

Disaster, Social Networks, and Social Status:  
Damage and Consciousness after the Great East Japan Earthquake

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### Abstract

The 2011 Great East Japan Earthquake brought enormous physical damage and personal loss not only to coastal areas, where the tsunami hit, but across much of Eastern Japan. However, post-earthquake effects may be unequal and vary by position in the socio-economic structure. This study uses original survey data to examine class differences and in post-disaster anxiety in Sendai city, the largest city of the Tohoku region, and Senhoku, a rural area near Sendai. The results show a significant association between post-earthquake anxiety and social position. High status persons show less disaster-related anxiety than low status people. Other measures of position in the socio-economic structure, such size of employing organization and education, affect anxiety indirectly through income and property. Social relational resources also affect anxiety. We found no relationship between amount of property damage and anxiety. In general, lower status people experienced less property damage, but expressed greater anxiety. This suggests that ability to recover after the disaster varies, with lower status persons least able to recover fully. We should consider these results in policy making process.

### Keywords:

The Great East Japan Earthquake, Relational Resource, Size of Employing Organization, Social Status, Anxiety about future

## **1. Introduction**

### **Purpose of this study**

On March 11 in 2011, the Great East Japan Earthquake was the fourth largest earthquake in the world and the largest in Japan since instrumental recordings began in 1900. Japan's National Police Agency reported over 15,800 deaths and 3,000 missing persons. It brought enormous damage both to coastal areas, where the tsunami hit and across Eastern Japan, especially in Tohoku region. The Tohoku region has traditionally been regarded as a poorer region throughout Japanese history. However, few large-scale social surveys with random sampling have been conducted regarding property damage or the disaster's effects on people's lives.

Sendai, 300 kilometers from Tokyo, is the largest city in the Tohoku region, with a population of about 1 million. About 10 kilometers from the coast, Sendai suffered little serious direct tsunami damage. Sendai is about 100 kilometers north from Fukushima Daiichi, the Fukushima No.1 Nuclear Power Plant, so radioactivity was not a serious. Nonetheless, the 9.0 earthquake damaged houses, destroyed household goods, and interrupted public services in Sendai and severely affected the regional economy. Especially hard hit were small companies and stores that heavily depend on customers from the tsunami-ravaged coastal area.

The earthquake disrupted people's lives and created a paralysis in urban services in Sendai. Transportation by air, sea, train and highways were curtailed. Some areas were without electricity and water service for more than ten days. Many people thronged to the temporary shelters which were gymnasiums of elementary schools or junior high schools with emergency electric generators. Officials had installed electric generators and the emergency water services based on the disaster prevention planning for the long-predicted earthquake, but aftershocks continued for weeks

afterwards. The number of evacuated people exceeded expectations and there was a shortage of fuel for emergency generators.

Unlike after Japan's Great Hanshin Awaji Earthquake in 1995, no discussions arose about earthquake damage in working-class urban areas. This may be because Sendai city has few large industrial areas where concentrations of working-class people reside. Growing income inequality in the US or China has been well-recognized. Recently, income inequality has grown in Japan as well (Tachibanaki 2009). Yet, there has been little discussion of how earthquake damages affected different social classes because of widespread perceptions that Japanese society remains relatively equal. Moderate to low income people who tend to be employed by small companies or self-employed receive little assistance when they suffer earthquake damages. They are also most affected by business down turns that decrease future incomes. For these reasons, the earthquake increased anxiety about their future well-being.

This study examines social status differences in property damage and anxiety after the earthquake in Sendai and Senhoku area (less populated nearby area further from the coast). Data are from a quantitative social survey in Sendai, the largest city of Tohoku region. The central area of Sendai city is 10 km or more away from the Pacific Ocean and property damages from the earthquake were not extensive. Areas most affected by the tsunami had only 0.5% of Sendai's population but suffered enormous property damage from the earthquake.

Sendai is a geographically large city (788.09 km<sup>2</sup> or 304.28 sq mi). We examined whether a person's socio-economic position produced differences in property damages and post-earthquake anxiety.

## **Previous Study**

Informal social relations and social capital are critical for maintaining trust and supporting political participation in a democratic society (Verba et al. 1978, Verba et al. 1995). However, increasing economic inequality, instability, and urbanization make maintenance of social capital and social networks difficult. Social stratification in Japan creates major differences in the standard of living and job security, with a major cleavage between the permanent employees of large companies and civil service and others. (Hara and Seiyama 1999).

Environmental sociology and disaster-prevention studies have found that disaster victims vary by social class or other statuses (Wisner, Blaikie, Cannon, and Davis 2004). Studies of disasters, such as Hurricane Katrina in the U.S., found that lower status people and racial minorities suffered more than high status people (Dyson 2006). The absence of discussion of inequality in effects from the March 2011 earthquake does not mean an absence of difference by social class; rather, no one has yet examined the relationship between disaster damage and socio-economic status.

Rehabilitation from damages caused by the Great East Japan Earthquake proceeded quickly in major cities. Life in Sendai and Tokyo returned to pre-earthquake normalcy within six months, and the earthquake was not a major issue in the Lower House election in December 2012. However, thousands were still living in temporary houses in coastal areas. Housing restoration has proceeded very slowly. Japan's mass media has been silent on differences in damage suffered by people of different social classes.

Sendai is the largest city in the region. In Sendai average electric power outage was 5.6 days and water outage was 8.2 days according to our survey results. The damage of people's property was not small.

## **Characteristics of Social Structure in Japan**

Japanese society has had huge changes due to drastic industrialization and urbanization after World War II. However Western-type social class was not prominent and was measured one-dimensionally by possession of production means. Recently, social stratum has measured continuously in multiple dimensions by possession of various social resources. According to Tominaga (1979), social resources are divided in three types: material resource, cultural resource and relational resource. Of course, in Japan, various social differences are also seen depending on income, education, etc. and class of high-school graduated workers exists. According to our survey result, more than 50% of men and more than 60% of women ended their education at high school, school of vocational skill or lower in Sendai city. However, in fact, difference derived from social stratum, social class, race or ethnic group has not been prominent in Japanese society for a long time. Almost all Japanese are covered with health insurance and public pension system, and class differences in average life expectancy or health are small. Most people live in houses of similar size and have access to similar public education. Especially in the high-speed economic growth era of 60's and 70's, equality of Japanese society was emphasized and the theme that "All 100 million Japanese are middle class" was well known. However, increasing inequality has become a recent public topic. In Japan, working for a large-company was very important after World War II. Permanent employees of large companies and civil service received high incomes, excellent benefits, and stable employment. There was a very big income and benefit gap between the permanent employees of large companies (and civil service) and the rest of the labor force. However it is not clear that factors other than income and education, e.g. possessing social relational resource, are related to degree of damage

from the earthquake. It is expected that small-company employees and self-employed individuals have greater anxiety due to a future decline in income, as their economic situation is relatively unstable and influenced more by an economic downturn. An important task is to investigate the relationship between Japanese social stratification and damage from the earthquake.

## **Hypothesis**

Our main hypothesis is that degree of access to social-economic resources is related to level of post-disaster anxiety about the future, while the amount of amount of earthquake property loss is not directly related.

The concept of “social capital” is ambiguous, so we use the more concrete variables of relational resource (having networks with influential people), informational resource (year of education), year of residence place, and size of people's employing organization. In the basic model, the dependent variables are influenced by the following factors: size of employing organization, self-defined social stratification position, amount of property, and social-relational resources. We will focus on company size of employing organization and relational resources in the analysis.

We can look at relationship between social stratum and suffering from a disaster in two ways. One is that the people owning more property suffer more property loss (such as loss from serious damage to their houses, people who do not own houses cannot have house damage), and this loss creates distress or anxiety. Another is that wealthier people live in better, newer houses and therefore suffer less damage, hence they express less distress. In Sendai, most buildings and houses were earthquake-resistant structures, making serious damage such as building collapse rare. However,

almost all people suffered losses due to damage to their furniture and household goods. We want to clarify this by analyzing the data of this survey.

## **2. Data and Method**

We used the data from the survey, "Citizens' consciousness survey on their life and disaster prevention." One part was conducted in Sendai in November and December 2011, with a panel survey in 2012. A second part was in the Senhoku area (rural area near Sendai, mainly Kurokawa county, inland area, most of the area does not face the ocean) in November 2012. The population was men and women of twenty years old or older. The Sendai sample size was 2,100 and 1,532 answers were obtained (73% response rate) in 2011. It was self-administered survey (described below). Data quality is high as we directly managed the survey instead of delegating it to a research company. In 2011 we hired more than 70 students of Tohoku University and they visited 70 points in Sendai and meet respondents or distributed questionnaires in post boxes and asked people to answer. The 70 points were based on constituent population distribution using probability proportionate sampling and sampled house units of targets by choosing target houses in each point. The target person in a house unit was chosen randomly.

Rikkyo University conducted the statistical social surveys in cooperation with Tohoku University. Data quality is high as we directly managed the survey instead of delegating it to a research company. The coastal areas of Sendai city, most severely hit by the tsunami, had had 0.5% or less of the city's population before the earthquake and nobody lives there after the earthquake. Consequently no points were to be chosen from the areas for the survey. Some points were close to the coast area. However there is no problem in everyday life in Sendai.\*

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\* For the details refer to the web page of Murase office, College of Sociology, Rikkyo University. A subsidy from Rikkyo University Special Focus Fund for Promoting Research (Rikkyo SFR) supported the survey as a research related to support restoration from the Great East Japan Earthquake. <http://www2.rikkyo.ac.jp/web/murase/11send.htm>

The Senhoku sample has 2,006 people and 1334 responses were obtained (67% response rate). It was a mail survey based on a random sample from electoral rolls. Town and village names of Senhoku area are in Table 1. The area is same as 1998 Senhoku survey conducted by Murase Lab of Rikkyo University.

Both surveys asked about social consciousness of various topics, job, health, etc. We also asked about individual income and household income. For property, we asked about ownership of fourteen items (house, PC, DVD player, etc.) and used the total number as the variable of property possession. For relational resources, we asked about the depth of relationship with four types of people on four-point scale: board members of neighborhood association; officials (department or division manager or higher) in the prefecture, city, town or village; local assembly members or Diet members; board members of professional associations or labor associations. We omitted people who had not lived in Sendai and Senhoku at the time of the Great Earthquake.

We also analyzed 2010 SSP-I survey (Social Stratification and Social Psychology Interview survey) data\*\* to compare our surveys with data in a national survey. The SSP 2010 population includes people aged 25 through 59, and has a sample size of 3,500 and 1,763 answers were obtained (50% response rate). The SSP survey investigated the transformation Japanese peoples' class consciousness and the association between social stratification and social psychology.

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\*\* SSP project was conducted by the Institute of Statistical Mathematics and Osaka University. For the details on the SSP survey, refer to the SSP project web page, School of Human Science, Osaka University. This survey has been conducted as the Network of Excellence project by the Institute of Statistical Mathematics (research collaboration program H23-J-4205). The SSP survey is aided by Grant-in-Aid for Scientific Research (S 23223002) of The Ministry of Education, Culture, Sports, Science and Technology (MEXT). <http://ssp.hus.osaka-u.ac.jp/>

### **3. Results**

#### **Basic Analysis**

In the results for Figure 1 on the "The amount of loss from the earthquake", 24% of male and 23% of female in 2011 answered 0 yen. 23% of male and 20% of female answered less than 100 thousand yen (about \$1,000 US). However, more than 10% of people in Sendai and Senhoku answered 2 million yen or more (\$20,000 US). Many people had earthquake damages to their house or their property even if they had no damages from the tsunami. Figure 2 is the relation between age and amount of loss. In general older people suffered a larger loss. It is possible that older people had greater damage on their houses as they often live in relatively older houses. Older people tended to have single-family houses rather than apartments of multi-family building. Younger people probably had less property.

**Table 1. Utility Stop and Damage: Days, JP Yen.**

<b>2011 Sendai</b>				
	<b>Electricity Stop</b>	<b>Water Stop</b>	<b>Gas Stop</b>	<b>Damage (Thousand)</b>
Aoba(city central)	4.5	8.2	19.7	1009
Miyagino(old area)	7.0	8.7	17.5	1678
Wakabayashi(old area)	6.0	3.2	19.2	2001
Taihaku(suburb)	5.9	6.7	20.5	785
Izumi(suburb)	5.1	11.4	22.6	1141
<b>Total</b>	<b>5.6</b>	<b>8.2</b>	<b>20.1</b>	<b>1225</b>

Miyagino and Wakabayashi faced to the Pacific Ocean

**Table 1. Cont**

<b>2012 Senhoku</b>				
	<b>Electricity Stop</b>	<b>Water Stop</b>	<b>Gas Stop</b>	<b>Damage (Thousand)</b>
Rifu(suburb)	6.9	20.9	15.6	1562
Tomiya(suburb)	5.9	15.5	11.4	841
Taiwa(town)	5.1	3.1	1.0	1255
Osato, Ohira, Sanbongi (village and country)	9.2	11.7	1.1	1788
<b>Total</b>	<b>6.7</b>	<b>14.0</b>	<b>8.5</b>	<b>1303</b>

Table 1 shows the average of loss by ward and community. There are 5 administrative wards in Sendai. Aoba ward is central area. Wakabayashi and Miyagino wards are relatively old residential areas and face the Pacific Ocean. Taihaku and Izumi are relatively new residential areas. Senhoku area is at the northern border of Sendai and is developed as new residential area. Average damage amount was highest in Wakabayashi ward (2,001 thousand yen; about \$20,000 US). Damage amounts were larger in Wakabayashi and Miyagino wards, which have coastal areas, and Osato etc which is a rural area. The ground in coastal areas may be less stable as they were closer to the sea, or perhaps they had more old residential zones than in other wards. The population of coastal areas was very small but there were more old houses. Also, some people in the coastal areas outside of Sendai city

had moved into these two wards because they were close to the ocean and had lower rents. The lowest loss was Taihaku ward and Tomiya town. These are new residential areas from which many people commute to central Sendai. It has well-developed land and is less susceptible to the earthquake. The electric power blackout was shortest in Aoba ward because the local government and electric company restored power to the central city first. Water stops were long in Rifu, Tomiya, Izumi and rural area. These were hilly areas, making breakages of the water pumps serious problems and slowing restoration. The gas outage was shortest in rural area because there was no large scale gas facilities and many people had propane gas or all-electric residences.

In Figure 3 on the statement, "I am anxious about my future life" 64% of 2011, 76% of 2012, and 76% of 2012 Senhoku male gave affirmative answers. 73% of 2011, 81% of 2012, and 77% of 2012 Senhoku female gave affirmative answers. Figure 4 on the statement, "It is highly possible that future income will decrease." 53% of male and 56% of female in 2011 gave affirmative answers and more people gave affirmative answers in 2012. Affirmative answers were less frequent for the question in Figure 5 "It is highly possible that I will lose my job in the future." We found a significant relationship: the older the respondents were, the more they gave affirmative answers about a possible decline in income or job loss.

Figure 6 and 7 are about Relational Resources. Being part of an influential social network can be essential for having political power, running a business, and gaining information access. Because of rapid urbanization, newer residents lack extensive social relations. The data show that men have stronger relational resources than women, and rural people (Senhoku) have more than people in Sendai city.

In 2012 Sendai panel survey, the answer of "Lower" self-identified social class is relatively small. Results of SSP survey confirm this feature of our survey. Figure 8

is self-defined stratification. This 5 category stratification measure is popular in Japanese social stratification surveys. Most of people answered “Upper Middle” or “Lower Middle”. The answers of “Upper” are very small in all surveys but proportion of middle is more than half in all surveys. In 2011 Sendai and 2012 Senhoku, the proportion of “Upper Middle” are less than the national survey (SSP) and “Lower” are more than SSP.

Figure 9 shows political party support. The answer of “No Party” is largest in all surveys. However in Sendai and Senhoku “No Party” is smaller than SSP. Women’s “No Party” is larger than man. “No Party” is smallest in the Senhoku (rural area) male because there are much social relations and many kinds of organizations are strong in Japanese rural area. The Democratic Party was ministerial party from September 2009 until 2012 but the support proportion was not large.

We conducted cross tabulation analysis to clarify the associations between post-earthquake anxiety and social stratification or political party support. Figure 10 and 11 show relations between self-defined class and future anxiety. Because the category of upper class is very small, we merged it into “Upper middle.” It appears that lower status people express greater anxiety. Figures 12 and 13 show there are no strong relationships between party support and future anxiety.

Figure 14 shows level of earthquake damage. Only 3-4 % of people answered their houses “are totally destroyed” but 45-50% answered their houses “are partially damaged but repairable.” More than 70% answered that their furniture or household things were damaged. Only 1- 2 % of people reported injury. However, over 10% reported a death in their family or among relatives death and over 20% reported a friend’s death.

## **Determinants of Damage in the Great Earthquake**

Next, we analyzed the amount of damage (each items in Figure 14, values are 0 or 1, in) as dependent variables based on Logistic regression model. We also used age, year of education, residence year rate, property, size of employing organization as independent variables as permanent employees of large companies and civil service are expected to have more stable basis of living. In addition, to examine social network (human relations) influence to social consciousness, we used variables of human relations, residence year rate (residence years of present living place/age) and other variables. The variable of network is the sum of answers of 2 questions (figure 6 and 7) with a range of 2 thru 8. People who have more relations are coded as 8. We also used property, self-employed business as dummy variable, area of residence as dummy variables. Table 2 shows results of the Sendai survey and Table 3 is from the Senhoku survey. In logistic regression model, the size of coefficient has no specific meaning and focus on whether an independent variable is significant or not. The Senhoku survey had a question on age of respondent's home that we added to the analysis as an independent variable.

In table 2, the model of dependent variable "house totally damaged", significant independent variables are "residence year rate" (1.19) and "life satisfaction" (-0.47). A positive value for the coefficient of residence year indicates that greater house damage occurs when residence year is higher (i.e., an older house). The negative sign on life satisfaction, probably indicates that people who have lost their home are not satisfied with their current life situation.

In the model for "house damaged but repairable" five variables (sex, age, property, anxiety, and area dummy) are significant. The negative value for sex means that women tend to answer with more damages. The positive value for the area

dummy variables means that people in each of the outer areas indicated more damage than those living in the central area (Aoba ward).

In the model for “home slightly damaged,” only residence year rate is significant. This suggests that people who lived at their current address longer tended have an older house that was less able to withstand the earthquake.

In the “Damage in Workplace or School” model, less educated, high residence year rate, employee of large company, and employed people reported more damage. Sense of unfairness has negative effect. Taihaku Dummy has also negative effect. People in Taihaku district (a relatively new residential area) tend to have little damage. Nagelkerke R-square is relatively large, so this model explains data variance well.

In the model for respondents injured and friends injured, the social network variable has a positive coefficient. Respondents who had social relations with influential people tended to have more injuries. This could be because they were local small business owners or they worked in areas where the earthquake was strongest. The results show that possession of social network is important factor in Japanese society. In the model for family or relatives death, education has negative effect, while residence year rate and Wakabayashi dummy (the area faced to the ocean and included tsunami area) all have positive effects. For the model of friend’s death, age and education are not significant, but the size of employing organization, and self-employment have positive coefficients.

In table 3 significant independent variables for the “house totally damaged” model include number in family (0.28) and age of house (0.04). Unlike in Sendai, residence year rate has no effect because age of house has a significant effect. Sex, age, and area dummy also have no effect. In other words, age, education, size of

employing organization, residential area dummy and stratification variables have no effect on damage to a house. This is an important finding. On table 1, country area (Osato etc.) have large amounts of damage (1788thousand JPY), but in the analysis, it is not significant because of the stratification and area dummy effects. In the model of “Home damaged but repairable” and “home slightly damaged” age of house has no effect. In the family or relatives death model, unlike the result of table 2, education and residence year rate do not have significant effects, and only the significant variable is sex. In the friend’s injured and friend’s death model, social network have positive effect. In the Senhoku area people with more extensive social relations were more likely to report that friends were injured or died. In other words, people in local social networks expressed a greater loss of friends. Not all the people have access to extensive social networks and the gap between older, local network people and newer residents can be large. Only in table 2 size of employing organization has a positive effect on friends’ death. Maybe employees of large companies are answering with regard to friends or colleagues of the same company.

Fitness coefficients of the models are generally good; in many models Nagelkerke R-squares are .10 or higher for example. These are not so large, but it can be said that the value, approximate .10, is not bad as the value in the result of social survey data.

Table 2. Logistic Regression of Damages: 2011 Sendai Survey

	Home Totally Damaged			Home Damaged but Repairable			Home Slightly Damaged			Damage in Workplace or School			Brokage of Furniture or Household thing		
	B	Wald	Exp (B)	B	Wald	Exp (B)	B	Wald	Exp (B)	B	Wald	Exp (B)	B	Wald	Exp (B)
Sex	-0.30	0.72	0.74	-0.33 *	6.70	0.72	0.21	2.00	1.23	0.02	0.01	1.02	-0.62 **	15.86	0.54
Age	0.01	0.43	1.01	0.01 **	8.14	1.01	-0.01	1.18	0.99	-0.04 **	52.41	0.96	0.01	3.83	1.01
Year of Education	0.14	2.48	1.15	0.00	0.00	1.00	-0.02	0.36	0.98	0.10 **	7.06	1.11	0.02	0.28	1.02
Residence year rate	1.19 *	4.29	3.27	0.18	0.82	1.20	0.57 *	5.89	1.77	-0.23	1.01	0.80	0.55 *	4.88	1.74
Number of Family	0.00	0.00	1.01	0.05	0.95	1.05	0.03	0.26	1.03	0.09	3.30	1.10	0.00	0.00	1.00
Property	-0.09	1.29	0.91	0.14 **	22.15	1.15	0.05	2.14	1.05	-0.02	0.44	0.98	0.10 **	7.98	1.11
Size of Employing Organization	-0.05	0.32	0.95	0.01	0.10	1.01	0.02	0.17	1.02	0.15 **	18.85	1.16	-0.05	1.34	0.96
Part time Dummy	0.39	0.72	1.47	-0.10	0.34	0.90	-0.01	0.00	0.99	-0.21	1.33	0.81	-0.01	0.00	0.99
Self Employment Dummy	0.61	0.93	1.84	0.40	2.47	1.50	0.34	1.40	1.41	-0.16	0.37	0.85	-0.27	0.76	0.76
Unemployed Dummy	-0.83	1.39	0.43	0.22	0.74	1.24	0.26	0.76	1.30	-0.88 **	10.39	0.41	-0.47	2.29	0.62
Anxiety of Future	0.35	2.44	1.42	0.20 **	8.09	1.22	0.07	0.69	1.07	-0.10	1.44	0.91	0.15	3.30	1.16
Life Satisfaction	-0.47 *	3.89	0.62	0.04	0.21	1.04	0.13	1.37	1.14	0.05	0.23	1.05	-0.05	0.18	0.95
Sense of Unfairness	-0.21	0.69	0.81	-0.07	0.69	0.93	-0.12	1.55	0.89	-0.25 *	6.69	0.78	-0.06	0.35	0.94
Social Network	-0.10	0.44	0.90	0.07	1.83	1.07	-0.05	0.87	0.95	0.06	1.18	1.06	0.04	0.54	1.04
Miyagino Dummy	0.32	0.38	1.38	0.38 *	4.42	1.46	-0.21	1.02	0.81	-0.07	0.12	0.93	0.64 **	7.99	1.90
Wakabayashi Dummy	0.74	2.14	2.10	0.73 **	12.08	2.08	-0.46	3.21	0.63	-0.23	0.91	0.80	0.59 *	4.92	1.81
Taihaku Dummy	0.26	0.25	1.30	0.39 *	5.11	1.48	-0.28	1.89	0.76	-0.46 *	5.31	0.63	-0.07	0.12	0.93
Izumi Dummy	0.09	0.03	1.10	0.67 **	15.99	1.96	0.19	1.12	1.21	-0.08	0.15	0.93	0.47 *	5.26	1.61
Constant	-4.98 **	6.07	0.01	-2.72 **	14.86	0.07	-1.71 *	4.52	0.18	0.39	0.24	1.48	-0.09	0.01	0.92
-2 LL	332.12			1684.27			1378.86			1350.97			1254.47		
Cox & Snell R sq	0.03			0.08			0.02			0.25			0.06		
Nagelkerke R sq	0.12			0.10			0.03			0.34			0.09		
N	1289			1289			1289			1289			1289		

	Respondent's injured			Family or Relatives injured			Family or Relatives death			Friends injured			Friends death		
	B	Wald	Exp (B)	B	Wald	Exp (B)	B	Wald	Exp (B)	B	Wald	Exp (B)	B	Wald	Exp (B)
Sex	-0.36	0.63	0.70	-0.34	1.06	0.71	-0.13	0.55	0.87	-0.27	1.14	0.76	-0.16	1.22	0.85
Age	-0.04 *	6.42	0.96	0.00	0.00	1.00	0.01	0.95	1.01	-0.01	1.40	0.99	0.00	0.05	1.00
Year of Education	0.09	0.51	1.09	-0.12	2.30	0.88	-0.13 **	9.02	0.87	0.02	0.11	1.02	-0.02	0.23	0.98
Residence year rate	1.03	2.31	2.81	-0.19	0.14	0.83	0.86 **	8.60	2.37	0.07	0.04	1.08	0.39	2.79	1.47
Number of Family	-0.26	2.04	0.77	0.27 *	6.34	1.31	0.09	2.11	1.10	0.02	0.05	1.02	-0.03	0.24	0.97
Property	-0.07	0.40	0.93	-0.06	0.61	0.94	0.05	1.60	1.06	0.03	0.27	1.03	0.03	0.88	1.03
Size of Employing Organization	-0.01	0.01	0.99	-0.09	1.11	0.91	0.00	0.00	1.00	0.06	0.97	1.06	0.07 *	3.98	1.08
Part time Dummy	-0.13	0.04	0.88	-0.09	0.04	0.91	-0.11	0.19	0.89	0.59	2.83	1.80	-0.28	1.86	0.75
Self Employment Dummy	0.57	0.38	1.76	0.07	0.01	1.07	-0.21	0.35	0.81	1.22 *	6.64	3.39	0.85 **	9.36	2.34
Unemployed Dummy	0.60	0.41	1.83	-0.36	0.31	0.70	-0.18	0.25	0.84	0.49	0.86	1.63	0.22	0.56	1.25
Anxiety of Future	0.68 *	5.21	1.97	0.05	0.08	1.05	0.16	2.50	1.18	0.47 **	9.97	1.60	0.10	1.64	1.11
Life Satisfaction	-0.30	0.97	0.74	-0.13	0.30	0.88	0.04	0.08	1.04	0.13	0.53	1.14	0.06	0.32	1.06
Sense of Unfairness	-0.05	0.02	0.95	-0.23	1.09	0.79	0.04	0.10	1.04	0.16	0.96	1.17	0.01	0.02	1.01
Social Network	0.38 *	5.56	1.46	0.07	0.29	1.07	0.08	1.43	1.08	0.21 *	6.06	1.24	0.09	3.08	1.10
Miyagino Dummy	0.52	0.62	1.69	0.00	0.00	1.00	0.30	1.28	1.34	0.33	1.03	1.39	0.28	1.89	1.32
Wakabayashi Dummy	0.64	0.82	1.90	0.38	0.76	1.47	0.78 **	8.24	2.19	0.08	0.05	1.09	0.42	3.32	1.52
Taihaku Dummy	0.57	0.76	1.78	-0.79	2.43	0.46	0.18	0.49	1.19	-0.36	1.01	0.70	-0.13	0.38	0.88
Izumi Dummy	0.63	0.95	1.87	-0.59	1.64	0.56	-0.02	0.01	0.98	-0.24	0.51	0.79	0.10	0.25	1.10
Constant	-5.82 *	5.02	0.00	-0.76	0.18	0.47	-2.37 *	5.43	0.09	-5.97 **	16.92	0.00	-2.37 **	8.58	0.09
-2 LL	218.82			392.27			986.76			595.38			1382.71		
Cox & Snell R sq	0.02			0.02			0.04			0.03			0.03		
Nagelkerke R sq	0.12			0.07			0.07			0.07			0.05		
N	1289			1289			1289			1289			1289		

Reference category of Occupational Status dummy is Full time worker. Reference category of Area dummy is Aoba ward (central area).

Table 3. Logistic Regression of Damages: 2012 Senhoku Survey.

	Home Totally Damaged			Home Damaged but Repairable			Home Slightly Damaged			Damage in Workplace or School			Brokage of Furniture or Household thing		
	B	Wald	Exp (B)	B	Wald	Exp (B)	B	Wald	Exp (B)	B	Wald	Exp (B)	B	Wald	Exp (B)
Sex	-0.08	0.05	0.92	0.00	0.00	1.00	0.20	1.85	1.23	0.19	1.44	1.21	-0.09	0.35	0.91
Age	-0.01	0.24	0.99	0.00	0.39	1.00	-0.01	2.89	0.99	-0.02 **	15.65	0.98	-0.01	1.48	0.99
Year of Education	0.00	0.00	1.00	0.01	0.18	1.02	-0.03	0.84	0.97	0.08 *	4.08	1.09	0.07	3.03	1.07
Residence year rate	-0.17	0.07	0.84	0.68 **	8.09	1.98	-0.17	0.44	0.85	-0.12	0.19	0.89	0.12	0.18	1.12
Number of Family	0.28 **	7.32	1.32	0.00	0.01	1.00	-0.06	1.56	0.94	0.03	0.37	1.03	0.09	3.31	1.09
Property	-0.01	0.03	0.99	0.14 **	17.23	1.15	-0.01	0.09	0.99	-0.01	0.10	0.99	0.09 **	6.11	1.10
Size of Employing Organization	-0.06	0.28	0.94	-0.01	0.12	0.99	-0.04	0.98	0.96	0.16 **	16.94	1.17	-0.05	1.39	0.95
Part time Dummy	-0.24	0.22	0.79	0.29	2.55	1.33	-0.34	3.11	0.71	-0.25	1.78	0.78	0.29	1.89	1.33
Self Employment Dummy	-0.21	0.10	0.81	0.30	1.37	1.34	-0.19	0.50	0.83	-0.52	3.60	0.60	0.09	0.09	1.09
Unemployed Dummy	-0.33	0.18	0.72	0.15	0.29	1.17	-0.57	3.49	0.57	-0.59	3.68	0.56	0.00	0.00	1.00
Anxiety of Future	-0.17	0.64	0.84	0.18 *	4.76	1.19	0.08	0.86	1.08	0.18 *	4.01	1.20	-0.04	0.15	0.96
Life Satisfaction	-0.14	0.35	0.87	-0.20 *	4.40	0.82	0.20	3.76	1.22	-0.02	0.02	0.99	0.15	1.96	1.16
Sense of Unfairness	0.01	0.00	1.01	0.01	0.02	1.01	-0.04	0.17	0.96	-0.17	2.68	0.85	-0.21 *	4.13	0.81
Social Network	-0.12	0.77	0.89	0.06	1.42	1.06	0.04	0.70	1.04	0.09	2.77	1.10	-0.02	0.10	0.98
Tomiya Dummy	-0.67	1.76	0.51	0.11	0.30	1.11	-0.12	0.32	0.89	-0.02	0.00	0.99	-0.23	1.04	0.80
Rifu Dummy	-0.76	2.31	0.47	0.10	0.24	1.10	0.07	0.10	1.07	0.11	0.24	1.11	-0.17	0.59	0.84
Taiwa Dummy	-0.49	1.15	0.61	0.03	0.02	1.03	-0.25	1.20	0.78	-0.48 *	4.15	0.62	-0.13	0.30	0.88
Age of Home	0.04 **	24.38	1.04	0.00	0.75	1.00	0.00	0.60	1.00	-0.02 **	10.60	0.98	0.00	0.52	1.00
Constant	-2.83	1.51	0.06	-1.87 **	5.12	0.15	0.02	0.00	1.03	-0.75	0.68	0.47	0.24	0.07	1.28
-2 LL	302.13			1471.53			1326.80			1243.14			1204.64		
Cox & Snell R sq	0.04			0.05			0.02			0.20			0.03		
Nagelkerke R sq	0.16			0.06			0.03			0.27			0.05		
N	1099			1099			1099			1099			1099		

	Respondent's injured			Family or Relatives injured			Family or Relatives death			Friends injured			Friends death		
	B	Wald	Exp (B)	B	Wald	Exp (B)	B	Wald	Exp (B)	B	Wald	Exp (B)	B	Wald	Exp (B)
Sex	1.29 **	4.72	3.62	-0.22	0.44	0.81	-0.39 *	3.90	0.68	0.35	1.65	1.42	-0.16	0.83	0.86
Age	0.01	0.36	1.01	-0.01	0.76	0.99	0.01	1.57	1.01	-0.02	2.36	0.98	-0.01	0.82	0.99
Year of Education	-0.06	0.19	0.94	-0.05	0.38	0.95	-0.06	1.41	0.94	-0.03	0.23	0.97	0.01	0.02	1.01
Residence year rate	0.45	0.23	1.56	0.80	2.37	2.23	-0.29	0.81	0.75	0.67	2.57	1.95	-0.53	3.66	0.59
Number of Family	0.06	0.12	1.06	-0.04	0.18	0.96	-0.09	2.13	0.91	-0.12	1.96	0.89	-0.09	2.72	0.92
Property	0.18	1.73	1.20	-0.01	0.02	0.99	0.00	0.00	1.00	0.05	0.68	1.06	0.00	0.00	1.00
Size of Employing Organization	-0.26	2.34	0.77	-0.01	0.02	0.99	0.03	0.41	1.03	0.04	0.30	1.04	0.06	1.67	1.06
Part time Dummy	0.52	0.45	1.68	1.12 *	5.75	3.08	-0.07	0.06	0.94	-0.05	0.02	0.95	-0.23	1.09	0.79
Self Employment Dummy	-0.29	0.09	0.75	0.89	2.05	2.44	0.01	0.00	1.01	0.10	0.05	1.11	0.63 *	4.73	1.87
Unemployed Dummy	-0.58	0.27	0.56	0.99	2.00	2.68	0.14	0.12	1.15	-0.08	0.02	0.93	0.00	0.00	1.00
Anxiety of Future	0.13	0.16	1.14	0.49 *	6.05	1.64	0.07	0.35	1.07	-0.16	1.09	0.85	-0.01	0.02	0.99
Life Satisfaction	-0.32	0.82	0.73	0.24	1.22	1.27	0.03	0.04	1.03	-0.27	2.44	0.76	-0.11	0.97	0.90
Sense of Unfairness	-0.34	0.78	0.71	0.23	1.19	1.26	-0.03	0.04	0.97	-0.38 *	4.30	0.68	-0.10	0.88	0.90
Social Network	-0.03	0.02	0.97	0.13	1.50	1.14	0.13	3.85	1.14	0.25 **	8.31	1.28	0.23 **	17.57	1.26
Tomiya Dummy	1.61	1.93	5.02	0.34	0.49	1.40	-0.09	0.11	0.91	0.20	0.28	1.22	0.03	0.02	1.03
Rifu Dummy	2.03	3.28	7.62	0.76	2.88	2.14	0.16	0.35	1.17	0.44	1.43	1.56	0.08	0.13	1.09
Taiwa Dummy	1.56	1.78	4.77	0.05	0.01	1.05	-0.17	0.33	0.84	-0.41	0.88	0.67	-0.64 *	5.37	0.53
Constant	-5.72	2.92	0.00	-6.15 **	9.06	0.00	-1.63	1.98	0.20	-0.94	0.38	0.39	-0.82	0.70	0.44
-2 LL	158.53			395.24			886.87			530.58			1104.40		
Cox & Snell R sq	0.02			0.02			0.02			0.03			0.04		
Nagelkerke R sq	0.11			0.07			0.03			0.07			0.06		
N	1112			1112			1112			1112			1112		

Reference category of Occupational Status dummy is Full time worker. Reference category of Area dummy is other area (village area).

## **Determinants of Anxiety after the Great Earthquake**

Next, we conducted an analysis setting the amount of damage and anxiety as dependent variables using structural equation models (SEM). We also used age, size of employing organization, self-employed business of dummy variable and others as independent variables as permanent employees of large companies and civil service are expected to have more stable basis of living and smaller anxiety. In addition, to examine human relations influence to social consciousness, we used variables of human relations, residence year rate (residence years of present living place/age) and other variables. Before analysis we deleted respondents without jobs to exclude influence of retirement.

The final dependent variables in Figures 15 and 16 are the anxiety variables. We examine what variables affect these. For Sendai (Figure 15), we found a significant association between the anxiety about future life and self-defined stratification (-.15), age (-.10), residence year rate (.07), sex (-.09) and anxiety about income (.49). As the negative coefficient indicates, people higher in the stratification structure express less anxiety. Anxiety about future income has large effect. In other words, a large part of future anxiety comes from a concern over future income. But there are other significant variables. Property ownership is related to age, education, number of family, size of employing organization, relational resources (connection with persons of influence) etc. and the related elements have indirect effects on future anxiety. In other words, size of employing organization and education affect the degree of anxiety through the property and stratification variables. This is a major finding. The results show that education and the size of employing organization are important factors in Japanese society and the employees of larger organization have greater stability and less anxiety about the future. Possessing relational resources also affects degree of anxiety through possession of property. Sex has negative effect on anxiety, indicating that women express more anxiety. Amount of Damage has significant association with age, number of family, self employment dummy and area dummy variable (Wakabayashi, old residential area near the ocean), and its determination coefficient is small and has no relationship with many explanatory variables and

property. In short, amount of damage is not related to social position in Sendai. This is also an important finding. Wakabayashi dummy has direct effect on Anxiety on income, so people in old residential area have greater anxiety.

However in the result of rural area (Figure 16), amount of loss has significant association with property (.16). As the coefficient has a positive value, it can be said that rich people have more damage than poor people. House age has positive effect (.22) so people who lived in older house tend to have larger damage. Age, education, area dummy variables (Tomoya and Rifu) etc have no direct effect to damage. We also found a significant association between the anxiety on future life and self defined stratification (-.19), relational resource (-.08), age (-.08), residence year rate (-.06), house age (.07) and anxiety on income (.39). Property has indirect effect through stratification. Anxiety on future income has also large effect.

Fitness coefficients of the models are generally good; RMSEA is .03 or lower for example. The determination coefficient  $R^2$  written under the anxiety variables and damage amounts are not so large, but it can be said that the value, approximate .10, is not bad as the value in the result of social survey data.

#### **4. Conclusions**

A key finding of this study is that having access to a social network (relational resource with influential people), residence year (or age of house), and size of employing organization significantly affect a person's damage experience. In Japan, the major factors influencing damage experience are not racial-ethnic minority status or production-defined social class, but economic status (property), size of employing organization, and access to social networks. An important finding is that economic status and size of employing organization affect the damage experience. For damage to house from the earthquake, socio-economic factors such as education, self-employment and part time employment have no effect. Property ownership has a significant effect on amount of home and household damage,

the coefficient is positive.

An important new finding is the absence of a relationship between home damage and stratification factors, (i.e., education or size of employing organization or self-employment) in table 2 and 3. It may be that lower status people suffer no greater property damage than others in Japan. For many countries, it is expected that low status people live in areas of bad housing conditions and suffer greater property damage in a disaster, but no such relationship was found in Japan. Sendai's economy is mostly in the tertiary sector, so it lacks a large laboring class area. This makes it different from other large cities. After the Great Hanshin Awaji Earthquake in 1995 urban small roads were extended and a lot of funding was invested in fire prevention systems. Unlike in 1995 Hanshin Awaji, in 2011 there was no large scale urban fire disaster in the working class areas. However, the data used this time covers Sendai area only, and a larger area survey may show some significant association. Generally, town and village areas tend to have people with relatively lower incomes and some of them could have had greater earthquake damage. Major cities received priority in restoration spending and recovery slower in village areas.

A person's position in the social stratification structure affects his/her post-disaster anxiety over income and the future generally. Size of employing organization and education level affect anxiety indirectly through the property and stratification variables. It is a characteristic of Japanese society that such factors shape expectations about the future. An important finding is that a person's economic status and employer size influence degree of anxiety. In general, the permanent employees of larger companies have higher economic status and less anxiety in Japanese society. To a degree, their high social position and employment security insulated them from the effects of the disaster. Factors related to social structure, such as self-defined stratification position and property ownership, have no effects on earthquake property damage in Sendai, but property has significant effect to damage in Senhoku.

We should consider future policy development based on these new findings. The mechanism

producing post-disaster anxiety (Murase 2013) and amount of disaster property loss differ. The size of the employing organization has a major impact on anxiety about one's future life. This suggests the employing organization is a key factor shaping people's lifestyles and social stability in Japan. After the great earthquake, this social structure factor remains, and it may become more important in an era of economic decline. However it is important to consider potential social changes. Restoration and construction have helped revive the Tohoku region's economy. However, once the construction boom ends, many people may not be able to adjust a future economic declines and the effects of globalization because many do not work for large companies which have adapted to globalization, and gap between high and low status people is increasing. On the other hand, traditional large companies may become less advantageous if they cannot quickly adapt to a fast changing post-industrial society.

In Japan, competition to enter a top university and the desire to work for a large company are declining. This social phenomenon reflects changing societal values. Although a consequence is not yet visible, it is important to investigate the influence on Japanese society from the downturn in consumer spending, population decline, emerging industries, new public policies, and the world economy change after the earthquake.

The logistic regression analysis shows a significant association between the damage and measures of social position, property, self-employment, size of employing organization, and access to relational resources. The self-employed and people with many social relationships tend to respond to friends' injury and death more. In general, people lower in the socio-economic structure had no greater property damages than others. However, the model for "damage in workplace or school" shows significant effects from size of employing organization. This suggests that employing organization remains important. Significant effects of "age of home" in Table 3 should also be considered. Both in table 2 and 3, there are some significant effects of social network and size of employment organization. Vibrant informal social relations are a foundation of democratic society.

In the results of SEM show a significant association between the consciousness about the

future instability and property, self-defined social stratification and relational resource. People with high status positions, i.e., having more property, show less anxiety than people of a lower position. Other measures of position in the socio-economic structure, size of employing organization and education, affect anxiety indirectly through stratification and property. Possession of relational resource has also effect to anxiety. Amount of loss (property damage amount of JPY) has significant association with relational resource, self-employment dummy, house age, area dummy etc. However, its determination coefficient is small and has no relationship with anxiety. In general, people in lower status in the socio-economic structure show greater anxiety about the future. This suggests that social status and a sense of instability are closely related. We should consider these results in future policy making process.

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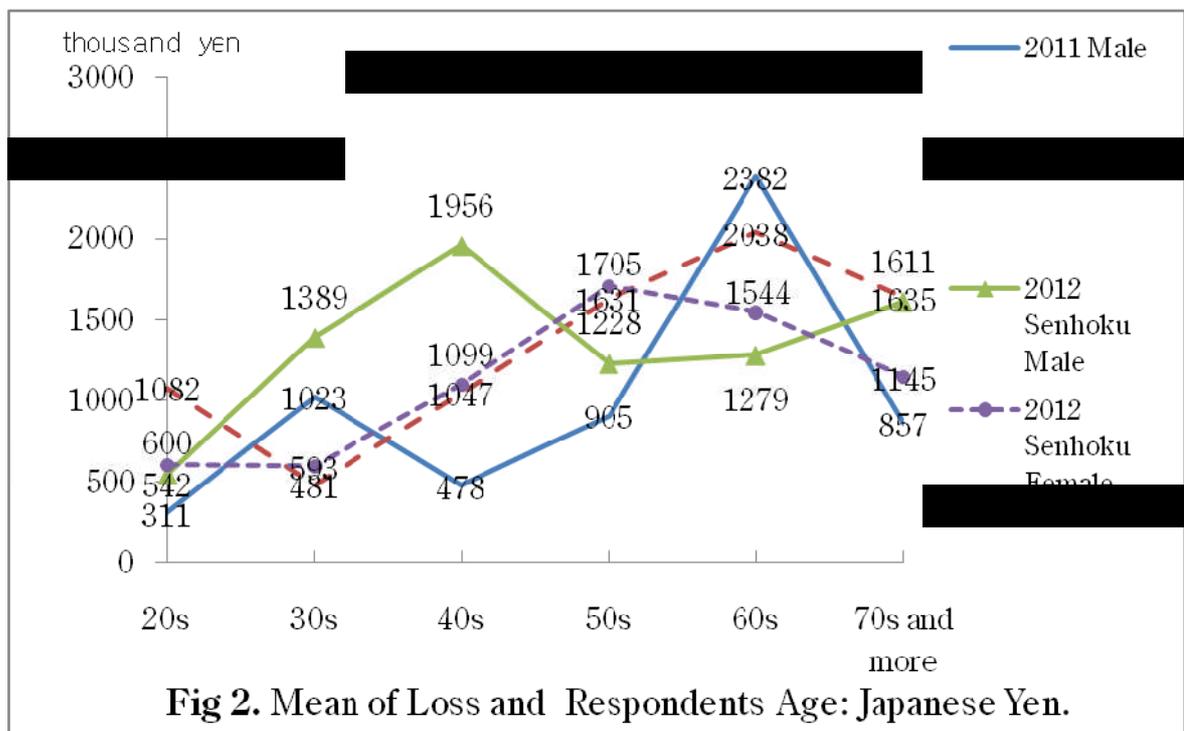
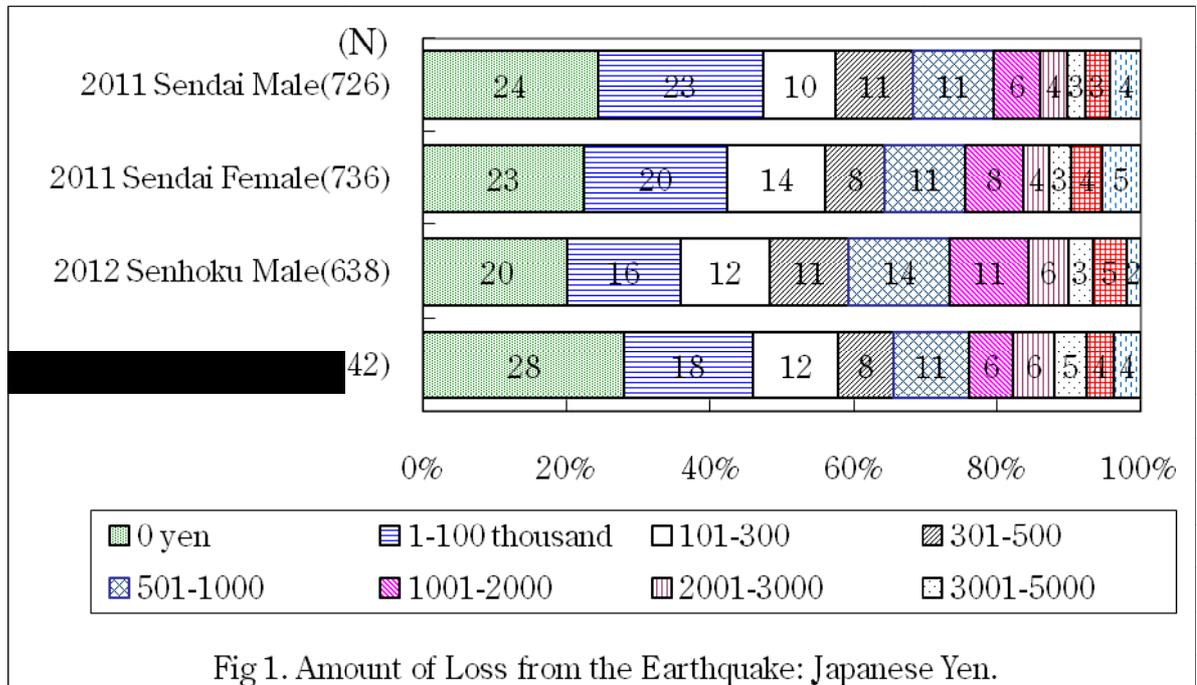
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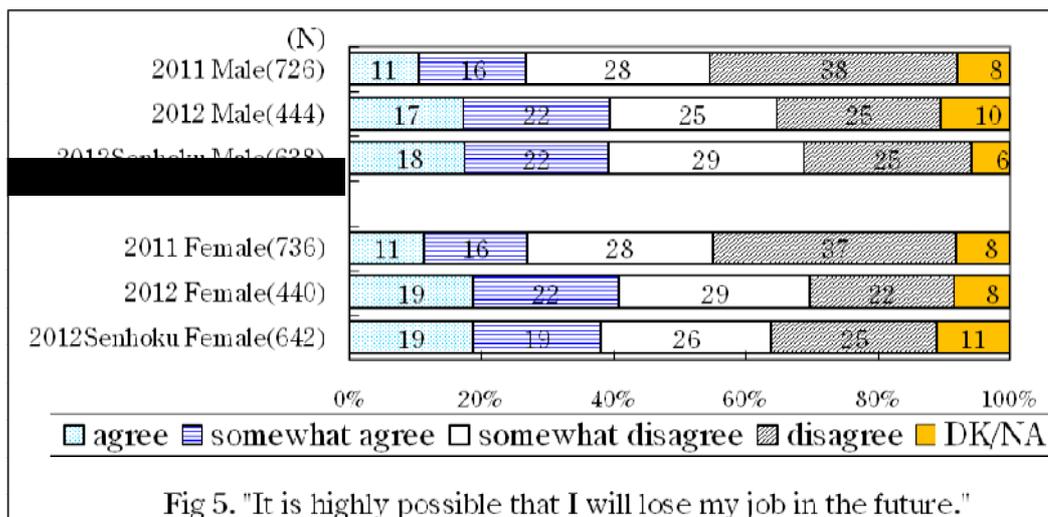
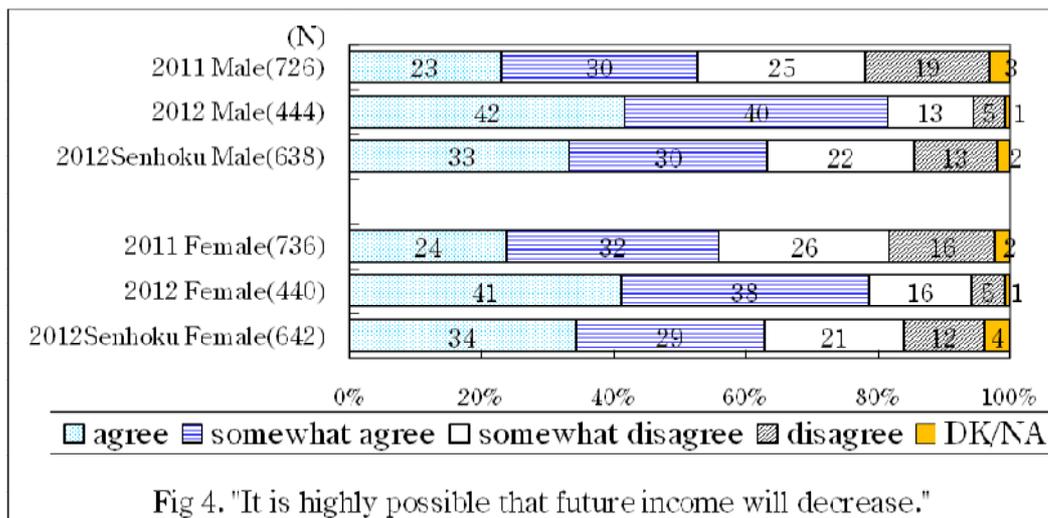
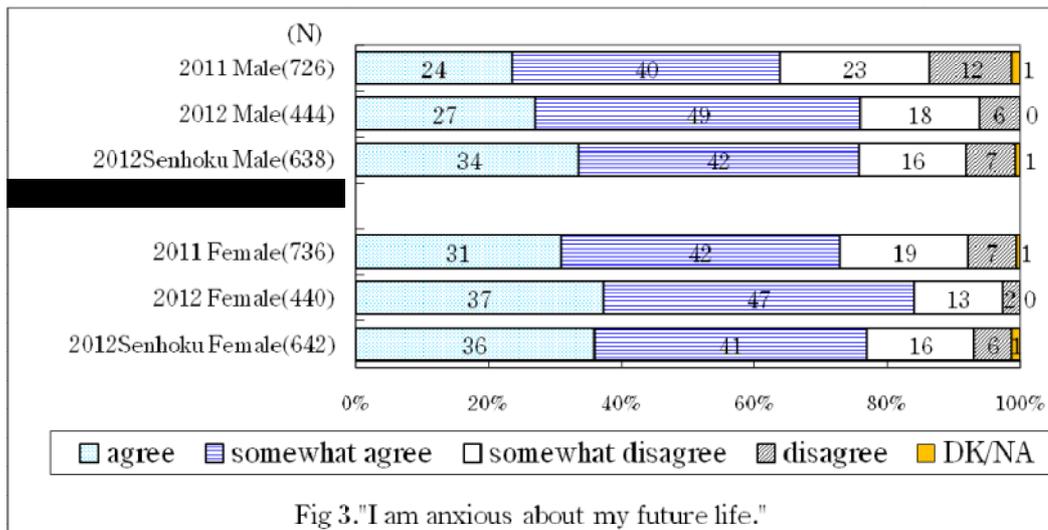
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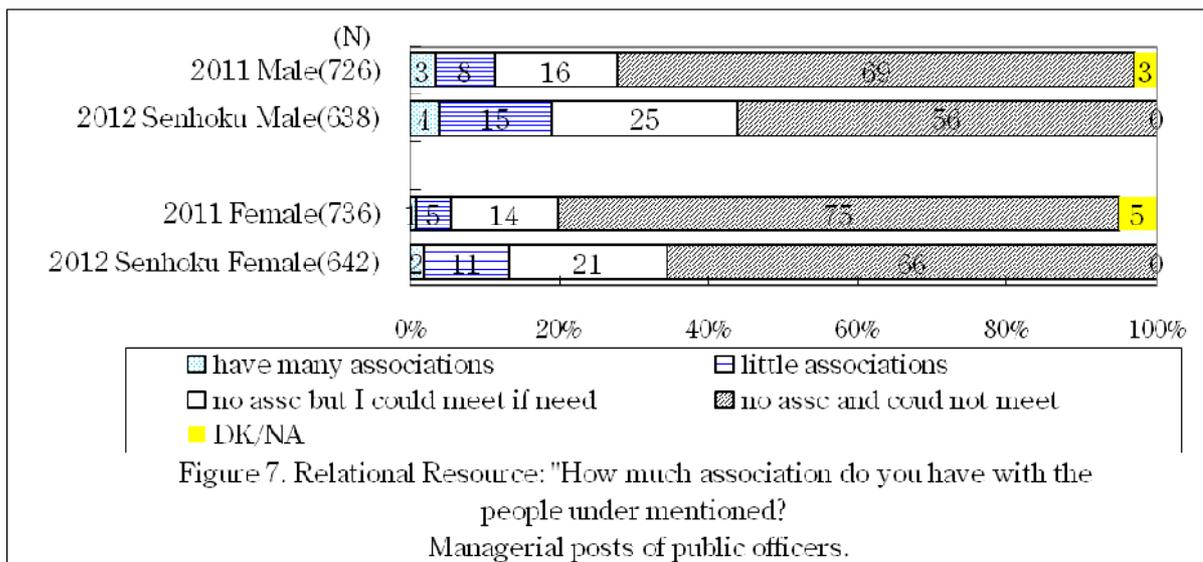
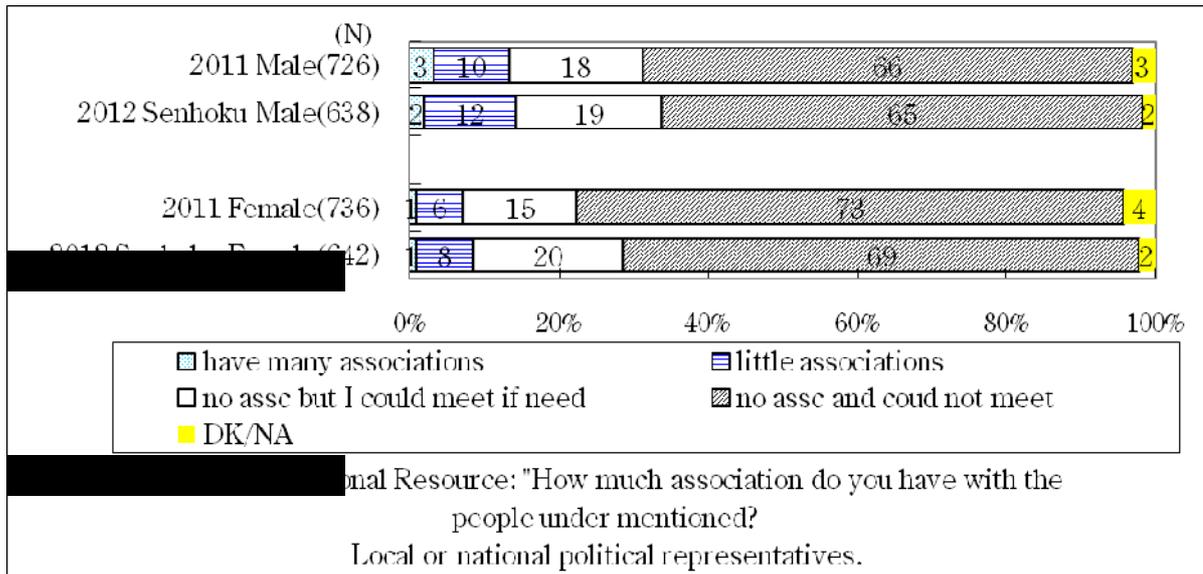
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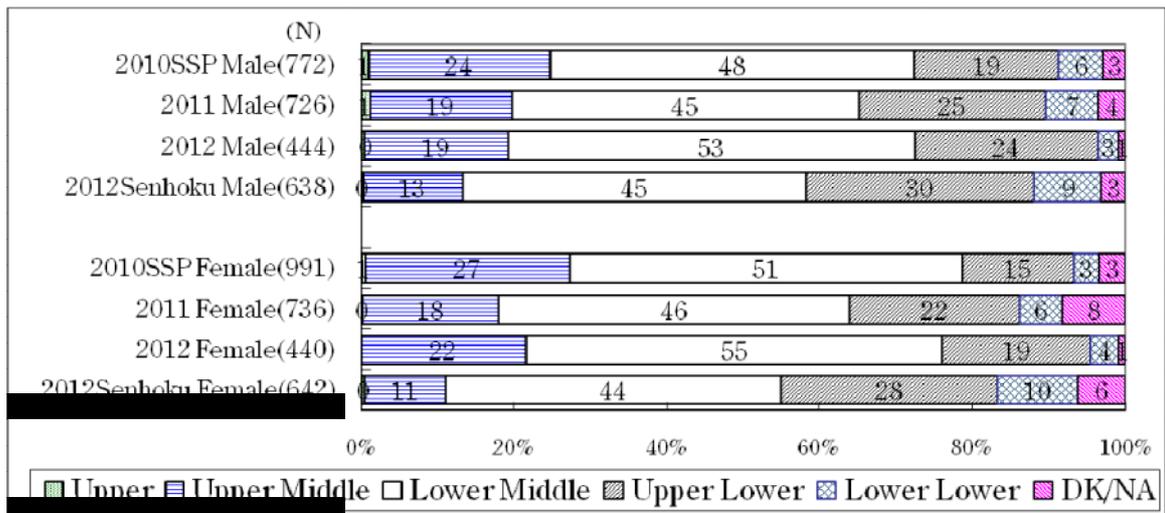


Fig 8. Self Dified Stratification

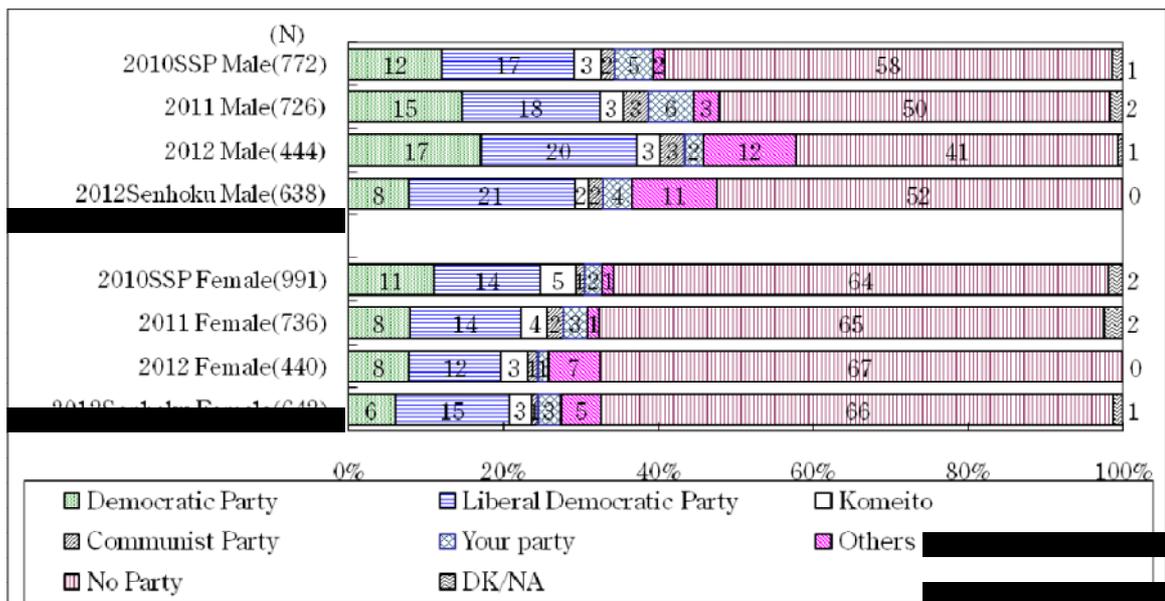
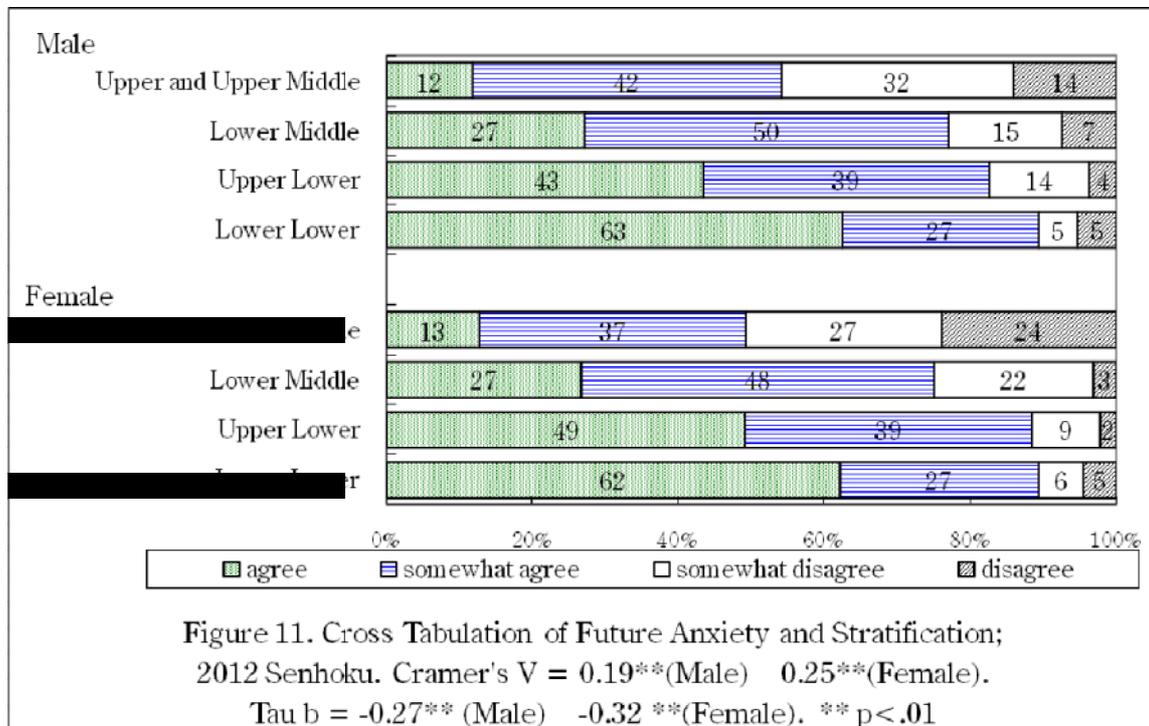
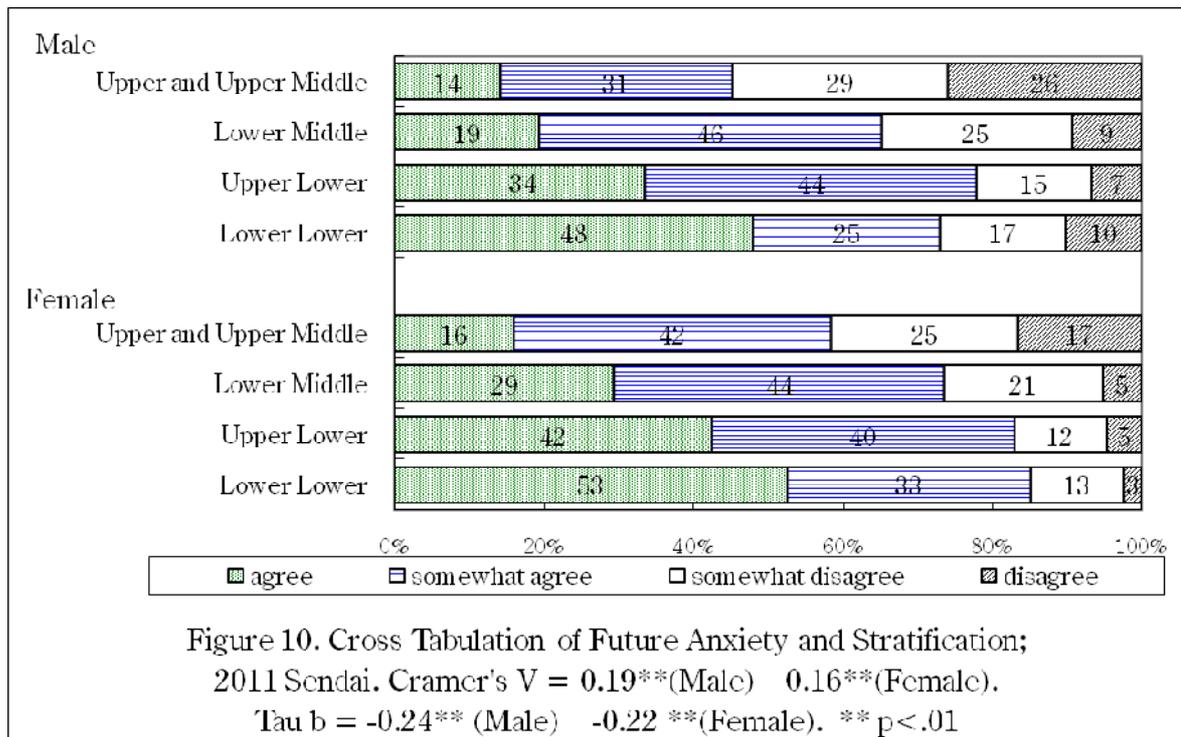
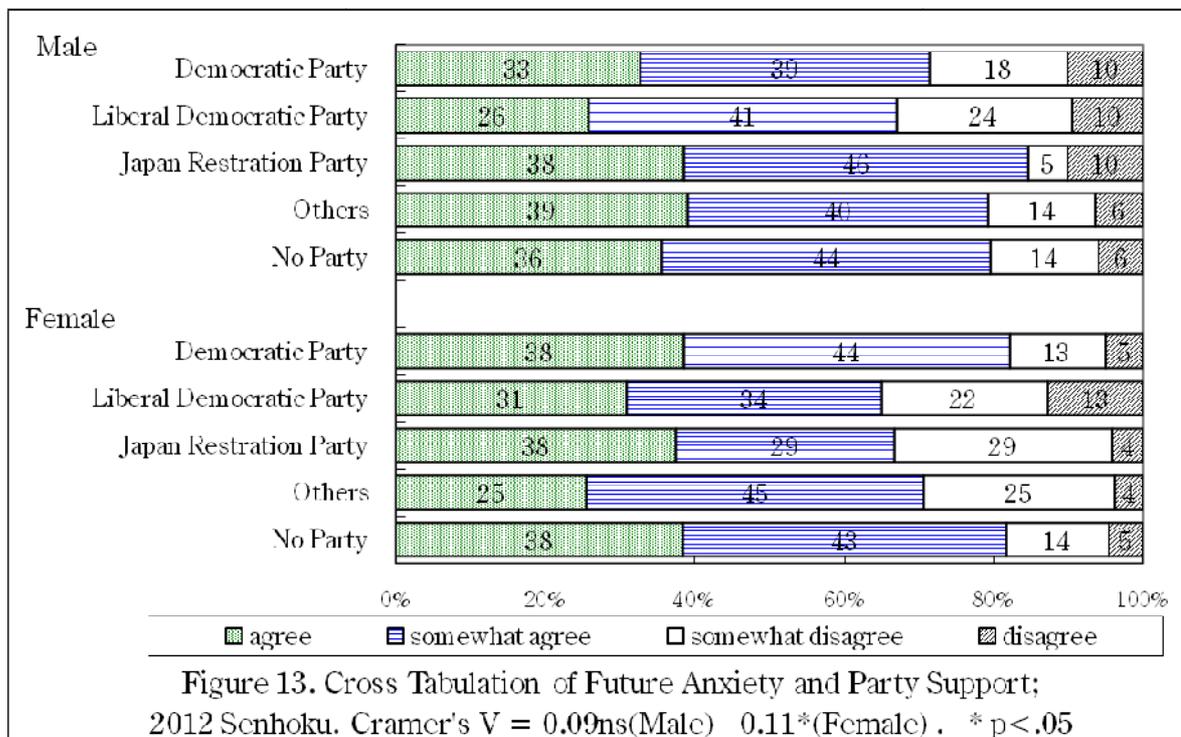
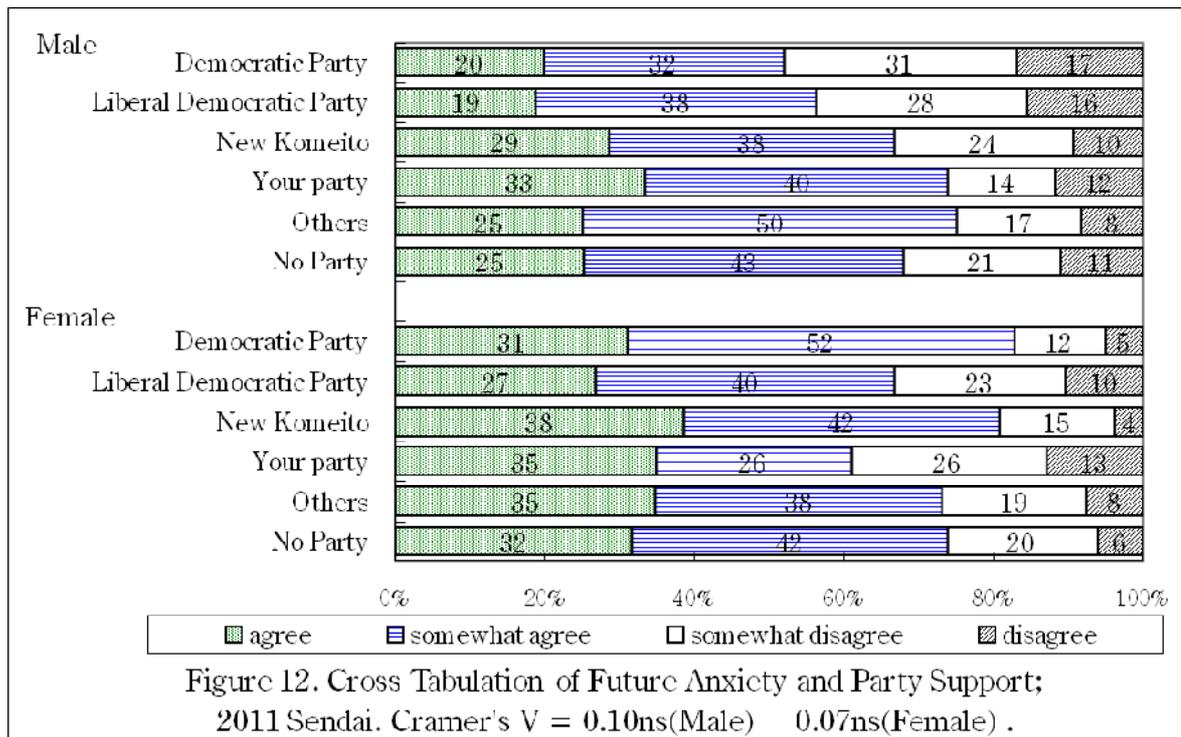
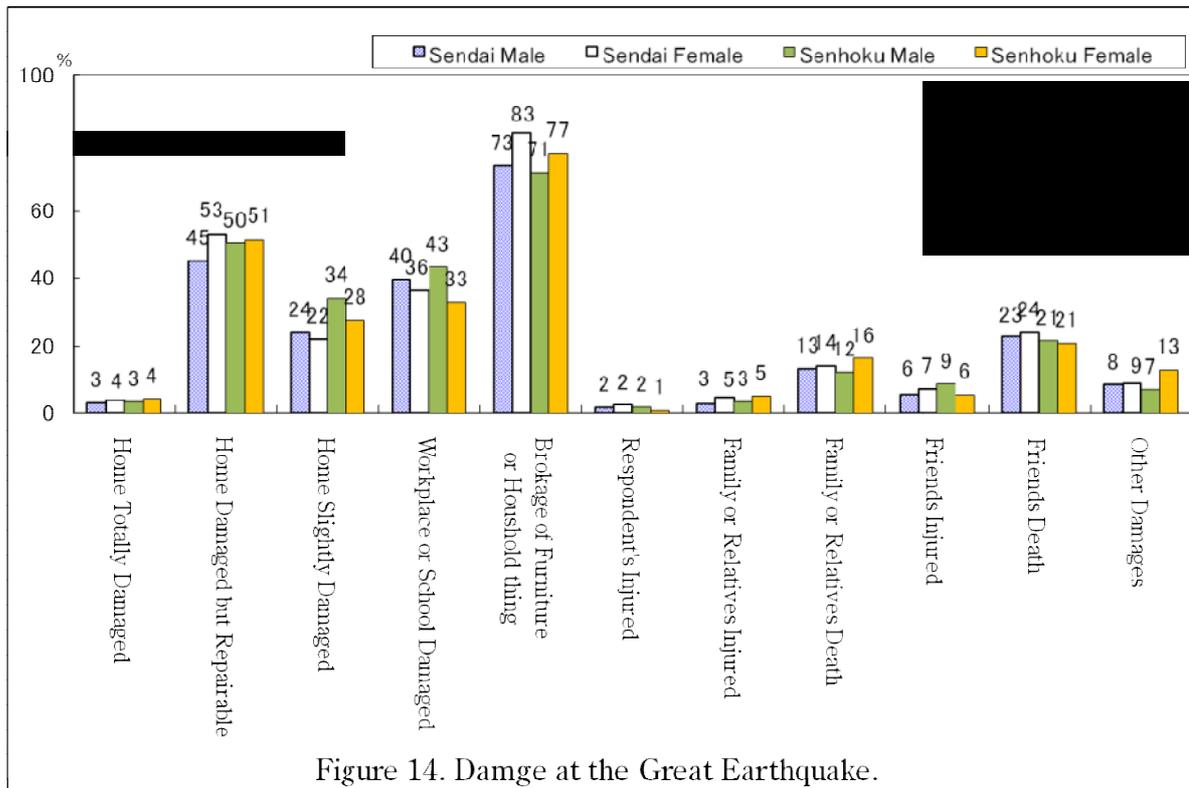


Fig 9. Attitude about Political Party Support







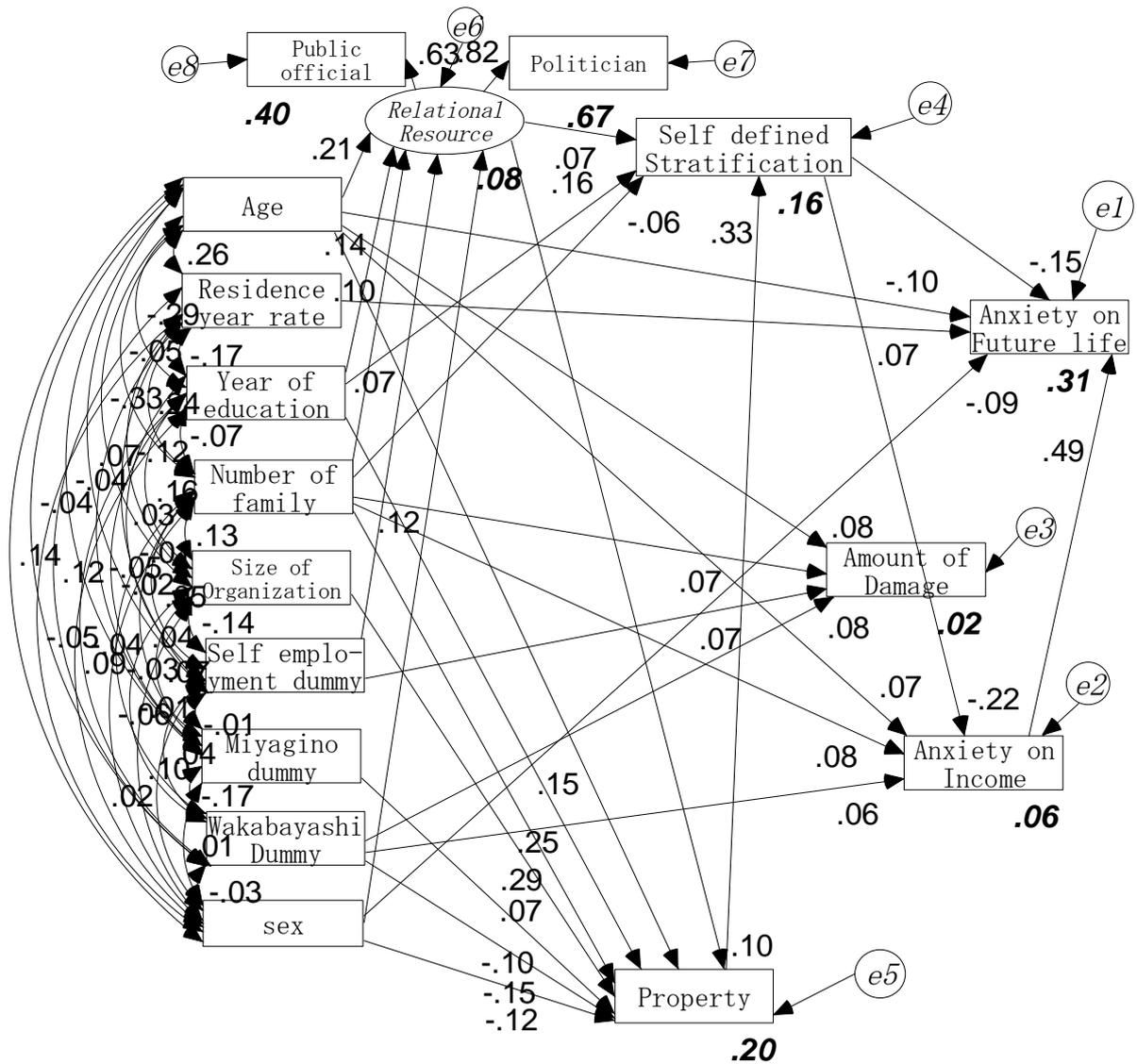


Fig 15. SEM on Amount of damage and anxiety.  
 2011 Sendai Survey. N=1216.  
 Standardized coefficients. Bold numbers below variables are  
 R-squares. Chi-square=76.74 df=52 p=.01 AIC=244.74  
 GFI=.99 AGFI=.98 CFI=.99 RMR=2.95 RMSEA=.02

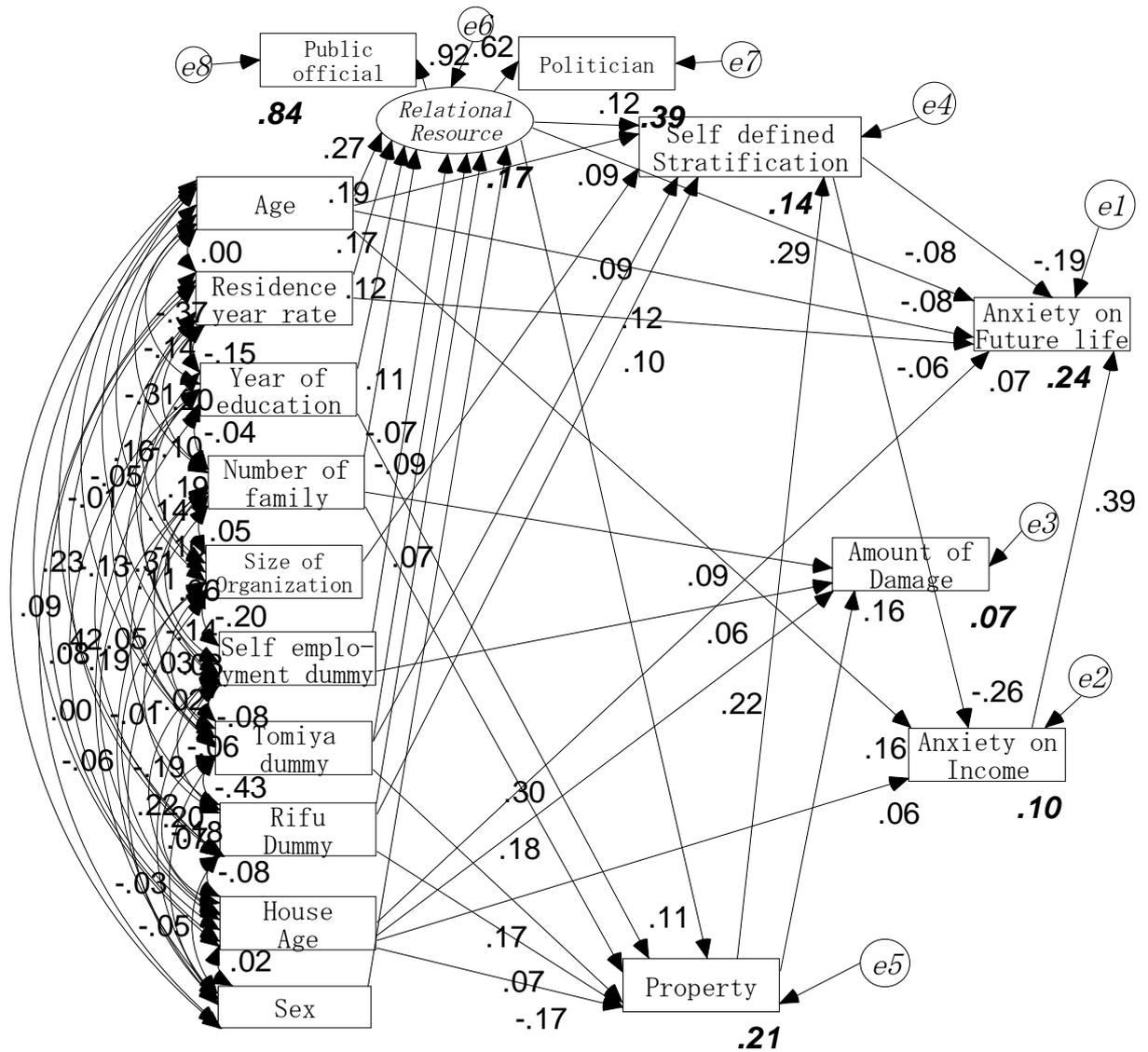


Fig 16. SEM on Amount of damage and anxiety.  
 2012 Senhoku Survey. N=1115.  
 Standardized coefficients. Bold numbers below variables are  
 R-squares. Chi-square=102.49 df=56 p=.00 AIC=296.49  
 GFI=.99 AGFI=.97 CFI=.98 RMR=9.46 RMSEA=.03