Impacts of the Great Hanshin-Awaji Earthquake on the Labor Market in the Disaster Areas*

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This paper examines the short-, medium- and long-term impacts of the 1995 Great Hanshin-Awaji Earthquake, which, like the 2011 Great East Japan Earthquake, inflicted devastating damage, on the labor market of the disaster-affected areas.This analysis might help us draw up a long-term vision of the reconstruction of the eastern Japan areas devastated by the Great East Japan Earthquake. To sum up our findings, regarding part-time workers, the number of new vacancies increased in the short term while the number of new job seekers declined and the number of job placements also dropped steeply. The number of job placements rebounded substantially in the medium term but fell back later. Regarding full-time workers, it was empirically observed that the growth in the number of job placements declined steeply even though the growth in the numbers of new job seekers and new vacancies rose or remained flat compared with the pre-earthquake level. This is presumed to be due in part to a mismatch between labor supply and demand. The number of job placements for full-time jobs recovered by 1999 (in the medium term) but declined later.

I. Introduction

It has been one and a half year since an earthquake and tsunami disaster of an unprecedented scale inflicted devastating damage in East Japan, mainly in the Tohoku region. The Great East Japan Earthquake and the ensuing tsunami killed or left missing around 20,000 people, and deprived numerous people of their homes and properties. Although it seems that the removal of debris and reconstruction work are proceeding, the site of an interim storage facility for soil polluted as a result of the nuclear accident at Tokyo Electric Power Company's Fukushima Daiichi Power Station, which was triggered by this natural disaster, has not yet been determined as of one year after the disaster.[1] The employment situation remains halfway through recovery. The period of the provision of unemployment benefits has been extended by four months in the disaster areas as an extraordinary measure. However, benefits recipients are beginning to reach the end of the extended provision period. As reported by the Sankei Shimbun newspaper on February 9, 2012, the Ministry of

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1 As of February 28, 2012.

Health, Labour and Welfare announced that up to 7,100 people will reach the end of the provision period of unemployment benefits in the January-March quarter of 2012 in the three disaster-stricken prefectures: Iwate Prefecture, Miyagi Prefecture and Fukushima Prefecture. Obviously, it is an urgent task to provide employment opportunities to people who have lost unemployment benefits. On the other hand, we see signs of a recovery in the employment situation. In December 2011, the effective ratio of job offers to seekers was 0.71 in Iwate, 0.80 in Miyagi and 0.74 in Fukushima. Although the ratio is still below 1.0, the employment situation improved in all three prefectures. The number of effective job offers increased 7.7% in Iwate, 1.9% in Miyagi and 6.7% in Fukushima compared with the previous month.[2]

It is conceivable that many jobs are expected to be created as a result of the implementation of reconstruction projects. Therefore, although a labor supply-demand mismatch may arise in the short term, the overall number of new jobs created is certain to increase. However, there is the question of whether the labor market in the three disaster-stricken prefectures will be restored to the pre-earthquake condition in the long term or if it will undergo structural changes. In some cases, the industrial structure of an area hit by a major exogenous shock such as a natural disaster undergoes significant change. In such cases, there will naturally be changes in the types of available jobs, employment arrangements, and working styles in the relevant labor market. Until now, attention has tended to be put on the short-term impact of natural disasters, including earthquakes, on the labor market. However, it is also important to consider possible long-term structural changes. Otherwise, it would be impossible to draw up a long-term vision of post-disaster reconstruction. This paper examines the impact of the 1995 Great Hanshin-Awaji Earthquake, which inflicted devastating damage as the Great East Japan Earthquake has done, on the labor market of the disaster-affected areas from short-, medium- and long-term perspectives.

There are two reasons why our research takes up the Great Hanshin-Awaji Earthquake as its subject. First, it is possible to examine the long-term impact of that earthquake. The Great Hanshin-Awaji Earthquake occurred on January 17, 1995, inflicting devastating damage in the Hanshin-Awaji region. We believe that the 17 years since the occurrence of the earthquake is a sufficient length of period for us to examine the long-term impact. The second reason is that like the Great East Japan Earthquake, the Great Hanshin-Awaji Earthquake was a natural disaster that destroyed physical and human capital on a huge scale in the disaster areas. Examination of the impact of the Great Hanshin-Awaji Earthquake on the affected areas' labor markets will provide an ideal comparison whereby to forecast structural changes that may occur in the future in the labor market of the three disaster-stricken

[2] Refer to the following websites. Iwate Labour Bureau: http://iwate-roudoukyoku.jsite.mhlw.go.jp/var/rev0/0032/4629/201232104215.pdf. Miyagi Labour Bureau: http://miyagi-roudoukyoku.jsite.mhlw.go.jp/library/miyagi-roudoukyoku/syokugyousyoukai/ippansyokugyousyoukaijyoukyouH24.1.pdf. Fukushima Labour Bureau: http://fukushima-roudoukyoku.jsite.mhlw.go.jp/var/rev0/0032/4821/2012 32102544.pdf.

prefectures. Of course, there are significant differences between the Great East Japan Earthquake and the Great Hanshin-Awaji Earthquake in various aspects. First of all, they are earthquakes of different types and scales. In addition, in the case of the Great East Japan Earthquake, the impact was complicated by the subsequent tsunami and nuclear power station accident, which would make a straightforward comparison with the impact of the Great Hanshin-Awaji Earthquake infeasible. Moreover, the disaster areas of these two earthquakes have different industrial characteristics. Whereas the Great Hanshin-Awaji Earthquake inflicted considerable damage to a region where manufacturing and service industries were concentrated, the Great East Japan Earthquake devastated a region where fisheries and agricultural industries were prosperous. As explained above, a straightforward comparison between the impacts of these two earthquakes would not be feasible given their differences in the extent of damage as well as the local characteristics and industrial structures of the disaster areas. However, it is important to examine how the Great Hanshin-Awaji Earthquake changed the labor market structure of the affected areas in the long term, and we expect that the results of the examination will make significant contributions to future studies on how to develop the labor market of the three disaster-stricken prefectures.

This paper uses monthly data of the employment placement services statistics compiled by the Hyogo Labour Bureau. As for the analysis method, we use the ARMA (autoregressive-moving-average) model, which is widely used for time series analysis. As Ewing, Kruse and Thompson (2009) did when they estimated the short- and long-term impacts of another type of natural disaster, a tornado, on the labor market of the disaster areas, we estimate the disaster impact by adding to the ARMA model variables that measure the effects of a shock in the form of a natural disaster.

The summary of the results obtained is as follows. Regarding part-time workers, while the number of new vacancies rose in the short term, the number of new job seekers declined and the number of job placements dropped steeply. As a result of the analysis of the number of new job seekers, it was observed that in many parts of the disaster-stricken region, the number of job placements dropped steeply in the short term, followed by a substantial rebound in the medium term and by a fallback in the long term. This trend was particularly notable in the eastern parts of the disaster-stricken region, including Kobe, Nada, Amagasaki, Nishinomiya and Itami. It is presumed that the decline in the number of part-time job placements after the earthquake resulted from a labor supply shortage.

As for full-time workers, it was empirically observed that the growth in job placements dropped steeply even though growth in the numbers of new vacancies and new job seekers rose or remained flat in the short term compared with the pre-earthquake level. This was presumably due to labor supply-demand mismatch. The values of the coefficients alone seem to suggest that the number of job placements for full-time jobs would recover in the medium term, followed by a decline in the long term, as in the case of part-time jobs. However, we cannot regard that as a definite trend since it is not statistically significant.

This paper is structured as follows. The next section describes previous studies that analyzed the economic impact of natural disasters, including earthquakes, on the disaster areas. Section III explains the key points of the extent of the damage inflicted by the Great Hanshin-Awaji Earthquake and its economic impact. Section IV explains the data used for our analysis and the estimation method, and Section V reports on the results of the estimation. The final section provides our conclusion.

II. Previous Studies

This section cites research papers that analyzed the economic and social impact of natural disasters. Cavallo and Noy (2011) published a detailed survey paper that summarized previous studies in this field. This section cites some of the research papers which were taken up by Cavallo and Noy (2011) and which are related to the purpose of our research. Studies in this field primarily aim to analyze the factors that determine the extent of damage caused by various natural disasters, including not only earthquakes but also typhoons, tornados, tsunamis and volcanic eruptions, and to estimate their short- and long-term economic impacts on the disaster areas. Data usually used in such studies are cross-country panel data.

First, let us cite papers which examined the short-term impact of natural disasters. Raddatz (2007) and Noy (2009) reported on their studies based on regression of per capita GDP on variables that indicate the scale of natural disasters. Both of them observed that natural disasters produce a negative economic impact on the disaster areas in the short term. Noy (2009) estimated the impact by adding to his analysis interaction terms with the natural disaster variables. As a result, Noy observed that the higher a country's living standards are and the more open and mature it is, the smaller the short-term negative impact of a natural disaster, as well as longer-term spill-over effects, is. To put it another way, the less economically developed a country is, the more serious the impact of a natural disaster is and the longer it takes to complete restoration and reconstruction work.[3]

However, the findings may vary depending on the estimation method and variables selected. As a result of an estimation using the GMM method, Loayza et al. (2009) observed that a natural disaster of a modest scale might produce a positive economic impact on the disaster area. Meanwhile, Loayza et al. (2009) reported that a large-scale natural disaster produces a negative economic impact in the short term,a finding consistent with the study by Raddatz (2007) and Noy (2009). Loayza et al. (2009) conjectured that a modest-scale natural disaster produces a positive economic impact because the benefits of special demand created by restoration and reconstruction work surpass the losses caused by the disaster damage.

[3] Cavallo, Powell, and Becerra (2010) estimated the amount of losses caused by the earthquake that occurred in Haiti on January 12, 2010. They estimated the amount at US$ 810 million at minimum.

Next, we cite studies that analyzed the long-term impact of natural disasters. As may be expected, some studies reported that a natural disaster produced a negative economic impact in the long term (Noy and Nualsri 2011). Meanwhile, Skidmore and Toya (2002), who estimated the long-term impact using country-specific cross-section data covering 1960-1990, reported that a natural disaster produced a positive economic impact in the long term, contrary to the finding of Noy and Nualsri (2011). Skidmore and Toya (2002) pointed to the effect of "creative destruction" as the reason for the positive impact. The idea is that a natural disaster destroys old, inefficient industries at once and spurs the birth of new industries, resulting in long-term economic growth. Cuaresma, Hlouskova, and Obersteiner (2008) examined the theory of natural disaster-induced creative destruction. Their study showed that economic growth due to creative destruction induced by natural disasters was observed in developed countries but not in developing countries. That is presumably because it is difficult to introduce and spread new technologies in developing countries. Their observation of the differences between developed and developing countries in the short-term economic impact and longer-term spillover effects of natural disasters is consistent with the findings of Noy (2009).

Cavallo et al. (2010) used a new method in estimating the long-term impact of natural disasters. Using the comparative event study, they showed the counterfactual economic growth curve that would have been followed in the absence of a natural disaster. They quantified the natural disaster impact on economic growth in terms of the difference between the actual economic growth path and the estimated counterfactual growth path. They reported that the long-term impact of natural disasters on economic growth is not very large.

A study by Ewing, Kruse, and Thompson (2009) is useful as a reference for our examination of the impact of a one-time shock caused by the Great Hanshin-Awaji Earthquake based on time-sequential data. They examined the short- and long-term impact of one-time shocks caused by tornados based on time-sequential data. They found that the labor market improved in the long term in the whole of the disaster areas and in most individual industries. As for our analysis method, which derives from Ewing, Kruse, and Thompson (2009), we will provide detailed explanations later.

III. Great Hanshin-Awaji Earthquake

This section provides an overview of the scale of the Great Hanshin-Awaji Earthquake, the extent of damage inflicted by it and post-earthquake reconstruction measures. At 5:46 a.m. on January 17, 1995, the magnitude 7.3 earthquake occurred with the area in the northern part of Awaji Island as its epicenter. The whole of the fault line that extends from Awaji Island to Mt. Rokko was displaced, causing particularly strong tremors in the areas located along the line. The most severely damaged region comprises the following 10 cities and 10 towns in Hyogo Prefecture: Sumoto City, Tsuna Town, Awaji Town, Hokudan Town, Ichinomiya Town, Goshiki Town, Higashiura Town, Midori Town, Seidan Town, Mihara Town and Nandan Town in Awaji Island; Kobe City (damage was particularly severe in Suma, Hyogo, Nagata, Nada and Higashi-Nada Wards); Amagasaki City; Itami City; Nishinomiya City; Ashiya City; Takarazuka City; Kawanishi City; Akashi City; and Miki City. Outside of Hyogo Prefecture, a seismic intensity of 4 on the Japanese scale was recorded in Toyonaka City, Osaka Prefecture. According to the status of damage as finalized by the Fire and Disaster Management Agency (FDMA) on May 19, 2006, 6,434 people were killed and three persons remained missing, while 104,906 houses (accommodating 186,175 households) were totally destroyed, 144,274 houses (accommodating 274,182 households) were partially destroyed and 269 fires occurred.[4]

Moreover, much of the infrastructure was destroyed. According to the FDMA's report, 1,579 public buildings, 7,245 sections of road and 330 bridges were damaged. Broadcast footage of a toppled section of the Hanshin Expressway's Kobe line shocked viewers. The Kobe lines of the railways operated by West Japan Railways and private railway companies (Hanshin, Hankyu and Sanyo), as well as the facilities of municipal subway and bus operators, were also considerably damaged, bringing traffic in the region to a standstill. The lifeline infrastructure also sustained significant damage. According to a report issued by the Hyogo Prefectural government in December 2011, approximately 2.6 million households were cut off from electricity supply, approximately 845,000 households from gas supply and approximately 1.27 million houses from running water. Approximately 478,000 telephone lines, including exchange and subscriber lines, went out of service. These lifeline services were mostly restored by April 1995 at the latest.[5] On the man-made Port Island, many condominium buildings were damaged due to soil liquefaction. The port operations at Kobe Port were considerably disrupted. According to the table of changes in the value of annual trade going through Kobe Port compiled by Kobe Customs, trade via Kobe Port accounted for around 10% of Japan's overall trade, including both imports and exports, in the pre-earthquake period. Immediately after the earthquake, Kobe Port's share declined to 5.9%, and it has never recovered to the pre-earthquake level since then. In 2010, the share was 5.9%.[6] Kobe's status as a trading hub city has remained damaged since the earthquake. This is evidence that the Great Hanshin-Awaji Earthquake significantly affected the industrial structure of the disaster areas. As a result of a decline in the volume of trade handled at Kobe Port, the number of workers engaging in trade and port-related jobs declined, with other industries absorbing workers made redundant.

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[4] Refer to the website of the Hyogo prefectural government: http://web.pref.hyogo.jp/pa20/pa20_000000015.html.

[5] "On the status of Restoration and Reconstruction after the Great Hanshin-Awaji Earthquake" by the Hyogo prefectural government, December 2011. http://web.pref.hyogo.jp/wd33/documents/fukkyu-fukko2012-12.pdf.

[6] Refer to the table of changes in the value of annual trade going through Kobe Port at the following website of Kobe Customs: http://web.pref.hyogo.jp/wd33/documents/fukkyu-fukko2012-12.pdf.

Next, we explain the economic losses caused by the Great Hanshin-Awaji Earthquake. According to an estimate by the Hyogo prefectural government (April 5, 2005), the total amount of losses came to ¥9,926.8 billion, of which losses from building destruction accounted for the largest portion, ¥5,800 billion. It should be noted that the losses as estimated by the Hyogo prefectural government cover only direct losses. Uenoyama and Arai (2007) explained the calculation method of the losses in detail. Toyoda and Kochi (1997) calculated the amount of economic losses, including both direct and indirect losses, caused by the earthquake. The indirect losses as defined by them are financial losses arising from the loss of commercial opportunities suffered by persons and companies as a result of the damage they sustained themselves or by their business partners. Toyoda and Kochi also estimated the amount of losses broken down by industry. According to their estimate, losses amounted to ¥2.9 trillion in the "wholesale/retail industries," ¥2 trillion in the "services/other industries" and ¥1.2 trillion in the "manufacturing industry." These figures reflect the high concentration of manufacturing and services industries in the Hanshin-Awaji region.

On November 30, 1998, the investigative committee on the Great Hanshin-Awaji Earthquake reported on its estimate of the indirect losses. This report paid attention to opportunity losses caused to industries by disruptions of freight transport due to the damage done to roads and port facilities. The committee estimated the amount of losses over the two-year period from February 1995, the month following the earthquake, to January 1997 at ¥1,828.8 billion. Broken down by industry, estimated losses amounted to ¥1,375 billion in the "manufacturing industry," ¥319 billion in the "wholesale industry," ¥84.2 billion in the "retail industry" and ¥51 billion in the "port-related industries." The committee also estimated the amount of losses based on the results of a survey conducted on companies in March 1995. The estimated losses totaled ¥50.2 billion. Uenoyama and Arai (2007) compiled a detailed summary of the results of various estimates of the economic losses caused by the Great Hanshin-Awaji Earthquake.

Next, we provide a brief overview of the reconstruction measures taken after the Great Hanshin-Awaji Earthquake and the effects thereof. In July 1995, the Great Hanshin-Awaji Earthquake Reconstruction Plan (Hyogo Phoenix Plan) was formulated with a view to not merely restoring the disaster areas to the pre-earthquake condition but creating a new, mature society. The plan set the goal of rebuilding the most severely damaged 10 cities and 10 towns by 2005 to make them highly disaster-resilient, create a cosmopolitan culture and strengthen welfare services. In fields that require quick reconstruction, such as infrastructure, housing and industry, emergency three-year reconstruction plans were formulated in August and November 1995. The goals under these emergency reconstruction plans were achieved on the whole by 1998, the final year of the plans. Thereafter, various reconstruction plans were drawn up and carried out, resulting in steady progress in post-earthquake restoration and reconstruction. Under the Three-Year Policy for Utilizing Results of Reconstruction Work for Prefectural Administration, which was formulated in February 2007, the emphasis started to shift from reconstruction in the disaster areas to passing the experiences and lessons of the Great Hanshin-Awaji Earthquake on to future generations.

Have the various reconstruction measures been effective in achieving post-earthquake reconstruction in the Hanshin-Awaji region? The damage done by the earthquake forced a large number of people to live away from their homes. Some people were temporarily evacuated and others left the region for good. According to "On the Status of Restoration and Reconstruction after the Great Hanshin-Awaji Earthquake" a report compiled by the Hyogo prefectural government, the population in Hyogo Prefecture was estimated at approximately 3.59 million as of January 1, 1995. The national census showed that the population in Kobe was down steeply to approximately 3.44 million as of October 1 of the same year. However, the population gradually rebounded later due to an increase in immigration from other parts of the country to stand at approximately 3.58 million, almost reaching the pre-earthquake level. Since then, the population has continued to grow, standing at 3.67 million as of October 1, 2010. The introduction of a housing rent subsidy scheme for young married couples has presumably led to the increase in immigration into the former disaster areas.

According to the Hyogo prefectural government's "On the Status of Restoration and Reconstruction after the Great Hanshin-Awaji Earthquake," real gross product in the disaster areas was higher in the three-year period from 1995, the year of the earthquake, to 1997 than in the pre-earthquake period because of special demand related to reconstruction work. However, real gross product later declined and remained below the pre-earthquake level as reconstruction-related demand disappeared and the entire Japanese economy weakened. Since 2004, gross product in the disaster areas rebounded in line with the recovery of Japan's gross domestic product due to improved economic conditions.

The post-earthquake industrial recovery policy comprised three pillars. The first pillar was support for earthquake-damaged small and medium-size enterprises (SMEs). The second pillar was the development of new industries and growth industries. The third pillar was the establishment of a special economic zone. This policy indicated eagerness to develop new industries by inviting various venture companies, instead of relying on existing companies alone. According to the Establishment and Enterprises Census (Ministry of Internal Affairs and Communications), the average business start-up ratio in the disaster areas in 1996 through 2006 was 5.5%, significantly higher than the national average of 4.3%.

The effective ratio of job offers to seekers in the disaster areas moved in line with the gross product there. In other words, the effective ratio of job offers to seekers rose immediately after the earthquake due to reconstruction-related demand. However, the ratio remained below 1.0, meaning a continued shortage of job vacancies in the affected areas. After reconstruction-related demand disappeared, the effective ratio of job offers to seekers declined in line with the weakness of the entire Japanese economy. It later rebounded in tandem with the recovery of the entire Japanese economy.[7]

Ohata (2011) also analyzed the impact of the Great East Japan Earthquake on employment in light of the impact of the Great Hanshin-Awaji Earthquake. Ohata's study showed that between 1992 and 1997, the number of regular workers declined in Kobe City, while the number of part-time and *arubaito* workers increased.[8] However, the number of regular workers in Kobe City had already been declining since the collapse of the economic bubble in the early 1990s, and the downtrend continued until 2002 (Ohata 2001, Figure 19). Ohata's findings do not necessarily mean that the Great Hanshin-Awaji Earthquake caused the decline in the number of regular employees. The number of non-regular workers has been increasing since 1982, regardless of the impact of the earthquake. A similar trend is observed in nationwide data on the number of non-regular workers. The increase in the number of part-time and *arubaito* workers is notable among younger men (15 to 39 years old).

Horwich (2000) gave high marks to the reconstruction after the Great Hanshin-Awaji Earthquake and also commented on disaster prevention/mitigation measures that should be taken by administrative organizations and private-sector companies based on the lessons of the earthquake. Horwich (2000) praised the faster-than-expected pace of the reconstruction and attributed it to the relatively small amount of capital resource losses compared with physical resource losses. While expressing his appreciation of administrative organizations' quick moves to restore the lifeline infrastructure and provide relief goods, he also cited points to be improved. One of the points was the failure of coordination with relevant people and organizations, as represented by a lack of cooperation with volunteers and the mismatch between disaster victims' needs and the supply of relief goods. It is necessary to enhance the mediation function of administrative organizations and develop a system that enables efficient provision of relief goods and allocation of volunteers. Moreover, Horwich observed that it is essential for the private sector to cooperate in enhancing the disaster prevention/mitigation functions, rather than leaving that task entirely to administrative organizations.

IV. Data and Model Specification

This section explains the data and estimation method used in our research. As our research examines how the Great Hanshin-Awaji Earthquake affected the labor market structure in the disaster areas in the long term, we use the job placement services statistics concerning the areas over a long period of time. With cooperation from the Hyogo Labour Bu-

[7] A graph indicating changes in the effective ratio of job offers to seekers is included in "On the Status of Restoration and Reconstruction after the Great Hanshin-Awaji Earthquake" by the Hyogo prefectural government. http://web.pref.hyogo.jp/wd33/documents/fukkyu-fukko2012-12.pdf.

[8] Refer to Figure 18, Ohata (2011). This figure is based on the Employment Status Survey compiled by the Ministry of Internal Affairs and Communications.

reau, we collected monthly data that covers the period from April 1993 to March 2009.

Among variables related to the job placement services statistics, we paid particular attention to the numbers of new job seekers, new vacancies and job placements. All of these numbers are presumed to have declined immediately after the earthquake as the labor market was severely damaged. In contrast, it may be presumed that the number of vacancies in the construction sector increased rapidly during the post-earthquake reconstruction period. However, if job seekers were not willing to work in the construction sector, a labor supply-demand mismatch would arise, limiting the rise in the number of job placements. If reconstruction-related demand disappears and the initial negative impact of the earthquake produce spillover effects, the numbers of new job seekers, vacancies and job placements would remain lower than the pre-earthquake level. Or, as observed by Cavallo, Galiani, Noy and Pantano (2010), the impact of the earthquake may not be significant in the long term.

Moreover, our analysis looks at full-time workers and part-time workers separately. In the job placement services statistics, full-time work is defined as including both permanent and extraordinary/seasonal work. The part-time worker refers to a worker whose weekly working hours are shorter than the weekly working hours of regular workers employed by the same employer. Of part-time workers, those who work under a non-fixed-term contract or under a contract of four months or longer are defined as "permanent part-time workers" and those who work under a fixed-term contract, under a contract of one to three months or under a seasonal fixed-term contract are defined as "temporary part-time workers."[9]

Analysis that looks at full-time workers and part-time workers separately enables us to indirectly examine how the Great Hanshin-Awaji Earthquake affected the industrial structure of the disaster areas in the long term. Roughly speaking, more full-time workers work in the manufacturing and trade/port-related industries than part-time workers, while the opposite is true in the retail and service industries. By comparing changes in the number of new vacancies broken down by full-time and part-time workers in the post-earthquake period, we can indirectly grasp the changes undergone by the industrial structure in the disaster areas. If the number of new vacancies for part-time workers increased more than the number of vacancies for full-time workers, that would mean that the center of gravity of the industrial structure shifted from the manufacturing and trade/port-related industries, which constituted the industrial core of the Hanshin-Awaji region before the earthquake, to the retail and service industries after the disaster. As in the case of the findings of Ohata (2011), given that the ratio of part-time workers has been rising on a nationwide basis since the 1990s, we must naturally keep in mind that the rise in the number of job vacancies for part-time workers cannot be attributed to the impact of the earthquake alone.

In 1995, when the Great Hanshin-Awaji Earthquake occurred, the Hyogo Labour Bureau was providing job mediation service at 18 "Hello Work" offices (Public Employment

[9] Refer to "Employment Placement Services Statistics" (Ministry of Health, Labour and Welfare) in the "Glossary" (in Japanese). http://www.mhlw.go.jp/toukei/itiran/roudou/koyou/ippan/detail/01.html.

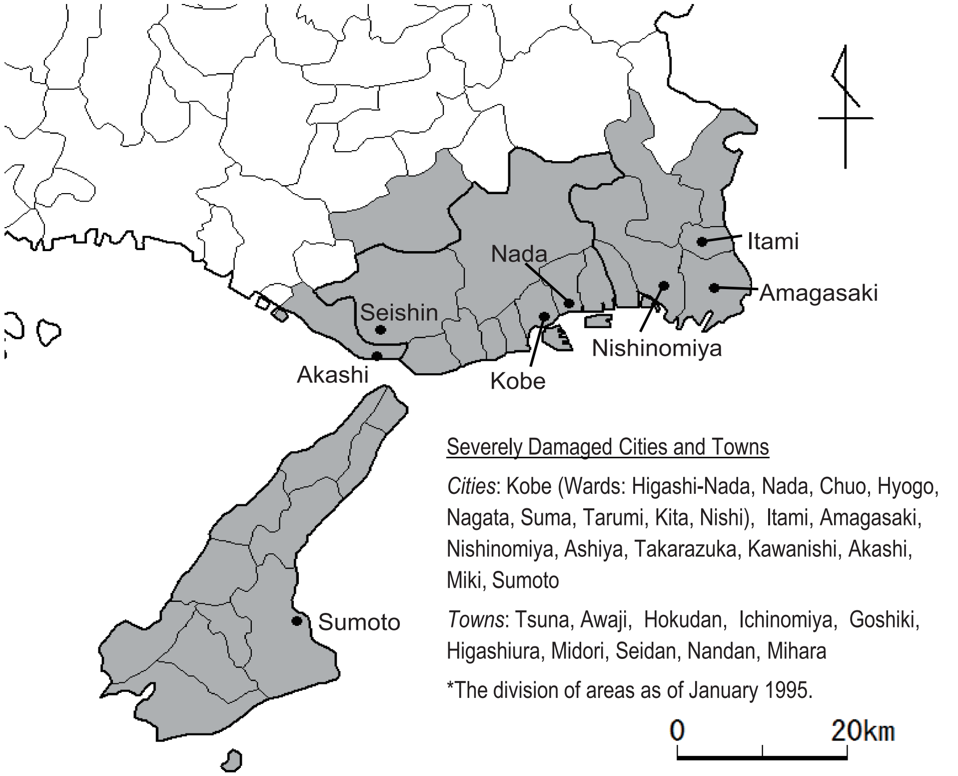

Figure 1. The Most Severely Damaged 10 Cities and 10 Towns and the Locations of Hello Work Offices

Security Offices). In 1995, Hello Work offices in Hyogo Prefecture were located in Kobe (there were three offices in Kobe—the Kobe office, the Seishin office and the Kobe Ladies office), Nada, Amagasaki, Nishinomiya, Himeji (two offices—the Himeji office and the Himeji-Minami office), Kakogawa, Itami, Akashi, Toyooka, Nishiwaki, Sumoto (Awaji Island), Kashiwabara, Tatsuno, Aioi and Yoka). By March 2009, three offices—Himeji-Minami, Aioi and Yoka—were closed, with their operations absorbed by other offices. The Kobe Ladies office, located in Kobe's Sannomiya area, was transformed into a facility that supported mothers seeking jobs (Mothers Hello Work Sannomiya). In addition, a new office focusing on support for young job seekers (Young Work Plaza Sannomiya) was opened in the Sannomiya area. As our study concentrates on the labor market in the disaster areas, it covers only the Hello Work offices there. The eight offices covered are Kobe, Nada, Amagasaki, Nishinomiya, Itami, Akashi, Sumoto (Awaji Island) and Seishin. As data concerning Kobe Ladies (Mothers Hello Work Sannomiya) and Young Work Plaza Sannomiya were not available, we excluded these two offices from our analysis. Data concerning new graduates were also excluded from our analysis. The eight Hello Work offices covered by the analysis are scattered across the disaster areas as shown in Figure 1. The gray-shaded areas represent the most severely damaged 10 cities and 10 towns. It should be noted that the Akashi, Sumoto and Seishin offices are located in the western part of the disaster-ravaged region.

The numbers of new job seekers, vacancies and placements are monthly data and may be affected by seasonal factors, so we use year-on-year growth figures for our analysis, as Ewing, Kruse, and Thompson (2009) did. As we calculated year-on-year growth rates based on monthly data for the period between April 1993 and March 2009, the number of observations is 180 in each case. Times series data were obtained from the Hello Work offices in Kobe, Nada, Amagasaki, Nishinomiya, Itami, Akashi, Sumoto and Seishin. Basic statistics regarding growth rates for part-time and full-time workers who obtained jobs through these eight Hello Work offices are as shown in Table 1.

This paper measures the impact of the Great Hanshin-Awaji Earthquake, which occurred in January 1995, by estimating the ARMA model using time series data such as the growth rates of the numbers of new job seekers, vacancies and placements. This method is based on the study by Ewing, Kruse, and Thompson (2009). Ewing, Kruse, and Thompson (2009) conducted analysis while taking account of the possibility of a natural disaster producing a negative impact in the short term, to be followed by a positive impact in the long term. In our study, we examine each of the short-, medium-, and long-term impacts because the data used covers a fairly long period of time, from April 1993 and March 2009. The impact variables are defined as below.

$$\pi_t^s = \begin{cases} 1, & \text{January 1995} \le t \le \text{December 1995} \\ 0, & \text{Other} \end{cases} \quad (1)$$

$$\pi_t^m = \begin{cases} 1, & \text{Janyuary 1996} \le t \le \text{December 1999} \\ 0, & \text{Other} \end{cases} \quad (2)$$

$$\pi_t^l = \begin{cases} 1, & t \ge \text{Janyuary 2000} \\ 0, & t < \text{Janyuary 2000} \end{cases} \quad (3)$$

π_t^s represents a dummy variable used to measure the short-term impact during the one-year period from the occurrence of the earthquake, while π_t^m represents a dummy variable used to measure the medium term impact between the second and fifth years from the earthquake. π_t^l represents a dummy variable use to measure the long-term impact in the period since the sixth year from the earthquake. The ARMA model incorporating these impact variables is as shown below.

$$\phi\,(L)g_t = \theta(L)\varepsilon_t + c_0 + \phi\, I_t + \lambda^s\pi_t^s + \lambda^m\pi_t^m + \lambda^l\pi_t^l \quad (4)$$

g_t represents the growth rates of the numbers of new job seekers, vacancies and placements. I_t represents the growth rate of the industrial production index (production)

Table 1. Basic Statistics (Year-on-Year Changes)

	Mean	Standard deviation	Minimum	Maximum
Number of job placements				
Part-time				
Kobe	0.0928	0.2504	-0.5333	1.0462
Nada	0.1506	0.359	-0.6522	2.1579
Amagasaki	0.0555	0.2077	-0.4353	0.8364
Nishinomiya	0.136	0.3235	-0.5909	2.25
Itami	0.1017	0.2501	-0.3538	0.8974
Akashi	0.0636	0.2083	-0.3631	1.1067
Sumoto	0.2294	0.6042	-0.7778	5.0000
Seishin	0.1685	0.4561	-0.5588	3.3846
Full-time				
Kobe	0.0383	0.2366	-0.5881	1.0412
Nada	0.0571	0.2826	-0.4842	1.2169
Amagasaki	0.0515	0.2331	-0.4167	0.8926
Nishinomiya	0.075	0.2321	-0.4493	0.9605
Itami	0.0673	0.2419	-0.3786	0.9219
Akashi	0.054	0.2217	-0.3401	0.8326
Sumoto	0.0591	0.2584	-0.4352	0.7895
Seishin	0.1228	0.3113	-0.3542	1.6111
Number of new job vacancies				
Part-time				
Kobe	0.1188	0.2479	-0.2715	1.1334
Nada	0.1536	0.3489	-0.5513	2.2139
Amagasaki	0.09	0.2577	-0.4204	1.5717
Nishinomiya	0.136	0.3265	-0.4884	1.8035
Itami	0.1142	0.3147	-0.603	1.7465
Akashi	0.106	0.3037	-0.4755	1.5881
Sumoto	0.1425	0.4772	-0.7877	2.7568
Seishin	0.16	0.3993	-0.6528	1.8438
Full-time				
Kobe	0.0809	0.3339	-0.5049	1.1987
Nada	0.114	0.3816	-0.5158	1.9946
Amagasaki	0.0592	0.3229	-0.4763	1.5201
Nishinomiya	0.0701	0.3706	-0.489	1.5277
Itami	0.066	0.3493	-0.6437	1.2105
Akashi	0.0648	0.3479	-0.4894	1.6142
Sumoto	0.0396	0.3977	-0.5395	1.7623
Seishin	0.1487	0.5471	-0.5631	2.0775

Table 1 (*Continued*)

	Mean	Standard deviation	Minimum	Maximum
Number of new job seekers				
Part-time				
Kobe	0.0587	0.194	-0.4771	0.6694
Nada	0.2079	0.5427	-0.6471	3.1333
Amagasaki	0.0643	0.2108	-0.4177	0.7532
Nishinomiya	0.1511	0.3886	-0.4079	2.1333
Itami	0.0405	0.1473	-0.3043	0.4079
Akashi	0.0435	0.1791	-0.4186	0.938
Sumoto	0.2076	0.4381	-0.5098	2.5385
Seishin	0.1068	0.2571	-0.4018	1.5455
Full-time				
Kobe	0.0251	0.2131	-0.6142	1.3803
Nada	0.0254	0.2394	-0.7054	1.5708
Amagasaki	0.01	0.1575	-0.386	0.4236
Nishinomiya	0.0215	0.1697	-0.3956	0.5988
Itami	0.0269	0.1938	-0.5203	0.505
Akashi	0.032	0.2022	-0.4929	1.2868
Sumoto	0.0498	0.2235	-0.6011	1.6985
Seishin	0.0576	0.2244	-0.4323	1.8009
Industrial production index	-0.0008	0.062	-0.2932	0.1119

for the Kinki region,[10] which is used to control economic cyclical fluctuations, and ϕ represents its coefficient. λ^s, λ^m and λ^l represent the coefficients of dummy variables π_t^s (short term), π_t^m (medium term) and π_t^l (long term), respectively. ε_t represents an error term. $\phi(L)$ and $\theta(L)$, which represent polynominals of the lag operator L, include the coefficients of the degree p of the AR term and the degree q of the MA term. We estimate this model using time series data such as the numbers of new job seekers, vacancies and placements regarding full-time and part-time workers who obtained jobs in Hello Work offices in Kobe, Nada, Amagasaki, Nishinomiya, Itami, Akashi, Sumoto and Seishin. When selecting the degree p of the AR term and degree q of the MA term, we made the selection based on BIC (Bayesian information criterion) after checking auto correlation and partial auto correlation regarding each series.

V. Estimation Result

This section presents the results of the estimation of equation (4) in the previous section using the numbers of new job seekers, vacancies and placements regarding full-time and part-time workers.

First, let us look at the number of job placements for part-time workers in Table 2.

[10] Raw numbers were obtained from the Kinki Bureau of Economy, Trade and Industry. Regarding the period before December 2002, connected index data were used.

The coefficient of the short-term dummy variable concerning Kobe was -0.7402 and was significant at the 1% level. This means that during the one-year period from the occurrence of the earthquake, the year-on-year growth rate of job placements dropped by 74.02 percentage points compared with the previous year. The coefficient of the medium-term dummy variable was -0.2025 and was not significant, while the coefficient of the long-term dummy variable was -0.3461 and was significant at the 5% level. This means that the growth rate declined by around 20.25 percentage points or recovered close to the pre-earthquake level during the second to fifth years from the earthquake compared with the pre-earthquake level, before falling back by as much as 34.61 percentage points in the long term. However, the long-term fall was not as steep as the decline that immediately followed the earthquake. When interpreting these results, we must keep in mind that the pre-earthquake data cover a fairly short period of time, from April 1994 to December of the same year. The constant term 0.4243 indicates a very high growth rate of the number of job placements during that period. Therefore, although the growth turned negative in the short term, it remained positive in the long term, despite dropping by 34.61 percentage points from 42.43%.

Not only in Kobe but also in Nada, Amagasaki, Nishinomiya and Itami, the growth rate declined steeply in the short term, followed by a substantial recovery in the medium term and a fallback in the long term. These five cities are located in the eastern part of the region comprised of the 10 cities and 10 towns mostly severely damaged (Figure 1). The coefficient of the short-term dummy variable concerning Seishin was negative, while a statistically significant decline was not observed in the short term in either of Akashi, Sumoto or Seishin. The coefficient of the long-term dummy variable concerning Seishin was significantly negative at a 10% level of significance. This suggests that the employment situation differed from area to area within the region according to the damage status and the industrial structure.

The coefficient of changes in the industrial production index, which indicates the economic condition across a broad area, was positive with regard to some areas and negative with regard to others. That is presumably because of area-to-area differences in labor supply and demand, both of which are reflected in the number of job placements.

The estimation results concerning the number of new vacancies for part-time workers are as shown in Table 3. The coefficient of changes in the industrial production index was positive with regard to all areas. The coefficient of the short-term dummy variable was positive with regard to all areas except for Itami. The coefficient was statistically significant with regard to Kobe (0.2555), Nada (0.6401), Nishinomiya (0.4324), Akashi (0.4207) and Sumoto (0.5905). The very high values of the coefficients regarding these areas indicate that the number of new vacancies for part-time workers increased steeply in the short term. We did not observe any notable trend regarding the medium- and long-term impact. Thus, while demand for part-time workers grew in the short term, that did not lead to an increase in the number of job placements.

Table 2. Estimation Results Concerning the Number of Job Placements for Part-Time Workers

	Kobe	Nada	Amagasaki	Nishinomiya	Itami	Akashi	Sumoto	Seishin
Industrial production index	1.0984 **	0.1686	-0.5942 **	0.0122	0.5446	-0.2305	-0.2157	-0.2317
	(0.461)	(0.632)	(0.278)	(0.658)	(0.378)	(0.291)	(0.887)	(0.892)
Short-term	-0.7402 ***	-0.4643 ***	-0.4210 ***	-0.4520 *	-0.6467 ***	0.0178	0.1052	-0.1728
	(0.104)	(0.159)	(0.075)	(0.233)	(0.149)	(0.107)	(0.450)	(0.263)
Medium-term	-0.2025	-0.0950	-0.1853 ***	-0.0869	-0.2593 *	0.0031	0.3708	-0.2672
	(0.124)	(0.134)	(0.056)	(0.164)	(0.140)	(0.135)	(0.456)	(0.202)
Long-term	-0.3461 **	-0.3184 **	-0.3364 ***	-0.2465	-0.4300 ***	-0.1023	0.0819	-0.3615 *
	(0.154)	(0.148)	(0.050)	(0.155)	(0.136)	(0.144)	(0.458)	(0.193)
Constant term	0.4243 ***	0.4079 ***	0.3399 ***	0.3424 **	0.4817 ***	0.1262	0.0734	0.4793 **
	(0.139)	(0.126)	(0.045)	(0.143)	(0.132)	(0.136)	(0.443)	(0.194)
Degree of AR term	3	2	2	2	2	3	2	2
Degree of MA term	0	2	1	0	0	2	2	2
Log likelihood	58.72	-47.94	61.87	-23.30	34.56	52.00	-153.7	-94.68
Observations	180	180	180	180	180	180	180	180

Note: The figures in parentheses indicate the values of standard errors. *** Significant at 1%. ** Significant at 5%. * Significant at 10%.

Table 3. Estimation Results Concerning the Number of New Job Vacancies for Part-Time Workers

	Kobe	Nada	Amagasaki	Nishinomiya	Itami	Akashi	Sumoto	Seishin
Industrial production index	0.9033 ***	0.4847	0.8734 **	0.1219	0.7851	1.2051 ***	0.7333	0.8643
	(0.344)	(0.542)	(0.378)	(0.677)	(0.503)	(0.417)	(0.841)	(0.656)
Short-term	0.2555 ***	0.6401 ***	0.0827	0.4324 ***	-0.0470	0.4207 ***	0.5905 **	0.1119
	(0.059)	(0.112)	(0.122)	(0.116)	(0.124)	(0.097)	(0.258)	(0.177)
Medium-term	-0.1141	0.1419	-0.0081	0.3142 ***	-0.1928 *	-0.0834	0.3198	-0.1895
	(0.113)	(0.112)	(0.108)	(0.112)	(0.109)	(0.090)	(0.290)	(0.151)
Long-term	0.0328	0.0849	-0.0681	-0.0532	-0.2276 **	-0.0785	0.3283	-0.1504
	(0.129)	(0.111)	(0.104)	(0.139)	(0.102)	(0.087)	(0.294)	(0.159)
Constant term	0.1055	0.0212	0.1294	0.0612	0.3096 ***	0.1496 *	-0.1838	0.3012 **
	(0.119)	(0.103)	(0.102)	(0.116)	(0.096)	(0.081)	(0.289)	(0.147)
Degree of AR term	7	0	0	2	1	0	0	2
Degree of MA term	2	0	0	3	1	0	3	2
Log likelihood	48.51	-48.50	-3.799	-23.89	-31.72	-15.61	-90.90	-62.95
Observations	180	180	180	180	180	180	180	180

Note: The figures in parentheses indicate the values of standard errors. *** Significant at 1%. ** Significant at 5%. * Significant at 10%.

Table 4 shows the estimation results concerning the number of new job seekers among part-time workers. The coefficient of changes in the industrial production index was positive with regard to some areas and negative with regard to others. The coefficient of the short-term dummy variable was negative with regard to all areas. The absolute values of the coefficients regarding Kobe (-0.4689), Nada (-0.2266), Amagasaki (-0.3449), Nishinomiya (-0.5031) and Itami (-0.2681) were high, indicating a steep drop in the supply of part-time workers in these areas. However, the absolute values of the coefficients regarding Akashi (-0.0800), Sumoto (-0.0330) and Seishin (-0.1614) were relatively low, indicating a modest decline in the supply in these areas. Presumably, that is why the number of job placements declined steeply in Kobe, Nada, Amagasaki, Nishinomiya and Itami but did not drop in Akashi, Sumoto and Seishin. In many areas, the number of new job seekers declined steeply in the short term, followed by a substantial recovery in the medium term and a fallback in the long term, as the number of job placements did.

Table 5 shows the estimation results concerning the number of job placements for full-time workers. The coefficient of changes in the industrial production index was positive with regard to all areas. The coefficient of the short-term dummy variable was negative with regard to all areas. The coefficient was statistically significant with regard to Kobe (-0.5444), Amagasaki (-0.3904), Nishinomiya (-0.5420), Itami (-0.3138) and Seishin (-0.4485), indicating that the number of job placements dropped sharply in the short term in these areas. While the coefficient regarding Nada was not statistically significant, its value, at -0.5166, was high. The number of job placements is presumed not to have declined much in Akashi and Sumoto as in the case of the estimation regarding part-time workers. Regarding areas other than Seishin, the coefficients of the medium- and long-term dummy variables were not significant. Therefore, it is presumed that although the number of job placements for full-time workers dropped in the short term, it recovered to the pre-earthquake level in the medium and long term. If we look at the values of the coefficients with no regard for their statistical significance, we can observe a pattern similar to the one in the case of part-time workers—a steep drop in the short-term followed by a substantial recovery in the medium term and a fallback in the long term. Regarding Seishin, the coefficients of the short-, medium- and long-term dummy variables were -0.4485, -0.3679 and -0.4435, respectively, indicating that the number of job placements dropped very steeply in the medium and long terms compared with the pre-earthquake level. However, the possibility cannot be denied that the reason for that was because the pre-earthquake growth rate, as indicated by the constant term 0.5253, was too high.

Table 6 shows the estimation results concerning the number of new vacancies for full-time workers. The coefficient of changes in the industrial production index was positive with regard to all areas except for Sumoto. The coefficient of the short-term dummy variable was positive with regard to all areas except for Itami. The coefficient was statistically significant with regard to Nada (0.3235), Amagasaki (0.3735), Akashi (0.6915) and Seishin (1.1495). The value of the coefficient in each of these areas was very high, indicating that

Table 4. Estimation Results Concerning the Number of New Job Seekers among Part-Time Workers

	Kobe	Nada	Amagasaki	Nishinomiya	Itami	Akashi	Sumoto	Seishin
Industrial production index	0.7378 ***	1.7774	0.3568	0.7374	-0.3139 **	-0.2475	-0.3425	-0.1188
	(0.177)	(1.109)	(0.339)	(0.828)	(0.157)	(0.305)	(0.848)	(0.338)
Short-term	-0.4689 ***	-0.2266	-0.3449 ***	-0.5031	-0.2681 ***	-0.0800	-0.0330	-0.1614 **
	(0.095)	(0.488)	(0.132)	(0.370)	(0.062)	(0.073)	(0.420)	(0.077)
Medium-term	-0.0375	0.2764	-0.3064 **	0.1325	-0.1055 *	0.0307	0.2585	-0.3956 ***
	(0.070)	(0.655)	(0.128)	(0.323)	(0.059)	(0.063)	(0.352)	(0.068)
Long-term	-0.1372 *	0.0719	-0.3655 ***	-0.2766	-0.2188 ***	-0.0963 *	0.2889	-0.4025 ***
	(0.074)	(0.565)	(0.107)	(0.326)	(0.058)	(0.054)	(0.346)	(0.062)
Constant term	0.1833 ***	0.1543	0.3996 ***	0.3256	0.2230 ***	0.0940 *	-0.0390	0.4684 ***
	(0.069)	(0.557)	(0.090)	(0.312)	(0.056)	(0.055)	(0.338)	(0.062)
Degree of AR term	2	5	1	1	4	2	1	2
Degree of MA term	2	1	1	0	3	3	0	4
Log likelihood	152.4	-73.83	78.67	9.691	135.6	98.46	-81.02	43.07
Observations	180	180	180	180	180	180	180	180

Note: The figures in parentheses indicate the values of standard errors. *** Significant at 1%. ** Significant at 5%. * Significant at 10%.

Table 5. Estimation Results Concerning the Number of Job Placements for Full-Time Workers

	Kobe	Nada	Amagasaki	Nishinomiya	Itami	Akashi	Sumoto	Seishin
Industrial production index	1.3139 ***	0.9307 *	1.2702 ***	0.9186 **	0.7289	1.5586 ***	0.3541	1.4466 ***
	(0.362)	(0.557)	(0.360)	(0.404)	(0.474)	(0.418)	(0.391)	(0.489)
Short-term	-0.5444 **	-0.5166	-0.3904 ***	-0.5420 ***	-0.3138 **	-0.1104	-0.0806	-0.4485 ***
	(0.242)	(0.350)	(0.144)	(0.182)	(0.141)	(0.146)	(0.147)	(0.165)
Medium-term	0.1009	-0.0760	-0.1617	-0.0920	-0.0899	-0.0585	0.1498	-0.3679 **
	(0.249)	(0.328)	(0.163)	(0.184)	(0.139)	(0.163)	(0.159)	(0.148)
Long-term	0.0646	-0.1312	-0.2147	-0.1045	-0.1712	-0.0813	0.0533	-0.4435 ***
	(0.259)	(0.327)	(0.142)	(0.216)	(0.153)	(0.146)	(0.172)	(0.135)
Constant term	0.0166	0.1952	0.2521*	0.2062	0.2234 *	0.1303	-0.0043	0.5253 ***
	(0.260)	(0.319)	(0.145)	(0.208)	(0.135)	(0.149)	(0.159)	(0.136)
Degree of AR term	2	2	2	4	1	4	2	5
Degree of MA term	0	0	2	2	1	1	0	1
Log likelihood	77.56	3.875	78.27	64.38	45.59	63.06	24.24	11.62
Observations	180	180	180	180	180	180	180	180

Note: The figures in parentheses indicate the values of standard errors. *** Significant at 1%. ** Significant at 5%. * Significant at 10%.

Table 6. Estimation Results Concerning the Number of New Vacancies for Full-Time Workers

	Kobe	Nada	Amagasaki	Nishinomiya	Itami	Akashi	Sumoto	Seishin
Industrial production index	1.5577 **	0.8005	0.0022	0.4663	0.1618	0.0183	-0.7916	1.3341
	(0.627)	(0.765)	(0.632)	(0.614)	(0.605)	(0.517)	(0.724)	(1.040)
Short-term	0.0521	0.3253 **	0.3735 ***	0.2534	-0.0311	0.6915 ***	0.2785	1.1495 ***
	(0.114)	(0.148)	(0.078)	(0.172)	(0.200)	(0.102)	(0.183)	(0.193)
Medium-term	-0.0591	0.3585 *	0.3365 **	0.1571	-0.0574	0.2364	-0.0214	0.6696 **
	(0.159)	(0.209)	(0.141)	(0.324)	(0.312)	(0.218)	(0.281)	(0.303)
Long-term	-0.0627	0.2937	0.2973 *	0.0612	-0.0886	0.2572	0.0973	0.6044
	(0.205)	(0.313)	(0.159)	(0.378)	(0.369)	(0.193)	(0.256)	(0.395)
Constant term	0.1293	-0.1818	-0.2311	-0.0219	0.1322	-0.1877	-0.0067	-0.4688
	(0.194)	(0.295)	(0.142)	(0.345)	(0.353)	(0.187)	(0.251)	(0.368)
Degree of AR term	3	3	4	1	1	6	4	1
Degree of MA term	2	0	1	1	3	3	1	2
Log likelihood	21.58	-33.35	17.00	-5.972	0.234	24.21	-11.64	-85.04
Observations	180	180	180	180	180	180	180	180

Note: The figures in parentheses indicate the values of standard errors. *** Significant at 1%. ** Significant at 5%. * Significant at 10%.

Table 7. Estimation Results Concerning the Number of Job Seekers among Full-Time Workers

	Kobe	Nada	Amagasaki	Nishinomiya	Itami	Akashi	Sumoto	Seishin
Industrial production index	1.0450 **	0.3945	0.4228 **	0.7763 ***	0.7129 **	0.6207 *	-0.0755	0.0387
	(0.515)	(0.593)	(0.204)	(0.284)	(0.288)	(0.319)	(0.394)	(0.393)
Short-term	-0.2900	-0.1482	0.0115	-0.1243	-0.0026	0.3778 ***	0.2398 **	0.4899 ***
	(0.265)	(0.170)	(0.088)	(0.090)	(0.184)	(0.067)	(0.101)	(0.072)
Medium-term	-0.0578	-0.0135	-0.0251	-0.0425	-0.0361	0.1260	0.0336	0.1019
	(0.205)	(0.216)	(0.204)	(0.153)	(0.198)	(0.125)	(0.139)	(0.140)
Long-term	-0.1440	-0.1561	-0.0407	-0.0951	-0.0283	0.1182	-0.0007	0.0551
	(0.179)	(0.223)	(0.261)	(0.202)	(0.242)	(0.194)	(0.161)	(0.182)
Constant term	0.1520	0.1373	0.0812	0.1161	0.1053	-0.0683	0.0295	-0.0268
	(0.146)	(0.210)	(0.246)	(0.190)	(0.216)	(0.164)	(0.147)	(0.147)
Degree of AR term	2	1	3	3	9	1	1	1
Degree of MA term	1	0	0	0	1	1	1	1
Log likelihood	73.35	32.42	165.6	126.4	144.2	91.82	35.08	62.81
Observations	180	180	180	180	180	180	180	180

Note: The figures in parentheses indicate the values of standard errors. *** Significant at 1%. ** Significant at 5%. * Significant at 10%.

the number of new vacancies for full-time workers rose steeply in the short term in these areas. We did not observe any notable trend regarding the medium- and long-term impact. As in the case of part-time workers, although demand for full-time workers grew in the short term, that did not lead to an increase in the number of job placements. Comparison between the estimation results concerning the numbers of new vacancies for part-time and full-time workers does not suggest that the industrial structure of the disaster areas changed after the earthquake. Of course, it will be necessary in the future to monitor changes in the number of vacancies on an industry-by-industry basis, as Ewing, Kruse, and Thompson (2009) did.

Finally, Table 7 shows the estimation results concerning the number of new job seekers among full-time workers. The coefficient of changes in the industrial production index was positive with regard to all areas except for Sumoto. Unlike in the case of part-time workers, the coefficient was not significantly negative with regard to any area. Rather, the coefficient was significantly positive and the value was large with regard to Akashi (0.3778), Sumoto (0.2398) and Seishin (0.4899). That this is not because changes before the earthquake were very small is clear from the values of the constant terms, -0.0683 for Akashi, 0.0295 for Sumoto and-0.0268 for Seishin. These values are not statistically significant. Thus, even though the number of new job seekers remained flat or rose compared with the pre-earthquake level and the number of new vacancies also increased in the short term, the number of job placements declined steeply. That is probably because there was a supply-demand mismatch. As the coefficients of the medium- and long-term dummies were not statistically significant with regard to any area, it is presumed that job hunting activity returned to the pre-earthquake condition in the medium and long terms.

VI. Conclusion

Although over one year has passed since the Great East Japan Earthquake, restoration and reconstruction work is still far from completion. It is an urgent task to stabilize local residents' lives and rebuild infrastructure. It is necessary to draw up a long-term vision of how to rebuild and transform the disaster-affected areas in the future while tackling challenges that require immediate response. We believe that future reconstruction work in East Japan will be carried out efficiently if we draw up a long-term vision of reconstruction in light of the changes that the labor market and industrial structure of the Hanshin-Awaji region have undergone over the 17-year period since the Great Hanshin-Awaji Earthquake. With such motivation, this paper examined the short- medium- and long-term impacts of the Great Hanshin-Awaji Earthquake on the labor market in the disaster-affected areas.

Regarding part-time workers, while the number of new vacancies rose in the short term, the number of new job seekers declined and the number of job placements dropped steeply. As a result of the analysis of the number of new job seekers, it was observed that in many parts of the disaster stricken region, the number of job placements declined steeply in the short term, followed by a substantial rebound in the medium term and by a fallback in the long term. This trend was particularly notable in the eastern parts of the disaster-stricken region, including Kobe, Nada, Amagasaki, Nishinomiya and Itami. It is presumed that the decline in the number of part-time job placements after the earthquake resulted from a labor supply shortage.

As for full-time workers, it has been empirically observed that the growth in job placements dropped steeply even though the growth in the number of new vacancies and new job seekers rose or remained flat in the short term compared with the pre-earthquake level. This was presumably due to labor supply-demand mismatch. The values of the coefficients alone seem to suggest that the number of job placements for full-time jobs would recover in the medium term, followed by a decline in the long term, as in the case of part-time jobs. However, we cannot regard that as a definite trend since it is not statistically significant.

Future tasks include examining the changes in the industrial structure based on industry-specific analysis and identifying the cause of the mismatch observed with regard to full-time workers.

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