated that the victims were less likely to have an economic advantage that would help reduce the damage caused by the earthquake. *Change of income* shows the difference in the perceived income level between age 15 and the time of the survey. As explained earlier, all respondents were over 15 years old in 1995. The change in the perceived income level between before and after the earthquake was as follows: –0.22 of victims means that the perceived income level declined by 0.22 points on the 5-point scale, whereas –0.08 of other Japanese means that the level declined by only 0.08 points on the 5-point scale. It follows from this that the natural disaster appeared to reduce the perceived income level by 0.14 points. In addition, *Schooling* of the victims was 12.8, which was longer than that of other Japanese (12.1). This shows that the victims had the potential to earn higher income than other people, which is not in line with the lower income of victims. What is more, the percentage of *Unemployed* was 3.1 for the victims and 1.5 for other Japanese. This suggests that the long-term psychological damage of natural disasters appears to reduce the opportunity for higher-educated people to earn higher income. Considering *Household income*, *Change of income, Schooling,* and *Unemployed* together leads me to conclude that the earthquake had a detrimental effect on the economic condition of the victims. On the other hand, Table 1 indicates that the happiness level of the victims was 4.03, which is higher than the 3.87 of other Japanese. From Table 1, I conclude that the higher level of the victims' happiness is unlikely to be due to economic advantage. Hence, the selection bias is not so large, even though the bias cannot be controlled because of the data limitation.

### *4.2. Econometric framework and estimation strategy*

For the purpose of examining the hypotheses proposed above, the estimated function of the baseline model takes the following form:

$$Happiness_i = \alpha_1 Victims_i + \alpha_2 Household\ Income_i + \alpha_3 Change\ of\ income_i + \alpha_4 Age_i + \alpha_5 Age^2_i + \alpha_6 Married_i + \alpha_7 Schooling_i + \alpha_8 Unemployed_i + \alpha_9 Male_i + u_i,$$

where $Happiness_i$ represents the dependent variable in individual $i$. Regression

parameters are represented by $\alpha$. The year specific effect, such as the macro-level shock, is controlled by including the year dummy. In addition, the characteristics of place of residence are controlled for by including the prefecture dummy and scale of urban area dummy. As explained earlier, the value of *Happiness* ranged from 1 (unhappy) to 5 (happy). Hence, the ordered probit model was used to conduct the estimations. The error term is represented by $u_i$. It is reasonable to assume that the observations may be spatially correlated within a prefecture, since the preference of one agent may well relate to the preference of another in the same prefecture. To consider such a spatial correlation in line with this assumption, I used the Stata cluster command and calculated Z statistics using robust standard errors. The advantage of this approach is that the magnitude of spatial correlation can be unique to each prefecture.

The key variables used to examine the Hypotheses proposed in the previous section are as follows. *Victims* was included to capture the individual experiencing the great Hanshin-Awaji earthquake. If *Hypothesis 1* was supported, its coefficient signs would become negative. On the other hand, if *Hypothesis 2* was supported, its coefficient signs would become positive. In addition to the baseline model shown above, the cross-term between *Victims* and *Past years* (*Victims* **Past years*) was incorporated in the extended model to examine how the effect of the earthquake changed with time. If victims adapted to the new circumstances, the effect of the earthquake would diminish. In this case, the coefficient of *Victims* **Past years* would take a negative sign.

Following previous studies (Luechinger and Raschky, 2009; Ishino et al., 2012), various individual characteristics were incorporated as control variables. [11] *Household income* was included to capture economic condition when the surveys were conducted. *Change of income* was incorporated to capture the change in economic condition before and after the earthquake. These variables can control for the economic status affecting *Happiness*. *Schooling* was a proxy for human capital. Standing in society and relationships with other people seemed to vary according to age, marital status, and gender. In previous studies, age and the square of age were incorporated to ascertain determinants of life satisfaction (or happiness, subjective well-being) because the effect of age was not considered linear (e.g., Alesina et al. 2004; Blanchflower and Oswald 2004, 2008; Di Tella and MacCulloch 2008). Following this, both age and the square of age are included as independent variables in this paper.

## 5. Estimation Results

### *5.1. Results of baseline estimations*

The estimation results of the baseline model are presented in Table 2. People who feel happy possibly consider their current economic position to be better than before even if the current economic position is not actually better. *Change of income* is a value of subjective evaluation. Hence, causality between *Happiness* and *Change of income* is ambiguous, resulting in endogeneity bias. Hence, it is necessary to

[11] Ishino et al. (2002) included proxies for social capital, such as participation in volunteer activities and the Charity dummy. However, these variables possibly cause endogeneity bias and hence were not included in the present paper.

check whether the estimation results change by including *Change of income.* Columns (1)–(3) present the results by excluding *Change of income* as an independent variable, while columns (4)–(6) present the results incorporating *Change of income*. In columns (1) and (4), results based on the whole period 2000–08 are reported. Further, to test whether the effect of *Victims* changes with time, the results of the first half (2000–02) are exhibited in columns (2) and (5), and the results of the second half (2003–08) appear in columns (3) and (6).

As shown in column (1), the sign of coefficient of *Victims* is positive for 2000–08 and statistically significant at the 1% level. After splitting the sample into a first half and second half, column (2) indicates a significant positive sign for *Victim* in the first half, whereas column (3) shows a non-significant positive sign for *Victim* in the second half. When *Change of income* is incorporated, as presented in columns (4)–(6), the *Victims* results do not change. That is, it is clear that *Victims* is positively associated with happiness in the first half but not in the second half. The results in Table 2 are consistent with *Hypothesis 2*, but not with *Hypothesis 1*. The aspiration level declined because of the disaster. Furthermore, the effect of the fall in aspiration level disappears with time, which is congruent with the adaptation hypothesis (e.g., Frey and Stutzer. 2002a,2002b; Statzer 2004).

All control variables exhibited statistical significance in all columns. The fact that *Household income* produces a significant positive sign in all estimations is congruent with standard economic theory. It is interesting to observe that *Change of income* yields a positive sign and is statistically significant at the 1% level in columns (4)–(6). This indicates that the increase in relative income makes people feel happy. The combined results of *Household income* and *Change of income* imply that both the level of income and change of income make a great contribution to increasing happiness.

The significant positive sign of coefficients for *schooling* reflects that higher education provides an opportunity for earning higher income and so makes people feel happier. The significant negative sign of *Unemployed* suggests that unemployment reduces income level, which has a detrimental effect on happiness. The significant positive sign for *Married* can be interpreted as suggesting that married people are less likely to feel solitary than single people. In addition, a spouse provides psychological stability. These would appear to be the reasons for married people being more likely to feel happy.

### *5.2. Results of estimations including the interaction term*

It appears that disaster victims become happier owing to a fall in aspiration level in the short term, but the increased happiness disappears in the long term because they eventually adapt to new living standards. To examine this issue more closely, it is necessary to investigate whether *Victims* (effect of experience of the earthquake) depends on *Past years* (the year of the survey minus the year when the earthquake occurred). For example, by definition, *Past years* for respondents for the survey conducted in 2000 is 5 (2000 minus 1995). Hence, in Table 3, a cross-term between *Victims* and *Past years* is included based on the sample during the period 2000–08. If the cross-term (*Victims* * *Past years*) takes a negative sign, the effect of *Victims* declines with time.

It is evident from Table 3 that the sign of the coefficient of *Victims* * *Past years* is negative and statistically significant at the 1% level in columns (1) and (2). This is

consistent with the results shown in Table 2. Hence, *Hypothesis 2* is strongly supported. From the combined results of Tables 2 and 3, I conclude that aspiration change and adaptation played a great role in determining the happiness of victims of the great Hanshin-Awasji earthquake.

## 6. Conclusions

Natural disasters have become a hot issue in social science since 2000. Disasters result in damage to physical capital and the workforce, resulting in economic loss. Apart from such measures of economic development as income level, natural disasters seem to have a psychological impact on victims. Existing studies have found that natural disasters reduce the victims' happiness level (Kimball et al., 2006; Luechinger and Raschky, 2009). Conversely, Ishino et al. (2012) suggested that the Great East Japan earthquake possibly increased the happiness level. However, those studies examined the temporary effect of disasters on happiness level. The present paper attempted to shed light on the long-term effects of natural disaster, rather than the temporary effect, using the JGSS data of Japan.

Even after controlling for household income level and subjective evaluation about the change in relative income level, earthquake victims were more likely to feel happy than other Japanese. That is, apart from absolute income level and changes in perceived income level, victims feel happier than people living in other areas. In a devastating disaster, the externality of one's neighbors' condition influences the individual's happiness level. The fact that their neighbors die as a result of the disaster causes people to consider themselves lucky in having survived, which lowers their aspiration level.

The importance of trust and neighborhood characteristics in raising the happiness level have been alluded to (e.g., Bjornskov 2003, Shields et al., 2009; Kuroki 2011). Recovery after a disaster should be measured not only by ordinary economic indices, such as per capita income, but also by the accumulation of social capital in providing mental care and a reciprocal network. The findings of the present paper indicate that the influence of a disaster on happiness persisted for several years; this is not in line with the findings after Hurricane Katrina, where the damage disappeared within a few weeks (Kimiball et al., 2006). The difference in the results between this paper based on Japanese data and other studies based on those of Western countries (Europe and the United States) can be interpreted as follows. Even though the situation has changed as a consequence of globalization and economic development, Japan is thought to be characterized by more racial homogeneity and more tightly knitted communities than Western countries. Because they belong to a strong community network, people in Japan are more likely to be influenced by their neighbors. The role of social capital was observed to play an important role in mitigating the damage due to natural disasters in Japan (Yamamura 2010). Inevitably, the externality of neighbors exerts a greater effect on people's happiness in Japan than in Western countries. When the long-term impact of natural disasters is considered, the fall in aspiration level caused by the hardship of one's neighbors has a greater influence on the victims' happiness level in Japan than in the West. This increases the happiness level of victims.

The sample of victims of natural disasters is thought to suffer inevitably from selection bias (Ishino et al., 2012). This is because victims of such disasters survived even though a number of their neighbors may have died. However, no data were

available relating to the numbers of neighbors who died in the great Hanshin-Awaji earthquake. Victims of a disaster in this sense are the survivors, and therefore data about them is available. Hence, it should be noted that careful attention is required when interpreting estimation results. Further, because of data limitations, this paper could not examine the effect of the earthquake immediately after its occurrence. Hence, I was unable to explore how the effect of the earthquake changed over time. To provide more certain, confirmatory evidence, it would be necessary to compile the data of a disaster that is comparable with the great Hanshin-Awaji earthquake, such as the Great East Japan earthquake. These data would enable us to investigate how the impact of the traumatic disastrous event changed over time. This issue requires attention in future studies.

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Figure 1. Location of Kobe, which suffered the greatest damage

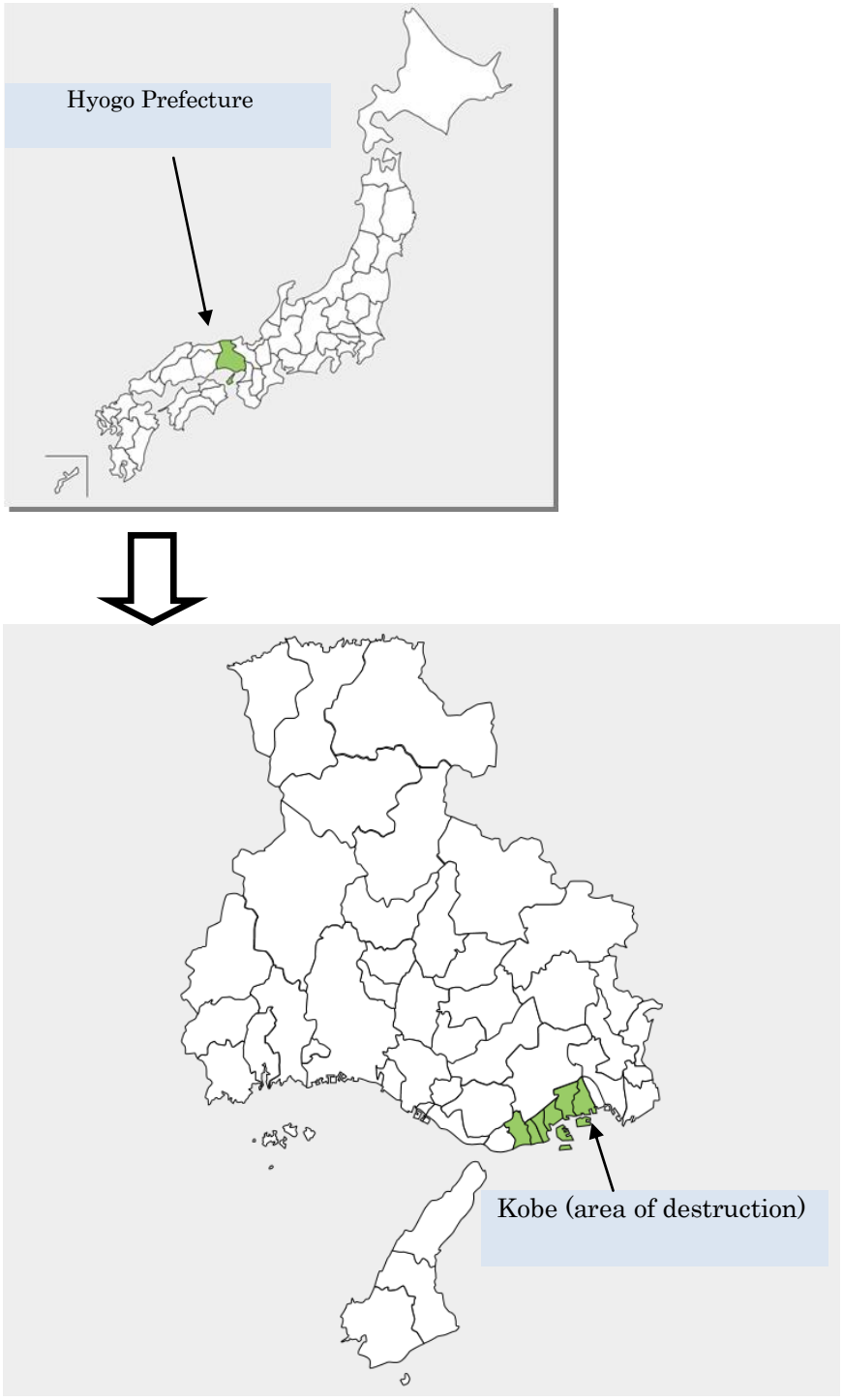

Table 1.
Basic statistics of variables used for those who experienced the Hanshin-Awaji earthquake and other Japanese.

| | Definitions | Victims of Hanshin-Awaji earthquake | Other Japanese |
|---|---|---|---|
| *Happiness* | Range of values 1–5: 1(unhappy) to 5 (happy)<br>Question: Are you happy? | 4.03<br>(0.80) | 3.87<br>(0.94) |
| *Victims* | Victims of Hanshin-Awaji earthquake.<br>Those who resided in Hyogo Prefecture at age 15 and resided in Kobe at the time of survey. | ——— | ——— |
| *Past years* | Years passed since 1995, when the Hanshin-Awaji earthquake occurred. | 7.93<br>(2.54) | 8.09<br>(2.64) |
| *Household income* | Average household income in the prefecture of residence (millions of yen) | 595<br>(394) | 625<br>(421) |
| *Change of income#* | *Family income* — *Family income at age 15*<br>Question: Compared with Japanese families in general, what would you say about your family income?<br>*Family income* ranges between 1 (well below average) to 5 (well above average)<br><br>Question: When you were about age 15, what would you say about your family income compared with that of Japanese families in general then?<br>*Family income at age 15* ranges between 1 (well below average) to 5 (well above average) | –0.22<br>(1.25) | –0.08<br>(1.11) |
| *Age* | Age | 50.6<br>(16.3) | 53.1<br>(15.3) |

| | | | |
|---|---|---|---|
| *Married* | 1 if respondent was currently married, otherwise 0 (%) | 84 | 81 |
| *Schooling* | Years of schooling | 12.8<br>(2.51) | 12,1<br>(2.58) |
| *Unemployed* | 1 if respondent was unemployed, otherwise 0 (%) | 3.1 | 1.5 |
| *Male* | 1 if respondent was male, otherwise 0 (%) | 41.2 | 49.3 |
| Observations | | 66 | 10,642 |

Notes: The numbers are mean values for household income, age, and years of schooling. Numbers in parentheses are standard deviations.
The numbers are percentages for trust, married, and male. #Number of observations is 63 (victims) and 10,473 (others) for *Change of income*.

Table 2. Baseline model (ordered probit estimation); dependent variable is *Happiness*

| | (1) 2000-2008 | (2) 2000-2002 | (3) 2003-2008 | (4) 2000-2008 | (5) 2000-2002 | (6) 2003-2008 |
|---|---|---|---|---|---|---|
| *Victims* | 0.18*** | 0.29*** | 0.09 | 0.15*** | 0.28*** | 0.01 |
| | (6.84) | (7.96) | (1.48) | (5.15) | (6.93) | (0.34) |
| *Household income* | $0.38*10^{-3}$*** | $0.40*10^{-3}$*** | $0.36*10^{-3}$*** | $0.30*10^{-3}$*** | $0.33*10^{-3}$*** | $0.28*10^{-3}$*** |
| | (12.3) | (9.09) | (8.79) | (9.69) | (7.38) | (6.44) |
| *Change of income* | | | | 0.07*** | 0.08*** | 0.07*** |
| | | | | (6.14) | (6.03) | (4.09) |
| *Age* | -0.06*** | -0.06*** | -0.06*** | -0.06*** | -0.06*** | -0.06*** |
| | (-13.1) | (-9.63) | (-9.56) | (-12.77) | (-9.37) | (-9.24) |
| $Age^2$ | 0.0006*** | 0.0006*** | 0.0006*** | 0.0006*** | 0.0006*** | 0.0006*** |
| | (13.7) | (9.82) | (9.68) | (13.4) | (9.47) | (9.30) |
| *Married* | 0.50*** | 0.54*** | 0.42*** | 0.50*** | 0.53*** | 0.42*** |
| | (20.4) | (15.4) | (7.86) | (18.7) | (15.4) | (7.78) |
| *Schooling* | 0.02*** | 0.02*** | 0.01*** | 0.02*** | 0.02*** | 0.02*** |
| | (4.82) | (3.80) | (2.85) | (5.22) | (4.04) | (3.14) |
| *Unemployed* | -0.39*** | -0.29*** | -0.65*** | -0.38*** | -0.27** | -0.67*** |
| | (-4.71) | (-2.79) | (-4.47) | (-4.60) | (-2.56) | (-4.62) |
| *Male* | -0.15*** | -0.17*** | -0.12*** | -0.16*** | -0.17*** | -0.13*** |
| | (-7.56) | (-6.86) | (-3.47) | (-7.79) | (-6.69) | (-3.85) |
| Log pseudo-likelihood | -13348 | -7134 | -6166 | -13085 | -6987 | -6088 |
| Observations | 10708 | 5753 | 4955 | 10536 | 5652 | 4884 |

Notes: The numbers in parentheses are Z statistics calculated using robust standard errors clustered in the prefecture. ** and *** indicate significance at the 5% and 1% levels, respectively. In all estimations, the proxies for size of residential area, prefecture dummies, and year dummies are included as independent variables but are not reported because of space limitations.

Table 3. Model with interaction term (ordered probit estimation);
dependent variable is *Happiness*

| | (1)<br>2000-2008 | (2)<br>2000-2008 |
|---|---|---|
| *Victims* | 0.34***<br>(6.45) | 0.27***<br>(4.85) |
| *Past years* | 0.01*<br>(1.95) | 0.009*<br>(1.76) |
| *Victims*Past years* | -0.02***<br>(-3.69) | -0.01***<br>(-2.70) |
| *Household income* | $0.38*10^{-3}$***<br>(12.3) | $0.31*10^{-3}$***<br>(9.64) |
| *Change of income* | | 0.07***<br>(6.09) |
| *Age* | -0.06***<br>(-13.0) | -0.06***<br>(-12.7) |
| $Age^2$ | 0.0006***<br>(13.7) | 0.0006***<br>(13.4) |
| *Married* | 0.50***<br>(20.2) | 0.50***<br>(18.9) |
| *Schooling* | 0.02***<br>(4.95) | 0.02***<br>(5.36) |
| *Unemployed* | -0.39***<br>(-4.72) | -0.38***<br>(-4.60) |
| *Male* | -0.15***<br>(-7.46) | -0.15***<br>(-7.66) |
| Log pseudo-likelihood | -13354 | -13091 |
| Observations | 10708 | 10536 |

Notes: The numbers in parentheses are Z statistics calculated using robust standard errors clustered in the prefecture. * and *** indicate significance at the 10% and 1% levels, respectively. In all estimations, the proxies for size of residential area and prefecture dummies are included as independent variables but are not reported because of space limitations.