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Fang HE

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Institute for Economic Studies, Keio University
2-15-45 Mita, Minato-ku, Tokyo 108-8345, Japan
ies-office@adst.keio.ac.jp
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Abstract

This paper examines the impact of the Great East Japan Earthquake on population movements and employment. To capture changes over time, we use government statistics and household panel data, which contain detailed demographic and economic information from before and after the earthquake. Our results show that after the earthquake, the three disaster-stricken prefectures experienced population loss through emigration; this caused labor market shortages. Negative impacts on individual employment status were mainly observed immediately after the earthquake. Individuals with lower incomes were found to be at higher risk of losing their jobs, whereas young individuals had higher probabilities of being newly hired.

Fang HE
Panel Data Research Center at Keio University
2-15-45 Mita, Minato-ku, Tokyo 108-8345, Japan
hefang2646@gmail.com

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1. Introduction

The magnitude 9.0 Great East Japan Earthquake that occurred on March 11, 2011 was the largest earthquake ever observed in Japan and the fourth-largest earthquake globally since 1900. It was accompanied by a powerful tsunami, and as a result of the two disasters approximately 16,000 people died and 2,700 people were reported missing. In addition, 126,500 buildings collapsed completely and 272,300 partially collapsed.[1] The casualties and property damage were concentrated in three prefectures of Tohoku Region: Iwate, Miyagi, and Fukushima. This catastrophic destruction had a significant impact on Japan's economy and society. Given the lost human capital, mass migration, infrastructure decimation, and widespread impact zone, the Great East Japan Earthquake was a disaster from which it was especially difficult to recover.

This paper thus aims to examine the impacts of the Great East Japan Earthquake on population movements and individual employment, with a special focus on temporal changes and how individual attributes and resident geography mediated the earthquake's effects. Earlier studies of disasters (Zhou, 2012; Bales, 2005; Bronson, 2006) have shown that human capital is crucial to recovery in disaster-stricken areas. For individuals in these areas, employment is essential for personal and economic recovery. Furthermore, since population movements and labor market dynamics have strong mutual influences, it is important to view these two factors jointly.

To analyze individual employment status, we use data from two Japanese household panel surveys, Keio Household Panel Survey (KHPS) and Japan Household Panel Survey (JHPS), as well as the Special Surveys on the Great East Japan Earthquake (SSGEJE) I and II. KHPS, JHPS, and the earthquake-specific surveys cover detailed demographic and economic information from before and after the disaster; they therefore allow us to analyze the pace of recovery while controlling for individual attributes. Considering impacts over time in this

[1] Figures announced by the National Police Agency on June 10, 2013.

manner is a critical contribution to the literature because it properly frames the earthquake's influence as a gradually unfolding process.

The sample size in KHPS and JHPS of people who lived in disaster-stricken areas and moved after the earthquake is very small;[2] this data thus cannot be used to capture the full picture of population movements. Because there is lack of individual-level data available to meet these needs, we use aggregate government data to measure changes in population movements and connect them with our discussion of the labor market situation following the Great East Japan Earthquake.

Following the earthquake, some research has analyzed its impacts and some of them has focused on comparing its impact to that of the Great Hanshin-Awaji Earthquake, which occurred on January 17, 1995. For example, Higuchi et al. (2012) focused on population movements and the mismatch between job offers and applicants in disaster-stricken areas following the Great East Japan Earthquake and concluded that the employment situation appeared to be improving even if it remained poor at that time (January 2012). Ohtake et al. (2012) used monthly employment placement services' statistics to analyze the short-, medium-, and long-term impact of the 1995 Great Hanshin-Awaji Earthquake, dividing between full- and part-time workers. Among part-time workers, the number of new vacancies increased in the short term, the number of new job seekers declined, and the number of job placements also dropped precipitously. The number of full-time job placements had recovered by 1999 (the medium term) but later declined again.

Outside of Japan, there has been considerable research focused on the impact of natural disasters such as hurricanes and floods on employment (Belasen and Polachek, 2009; Leiter et al., 2009), macroeconomic growth (Otero and Marti, 1995; Skidmore and Toya, 2002), household budgets (Skidmore, 2001), and population migration (Boustan et al., 2012). However, most of

[2] This is partly because people who moved after the earthquake probably stopped participating in the panel survey.

these studies use macro-level or individual cross-sectional data, without examining impact changes over time.

This paper thus poses three main research questions. First, how did the population and labor market situation change between before and after the earthquake? Second, did the earthquake affect the probability of an individual being unemployed or their job-starting behavior? Finally, if there were influences, did any of them change over time (i.e., three, six, and ten months later)?

The remainder of this paper is organized as follows. In the second section, we examine population movements and the labor market situation in the three prefectures after the earthquake. In the third section, we describe the data used in the analysis and the estimation strategy, and then present the results. The fourth section concludes the paper.

2. Post-Disaster Population Movements and the Labor Market

In this section, we use government aggregate data to examine population movements and the labor market situation in the three prefectures of Tohoku Region before and after the earthquake.

2.1 Population Movement

Figure 1 shows the changes in people evacuated to other prefectures after the Great East Japan Earthquake. According to the National Police Agency, immediately after the earthquake, the number of evacuees reached a peak of more than 450,000 people, 400,000 of whom came from the three prefectures in Tohoku Region. Between June 2011 and March 2014, the peak number of people evacuated to other prefectures was reached at the end of 2011 for the whole Japan (350,000 people) and the middle of 2012 for the three Tohoku prefectures (73,000

people).[3] Delayed returns were partly due to the influence of the Fukushima Daiichi Nuclear Power Plant disaster. Even three years after the great earthquake, there are still approximately 264,000 people who have not returned to their home prefectures.

Figure 2 shows population movements in the three Tohoku prefectures from 1954 to 2013. Before the great earthquake, these three prefectures had already begun to experience population outflows. In 2011, the total net migration for these three prefectures was -41,226 people. Examining the age structure of these emigrants,[4] 91.7% of them are younger than 64, and 68.3% are between ages 15 and 64. In 2012 and 2013, respectively the three prefectures combined experienced net emigration of 10,159 and -2,975. Although Miyagi Prefecture experienced a population influx, these immigrants were mainly coming from Fukushima and Iwate.

2.2 The Labor Market Situation

We will now consider the labor market situation within the three prefectures by analyzing changes in the labor force, quarterly active job openings ratios, and quarterly unemployment rates.

Population migration strongly influenced the labor supply in the disaster-stricken areas. Figure 3 shows changes in the labor forces of the three Tohoku prefectures. Due to emigration and aging, the labor forces in Iwate Prefecture and Fukushima Prefecture began to decline in 2000, a trend that continued after the earthquake. The labor force in Miyagi Prefecture had also been on a generally decreasing trend but has been more stable than those of the other two prefectures; after the earthquake, partly because of the population influx from Fukushima and

[3] The only data available for those who evacuated to other prefectures after the Great East Japan Earthquake is from June 2011.

[4] Data source: Ministry of Internal Affairs and Communications Statistics Bureau's "Report on Internal Migration in Japan According to Basic Resident Registration."

Iwate, Miyagi's labor force increased. Examining just the population and labor force figures, Fukushima and Iwate prefectures were in states of stagnation before the disaster, which worsened afterwards. According to the "Labor Force Survey", the total labor force for these three prefectures was 2,904,000 people in 2010 and fell to 2,850,000 in 2013.

Figure 4 shows the quarterly active job opening ratio (i.e., active job openings divided by total applicants) for the three Tohoku prefectures as well as the national average. Pre-disaster, the average active job opening ratio was higher for Japan as a whole than for the Tohoku prefectures, but this relationship reversed starting at the end of 2011. Since the ratio indicates the number of job offers per job seeker, these figures indicate a rise in labor force demand and a shortage of employees in these three prefectures compared to the national average. This is probably because of the concomitant reconstruction activities and population outflows in the earthquake's aftermath. Due to the influence of the nuclear disaster, the labor force shortage is especially severe in Fukushima Prefecture.

Figure 5 shows changes in the quarterly unemployment rates of the three Tohoku prefectures, as well as the national average. In the first and second quarters of 2011, immediately after the earthquake, the unemployment rates in Fukushima and Iwate prefectures first increased sharply and then declined starting in the second quarter of 2012, eventually falling to below the Japanese average. This may imply that, while employment in these two prefectures was negatively affected by the earthquake, reconstruction activities and population outflows led to a labor force demand that exceeded supply. For Miyagi Prefecture, the unemployment rates were relatively stable but always above the national average. Even immediately after the earthquake, there were no large fluctuations in unemployment rates. Taking the unemployment rate as an index of the labor market situation thus suggests that the earthquake did not greatly influence Miyagi Prefecture.

The statistics above identify several key changes. First, after the earthquake, the three Tohoku prefectures experienced population outflows and a decline in labor force supply. Second, immediately after the earthquake, the active job opening ratio fell and unemployment rates rose,

but from the fourth and second quarters of 2012, respectively, the active job opening ratios rose and unemployment rates declined. In the next section, we will build on this macro-level analysis to consider the influences of the earthquake on individual employment by examining household-level panel data.

3. Impacts on Individual Employment

3.1 Data

To analyze individual employment, we use the KHPS, JHPS, and SSGEJE *I*, *II*. The KHPS and JHPS are both conducted by Keio University. The subjects of the first KHPS were 4,005 men and women aged 20-69 as of January 31, 2004; the first JHPS surveyed 4,022 men and women aged over 19 as of January 31, 2009. For both the KHPS and JHPS, subjects were selected using two-stage stratified random sampling, and annual follow-up surveys on the same respondents were conducted every January until the present. Each survey program added an additional survey, the SSGEJE, to examine the effects of the earthquake. The first SSGEJEs were conducted in June 2011 (KHPS) and July 2011 (JHPS)[5], and both second special surveys were conducted in September 2011. The main KHPS and JHPS questionnaires ask about participants' social and economic attributes. For married survey participants, the same questions are asked about their spouses.

Since the dataset contains information from before and after the great earthquake, it allows us to see changes in employment over time. KHPS and JHPS also include municipality-level geographical information on participants' residences. Disaster areas[6] are defined according

[5] Although the timing of the first SSGEJEs were different for the KHPS and JHPS, questions about employment status both asked about the situation in June.

[6] In this paper, "disaster areas" refers to the areas in which the Disaster Relief Act was applied. To identify them, we used information from the Ministry of Health, Labor, and Welfare (the latest data was released on March 24, 2011). The use of the Disaster Relief Act is dictated by prefecture governors, and it was applied to the entirety of Iwate, Miyagi, and Fukushima. Since the 47 municipalities in Tokyo applied this act only to

to the areas within which the Disaster Relief Act was applied, according to information provided by the Ministry of Health, Labor, and Welfare. Since the age ranges covered by the KHPS and JHPS are different and in order to avoid the effects of aging, we only use data on individuals younger than 60. Table 1 offers an overview of the datasets used in our estimation.

For the special survey, Keio University only sent the questionnaires to main survey participants who are willing to answer this supplement, making the response rate approximately 30% lower than that of the main survey. If the fall in response rates varied across different groups in disaster-stricken and other areas, our estimate of the impact of the earthquake, which was mainly obtained by comparing differences between disaster and non-disaster areas, may be biased.[7] In other words, if the composition of omitted survey participants was notably different in disaster areas than in other areas, the estimation results could be biased. As such, we compared the composition of the omitted and retained participants in disaster and non-disaster areas.[8] The attrition rate between the main survey in 2011 and the first special survey was higher in disaster areas, but considering the composition of respondents (e.g., age, gender, income, and education level), we only observed a higher attrition rate in disaster areas among younger people. For other demographic attributes, there were no significant differences between the samples for disaster and non-disaster areas. We thus concluded that, aside from the age structure, there was no bias caused by sample attrition.

3.2 Methods and Model

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help stranded commuters, and the earthquake damage was much lighter than that in other disaster areas, we did not treat the 47 Tokyo municipalities as disaster areas.

[7] If sample attrition made the composition of the samples different from the composition of the targeted area, bias might also result. Since the interest of this paper lies in the influence of the earthquake, we mainly pay attention to differences in sample omissions between disaster and non-disaster areas.

[8] We conducted Chi-squared tests to determine whether there was a statistical difference in the composition of samples between disaster- and non-disaster areas.

We focus mainly on two types of changes in individual employment following the earthquake. One is changing from having a job in the previous survey to being unemployed in the current survey, and the second is the inverse (changing from having no job in the previous survey to having a job in the current survey). The purpose of estimating the first kind of change is to estimate the negative impact of the earthquake. In estimating the second kind of change, we aim to see if there is an "additional worker effect" after the earthquake and whether there are positive influences on employment over time due to reconstruction activities. We employ a probit regression in which the dependent variable is an indicator for switching from having a job to being unemployed or for newly entering the workforce.

In order to see the influence of the earthquake, we created a disaster area dummy variable (1 for areas in which the Disaster Relief Act was applied), survey time dummy variables (with the 2011 main survey as the reference), and interaction terms between the two sets of dummy variables. These interaction terms are used to capture changes in the impacts on disaster areas with the passage of time. We control for individual attributes such as gender, education, and income and also include dummy variables for industry and occupation in the first part of the analysis.

Equation (1) depicts the analytical model. The dependent variable Y_{it} is the employment status change for individual i in survey t, compared to survey t-1. D_{it}=1 when individual i lives in a disaster area at the time of survey t, S_t represents the survey time, and each SD_{it} refers to an interaction term between the disaster area variable and a survey time variable. X_{it} represents a vector of individual i's attributes, such as age, gender, and income, as well as their occupation and industry at the time of the previous survey.

$$Y_{it} = A_1 X_{it} + A_2 D_{it} + A_3 S_t + A_4 SD_{it} + e_{it} \quad (1)$$

3.3 Estimation Results

Table 3 presents descriptive statistics, and Table 4 presents estimation results for becoming unemployed. In this model, we controlled for the individual's labor income, occupation, and industry at the time of the previous survey, in addition to personal attributes.

We can observe changes over time by examining estimation results for the survey time dummies. Compared to January 2011, the probability of being unemployed rose, indicating that the employment situation worsened immediately after the great earthquake. However, the survey time dummy variable for ten months later has a negative and statistically significant impact: in January 2012 as compared to January 2011, fewer people were losing jobs. If this employment status change is viewed as an index of the negative impact of the great earthquake, this impact appears to be a short-term one.

Considering the impact of the great earthquake on employment in disaster areas, we see that the interaction terms between the disaster area dummy and survey time dummies are all insignificant: we thus do not observe any differences between disaster areas and other areas. Among differences arising due to personal attributes, people in their forties and fifties have more stable employment compared to the younger generation. The sign of the gender variable's coefficient changes when annual labor income is controlled for: compared to men, women's employment status is less stable, but among those earning the same amount, women's employment is more stable than that of men. Compared to the low-income group (those with annual labor income below 200 million yen), individuals with higher income have relatively stable employment status. To save space, we do not show results for industries and occupations here, but our estimation results show that, compared to the reference group of people working in manufacturing, those who work in wholesale and retail have lower probabilities of becoming unemployed. Also, salespeople have lower probabilities of becoming unemployed than do clerical workers.

The purpose of examining changes in employment status from having no job to having a job (i.e., becoming newly employed) is to see if an "additional worker effect" existed after the earthquake and if reconstruction activities led to a positive change in individual employment

status over time. Table 4 shows the descriptive statistics, and Table 5 presents the estimation results. In addition to personal attributes such as gender, age, and education, we also controlled for marital status, because a shock would be managed differently by married and unmarried people. To control for living standards, we included equivalent income in the estimation.

We observe positive effects on becoming newly employed three and six months after the great earthquake, compared to January 2011. The interaction terms between the disaster area dummy and the survey time dummies were all insignificant, indicating no differences between disaster areas and other areas. Compared with men, women have a lower probability of newly entering the workforce. Compared to other age groups, people younger than 30 have a higher probability of newly entering the labor force.

4. Conclusion

This paper first used government statistics to examine population movements before and after the Great East Japan Earthquake, discussing the event's influence on the labor market situation. We then used panel data from household surveys (KHPS, JHPS, and SSGEJE I, II) to examine the impacts of the earthquake on changes in employment status, with a special focus on changes over time and geographical differences. We examined two types of employment changes: becoming unemployed and becoming employed.

Considering population movements and the labor market situation in the disaster areas, we observed that after the earthquake, the three prefectures experienced population outflows and declines in labor force supply. Furthermore, immediately after the earthquake, the active job opening ratios fell and unemployment rates went up; one year later, however, the active job opening ratios had risen and unemployment rates had declined.

For changes in individual employment status, our estimations revealed four main results. First, a negative impact on employment status was observed only immediately after the earthquake; ten months after the earthquake (January 2012), the probability of being unemployed

was lower than that before the earthquake. Second, three and six months after the earthquake, the unemployed had a lower probability of joining the workforce. This effect, however, disappeared with the passage of time. After controlling for income, male workers faced a higher probability of being unemployed and a lower probability of being newly employed after the earthquake. Finally, the youngest age group and lowest income group had higher probabilities of being unemployed. Young people also had a higher probability of newly entering the workforce.

In this paper, we have viewed the impacts of the earthquake as an unfolding process and examined changes in population movements and employment status three, six, and ten months after the earthquake. Considering changes over the passage of time is essential, but data limitations prevented us from examining the longer term influences of the disaster. We thus leave this as a task for future research.

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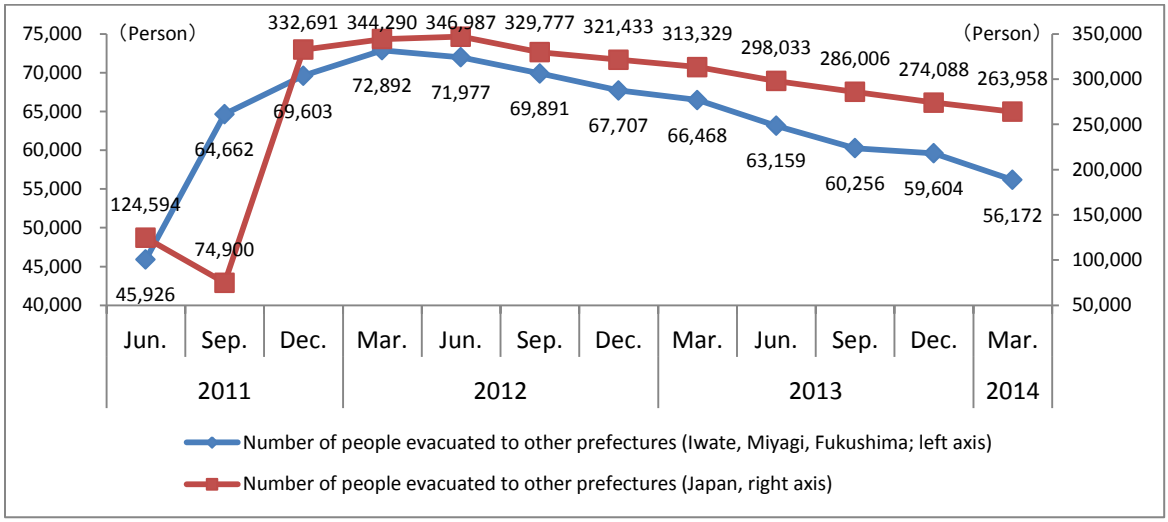
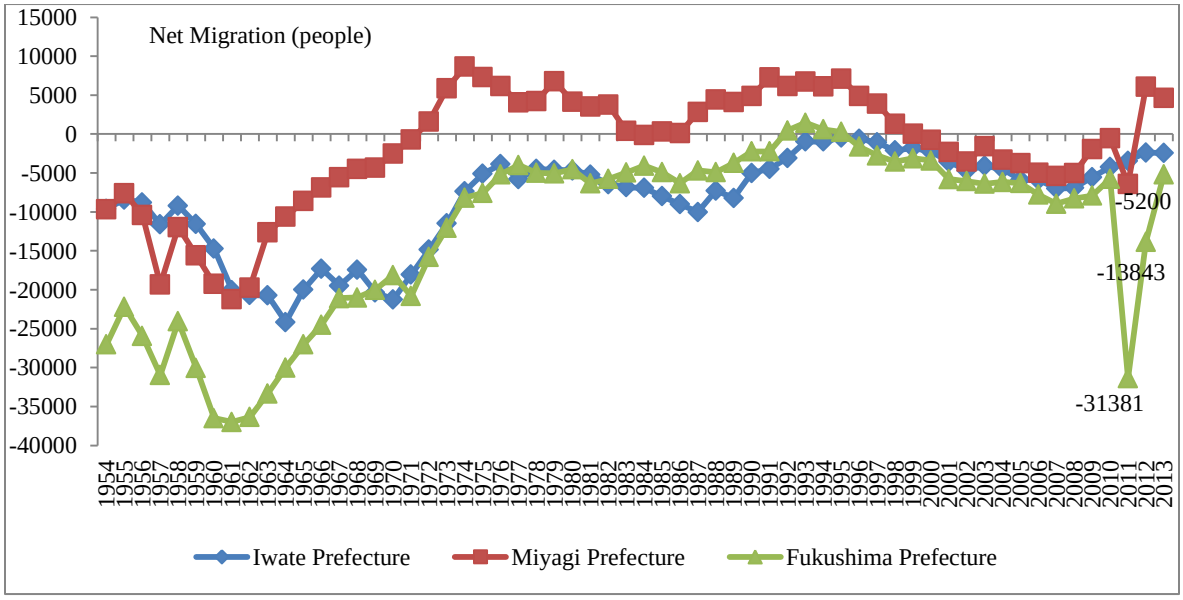
Figure 1 People Evacuated to Other Prefectures after the Great East Japan Earthquake



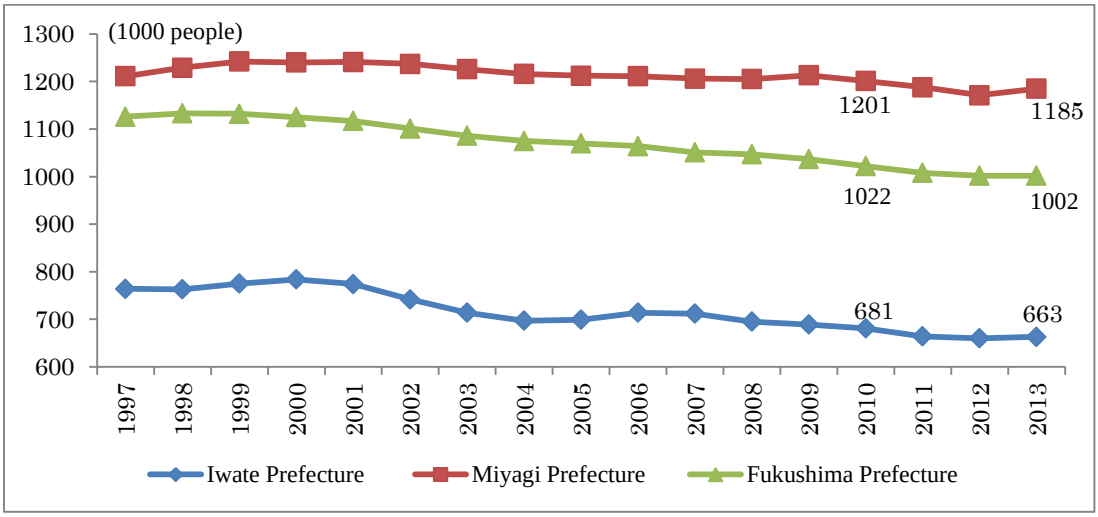
Source: Compiled by the author based on data published by the Reconstruction Agency, March 28, 2014

Figure 2 Trends in Population Movements in the Disaster-Stricken Area



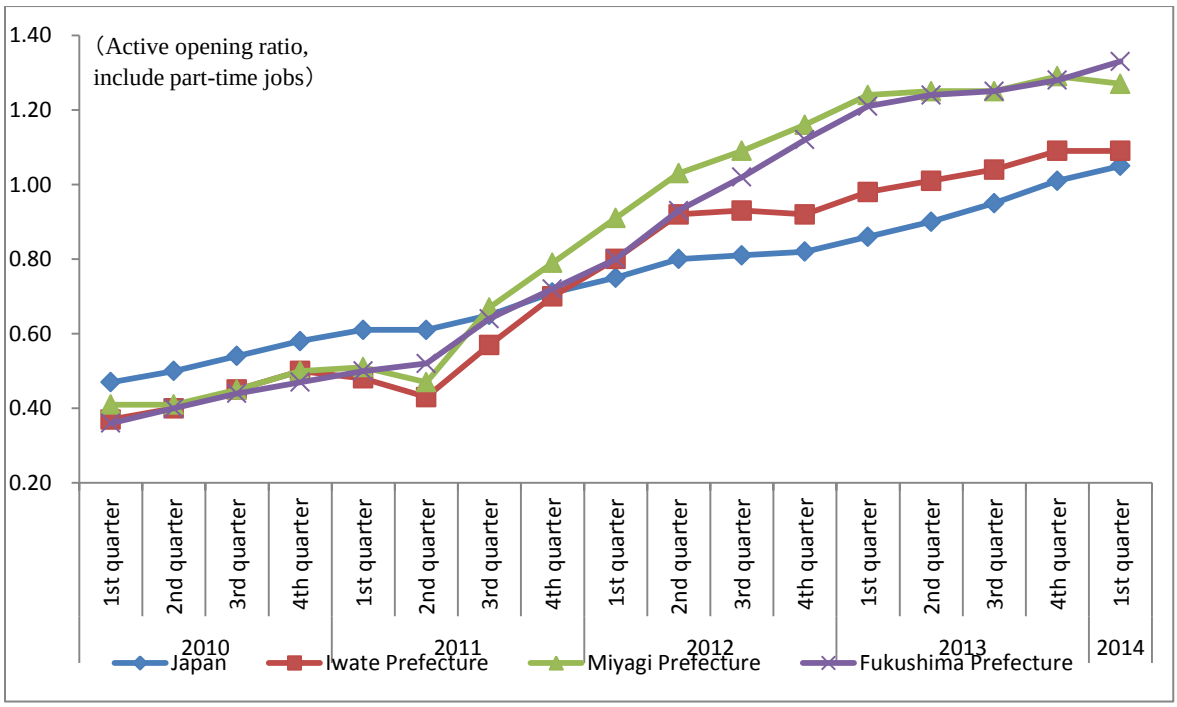
Source: Compiled by the author based on data from the Ministry of Internal Affairs and the Communications Statistics Bureau's "Report on Internal Migration in Japan According to Basic Resident Registration."

Figure 3 Labor Force Changes in the Three Prefectures



Source: Compiled by the author based on data from the Ministry of Internal Affairs and the Communications Statistics Bureau's "Labor Force Survey"

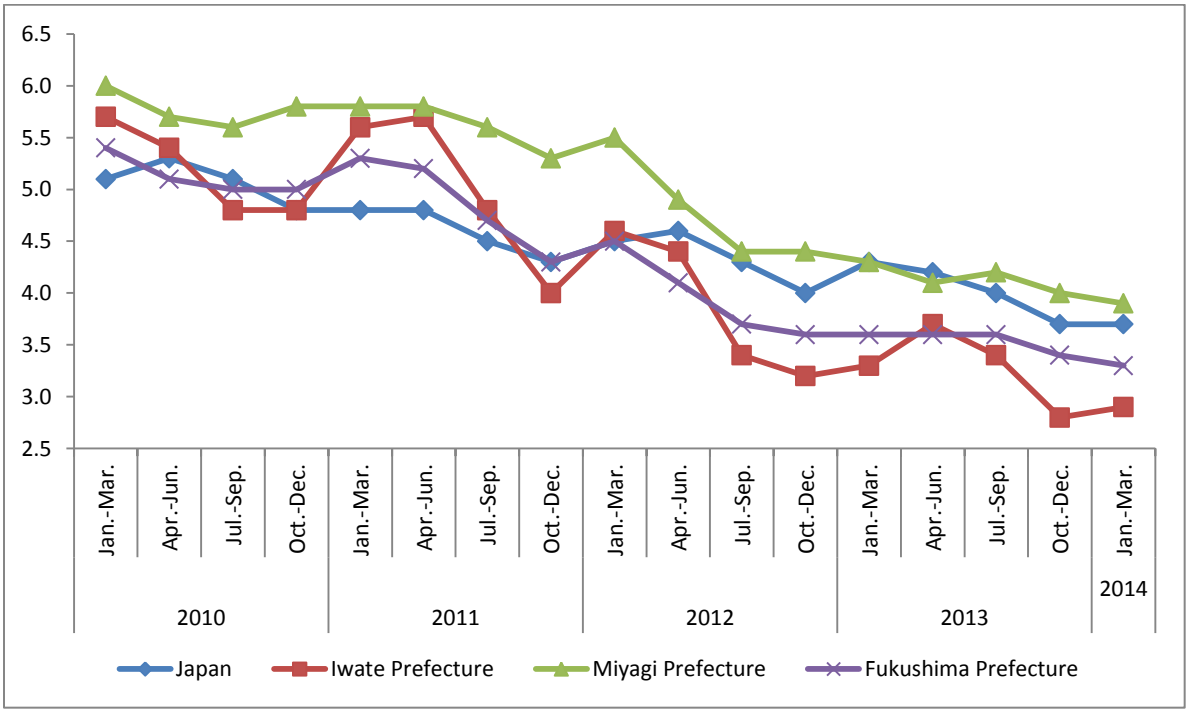
Figure 4 Active Job Openings Ratio Trends



Source: Compiled by the author based on data from the Ministry of Health, Labor, and Welfare's "General Placement Situation"

Note: Seasonally adjusted values are used.

Figure 5 Trends in the Unemployment Rate



Source: Compiled by the author based on data from the Ministry of Internal Affairs and the Communications Statistics Bureau's "Labor Force Survey"

Note: Seasonally adjusted values are used.

Table 1 Overview of Dataset Samples

Survey	JHPS			KHPS		
	Disaster Relief Act applied areas	Other areas	Sample size	Disaster Relief Act applied areas	Other areas	Sample size
Main survey 2011 (2011.01)	145	1,821	1,966	155	1,857	2,012
Special Survey I (2011.06, 07)	38	1,149	1,187	41	1,292	1,333
Special Survey II (2011.09)	31	949	980	32	1,046	1,078
Main survey 2012 (2012.01)	124	1,611	1,735	143	1,692	1,835
Main survey 2013 (2013.01)	103	1,456	1,559	128	1,543	1,671
Total	441	6,986	7,427	499	7430	7,929

Sources: KHPS 2011-2013, JHPS 2011-2013, and SSGEJE I, II.

Note: The sample includes individuals aged less than 60.

Table 2 Descriptive Statistics for Individual Employment Changes (1)

Variables	Sample size	Mean	Std. Dev.	Min	Max
From having a job to not having a job	9882	0.031	0.173	0	1
Disaster area	9882	0.058	0.234	0	1
Main survey 2011	9882	0.298	0.458	0	1
Special survey I	9882	0.185	0.389	0	1
Special survey II	9882	0.144	0.351	0	1
Main survey 2012	9882	0.133	0.340	0	1
Main survey 2013	9882	0.240	0.427	0	1
Disaster area× Special survey I	9882	0.007	0.081	0	1
Disaster area× Special survey II	9882	0.005	0.072	0	1
Disaster area×Main survey 2012	9882	0.005	0.071	0	1
Disaster area×Main survey 2013	9882	0.018	0.131	0	1
Female	9882	0.445	0.497	0	1
Male	9882	0.555	0.497	0	1
Age 20-29	9882	0.089	0.285	0	1
Age 30-39	9882	0.230	0.421	0	1
Age 40-49	9882	0.343	0.475	0	1
Age 50-59	9882	0.338	0.473	0	1
Education					
Junior school	9882	0.045	0.208	0	1
High school	9882	0.439	0.496	0	1
Some college/associate's degree	9882	0.203	0.402	0	1
Bachelor's degree or more	9882	0.312	0.463	0	1
Annual labor income					
Less than 2 million yen	9882	0.327	0.469	0	1
2-Less than 3 million yen	9882	0.114	0.318	0	1
3-Less than 4 million yen	9882	0.130	0.337	0	1
4-Less than 5 million yen	9882	0.121	0.326	0	1
5-Less than 6 million yen	9882	0.088	0.284	0	1
More than 6 million yen	9882	0.220	0.414	0	1
Occupation					
Agriculture, forestry, or fishery worker	9882	0.014	0.119	0	1
Salesperson	9882	0.156	0.363	0	1
Service worker	9882	0.133	0.340	0	1
Manager	9882	0.053	0.224	0	1
Clerical worker （ref.）	9882	0.195	0.396	0	1
Transportation or communications worker	9882	0.045	0.208	0	1
Manufacturing, construction, maintenance or freight worker	9882	0.174	0.379	0	1
Specialized or technical worker excluding IT engineer	9882	0.203	0.403	0	1
Other	9882	0.026	0.160	0	1
Industry					
Agriculture, forestry, marine products	9952	0.016	0.127	0	1
Construction	9952	0.079	0.269	0	1
Manufacturing (ref.)	9952	0.176	0.381	0	1
Wholesale, retail	9952	0.161	0.368	0	1
Restaurants, accommodations	9952	0.050	0.218	0	1
Finance, insurance	9952	0.046	0.208	0	1
Transportation	9952	0.055	0.228	0	1
Information and telecommunications	9952	0.045	0.207	0	1
Medicine, welfare	9952	0.105	0.307	0	1
Education, learning support	9952	0.063	0.244	0	1
Other services	9952	0.117	0.321	0	1
Public service	9952	0.055	0.228	0	1
Other	9952	0.033	0.179	0	1

Source: KHPS 2011-2013, JHPS 2011-2013, and SSGEJE I, II.

Note: The sample includes individuals aged less than 60

Table 3 Estimation of Individual Employment Changes (1)

Independent variable : 1= From having a job to not having a job	Model (1) Marginal effect	Model (2) Marginal effect	Model (3) Marginal effect	Model (4) Marginal effect	Model (5) Marginal effect	Model (6) Marginal effect
Disaster area	-0.00127	-0.00169	-0.000218	-0.000566	0.000419	0.00116
	(-0.120)	(-0.183)	(-0.0232)	(-0.0910)	(0.0715)	(0.192)
Main survey 2011 (ref.)						
Special survey I	0.00920*	0.00883**	0.00762*	0.00764**	0.00764***	0.00868***
	(1.888)	(2.006)	(1.686)	(2.418)	(2.603)	(2.906)
Special survey II	-0.00718	-0.00707	-0.00798*	-0.00503	-0.00527*	-0.00510*
	(-1.422)	(-1.604)	(-1.756)	(-1.613)	(-1.763)	(-1.684)
Main survey 2012	-0.0188***	-0.0165***	-0.0153***	-0.0100***	-0.0113***	-0.0112***
	(-3.646)	(-3.637)	(-3.271)	(-3.427)	(-4.079)	(-3.940)
Main survey 2013	-0.00380	-0.00302	-0.00286	-0.000705	-0.000481	-0.000311
	(-0.856)	(-0.764)	(-0.703)	(-0.260)	(-0.191)	(-0.122)
Disaster area × Special survey I	-0.000915	0.00547	0.00661	0.00480	0.00424	0.00157
	(-0.0425)	(0.257)	(0.305)	(0.309)	(0.300)	(0.118)
Disaster area × Special survey II	0.0107	0.0146	0.0144	0.00636	-0.00456	-0.00561
	(0.377)	(0.540)	(0.537)	(0.374)	(-0.339)	(-0.435)
Disaster area × Main survey 2012	0.00568	0.00856	0.00524	-0.000586	0.00465	0.00346
	(0.172)	(0.275)	(0.177)	(-0.0349)	(0.260)	(0.196)
Disaster area × Main survey 2013	-0.0106	-0.00925	-0.00930	-0.00587	-0.00544	-0.00565
	(-0.681)	(-0.682)	(-0.693)	(-0.669)	(-0.684)	(-0.706)
Female		0.0345***	0.0323***	-0.00814***	-0.00617**	-0.00733**
		(10.76)	(9.351)	(-2.724)	(-2.097)	(-2.466)
Age 20-29						
Age 30-39		-0.00896**	-0.00543	-0.00138	-0.00365	-0.00284
		(-1.995)	(-1.114)	(-0.393)	(-1.141)	(-0.866)
Age 40-49		-0.0180***	-0.0147***	-0.00988***	-0.00984***	-0.00905***
		(-4.096)	(-3.136)	(-2.959)	(-3.157)	(-2.869)
Age 50-59		-0.0145***	-0.0113**	-0.00831**	-0.00897***	-0.00849***
		(-3.265)	(-2.378)	(-2.497)	(-2.883)	(-2.689)
Education (Junior school)						
High school			-0.00653	-0.00486	-0.00142	-0.00261
			(-1.013)	(-1.099)	(-0.321)	(-0.595)
Some college/associate's degree			-0.00444	-0.00273	0.000832	-0.000703
			(-0.671)	(-0.604)	(0.175)	(-0.150)
Bachelor's degree or more			-0.0145**	-0.00433	-0.00186	-0.00333
			(-2.329)	(-0.954)	(-0.404)	(-0.719)
Annual labor income (Less than 2 million yen)						
2-Less than 3 million yen				-0.0196***	-0.0176***	-0.0177***
				(-8.811)	(-8.505)	(-8.502)
3-Less than 4 million yen				-0.0213***	-0.0191***	-0.0194***
				(-9.412)	(-9.253)	(-9.261)
4-Less than 5 million yen				-0.0222***	-0.0200***	-0.0204***
				(-8.202)	(-7.821)	(-7.946)
5-Less than 6 million yen				-0.0203***	-0.0183***	-0.0185***
				(-7.473)	(-7.136)	(-7.239)
More than 6 million yen				-0.0274***	-0.0253***	-0.0259***
				(-10.50)	(-10.09)	(-9.258)
Occupation dummies					YES	
Industry dummies						YES
Observations	11,381	11,381	10,469	10,125	9,952	9,882

Source: KHPS 2011-2013, JHPS 2011-2013, and SSGEJE I, II.

Notes: A Probit model was conducted. Robust z-statistics are given in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The sample includes individuals aged less than 60.

Table 4 Descriptive Statistics for Individual Employment Changes (2)

Variables	Sample size	Mean	Std. Dev.	Min	Max
To be newly employed	1871	0.166	0.372	0	1
Disaster area	1871	0.040	0.195	0	1
Main survey 2011	1871	0.270	0.444	0	1
Special survey I	1871	0.197	0.398	0	1
Special survey II	1871	0.169	0.375	0	1
Main survey 2012	1871	0.154	0.361	0	1
Main survey 2013	1871	0.210	0.407	0	1
Disaster area × Special survey I	1871	0.004	0.065	0	1
Disaster area × Special survey II	1871	0.003	0.057	0	1
Disaster area × Main survey 2012	1871	0.003	0.052	0	1
Disaster area × Main survey 2013	1871	0.013	0.113	0	1
Female	1871	0.862	0.345	0	1
Male	1871	0.138	0.345	0	1
Married	1871	0.825	0.380	0	1
Age 20-29	1871	0.070	0.255	0	1
Age 30-39	1871	0.311	0.463	0	1
Age 40-49	1871	0.302	0.459	0	1
Age 50-59	1871	0.317	0.466	0	1
Education					
Junior school	1871	0.038	0.191	0	1
High school	1871	0.440	0.497	0	1
Some college/associate's degre	1871	0.317	0.466	0	1
Bachelor's degree or more	1871	0.201	0.401	0	1
Equivalent income					
Less than 2 million yen	1871	0.211	0.408	0	1
2-Less than 3 million yen	1871	0.243	0.429	0	1
3-Less than 4 million yen	1871	0.235	0.424	0	1
4-Less than 5 million yen	1871	0.154	0.361	0	1
5-Less than 6 million yen	1871	0.066	0.248	0	1
More than 6 million yen	1871	0.092	0.289	0	1

Source: KHPS2011-2013, JHPS2011-2013, and SSGEJE I, II.

Note: The sample includes individuals aged less than 60.

Table 5 Estimation of Individual Employment Changes (2)

Independent variable : 1＝To be newly employed	Model (1) Marginal effect	Model (2) Marginal effect	Model (3) Marginal effect	Model (4) Marginal effect
Disaster area	0.0108	-0.00981	-0.00324	-0.0386
	(0.177)	(-0.170)	(-0.0550)	(-0.677)
Main survey 2011 (ref.)				
Special survey I	-0.0854***	-0.0771***	-0.0596***	-0.0616***
	(-4.062)	(-3.692)	(-2.713)	(-2.656)
Special survey II	-0.109***	-0.109***	-0.0950***	-0.0935***
	(-5.005)	(-5.257)	(-4.369)	(-4.080)
Main survey 2012	-0.0437*	-0.0329	-0.0203	-0.0165
	(-1.934)	(-1.452)	(-0.841)	(-0.648)
Main survey 2013	-0.0405*	-0.0329	-0.0230	-0.0275
	(-1.908)	(-1.569)	(-1.048)	(-1.188)
Disaster area × Special survey I	0.101	0.128	0.107	0.133
	(0.663)	(0.793)	(0.663)	(0.789)
Disaster area × Special survey II	0.274	0.168	0.127	0.167
	(1.401)	(1.030)	(0.804)	(0.972)
Disaster area × Main survey 2012	0.145	0.0936	0.0568	0.144
	(0.819)	(0.566)	(0.368)	(0.779)
Disaster area × Main survey 2013	0.0685	0.0558	0.00796	0.0257
	(0.689)	(0.582)	(0.0890)	(0.261)
Female		-0.174***	-0.198***	-0.216***
		(-5.561)	(-6.127)	(-5.939)
Married		0.00466	0.00661	0.00657
		(0.185)	(0.254)	(0.231)
Age 20-29				
Age 30-39		-0.0574**	-0.0751***	-0.0787**
		(-2.131)	(-2.611)	(-2.515)
Age 40-49		-0.0757***	-0.0828***	-0.0753**
		(-2.811)	(-2.876)	(-2.408)
Age 50-59		-0.119***	-0.129***	-0.118***
		(-4.562)	(-4.606)	(-3.825)
Education (Junior school)				
High school			0.0641	0.0645
			(1.497)	(1.380)
Some college/associate's degree			0.0288	0.0314
			(0.648)	(0.645)
Bachelor's degree or more			0.0111	0.0151
			(0.245)	(0.303)
Equivalent income (Less than 2 million yen)				
2-Less than 3 million yen				0.0276
				(1.040)
3-Less than 4 million yen				-0.0251
				(-0.936)
4-Less than 5 million yen				-0.0127
				(-0.426)
5-Less than 6 million yen				-0.0296
				(-0.824)
More than 6 million yen				-0.0703**
				(-2.083)
Observations	2,243	2,243	2,061	1,871

Source: KHPS2011-2013, JHPS2011-2013, and SSGEJE I, II.

Notes: A Probit model was conducted. Robust z-statistics are given in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The sample includes individuals aged less than 60.