ASIAN ECONOMIC JOURNAL
Journal of the East Asian Economic Association

Japan's Post-Disaster Economic Reconstruction: From Kobe to Tohoku*

Toshihiko Hayashi

Received 1 November 2011; accepted 1 May 2012

The purpose of this paper is to provide an overview of how economic reconstruction is carried out after major natural disasters in Japan, where disaster casualties have been declining but economic damage has been increasing over the past century. The Kobe and Tohoku earthquakes were exceptionally rare incidents. The Great Hanshin–Awaji Earthquake (Kobe) on 17 January 1995 killed more than 6000 people, and the Great East Japan Earthquake (Tohoku) on 11 March 2011 killed approximately 18 000 people. We will recapitulate the post-disaster reconstruction process in Kobe and draw lessons for Tohoku. After discussing the relative magnitude of economic damage, public and private finance for reconstruction, political leadership and the role of the academic community, we conclude that post-disaster reconstruction means a whole new process of economic development for the affected people, the communities and the nation alike.

Keywords: Kobe, Tohoku, earthquake, triple disaster, recovery and reconstruction, public finance, long-term effect.

JEL classification codes: H84, Q54, R58.

doi: 10.1111/j.1467-8381.2012.02082.x

No man is an island, entire of it self; every man is a piece of the Continent, a part of the main; if a clod be washed away by the sea, Europe is the less, as well as if a promontory were, as well as if a manor of thy friends or of thine own were; any man's death diminishes me, because I am involved in mankind, and therefore never send to know for whom the bell tolls; it tolls for thee. (John Donne, *Devotions upon Emergent Occasions* (1624), 'Meditation XVII')[1]

I. Introduction

For the people of Japan, it was a case of déjà vu. The nightmare of Kobe 1995 was repeated on 11 March 2011 in Tohoku.[2] However, the severity of the damage was

*Hayashi: Professor, Faculty of Policy Studies, Doshisha University, Karasuma Imadegawa, Kamikyo-ku, Kyoto 602-8580, Japan. Email: tohayash@mail.doshisha.ac.jp. Email: tohayash@mail.doshisha.ac.jp. This research was conducted while the author was affiliated as director of research with the Hyogo Earthquake Memorial 21st Century Research Institute.

1 See Partington (1996).

2 The official name of the Kobe earthquake of 1995 is the 'Great Hanshin–Awaji Earthquake'. Similarly, the Tohoku earthquake is a combination of '2011 earthquake off the Pacific coast of Tohoku' and the tsunami that followed; that is, 'the Great East Japan Earthquake'.

Table 1 Asia's share in worldwide natural disasters

	Number of occurrences		*Number of deaths*	
Asian countries	4 156	34.2%	25 878 967	79.7%
World total	12 169	100.0%	32 480 939	100.0%

Data: EM-DAT.

more than threefold this time. Almost 15 000 people died and hundreds of thousands of families lost their homes that day. The seaboard area of the Tohoku region, which stretches to the north-east part of Japan's mainland, was washed away by the sea. As if to add insult to injury, a series of nuclear power station accidents in Fukushima followed in the immediate aftermath. The Tohoku earthquake became an unprecedented triple disaster for Japan.

In Kobe, the damaged infrastructure was rebuilt within 5 years of the disaster. However, its economy slid into a long decline, except for the short period during which reconstruction spending provided a temporary boost. The disaster legacy is still lingering in permanently lost opportunities and weakened local public finance. It is no one's guess how long it will take for Tohoku to recuperate, nor is there any public consensus regarding when the post-disaster reconstruction phase will be considered over.

In this essay, we compare the economic reconstruction efforts of Kobe and Tohoku. Our method will be historical and descriptive. Each disaster has distinctive characteristics. Disasters of the magnitude of the Kobe and Tohoku earthquakes are a rare occurrence and, therefore, defy any statistical analysis. All we can hope for is to extract as much information as possible from one historic event for the other, whose recovery process has barely started. In doing so, we also hope that our lessons can be shared by other disaster-prone Asian countries.

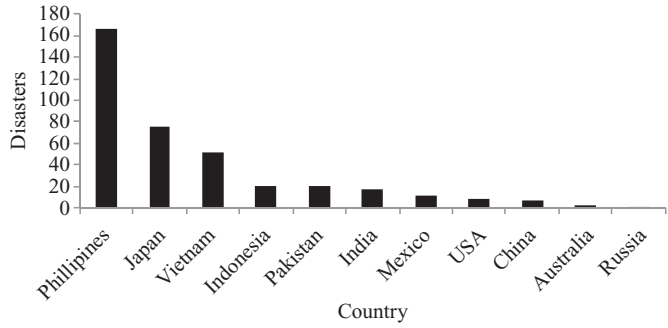
II. Asia as a Disaster-prone Region

II.1 Asia's share of natural disasters

Asia is a natural disaster-prone region. According to the international disaster database of the Center for Research on the Epidemiology of Disasters, the total number of natural disasters worldwide from 1900 to 2010 was 12 169, of which 34 percent were concentrated in the Asian countries that are covered by this Journal (see Table 1).[3] Asian countries' share of the total deaths caused by natural disasters worldwide during the same 111 years is 80 percent.

3 According to the Center for Research on the Epidemiology of Disasters database, EM-DAT, an incident is recorded as a disaster if any of the following conditions are satisfied: 10 or more people are reported killed, 100 or more people are reported as affected, there is a declaration of a state of emergency or there is a call for international assistance.

Figure 1 Natural disaster occurrences per land area, 1900–2010



Data: EM-DAT.

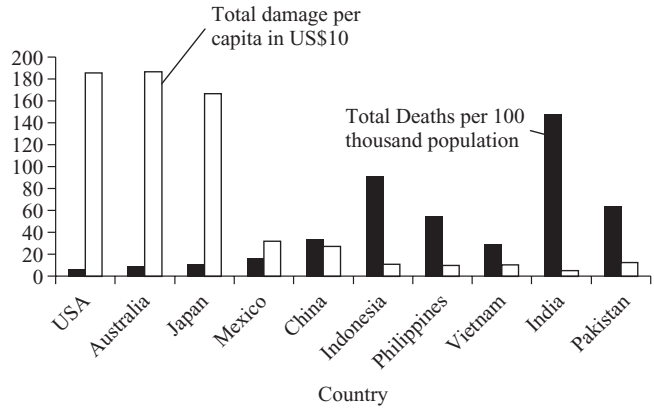
Moreover, the top 10 countries by the number of events in 2010 reported in the *Annual Disaster Statistical Review* 2010 (Guha-Sapir et al., 2011) are: China, India, the Philippines, the USA, Indonesia, Mexico, Russia, Australia, Vietnam and Pakistan.[4] We calculate the total number of natural disasters per 100 000 km^2 of land territory for the 10 countries and Japan, with the results displayed in Figure 1. The Philippines is on top, followed by Japan and Vietnam. In fact, Japan has the highest per land disaster occurrences among OECD countries.

II.2 Death tolls and economic damage

Through empirical analyses using cross-country data, Kahn (2005) establishes the existence of a negative correlation between per capita GDP and the death toll resulting from disasters. The statistical analysis in Kellenberg and Mobarak (2008) reveals that rising income level increases damage risk in the early stage of economic development, but it decreases damage in the later stage. Padli and Habibullah (2009) find, through their panel analysis of Asian countries, that higher per capita GDP tends to produce smaller human damage when disasters strike. These studies point to the fact that the best mitigation against natural disasters is economic development. However, there is what may be referred to as the 'paradox of development'. Figure 2 illustrates the point. The data used for this graph are the number of deaths and economic value of damage; other variables such as land area and other characteristics of the countries involved are not controlled for. Countries are listed along the horizontal axis in order of per capita GDP. It can clearly be seen that disaster death is concentrated in the lower income countries, but economic damage is greater in the higher income countries.

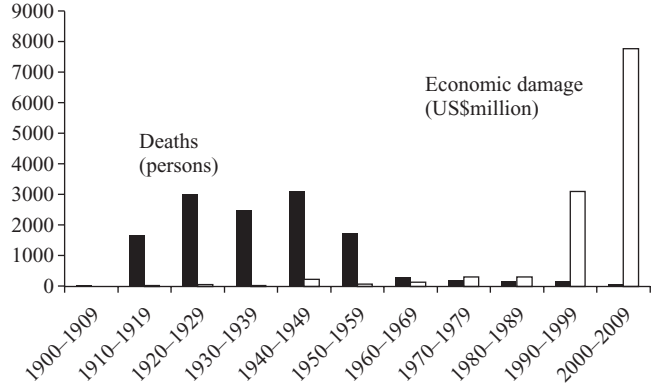
4 See Guha-Sapir et al. (2011).

Figure 2 Selected countries' deaths and economic damage, 1960–2010



Data: EM-DAT.

Figure 3 Japan's disaster fatalities and economic damage



Note: Yearly average excluding 1923 (Kanto) and 1995 (Kobe).
Source: EM-DAT.

A similar tendency can be observed using time-series data for Japan. As Figure 3 illustrates, Japan's disaster casualties have been declining and economic damage has been increasing over the past 100 years. To observe the secular trend, in the graph we exclude the data for 1923 (Kanto) and 1995 (Kobe).

The paradox is that when disasters occur, economic development is associated with decreased human casualties but increased economic damage.

II.3 Japan's disaster statistics

As the country with the highest frequency of natural disasters among developed countries, Japan has accumulated fairly rich data on natural disasters. Some of the main sources of statistical data are annual reports published by the Cabinet Office, and the Ministry of Internal Affairs and Communication (MIC). Each year, the Cabinet Office publishes the *White Paper on Disaster Management*, and the Fire and Disaster Management Agency of the MIC produces an annual report (the *FDMA*). The most reliable and frequently updated data for major disasters are produced by the Police Agency. The affected prefectures routinely publish their account of disasters from the early stages of their recovery efforts.

However, the rich array of data is not without shortcomings. Official statistics can be plagued by inconsistencies and errors of omission and double counting, resulting from the bureaucratic sectionalism. A case in point is 'economic damage'. 'Economic damage' data is available from the *FDMA* annual reports. However, they only record estimated reconstruction costs of damage caused to roads, bridges, railroad facilities, schools, hospitals, ships, rice fields and vegetable patches, and exclude, most notably, damage to residential houses and commercial buildings in the private sector.

Two pieces of legislation, both of which date back almost 60 years, lie at the heart of this disparity: the 'Law on Government Expenditure on Post-Disaster Public Infrastructure Reconstruction (1951)' and the 'Interim Law on Government Subsidies on Post-Disaster Recovery Assistance for Agriculture, Forestry and Fishery Industries (1950)'. These laws prescribe the rules for the national government subsidies to local governments, which are responsible for post-disaster infrastructure reconstruction and primary sector recovery. Local governments try to file quick and detailed reports on the damage done to these categories of capital stock. Economic damage compilation in the *FDMA* is based on those reports alone.

Nevertheless, researchers in academia, governments and private institutions have made efforts to overcome the shortcomings, with a view to learning lessons for future mitigation. For engineers, rebuilding mitigation infrastructure, reinforcing building codes and new urban and rural landscape design, and rekindling the emergency medicine system are some of the most urgent focuses of research.

For social scientists, not only the emergency response after a disaster but also the long phase of recovery and reconstruction are of concern. Disasters reveal the deeper layers of society's structure and individual psychology, which are hidden beneath the surface of the social fabric in peaceful times. Repeatedly, we observe that paradise arises in hell; repeatedly, we are made aware of the disparity between the strong and the weak; and, repeatedly, we have to confront the difficulties of institutionalizing the dearly learned lessons of crises.[5]

5 See Solnit (2010).

Figure 4 Three most heavily affected prefectures in Tohoku

III. Triple Disaster of Tohoku

III.1 Impacts of the earthquake and tsunami

On 11 March 2011, the Tohoku region, which stretches to the north-eastern part of Japan's main island, was hit by a mega-earthquake at 14.56 hours. The seismic intensity registered magnitude 9 on the Richter scale, and an area spanning 500 km in the north–south direction felt the jolts ranging in intensity from 6 to 7 on the Japanese scale. The seismic activity was not single-peaked but was followed by large-scale aftershocks one after another. Tohoku shook for 3 long minutes.[6] Hundreds of weaker aftershocks were recorded by the Meteorological Agency.[7]

As it is marked in Figure 4, the epicenter was located 130 km off the Sanriku Coast. It was later discovered that the earthquakes were caused by upheavals in part of the tectonic plate edges, which lie 24 km beneath the ocean surface. This

6 In the case of Kobe, the main tremor lasted for 15 seconds.

7 Sizable aftershocks were felt on 7, 11 and 12 April, 22 May, 25 and 31 July, 12 and 19 August and 10 September 2011.

created a massive tsunami that devastated the seaboard areas in Iwate, Miyagi and Fukushima Prefectures.[8] The tsunami rose to 30 m in height, and black water ran upstream in narrow valleys, engulfing people, buildings, cars and debris. When the water subsided, what were once people's homes and businesses were reduced to a shambles; tens of thousands of tons of debris were left on the flattened ground. The Meteorological Agency's tsunami warning system failed to forecast the power of the water correctly.[9] Seismologists later found that the first earthquake of magnitude 9 created a tsunami and the waves were lifted again as they rushed to shore with another jolt of magnitude 7.

The human damage from the 11 March earthquake and tsunami is reported to be 15 866 dead and 2946 missing as of 4 July 2012. Physical damage consists of destroyed buildings, roads, bridges, embankments and levees. More than 130 000 residential buildings were demolished or washed away, and 260 000 houses and 59 000 non-residential buildings were partially destroyed.[10] Later, it was discovered that the seaboard area had sunk 1 or 3 m and the dry land of Tohoku had stretched 50 m into the Pacific Ocean.

III.2 Fukushima nuclear accident

However, what was truly unprecedented was the Fukushima nuclear accident that immediately followed the double disaster. Tokyo Electric Power Company (TEPCO) operated two nuclear power stations in Fukushima Prefecture: Fukushima Dai-ichi (F1) and Fukushima Dai-ni (F2).[11] There are six nuclear reactors in F1. Among them, Reactor 4 had been de-fuelled, and 5 and 6 were in cold shutdown for planned maintenance at the time of the earthquake and tsunami.

The remaining three operating reactors were automatically shut down after the tsunami. However, multiple failures followed in the hours and days following 11 March. Equipment failed, external power supply was completely lost, and hydrogen explosions destroyed buildings housing Reactors 1, 3 and 4. All this led to fuel meltdowns in Reactors 1, 2 and 3, and emission of radioactive materials in the air and the sea. Fukushima came to be known as the worst nuclear accident since Chernobyl. Nine months later, the national government and TEPCO would agree to decommission Reactors 1 through 4 within 40 years.

The peculiar nature of the nuclear accident as distinct from natural disasters is that it carried with it enormous economic damage without significant human

8 A prefecture is a subnational jurisdiction. Japan is divided into 47 prefectures.

9 Japan has one of the most advanced electronic early warning systems in place. However, the early earthquake warning gives only several seconds to prepare for the coming seismic wave. In the case of the Tohoku tsunami, several cases of mechanical malfunction were reported with respect to the installed public address system. A tragic story has been told many times of a young female clerk who kept delivering tsunami warnings to the community using a microphone with utmost composure to the end, only to be engulfed by the tsunami herself. She has been missing ever since.

10 This was the case as of 4 July 2012, according to the Police Agency.

11 The Fukushima Dai-ni was not damaged by the earthquake and tsunami.

casualties. Apart from the nuclear plants themselves, the accident did not bring about physical destruction to buildings in the vicinity, such as houses, factories and agricultural facilities. Economic damage is largely due to mandatory and voluntary evacuations in the radioactively contaminated communities. More than 110 000 people were evacuated. People had to abandon houses, farms, cattle, rice fields, vegetable patches, factories and commercial facilities. To this day, destroyed houses and ships, and tons of debris caused by the earthquake and tsunami are left unattended because of high radioactive fallout in the seaboard area close to the nuclear facilities.

Government officials, the TEPCO representatives and the media referred to the triple disaster as 'unpredictable' and 'beyond imagination'.

III.3 Emergency response

The national government declared the case of the earthquake and tsunami an 'extraordinarily serious disaster'. By doing so, it was able to deploy extraordinary assistance programs with separate budgetary accommodations.[12] For the case of the nuclear accident, the national government declared a 'state of nuclear emergency' based on the Special Law for Nuclear Emergency Responses. Invoking this law, it issued several rounds of orders to the affected cities and townships as well as Fukushima Prefecture to evacuate residents in the area under threat of nuclear contamination.

Emergency workers were deployed to the areas devastated by the earthquake and tsunami: 83 000 police officers, 28 000 fire fighters, 10 000 Japan Coast Guard boats, 100 000 from the Japan Self-Defense Force and scores of medical teams. Assistance also came from abroad. Approximately 20 battle ships, including an aircraft carrier, 160 aircraft and 20 000 military personnel from the US military stationed in Japan, engaged in 'Operation Tomodachi'. Search and rescue teams came from 28 countries and regions; emergency provisions poured into Tohoku from 62 countries and regions; and monetary donations were sent in by well-wishing people from 93 countries and regions. Volunteers came to the mud-covered homes to offer clean-up assistance, and to the makeshift shelters to deliver emergency supplies for victims.[13]

III.4 Reconstruction efforts

Nine months after the triple disaster, the country embarked on a full-fledged reconstruction process for Tohoku. Pursuant to the Prime Minister's request, an

12 The Prime Minister did not declare a 'state of emergency' for the case of the earthquake and tsunami because there are no concomitant legal actions stipulated for the national government in the Basic Law for Disaster Mitigation.

13 The total number of volunteers was 1 350 000 for Kobe and 820 000 for Tohoku. Lack of experience to accept and work with volunteers on the part of local officials is cited as the main cause for the lower turnout in Tohoku.

advisory council had been set up in the Cabinet Office. The East Japan Great Earthquake Reconstruction Planning Council met on 14 April, almost 1 month after the disaster. For the following 2 months, the council engaged in extensive research, field trips and heated discussions. The output of the Council was reported to the Prime Minister on 25 June.[14]

The document highlighted the concept of disaster mitigation and recommended building a long-term reconstruction plan. The report urged the national government to adopt recovery measures for work and livelihood immediately. It suggested the government draft a solid recovery plan from the nuclear accident. It also pointed out the importance of making reconstruction process open to new ideas, new people and new industry. On 24 June, the 'Basic Law for Reconstruction from the East Japan Great Earthquake' was promulgated, which mandated the national government to create a new agency, the 'Reconstruction Agency'.

The national government proposed and obtained the Diet approval for the first supplementary budget of ¥4tn on 1 February, the second supplementary budget of ¥2tn on 25 July and the third supplementary budget for ¥12tn on 21 November. The reconstruction process is gaining momentum 8 months after the disaster.

However, the recovery and reconstruction process is projected to be long, difficult and complicated.[15] We will recapitulate the experience of the Kobe earthquake in a search for clues.

IV. Post-disaster Reconstruction

IV.1 Kobe and Tohoku

On 17 January 1995, the city of Kobe and its neighboring municipalities were caught off guard by a massive earthquake of magnitude 7.3 on the Richter scale. The earthquake was caused by movement of inland faults and the epicenter was directly beneath the modern metropolis inhabited by one and a half million people. Human casualties added up to more than 6000, and approximately 120 000 houses were destroyed. Table 2 compares disaster damage between Kobe and Tohoku.

The immediate impacts of the two disasters were different. In the case of Kobe, the affected areas were contained more or less in Hyogo Prefecture. In the case of Tohoku, 10 different prefectures recorded at least 1 death. Kobe's damage was concentrated in highly developed metropolitan cities, whereas Tohoku's damage

14 Advisory Council for the East Japan Great Earthquake Basic Reconstruction Planning, 2011, *Towards Reconstruction: Hope beyond the Disaster*.

15 'Recovery' means restoring the original form or function of damaged facilities. It is a well-defined legal term. However, there is no legal definition for 'reconstruction'. We are using the term as synonymous to 'rebuilding to a better standard'.

Table 2 Kobe and Tohoku

	Kobe	*Tohoku*
Date	05.46 hours, 17 January 1995	14.46 hours, 11 March 2011
Magnitude	7.3	9.0
Affected area	Urban area	Rural area
Tsunami	No damage	Height 8.0–9.3 m, severe damage
Nuclear accident	No accident	Fukushima, severe indirect damage
Damage	Destroyed buildings and fire	Seaboard area damaged by tsunami
Casualties	6437; 80% crushed	19 451; 80% drowned
Buildings totally lost	104 906	121 658
Direct economic damage	¥9.9tn (2% of GDP)	¥30tn (6% of GDP)[a]

[a]Estimate by M. Hayashi (2011).

was centered around agriculture and fishery areas.[16] Approximately 80 percent of victims were crushed to death in Kobe, and 80 percent drowned in the Tohoku earthquake and tsunami.

There was no nuclear plant in the affected area in Kobe, but historic nuclear accidents in Fukushima were induced by the earthquake and tsunami. The direct economic damage for Kobe was estimated at ¥9.9tn, or 2 percent of Japan's GDP. In the case of Tohoku, the national government estimated the damage at ¥16.9tn, or 3.5 percent of GDP. However, the cost of the damage is not yet conclusive. M. Hayashi (2011) estimates it at ¥30tn, excluding the indirect damage caused by the nuclear accidents.

To date, no scientific efforts have focused on the economic damage of the nuclear accidents. It is estimated (by the Investigation Committee on the State of Management and Finance of TEPCO), however, that the government-assisted indemnity payment by TEPCO to households and companies that were obliged to evacuate in Fukushima may come to ¥4.5tn. The annual gross regional product of the affected cities and townships in Fukushima is roughly ¥1tn. If we suppose that this much output will be lost over the coming decade, the total indirect damage comes to ¥10tn. All in all, the Tohoku damage is three to four times the Kobe damage.

IV.2 Regional economies

Table 3 summarizes some of the fundamentals of the regional economies of Hyogo and 3 prefectures in Tohoku (Tohoku 3). Hyogo's population is approximately the same as that of Tohoku 3, and so is the proportion of gross regional products (GRP) in the national GDP. Both regions account for approximately 4 percent of the national GDP. The average per capita income is a little higher in Hyogo than in Tohoku 3.

16 There were production facilities in the affected area that were closely integrated in international supply chains. Auto makers received a heavy blow because supply chains were broken. However, the effect was relatively short-lived.

Table 3 Regional economies of Hyogo and Tohoku

	Population (thousand)	*GRP as % of GDP*	*Per capita income (yen, thousand)*	*Primary industry as % of GRP*
Hyogo	5 588	3.8	2740	0.61
Tohoku	5 707	4.0	2521	2.60
Iwate	1 330	0.9	2267	4.56
Miyagi	2 348	1.6	2473	2.00
Fukushima	2 029	1.5	2743	2.29
Japan total	128 057	100.0	2916	1.56

Data: SNA.

Table 4 Japan's four largest natural disasters

	Dead or missing	*Economic damage (% of GDP)*
Great Kanto Earthquake (1923)	105 000	¥5.5bn (35.3%)
Isewan Typhoon (1959)	5 098	¥551.2bn (4.6%)
Kobe Earthquake (1995)	6 437	¥10tn (2.1%)
Tohoku Earthquake (2011)	18 915 (2 May 2012)	¥30tn[a] (6.0%)

[a]Estimate by M. Hayashi (2011).

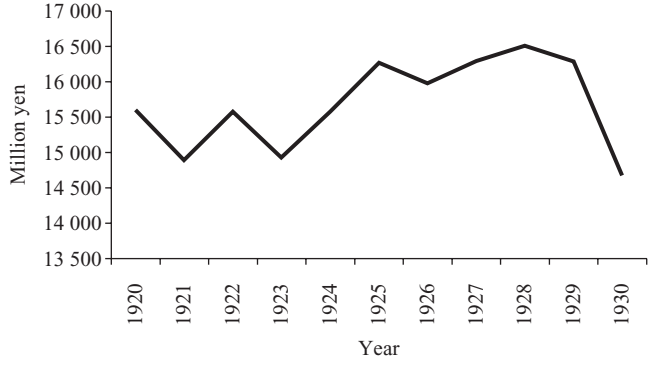
The primary industry ratio in GRP is 0.61 percent for Hyogo, and it is 2.60 percent for Tohoku 3. Compared with Hyogo, Tohoku 3 is more dependent on agriculture, forestry and fishery industries. Among Tohoku 3, the primary industry ratio is the highest in Iwate, followed by Fukushima and Miyagi. In fact, Fukushima has the highest secondary or manufacturing industry ratio, and Miyagi has the highest tertiary or service industry ratio among Tohoku 3. Reconstruction plans must adapt to the characteristics and needs of the affected region.

IV.3 Economic reconstruction from earthquakes

The Tohoku earthquake was the second largest disaster in Japan since the beginning of the 20th century. Table 4 summarizes the four largest natural disasters. By far the greatest natural disaster was the Great Kanto Earthquake of 1923. The tremor and the fire that broke out in the immediate aftermath killed 10 500 people and caused truly devastating economic damage. It is estimated at 35.3 percent of GNP (Togashi, 2009).

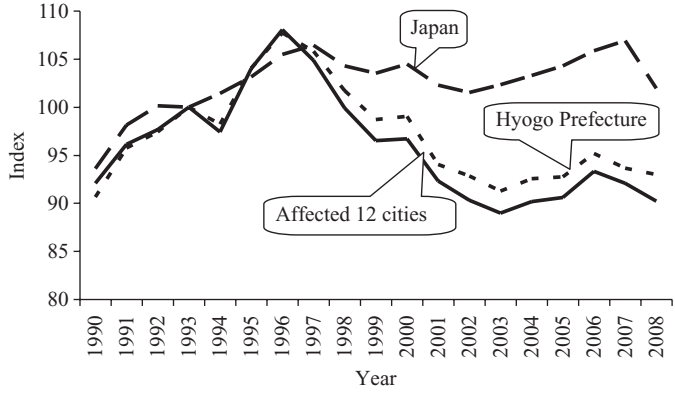
The shock was evidenced in the GNP, but the recovery was fairly quick. Figure 5 illustrates the changes in Japan's GNP before and after 1923. It dropped by 4 percent in the year of the earthquake and made a quick recovery. GNP rose to 10 percent above the 1923 level 5 years after the disaster. This was due to

Figure 5 Recovery from the Great Kanto Earthquake



Note: Japan's GNP.
Source: T. Hayashi (2011a).

Figure 6 Kobe earthquake and its aftermath



Note: GDP (Japan) and GRP ('Hyogo Prefecture' and 'Affected 12 cities').
Source: T. Hayashi (2011a).

massive post-disaster public spending on reconstruction. Japan had recovered from the damage by 1929. However, the worldwide Great Depression soon followed. Japan's GNP plummeted in tandem with those of the USA, European countries and natural resource-exporting countries.

Kobe followed a similar path. In Figure 6, the broken line for 'Hyogo Prefecture' indicates the GRP of Hyogo Prefecture. The prefecture has 40 sub-prefectural jurisdictions, of which the largest is Kobe City. The line 'affected 12 cities'

represents the sum of GRP over the 12 cities that were affected by the earthquake. All data are normalized so that values for the 1993 fiscal year are set to 100.

Comparing with the country's GDP, it is evident that the GRP of affected localities and the prefecture rose in the immediate aftermath of the disaster. Again, this comes from the fiscal and private spending in the post-disaster reconstruction. It is also clear that a strong economy was maintained for approximately 5 years, after which the GRP of affected sank into a decline for many years to come.[17]

The same pattern is observable in unemployment statistics. In the middle of the reconstruction investment boom in 1997, Hyogo's unemployment rate was 3.8 percent when the national average was 3.4 percent. Hyogo's rate rose to 5.7 percent in 2003, which was much higher than the national rate of 5.0 percent.

IV.4 Indirect damage

Economists have attempted to determine the indirect economic effects of the disaster; that is, the lost business opportunities due to supply-side bottlenecks and the demand loss arising from reduced local population and diminished consumption. In a series of studies using input–output analyses, Toyoda (1996, 1997) estimates that the indirect losses came to approximately half of the direct damage for Hyogo Prefecture. Ashiya and Jinushi (2001) argue that the post-disaster local output was at least 5 percent below the pre-disaster trend. Hagiwara (2001) construct a computational general equilibrium model and estimate that the indirect losses were12 percent of the reported direct economic losses.

However, these studies include an unavoidable methodological problem. All of them had to estimate both the post-disaster movement of GRP and the trajectory of the local GRP without the disaster. They compare a history that never was with a future that is about to unfold, referring to the difference as 'indirect economic damage'.

Statistically and quantitatively inconclusive as their studies may be, it is evident from Figure 6 that the GRP of the damaged local economies fell further from the national average after 5 years of reconstruction. The legacy of the disaster lingered in many facets of business in Kobe. An illustrative story is the fate of Kobe Port.

In 1990, Kobe was ranked number 5 in the world in terms of the volume of container handling. It was almost totally destroyed in the disaster, and it took 2 full years to rebuild the seaport, with a deeper berth and slightly enhanced facilities. However, during reconstruction, Kobe lost the status of the largest sea transport hub in Asia. It lost the bulk of business to Hong Kong, Busan and

17 This observation conforms to the empirical finding of Skidmore and Toya (2002), which they obtained from their cross-country studies regarding the relationship between geologic disasters and long-run growth in per capita GDP.

Kaohsiung, and it sank to rank 23 in terms of the volume of container handling. Kobe also lost the status of being Japan's busiest seaport to Tokyo, and it has not managed to bounce back yet.[18]

IV.5 Social demography in Kobe

In the case of the Kobe earthquake, the population of 12 cities fell by approximately 1 500 000 million after the disaster, equating to roughly 10 percent of Kobe's population. A vicious cycle sets in after a disaster, especially in an urban area where mutually dependent economic activities are concentrated. People who lost their homes and jobs moved out of the devastated area to find better places to live and work. Large companies were quick to relocate their employees to unaffected plants and offices elsewhere. As a natural response to the disaster, the affected localities experienced declines in population numbers well over the number of victims.

Social demographic change, then, leads to a stagnant local economy. A smaller population implies a decreased demand for transportation services, commercial activities and offices, which make up the city's business landscape. This leads to another wave of emigration, and so the cycle repeats itself.

However, the 12 cities regained their populations within 5 years. The current population of those cities is approximately 5 percent above the pre-disaster level, despite the fact that the population of the country as a whole started to fall after 2005. Careful examination reveals, however, that the people who moved in are not the same as those who moved out. They are largely new families. With a relatively stagnant economy lingering in Kobe, the reason for this phenomenon must be sought in the perceived image or attractiveness of life in Kobe.

The situation is more adversarial for Tohoku. In Iwate and Fukushima, a decline in population levels due to social factors had been ongoing since 1960, and the population change which had been positive turned to negative around 2000 for Miyagi. In addition, the Tohoku population had been aging more quickly than the national average. The elderly ratio or the proportion of people 65 years and above in the total population for Tohoku 3 had been steadily rising since the 1950s. The ratio was 20.0 percent for Miyagi, which was comparable to the national average of 20.2 percent. However, the elderly ratio for Fukushima was 22.7 percent, and that for Iwate was 24.6 percent in 2005. The region had been feeling the 'population onus' for decades preceding the disaster.

Hence, one of the greatest challenges for Tohoku is how the region can attract new people. The region would have to attract new production facilities and

18 The basic reason for Kobe's relative decline is related to the faster economic growth in China and Korea. However, bureaucratic red tape for Kobe's reconstruction is also cited as an impediment to the Port of Kobe's comeback. As of 2008, the Port of Kobe ranks 44th in the world in terms of the volume of container handling.

Table 5 Five categories of public expenditure

Well-being	Health care, medical and welfare services, housing assistance
Education and culture	Arts, education, cultural heritage, street view
Industry and employment	Medium and small-scale enterprises, financial assistance, creation of new business and jobs
Disaster mitigation	Shelter, facility, fire prevention, earthquake-resilient structure
Urban infrastructure	City planning, community restoration, urban infrastructure

Table 6 Costs of post-disaster reconstruction for Kobe: 1995–2004

Category	*National government*	*Prefecture*	*Cities*	*Fund and townships*	*Private*	*Total institution*
Well-being	14 032	7 731	3 240	2710	637	28 350
Education and culture	1 350	1 148	960	190	52	3 700
Industry and employment	9 940	8 636	2 690	540	7 694	29 500
Disaster mitigation	1 200	733	1 170	30	17	3 150
Urban infrastructure	57 058	13 125	20 990	30	7 830	99 033
Total	83 580	31 373	29 050	3500	16 230	163 733

Source: Hyogo Prefecture (2005).

develop new industries or revive old industries. Social infrastructure, schools, hospitals and nursing homes need be rebuilt, and possibly new people from other countries have a role to play.[19]

V. Reconstruction Finance

V.1 How Kobe was rebuilt

Against the estimated direct damage of ¥9.9tn, the total amount of money expended on reconstruction by the public sector was approximately ¥16.3tn for Kobe (Hyogo Prefecture, 2005). The ratio of 10 to 16 became the rule of thumb and would be remembered by the government for Tohoku 2011. Most public expenditure was concentrated in the first 5 years, during which time reconstruction of public infrastructure was given the highest priority. Later in the recovery process, public projects gradually shifted focus to social and economic programs. Public expenditure was classified into five categories, as shown in Table 5.

The amount of public funds expended on these five categories of projects in the 10 years after the disaster is summarized in Table 6. In the table, 'Fund' refers to the Great Hanshin–Awaji Earthquake Reconstruction Fund. 'Private Institution' includes the privatized Japan Railway Corporation and publicly withheld

19 Japan is a peculiar country in that it does not have an immigration law or a legal definition of immigrants.

properties. Note that costs that were born by private households, companies and non-profit organizations are not shown in the table.

Regarding the public/private demarcation, T. Hayashi, (2011b) finds that for the first 5 years of reconstruction, 60 percent of funding came from the public sector and 40 percent from the private sector. However, in the GRP statistics, private capital formation and consumer spending accounted for 60 percent of increased aggregate demand. The public investment and government consumption covered 40 percent of the increase in the aggregate demand.[20] The apparent difference comes from the fact that two-thirds of public spending took the form of subsidies to households and large and small-scale businesses, and, therefore, constituted transfers to the private sector.

Significant as they were in size, the public expenditures were loaded with complex rules and sophisticated procedures. It was frequently proclaimed by government officials that public money should not be used for the purpose of advancing the value of private property. Thus, the national administration insisted that public money should not be used for repairing damaged houses or purchasing mortgages on the lost houses.[21]

V.2 Reconstruction fund

Given the pressing need for private livelihood recovery and the legal restrictions in place, with an understanding by the national administration, Hyogo Prefecture and Kobe City jointly set up a private foundation, the Great Hanshin–Awaji Earthquake Reconstruction Fund (the Fund).

The Fund was established using bonds floated by these two local administrations and sold to a consortium of banks. The administrations transferred money to the Fund with which the Fund purchased the bonds in the hands of the banks. It was a totally risk-free transaction for the banks. The administrations have to pay interest on their debt, which is now held by the Fund. The understanding between the local governments and the national administration was that the debt was issued for the purpose of disaster recovery and, hence, the interest payable on the debt qualifies for national subsidy. The national government covered 95 percent of interest payments, and the interest was received by the Fund as revenue. Tax money was transformed into private money. The Fund, making use of the revenue thus created, extended financial assistance to private individuals, small and medium-sized enterprises, and schools. The Fund's tenure was 10 years. The financial aid the Fund provided through its duration came to just 2 percent of the

20 See T. Hayashi (2011a).

21 As it turned out, this claim was groundless because the government assisted in reconstructing damaged rice fields and vegetable patches, which were on private property, using public funds. What was lacking was a law to allow bureaucrats to spend public money on houses and facilities and a political will to enact such a law.

total reconstruction costs of ¥16tn. Nevertheless, it was a private fund that was not bound by bureaucratic red tape.[22]

Such a reconstruction fund has not been established for Tohoku for reasons unknown to this author.

V.3 Fiscal burden for local governments

In retrospect, Kobe was fortunate as far as the fiscal expenditures on reconstruction are concerned. The national economy was in the middle of the 'lost decade' after the economic bubble burst in 1990. The slower growth of the world's second largest economy posed a threat to the world economy, or, so it was perceived by the national government. On many occasions during international gatherings, Prime Minister Kiichi Miyazawa (1993) pledged to revive the national economy through heavy spending on government capital formation. When the earthquake hit Kobe, the government did not hesitate to rebuild public infrastructure in the affected area. Spending had to be financed through an increase in national debt.

According to the Basic Law for Disaster Response, it is the primary responsibility of local governments to implement reconstruction projects. The national government provides support by means of subsidies to local governments. However, government subsidies do not cover the full cost of reconstruction. A 5, 10 or 50-percent share of the cost must be borne by local administrations in accordance with the degree of devastation.[23]

Thus, Hyogo Prefecture, as well as damaged local jurisdictions, issued bonds to finance reconstruction. Hyogo's bond issues in the 1996 fiscal year were 3.2-fold that of the pre-disaster level, and the 12 cities issued 3.6 times more bonds than in the previous fiscal year. In the 1997 fiscal year, Hyogo's bond issues remained at a high level: 2.1 times the 1995 level. For the 12 cities, the bond issues were 2.3 times the 1995 levels.

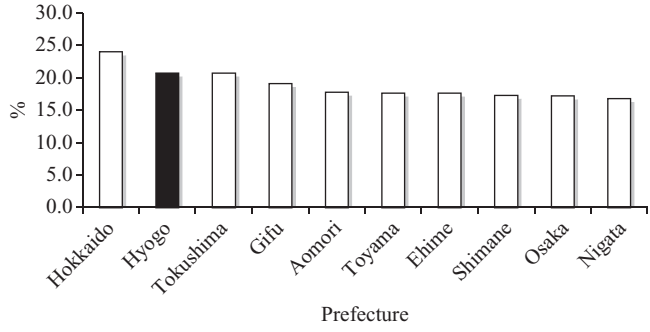
In the fiscal year 2009, the debt service to fiscal revenue ratio for Hyogo was 20.7 percent, which is the second highest among 47 prefectures (Figure 7). If this ratio exceeds 18 percent, the local government finances are considered to be unhealthy and the local government is penalized by the national government. Hyogo Prefecture is exempt from the penalty because of the disaster legacy. The situation for each of the 12 cities varies. Some cities, including Kobe City, have managed to lower their debt service to fiscal revenue ratio. However, some of smaller cities are still feeling the strain.

The moral of the story is that reconstruction projects must be financed either through past fiscal savings or by borrowing, and this debt must be serviced over many years. Either way, the burden of reconstruction is borne by present and future generations of local residents.

22 See Ioroi (2011).

23 The underlying principle is to avoid moral hazard on the part of local administrations, which is a sound policy in peaceful times, but not in emergency situations. Table 6 shows that local administrations covered 42 percent of public expenditures.

Figure 7 Debt service to fiscal revenue ratios of prefectures, 2009



Source: T. Hayashi (2011a).

VI. Lessons for Tohoku

Can we make any prediction as to how reconstruction from the Tohoku disaster will proceed? Before making any assessment, we must recognize the similarities and differences between Kobe and Tohoku. The different nature of the disasters and the scope of damage have already been mentioned. Three further differences between Kobe and Tohoku can be found in their: political leadership, administrative central/local government nexus and academic community cooperation.

VI.1 Political leadership

At the time of the Kobe earthquake, political leadership was provided by Prime Minister Tomi-ichi Murayama. He was 71 years old, and he had been chosen from the Japan Socialist Party to form a coalition government. He knew he was inexperienced in crisis management. He appointed a former top bureaucrat, Atsushi Shimokobe, to run the Great Hanshin–Awaji Earthquake Reconstruction Committee and to advise him.[24]

Murayama was humble. He notified Shimokobe that he would do everything in his power to assist in the recovery effort. Murayama acted exactly as Shimokobe told him to do. Shimokobe solicited requests from the affected local governments and made phone calls to vice ministers in person. The vice ministers were his friends or ex-subordinates in the national administration. Reconstruction proceeded relatively smoothly and with haste.

In 2011, political leadership had shifted to Prime Minister Naoto Kan of the Democratic Party of Japan. He and his cabinet members were not experienced in crisis management either. However, Kan insisted on demonstrating his leadership ability to his constituencies and the media. He was bound by his own political

24 See T. Hayashi (2011a).

manifesto which brought him to power in peace-time. His party had proclaimed that they, as elected officials, would not be besieged by the shrewd bureaucrats. He isolated himself from bureaucracy and tried to control the unprecedented triple disaster with his bare hands. It did not occur to him that in times of national emergency, a prime minister should garner all possible professional help irrespective of ideology or affiliation. Kan failed to maneuver political opposition. He took too long to create much needed solidarity in the administration, and he was eventually ousted.[25]

VI.2 Central/local government nexus

Japan's Basic Law of Disaster Mitigation stipulates that the principle of subsidiarity should be observed. It is the responsibility of the affected local governments to provide emergency and reconstruction assistance to the victims. When local resources and capability are overwhelmed by a disaster, cities and townships request administrative support to the higher jurisdiction (i.e. the prefecture). The affected prefecture would then request the national government's support if necessary. In the case of serious disasters, this process is completed within a matter of hours.

More or less the same principle applies to the reconstruction phase. It is here that the capability of local governments and the disposition of governors make a difference. In the case of Kobe, the responsibility rested almost entirely on the Hyogo prefectural government. The local government's buildings and facilities were damaged so government employees were immersed in the emergency. The governor urged the national government to take immediate action for recovery. He proposed 660 recovery projects and asked the national government for financial assistance. It was a bottom-up process.

However, in the case of Tohoku, three prefectures were heavily damaged so a consensus among governors and mayors was slow to develop. Some townships lost their mayors and office buildings entirely. As officials were working, their office buildings was washed away by the tsunami. Under such circumstances, it was not practical to insist on a bottom-up approach. Strong leadership was necessary from the central government, but it not well prepared for such a difficult and complex disaster. For example, the national administration missed the

25 Criticism mounted regarding his mishandling of the Fukushima emergency. Failures of information sharing between his government and the TEPCO management created mistrust on the part of the prime minister. Confusion and failure in emergency communications among high-ranking government officials was later referred to as 'elite panic' in a report published by a private research foundation on 11 March 2012 (see the Rebuild Japan Initiative Foundation, 2012). TEPCO's *Interim Report* (2011) emphasized how unpredictable the magnitude of the earthquake and tsunami were. The government's Investigation Committee on the Accident at the Fukushima Power Stations of Tokyo Electric Power Company published an *Interim Report* on 26 December 2011, in which the committee played down the mistakes made by the government. The Dietal investigation is still under way by the Fukushima Nuclear Accident Investigation Commission. The jury is still out.

opportunity to initiate a new and provisional tax for Tohoku reconstruction.[26] Slowly, however, the national government lived up to the task. By the first anniversary of the disaster, a new 'Reconstruction Agency' had been established in the administration to facilitate Tohoku's reconstruction.[27]

VI.3 Intellectual community

There was a close relationship between the academic community and local administrations in Kobe. Disaster recovery provided a strong incentive for academia to engage in research and community projects. What was really needed was a warm-hearted and cool-headed approach to fellow citizens' misfortune and the accumulation of experience through learning by doing. University professors, consultants and non-profit organization representatives all sat at council tables on various occasions for reconstruction planning.

As a result, a new institute for research in disaster recovery was established in a university in 2005 (Institute for Research on Disaster Recovery and Revitalization was established in Kwansei University), an independent non-profit institute for disaster exhibition and research was inaugurated in 2006 (Hyogo Earthquake Memorial 21st Century Research Institute), and a new department was created in a university in 2010 (Faculty of Safety Science at Kansai University). Through research and education, the lessons learned from the tragedy will be passed on for generations.

The intellectual community in Tohoku will be able to contribute to the preparedness for great earthquakes and tsunamis that seismologists predict to hit Japan's southern seaboard within 30 years. They will also be able to share their studies with other countries, such as China, India, Vietnam, the Philippines and Thailand.

VII. Concluding Remarks

So, what is post-disaster economic reconstruction after all? When can we declare that the reconstruction is complete? It is certainly not when the affected societies restore the pre-disaster state of affairs, which is impossible anyway. Physical infrastructure can be rebuilt, but victims of disasters are lost forever and some of those left behind are never able to recover. It is not when the GRP of local economies return to pre-disaster trends, the trend itself being battered by the growth of the national economy and other factors. It is not when the fiscal balance is restored for local governments. That has not yet happened for Kobe.

26 A poll taken in the immediate aftermath showed that 60 percent of respondents were in favor of raising consumption tax for reconstruction purposes.

27 Critics and media pointed out the slowness of Government response. However, what appeared slow in Kobe may not be too slow in the eyes of Tohoku people, who should be the final judge. At any rate, no Golden Gate Bridge or Empire State Building was included in the government reconstruction plan.

In this regard, the research by Skidmore and Toya (2002) provides us with a clue. Through cross-country empirical analyses, they study the effect of disasters on long-run growth. They find that the effects are different among natural disasters. In the case of climatic disasters, the frequency of disasters is positively correlated with the 30-year average growth rate of per capita GDP in the country concerned. They hypothesize that physical destruction caused by disasters induces a forced capital formation, which embodies better technology and, therefore, higher total factor productivity.

However, they find a negative correlation between disasters and economic growth in the case of geologic disasters: earthquake damage is negatively correlated with long-run growth rates. If their findings apply in the case of Tohoku, it will suffer from slower growth for decades to come.

However, disasters create an opportunity to build back better communities and economies. What seems to be needed is a concerted effort, including political will, to redevelop the sub-national region that is suddenly thrown into crisis. Private investments in production and employment, public investments in infrastructure and peoples' aspiration for a better livelihood will be the keys to lead the Tohoku region onto a new growth path.[28]

References

Ashiya, T. and T. Jinushi, 2001, The earthquake and the change in industrial structure in the affected localities: An estimation of the input–output coefficients and its application (in Japanese), *Kokumin Keizai Zasshi*, **183**, pp. 79–97.

Guha-Sapir D., V. R. Below and S. Ponserre, 2011, *Annual Disaster statistical review* 2010. Center for Research on the Epidemiology of Disasters. Université Catholique de Louvain, Belgium.

Hagiwara, T., 2001, An analysis of economic effects of the Great Hanshin–Awaji Earthquake by the Kobe CGE model, *Kokumin Keizai Zasshi*, **183**, pp. 71–8 (in Japanese).

Hayashi, M., 2011, A quick method for assessing direct economic damage caused by natural disasters: An epidemiological approach. Presented at the 72nd International Atlantic Economic Conference held in Washington DC, 20–23 October. Also forthcoming in *International Advances in Economic Research*.

Hayashi, T. 2011a, *Economics of Great Natural Disasters* (in Japanese), PHP Shinsho, pp. 1–283.

Hayashi, T. 2011b, Financing post-disaster reconstruction (in Japanese), Hayashi, T. et al. eds, *Handbook of Disaster Management 3: Recovery and Reconstruction*, pp. 92–3. Gyosei, Tokyo.

Hyogo Prefecture, 2005, *A Comprehensive Inspection*, *The Great Hanshin-Awaji Earthquake: The Report of the 10-Year Reconstruction*, Vol. 2 (in Japanese).

Ioroi, T. 2011, The Great Hanshin–Awaji Earthquake Reconstruction Fund. In: Hayashi, T. et al. (eds), *Handbook for Disaster Response* II; *Recovery and Reconstruction*, Gyosei, Tokyo, pp. 108–11 (in Japanese).

Kahn, M. E., 2005, The death toll from natural disasters: The role of income, geography, and institutions, *The Review of Economics and Statistics*, May, **87**, pp. 271–84.

28 In this regard, the country's energy policy should be different following the Fukushima accident, which revealed the technological, administrative and political vulnerabilities surrounding nuclear power generation. This involves the short-term problem of how to meet the country's power demand without nuclear generation and the long-term question of providing an optimal energy mix for the country. Another contribution that Japan can make for other countries is to propose a new nuclear safety standard based on the dearly-learned lessons from Fukushima.

Kellenberg, D. K. and A. M. Mobarak, 2008, Does rising income increase or decrease damage risk from natural disasters? *Journal of Urban Economics*, **63**, pp. 788–802.

Miyazawa, K. (1993), The new era of the Asia-Pacific and Japan–ASEAN Cooperation Policy, Bangkok, 16 January 1993. In: *ASEAN Economic Bulletin*, **9**, p. 375.

Padli, J. and M. S. Habibullah, 2009, Natural disaster death and socio-economic factors in selected countries: A panel analysis. *Asian Social Science*, **5**, pp. 65–71.

Partington, A. 1996, ed., *The Oxford Dictionary of Quotations*, revised 4th edn. Oxford University Press, New York.

Rebuild Japan Initiative Foundation, 2012, *Report of Independent Investigation Team on the Fukushima Nuclear Accident* (in Japanese), 11 March. Discover Twenty-one, Tokyo.

Reconstruction Design Council in Response to the Great East Japan Earthquake, 2011, *Report to the Prime Minister: Towards Reconstruction: 'Hope beyond the Disaster.'* Reconstruction Design Council, Cabinet Office, Tokyo.

Skidmore, M. and H. Toya, 2002, Do natural disasters promote long-run growth? *Economic Inquiry*, **40**, pp. 664–87.

Solnit, R. 2010, *A Paradise Built in Hell: The Extraordinary Communities That Arise in Disasters*, Penguin Books, New York.

Togashi, T.,2009, Cliometric studies on the Great Earthquake. *Meiji University Junior College Bulletin*, **34**, pp. 43–76

Toyoda, T., 1996, Economic issues in the Great Hanshin–Awaji Earthquake, *Kokumin Keizai Zasshi*, **173**, pp. 1–11 (in Japanese).

Toyoda, T. and A. Kawauchi, 1997, Estimation of business damages caused by the Great Hanshin–Awaji Earthquake (in Japanese), *Kokumin Keizai Zasshi*, **176**, pp. 1–15.