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Impact of the Great East Japan Earthquake on Intentions to Relocate

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Abstract This study identifies factors that influence whether residents of Noda in Iwate Prefecture remained in or relocated from their village following the 2011 Great East Japan Earthquake, drawing from data gathered in an original questionnaire. Results show that younger villagers, women and unmarried persons indicated a greater likelihood of relocating.

Respondents from higher-income households indicated stronger intentions to remain in their hometown, which accords with the compensating wage hypothesis. Damage to homes and loss of job or household income did not significantly affect intentions to relocate. However, villagers who suffered loss of personal and family networks declared stronger intentions to relocate after the disaster.

We analysed how the earthquake affected intentions to relocate. Results indicate that among respondents stricken by the disaster the loss of human networks rather than material capital was the main motivation to relocate. This study indicates that Japan's disaster-recovery policies must consider residential rebuilding and reconstruction of human networks simultaneously.

Key words Great East Japan Earthquake; Intention to relocate; Local-specific capital; Human networks; Disaster-recovery policies

1. INTRODUCTION

The March 2011 Great East Japan Earthquake took 15,883 lives and left 2,671 people still reported missing (Reconstruction Agency, June 2013). Among the three most-stricken prefectures a year following the disaster, more than 131,000 persons in Iwate, Miyagi and Fukushima have relocated to other prefectures. Coastal areas of these prefectures have lost nearly 10 percent of their population since the disaster.

Population in rural Japan has been declining since the growth era of the 1960s. Substantial numbers have migrated to metropolitan areas to fill demand for labour in manufacturing. Not surprisingly, consumption, production and birth rates in rural areas declined following out-migration of the younger

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population. Deprived of their economic force, many rural areas are becoming unsustainable. Making matters worse, persons younger than 29 account for 55 percent of the net migration from the three prefectures most stricken by the 2011 earthquake, according to *the Report on Internal Migration in Japan* (Statistics Bureau 2013). Population outflow is impeding authorities' efforts to restore sustainable areas through reconstruction. We used the results of our original questionnaire to identify the primary factors that prompt respondents to consider relocating.

Income differences that motivate people to move between regions still persist. Shioji (2001) examines whether the composition effect—i.e. migrants possess greater human capital than those who remain—accounts for interregional income differences in Japan. He finds that when this effect exists, migration from low- to high-income regions does not contribute to a convergence, contrary to a simple theoretical model. He shows that this effect demonstrated slow convergence, but its magnitude was small.

With regard to regional characteristics of Japan's youth labour market, Ohta (2005) finds that youth unemployment is higher in regions with few vacancies for the less-educated and workers commonly migrate elsewhere. Although their migration mitigates unemployment in such regions, this movement has weakened because finding jobs in urban areas has become more difficult. Ohta also stresses the need for labour market policies to consider regional, economic and social characteristics because interregional differences lead to differences in younger workers' attitudes towards employment.

Abe and Tamada (2007) investigate regional patterns in employment of less-educated Japanese men from 1990 to 2007 and find that the employment–population ratio of male junior high school graduates declined from 1990 to 2007. Inter-regional wage growth displayed a unique pattern during this period: it was high in low-wage regions during the 1990s, but high in high-wage regions during the 2000s.

Drawing on the authors' survey of Noda village in northern Japan's Iwate Prefecture, this study clarifies factors determining respondents' intention to relocate following the Great East Japan Earthquake. In this context, 'intention to relocate' refers to the nature and extent of villagers' motives to remain in or leave the village after the disaster. Focusing on characteristics of questionnaire respondents, we examine which population groups intended to remain in or leave the village.

Paxson and Rouse (2008) examine the decisions of residents displaced by Hurricane Katrina to return to their previous locations. They assume that individuals' utility is a function of their incomes and location-specific capital. Location-specific capital includes homes, communities and networks of friends that are difficult to replace elsewhere. Kline and Moretti (2013) suggested place-based policies to correct local market failures considering the level of local amenities.

Landry *et al.* (2007) examine the evacuation-migration decisions of Hurricane Katrina survivors. Their results indicate that decisions to return after relocating are affected by age, education, household income, employment, marital status and home ownership. They assess the effect of 'connection to place' by asking whether people were born where they lived before the hurricane. Contrary to their expectations, they found a negative correlation between birthplace and the decision to return and interpreted that persons with longstanding connections to a locale might have been more highly traumatized by the disaster.

We examine the effect of 'connection to place' on the intention to relocate not only from the perspective of villagers' personal history but also from the perspective of connections with family and friends. We estimate how human networks affect relocation by asking about respondents' ties with families, neighbours and co-workers.

In creating recovery policies that consider population mobility, it is crucial for policymakers to understand what drives peoples' intention to relocate following a natural disaster. In examining relocation following the 2011 earthquake and tsunami, we clarify how extensively loss of economic activity such as employment or of human networks affects Noda villagers' intentions to relocate. Policies intended to bolster financially locales devastated by disasters can perhaps restore economic activity, but they cannot

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necessarily restore human networks.

Unlike the case of Hurricane Katrina, residential damage did not exert a presiding influence on Noda residents' decisions to relocate. One reason is that they developed strong ties by helping each other overcome difficulties following the earthquake and in doing so formed location-specific capital. Another reason is that as the compensating wage hypothesis suggests, the expected benefit from relocating is so small that people tend to remain in the village.

This study is organized as follows. Section 2 introduces previous studies of interregional relocations and develops our theoretical approach. Section 3 provides details about data employed in this study, presents empirical results and discusses their implications. Section 4 summarises and concludes.

2. THEORETICAL FRAMEWORK

The seminal work of Sjaastad (1962) provides a theoretical framework for examining households' decisions to relocate from a geographical area, defining the issue as their desire to maximize their net economic return on human capital. Early models focus on interregional wage differentials, distance between origin and destination and labour market conditions such as the unemployment rate as factors determining migration.

The compensating wage hypothesis (Harris and Todaro 1970) assumes that the expected income is equalized across regions by internal migration. High-wage areas attract more workers than the available jobs until the wage rate falls to the level of surrounding lower-wage areas and internal migration ceases.

Roback (1982) introduced a model in which wages and land rents are simultaneously determined in an equilibrium that is conditional on the level of local amenities. This formulation of household migration follows the compensating differentials model of Rosen (1974) in which interregional wage differentials can persist and reflect the value of location-specific amenities. Location-specific amenities include natural attributes valued by households such as temperature, rainfall and clean air.

Clark and Cosgrave (1991) found evidence for persistence of interregional wage differentials, supporting the human capital model of Sjaastad (1962) and the hedonic model of Roback (1982). Local amenities are likely to affect wages significantly and negatively. Landry *et al.* (2007) examine the evacuation-migration decisions of Hurricane Katrina survivors following the previous studies mentioned above.

Our analysis is based on the model of Paxson and Rouse (2008). The reason we adopt their model is that it is a unique model that introduces local-specific capital to assess the effect of a natural disaster, as far as we know. Our research focuses on local-specific capital, especially the damage to human network, not just on economic damage. From this viewpoint, Paxson and Rouse's (2008) framework is appropriate to estimate losses in nonfinancial assets.

Individuals' utility is assumed to be a function of their income (Y) and their stock of location-specific capital (C). Location-specific capital is defined as home ownership, human networks and location-specific jobs such as agriculture and fisheries—i.e. attributes not easily obtained elsewhere.

An individual who lives in a village receives income Y^S and has a location-specific capital C. If the individual decides to leave, he/she would receive income Y^O and have a location-specific capital of zero. However, the individual would decide to relocate if the utility of staying in the village exceeds that of relocating. That is,

$$\mathrm{U}(Y^S, (1-\lambda)C) \geq U(Y^O, 0),$$

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where λ denotes the fraction of location-specific capital that is destroyed.

Several comparative statics results emerge straightforwardly from the model. First, the likelihood of relocating decreases with income received (Y^S) in the current location and increases with income obtainable elsewhere (Y^O), conditional on the level of location-specific capital C. Our results endorse the compensating wage hypothesis (Harris and Todaro 1970). Second, the probability of relocating increases with the level of destruction of location-specific capital (λ), holding the pre-disaster level of location-specific capital (C) fixed. Third, the probability of relocating decreases with C, holding the fraction of damage (λ) fixed. Our formulation allows interactions between the magnitude of damage (λ) and location-specific capital (C).

3. EMPIRICAL ANALYSES

Our data are from Survey of resident's sentiment and current situation conducted by the authors in Noda village,3 Iwate Prefecture, one of the stricken areas, from February to March 2013. Noda village is a good example of stricken coastal areas. There are three villages and four towns along the coast in Iwate prefecture. These areas have similar geographic and economic characteristics and share the same problems such as depopulation and aging. According to the 2010 national census, population density of Noda village is 57.3 persons per square kilometres, while the average of these areas is 49.0. The proportion of the residents aged 65 or more is 30.0 percent, while the average is 32.6 percent. The share of people engaged in primary industry is 17.7 percent, while the average is 20.0 percent.

The questionnaire is based on an interview conducted in tandem with the support activity immediately following the disaster. This survey was conducted in collaboration with the village office to establish the economic condition of the victims, damage to social capital, intention to migrate and sense of life restoration. Our samples are drawn from people who remained within the stricken areas, not from evacuees, as in previous studies. There will be a sampling bias by excluding samples that have already relocated. However, this problem is left to be addressed in future studies.

Our sample encompassed all 2,853 inhabitants aged 18 to 69 in Noda village in February 2013. The survey was conducted by mail. Inspectors entrusted to specialists the task of maintaining the objectivity of the survey. The authors received 1,142 responses, a 40.2 percent response rate. Our analyses are based on 971 residents (excluding non-respondents): 53.2 percent were women and 46.8 percent were people who suffered heavy damage from the disaster.

Table 1 shows sample means and standard deviations (in parentheses) arranged according to whether respondents wished to remain in Noda or to relocate. The intention to relocate was subjectively measured by asking the question 'From now onwards, are you planning to live in Noda village?' with three choices; (a) 'want to keep living in Noda village', (b) 'want to live outside the village' and (c) 'probably live outside the village once, but want to come back sometime'. In all, 83 percent indicated they wanted to

[3] Noda's population was 4,800 when the disaster occurred, according to the 2010 national census. The centre of the village was hit by a tsunami 37.2 metres high, killing 37 persons and obliterating or badly damaging 810 buildings and houses. Damage was concentrated on the village centre, causing extensive losses to the village and basic industries such as fishery and agriculture. In this survey, excluding the non-respondents, 36 percent (402) people are confirmed to have been injured.

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remain in Noda, 11.1 percent indicated they wanted to live elsewhere and 5.9 percent said they probably would live elsewhere for a time but would return eventually. In the following analysis, we disregard the

Table 1. Descriptive Statistics.

Variable	Remain	Relocate	
Male (=1 if respondent is male, zero otherwise.)	0.49(0.50)	0.31(0.47)	*
Age(= years at last birthday)	52.70(12.23)	40.83(15.40)	*
Married(=1 if the respondent is married, zero otherwise)	0.81(0.39)	0.58(0.50)	*
Child (=1 if respondent has a child, zero otherwise)	0.80(0.40)	0.58(0.50)	*
Household Income(= real annual income, ten thousant yen)	350.69(234.02)	308.04(227.65)	
Hometown(=1 if respondent was born in Noda, zero otherwise)	0.77(0.42)	0.59(0.49)	*
House ownership (=1 if respondent has house ownership, zero otherwise)	0.88(0.33)	0.64(0.48)	*
Families and Relatives Network (= number of families and relatives at the point of survey, February 2013)	9.82(9.53)	9.17(31.11)	*
Local Human Network (= number of friends in Noda, not include families and reativers at the point of survey, February 2013)	10.78(20.33)	7.38(30.11)	*
Agriculture(=1 if respondent engaged agriculture, zero otherwise)	0.09(0.29)	0.02(0.15)	*
Fishery (=1 if respondent engased fishery, zero otherwise)	0.54(0.23)	0.03(0.18)	
Damage to Residence (=1 if respondent's residence suffered damage beyoud a specified extent, zero otherwise)	0.36(0.48)	0.34(0.48)	
Damage to Household Income (=1 if respondent's real income declined, zero otherwise)	-0.34(0.62)	-0.30(0.66)	
Damage to Job (=1 if respondent lost his/her job due to the disaster, zero otherwise)	0.05(0.21)	0.04(0.19)	
Damage to families and relatives network (= numbers of families and relatives on pre-disaster minus numbers on post-disaster)	0.53(3.56)	-1.72(24.95)	
Damage to Local Human Network (= numbers of friends on pre-disaster minus numbers on post-disaster)	1.37(5.72)	-1.81(26.30)	

Notes: Standard errors are provied in parentheses. The sample contains 971 respondents of whom 846 indicated a desire to remain in the village and 146 indicated a desire to relocate. Values for those wishing to remain and those wishing to relocate differ at the 5 percent level of confidence or higher.

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last group of respondents because the number of observations is insufficient to estimate separately.

From Table 1 we observe that primarily women and the relatively young indicated a desire to relocate. Married respondents and respondents with children were comparatively more willing to remain in the village.

This paper measures individual utility using levels of income and location-specific capital. Income is based on the February 2013 survey, which took the whole household income into account. Income is divided into nine tranches from zero to ten million yen. Analysing the average values for each group in Table 2, it is clear that incomes of respondents willing to remain in Noda were high, whereas incomes among groups wishing to relocate were low.

Location-specific capital is expressed by four variables. The first represents place of birth. This variable is included because it shows that respondents have an attachment to their village and know the locale well because they have lived there a long time. The second variable is a dummy indicating whether respondents owned their residence before the disaster. The third variable captures the number of villagers who have family, relatives and friends within walking distance in the region. The fourth variable indicates agriculture and fishing industries because those industries are location-specific. Furthermore, fishing licenses granted to respondents are valid only for a specific region.

Table 2. Factors Contributing to Intentions to Relocate

Variable	model 1		model 2		model 3	
Male	-0.8519 ***	(-0.2220)	-0.7543 ***	(0.2335)	-0.5470 *	(0.2829)
Age	-0.0554 ***	(0.0085)	-0.0599 ***	(0.0091)	-0.0554 ***	(0.0113)
Married	-0.7178 **	(0.2906)	-0.5904 *	(0.3103)	-0.8920 **	(0.3756)
Child	0.1036	(0.3231)	0.1405	(0.3316)	-0.0086	(0.3928)
Household Income			-0.0009 *	(0.0005)	-0.0007	(0.0006)
Hometown					-1.0952 ***	(0.2980)
House ownership					-0.6672 **	(0.2989)
Families and Relatives Network					0.0101	(0.0139)
Local Human Network					-0.0052	(0.013)
Agriculture					-0.5187	(0.7547)
Fishery					-0.1388	(0.5850)
Number of Observations	971		912		710	
Pseude R^2	0.1376		0.1345		0.1845	
Log L	-321.55239		-294.01302		-213.73654	

Notes: Standard errors are provied in parentheses. ***, ** and * denote significance at the 1%, 5% and 10%, respectively.

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Table 2 shows the results of logistic regressions to determine factors behind respondents' intentions to relocate. We used logistic regression incorporating the idea of local-specific capital into Landry et al.'s (2007) evacuation-migration decision model. The merit of this model is that it allows both numerical and categorical independent variables to estimate a binary choice. The drawback of this model is that the parameter estimates are not intuitive unlike the linear regression model, because they are interpreted as the rate of change in the logarithmic odds of intentions to relocate as the characteristics change.

Model 1 indicates the estimated results of how individuals' characteristics affect the intentions to relocate. The coefficients of male, age and marriage were negative in the model 1. Men, the elderly and married respondents indicated strong willingness to remain in Noda. We added the household income as one of the variables of model 2. The variables that indicate individuals' characteristics in model 1 and 2 are equally significant. Respondents from high-income families indicated greater likelihood of remaining, which accords with the compensating wage hypothesis. Moreover, the variables of location specific capitals are included in the model 3. The home ownership and hometown dummy display significant and strong effects. Having been born and reared in an area reduced respondents' desire to relocate.

It is commonly thought that the intention to relocate is stronger among persons who have a network of family and relatives. However, the human network variable—the presence of family and friends in the region—did not display the expected results in the model 3. Furthermore, we could not obtain statistically sound results from dummies for location-specific industries. Whether respondents were born in the Noda area and owned a residence significantly affected their stated intention to relocate.

We examine how the disaster influenced respondents' intentions to relocate. Using the logit model shown in Table 3, we regressed the effect of the 2011 disaster by employing five variables. The first variable describes whether a respondent's residence suffered damage beyond a specified extent. The second variable indicates whether respondents' real income declined, remained unchanged or increased. The third variable is a dummy indicating whether respondents lost their jobs due to the disaster. We asked how many family members, relatives and friends in the region the respondent could communicate with compared to the pre-disaster period and calculated the numerical difference between the two points. The fourth and fifth variables are concerning the families of relatives and friends, respectively.

Table 3. Effects of the 2011 Disaster on Intentions to Relocate

Variable			
Damage to Residence	0.2526		(0.2491)
Damage to Household Income	0.0399		(0.1963)
Damage to Job	-0.1496		(0.6282)
Damage to families and relatives network	0.0281		(0.0250)
Damage to Local Human Network	-0.0486	**	(0.0226)
Number of Observations	669		
Pseude R^2	0.0179		
Log L	-238.56401		

Notes: Standard errors are provied in parentheses. ***, ** and * denote significance at the 1%, 5% and 10%, respectively.

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Table 4. Extent of Damage Suffered and Its Effect on Intentions to Relocate

Variable	Damaged		Non Damaged	
Male	-0.4173	(0.4412)	-0.8140 **	(0.3897)
Age	-0.0637 ***	(0.0194)	-0.0513 ***	(0.0154)
Married	-0.9444	(0.6405)	-0.9247 *	(0.4936)
Child	0.7524	(0.6447)	-0.2522	(0.5323)
Household Income	-0.0008	(0.0010)	-0.0007	(0.0009)
Hometown	-1.0752 **	(0.4902)	-0.9258 **	(0.3910)
House ownership	0.2789	(0.4817)	-1.0979 ***	(0.4152)
Families and Relatives Network	-0.1329 **	(0.0548)	0.0187	(0.0166)
Local Human Network	-0.0323	(0.0465)	-0.0091	(0.0158)
Agriculture	-14.9616	(1809.723)	-0.6558	(1.0596)
Fishery	-16.1852	(1626.697)	0.6470	(0.6240)
Number of Observations	266		440	
Pseude R^2	0.2528		0.2152	
Log L	-78.786974		-120.63415	

Notes: Standard errors are provied in parentheses. ***, ** and * denote significance at the 1%, 5% and 10%, respectively.

Results were not significant for variables other than changes in the number of friends in the region. Depopulation is a concern in the stricken area, but our results indicate that the occurrence of the disaster was not the main factor strengthening respondents' intentions to relocate. As Table 3 indicates, damage to local human networks was more likely to drive respondents' intention to remain in the village than economic loss.

The Great East Japan Earthquake created massive physical damage and altered the socioeconomic environment of daily life. Table 4 shows the results of estimation that clarify how intentions to relocate varied between two groups—those who suffered damage to residence from the 2011 disaster and those who did not. Among both groups, only age presents statistically stable results. Older respondents in both groups showed a strong intention to remain in place.

The coefficient for the hometown dummy is statistically negative for both groups. The coefficient for home ownership is significantly negative for the group that suffered no damage from the 2011 disaster. The attachment to hometown strengthen ties with the village, but home ownership does not strengthen any longer for people who suffered damage from the disaster. Furthermore, the effect of losing their network of family and friends on intentions to remain was profoundly negative and significant among the group that suffered damage. These results indicate that respondents value non-material assets like human

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networks over material assets. Human network is important to think about reconstruction from the disaster.

4. CONCLUSION

This paper has clarified several factors affecting the intention to relocate among the people of Noda village in northern Japan following the Great East Japan Earthquake. Our questionnaire results show that young, female and unmarried respondents expressed greater intentions to relocate and that respondents from high-income families indicated greater likelihood of remaining, a finding that accords with the compensating wage hypothesis. The home ownership and hometown dummy variables display significant and strong effects.

Direct damage to residence, job or income did not significantly affect respondents' intentions to relocate. However, those who suffered greater devastation to personal networks expressed stronger intentions to leave the village. We analysed how the disaster affected respondents' intentions to relocate. We found that home ownership was negatively correlated to the decision to relocate among respondents whose homes were not damaged. However, among the group harmed by the 2011 disaster, loss of personal networks had a negative and significant effect on intentions to remain in the area. In other words, the loss of their network of families and friends rather than material capital stands out as a main motivation to leave the area.

Our results suggest an important and agreeable message for authorities who create and implement reconstruction policy following natural disasters. That is, it is highly important to make initiatives based on residential ownership as location-specific capital. Also, for residents suffering from disaster, reconstructing the network of family and relatives is more essential than residence rebuilding. As one of the reconstruction process of the Great East Japan Earthquake, residential districts are being transferred to new places. This study shows that reconstruction authorities must consider residential reconstruction and reconstruction of human networks simultaneously.

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