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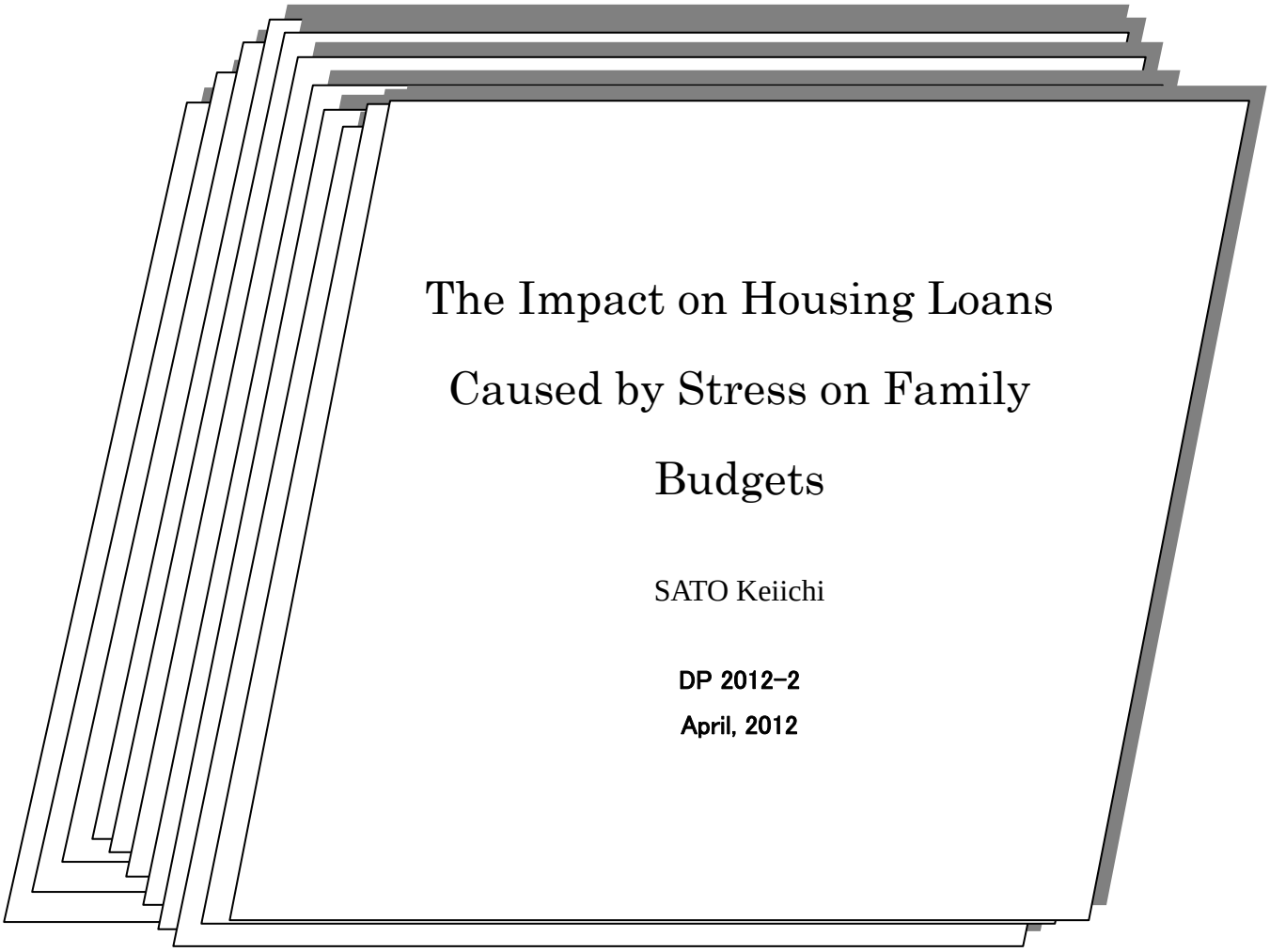

The Impact on Housing Loans Caused by Stress on Family Budgets

SATO Keiichi

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Financial Research Center (FSA Institute)
Financial Services Agency
Government of Japan
3-2-1 Kasumigaseki, Chiyoda-ku, Tokyo 100-8967, Japan

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The Impact on Housing Loans Caused by Stress on Family Budgets

Keiichi SATO*

Abstract

This paper uses social surveys and statistical techniques to investigate methods for monitoring the risks on housing loans in Japan caused by family budgets.

With the income of households burdened with a mortgage continuing to decrease, and savings also on the decline, the only thing not decreasing is the amount of mortgage repayments. If anything, it is on a slight upward trend. Consequently, the mortgage repayment ratio is also continuing to rise. One of the concerns in terms of risks on housing loans in Japan is that the decline in income levels will cause the middle class, which had previously maintained steady repayments, to become disjointed, and there will be an impact on repayments.

Before we begin to investigate the effects that environmental changes, such as decreasing incomes and rising interest rates, have on housing loans, we must first gain an understanding of the circumstances of individual family budgets (income, spending, savings, etc.) and of the details of their housing loans (product attributes, amounts of repayment, etc.).

In this study, with data obtained by utilizing the National Survey of Family Income and Expenditure to correct estimates from an Internet survey, which simultaneously asks about family budgets and the product attributes of housing loans, I prepared three determination processes:
(1) Sustainability of repayment (check of the relationship between disposable income, consumption expenditure and the amount of monthly mortgage repayments);
(2) Adjustment of family budgets (attachment of a maximum consumption expenditure, set according to the regional division and the number of household members); and
(3) Dissaving (check of whether a repayment amount, which is still short even after adjusting the family budget, can partially be covered by dipping into savings),
and I conducted an impact analysis by altering the environment, such as income or the amount of mortgage repayments.

Keywords: Housing loans, family budgets, Internet survey, National Survey of Family Income and Expenditure

* Associate Professor at the Center for Social Research and Data Archives, Institute of Social Science, University of Tokyo (Special Research Fellow, Financial Research Center (FSA Institute), Financial Services Agency). I would like to acknowledge Ms. Rie ASAKURA of FSA of Japan and Mr. Yoshitaka SAKAI of FSA Institute for the valuable feedback they provided on the earlier drafts of this paper.

1. Introduction

The Bank of Japan (2011) focuses on the idea that the term structures of default probability and prepayment are important for gaining an understanding of the lifetime earnings needed for ensuring the profitability of housing loans, and it introduces ways of measuring this. As part of this, the report cites the importance of stress testing as something to keep in mind, making several comments, including that: no mention has been made of the effects of macroeconomic factors on defaults and prepayments; there are few noticeable examples of macroeconomic factors having been incorporated directly into a model because the model would become increasingly complex; and the impact of significant stress events like the Great East Japan Earthquake are difficult to assess in analyses using ordinary models.

The Bank of Japan (2007) sets forth a hypothetical example of a mortgage stress test to be conducted by financial institutions. It sets stresses such as a default rate of double the base scenario,[1] a default recovery rate[2] of half the base scenario, and a prepayment rate[3] of double the base scenario. The question here is: How much of a stress would it be appropriate to set? For example, suppose a situation where profitability can be ensured even if the default rate is set at double the base scenario, but cannot be ensured if the rate is tripled. How likely is the triple scenario? The appropriateness of the stress to apply is information necessary for implementing measures.

We cannot begin to investigate the effects that changes in the external environment, such as decreasing incomes, rising interest rates and tax increases, have on current housing loans—the balance of which is said to be 180 trillion yen—unless we first gain an understanding of the circumstances of individual family budgets (income, spending, savings, etc.) and of the details of their housing loans (product attributes, amounts of repayment, etc.).

Let us look for a moment at some of the surveys on Japan's housing finance. The Family Income and Expenditure Survey and the National Survey of Family Income and Expenditure, which are both conducted by the Ministry of Internal Affairs and Communications (MIC) Statistics Bureau, allow us to understand the details of family budgets, but not about the product attributes of housing loans. Surveys conducted by the Japan Housing Finance Agency (JHF) and the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) allow us to understand the product attributes of housing loans, but not about the details of family budgets.

Consequently, I designed and conducted an independent Internet survey, which simultaneously asks about family budgets and the details of housing loans, and I then used the National Survey of Family Income and Expenditure and a propensity score to correct the estimates. By comparing this against the results of other surveys, including the National Survey of Family Income and Expenditure, I was able to confirm that corrected estimations are possible which are, for the most part, appropriate (Sato (2012)).

In this paper, having conducted a number of interview surveys, I have written a number of arguments concerning the risk management of housing loans (Chapter 2); I have used the data and corrected estimates of Sato (2012) to analyze the impact on housing loans caused by individual stresses on family budgets (Chapters 3 and 4); and I have described my observations (Chapter 5).

[1] In the hypothetical example, a term structure of default probability has been assumed, estimated from data from financial institutions.
[2] In the hypothetical example, assumed to be fixed at 60%.
[3] In the hypothetical example, a 6% PSJ is assumed. The term "PSJ" refers to the Prepayment Standard Japan (PSJ) model for housing loans, developed by the Japan Securities Dealers Association (JSDA).

2. Circumstances Surrounding Housing Loans in Japan

2.1. Securitization trends

In Japan, the Japan Housing Finance Agency (JHF), formerly the Government Housing Loan Corporation, has essentially withdrawn from the business of direct lending. It is engaged in the business of securitization support, and provides the "Flat 35" Purchase Program and Guarantee Program schemes.

Statistics on the balance of the Purchase Program and the Guarantee Program have been kept since 2003 and 2006 respectively. As at the end of 2010, the balance of housing loans was approximately 180 trillion yen, whereas the balance of the Purchase Program was about 6.40 trillion yen and the balance of the Guarantee Program was about 0.26 trillion yen, giving an overall securitization ratio of about 4%.

Meanwhile, in the United States (US), where subprime mortgages became a problem, as at the end of 2010, whereas the balance of housing loans was approximately 10 trillion dollars, the balance of agency mortgage-backed securities (MBS) was about 5 trillion dollars and the balance of private MBS was about 1.3 trillion dollars, giving an overall securitization ratio in excess of 60%. Compared to this, Japan's securitization market is arguably quite small.

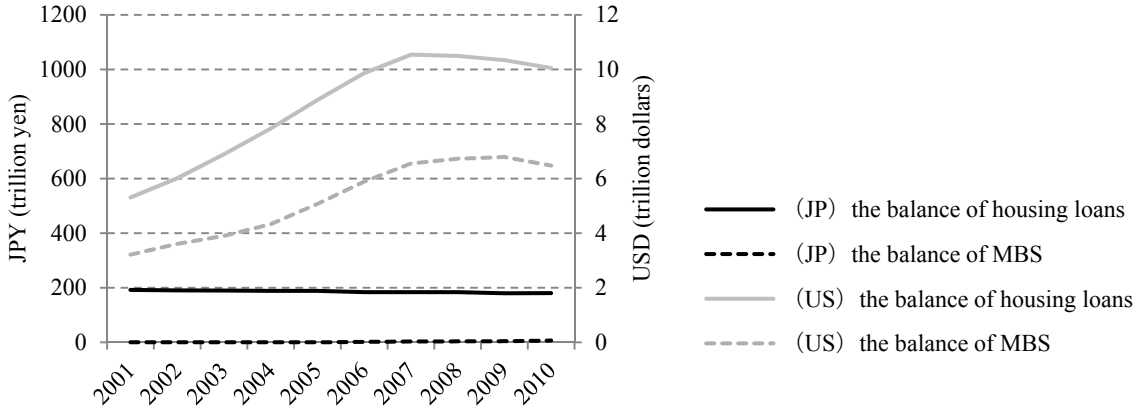


Figure 1. Balance of housing loans and securitization transition

2.2. Increase in housing loans provided by private-sector financial institutions

In Japan, ever since the collapse of the bubble economy, loans by domestic financial institutions to government and business have stagnated, and with the abolishment of the Government Housing Loan Corporation, the balance of outstanding housing loans at Japan's banks has continued to trend upward.

Looking at the sector-by-sector changes in loans and discounts provided by domestic banks, we can confirm that loans to government and business have decreased, while personal loans for housing finance have increased.

Looking at the changes in the balance of outstanding housing loans by business type, whereas JHF's direct finance has decreased significantly from a high of 76 trillion yen (2000) to 21 trillion yen (2010), the balance of outstanding housing loans by domestic banks has continued to increase, and as at the end of FY2010, it exceeded 100 trillion yen. Likewise, the balance of outstanding housing loans by "Other" non-bank financial institutions had reached close to 50 trillion yen as at the end of FY2010.

The Bank of Japan (2011) has calculated the ratios of housing loans as a percentage of all loans for correspondent banks and *shinkin* banks (credit associations) of the Bank of Japan. One of the things

this shows is that, between the end of FY2000 and the end of FY2010, the peak of the housing loans ratio distribution had shifted from 15-20% to a higher level of 20-25%.

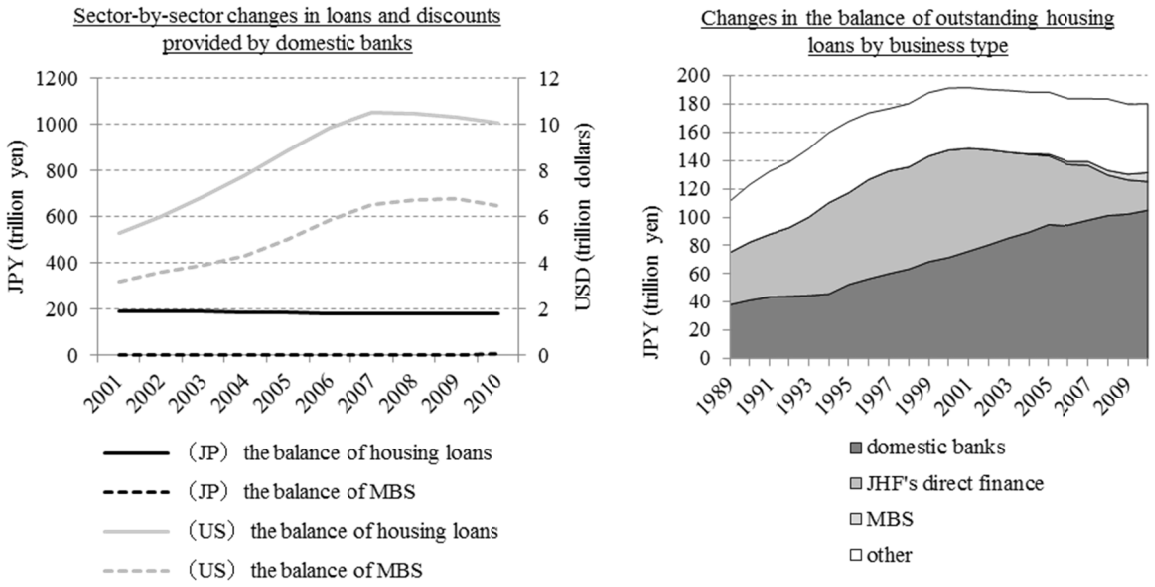


Figure2. Increase in the housing loan of a commercial financial institution

2.3. Movement of housing loan interest rates

Figure 3 shows the shift in housing loan interest rates. The median variable interest rate for city banks was 6.9% in 1991. This had fallen to 2.625% in 1995, and it has remained at a low level ever since.

With trust banks and regional banks, there have also been reports in the media that competition for low-interest housing loans has accelerated, with the banks widening the range of preferential interest rates one after the other, and some banks even applying extremely low interest rates of about 0.7% depending on the customer.[4]

Variable interest rates are said to be determined based on the short-term prime rate which is influenced by the policy interest rate. It can be confirmed that the two are more or less linked.

Based on the funds received in February 2012, the Flat 35 interest rate, which corresponds to a fixed interest rate, was at the 2.180% - 3.200% level (for loans with a repayment period of between 21 and 35 years inclusive.)

[4] Source: "*Juutaku Roon: Teikinri Kyousou*" (Housing Loans: Competition over Low Interest Rates), page 1, Nihon Keizai Shimbun (morning edition, July 22, 2011). Using the advertising materials of a number of financial institutions, the Bank of Japan (2011) as shown examples of preferential interest rates. Even though the variable interest rate is standard at about 2.5%, their rates are about 1% after preferential treatment.

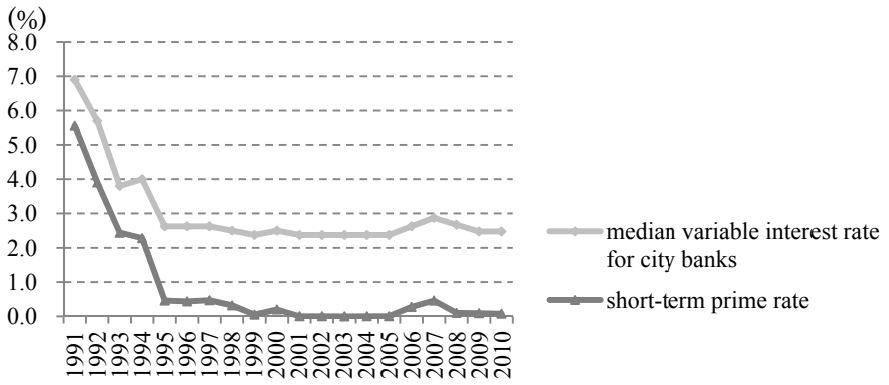


Figure3. Shift in housing loan interest rates

2.4. Refinancing, prepayments, defaults, changes in loan conditions

In FY2009, the ratio of refinancing as a percentage of the amount of new housing loans was an average of 33%, that is, over a third of new loans (26% in FY2008, 25% in FY2007 and 26% in FY2006).[5]

In its monthly disclosure of factors and other information for investors, the JHF discloses such data as the conditional prepayment rate for each issued bond (illustrated by example in Figure 4) and the replacement or partial cancellation rate (illustrated by example in Figures 5 and 6). From this we can surmise the prepayments and defaults situation. Looking at the figures for each fiscal year, while it could seem that there is no apparent significant variance in the trend for the term structure of conditional prepayment rates, it would seem that the term structure of replacement or partial cancellation rates (long-term delinquency) has been changing in recent years.

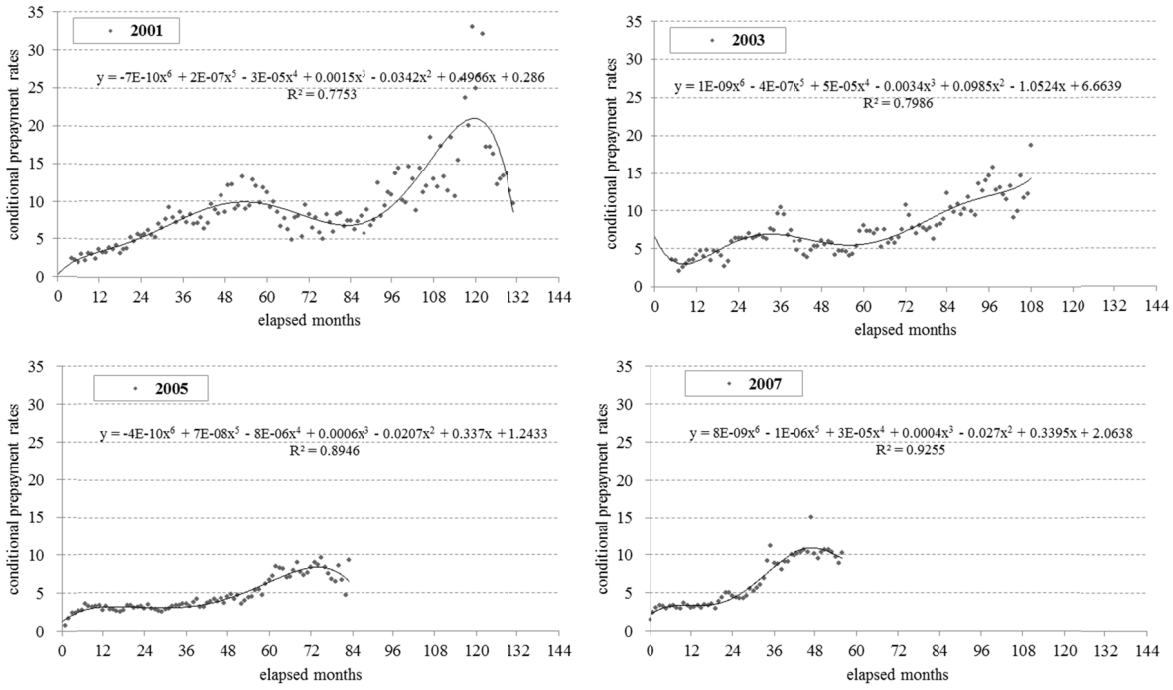


Figure4. Conditional prepayment rates of the JHF disclosure

[5] Source: "*Heisei 22 Nendo Minkan Juutaku Roon no Kashidashi Doukou Chousa Kekka*" (Results of the Survey on Movements in Private-Sector Housing Loans, FY2010), JHF (October 29, 2010).

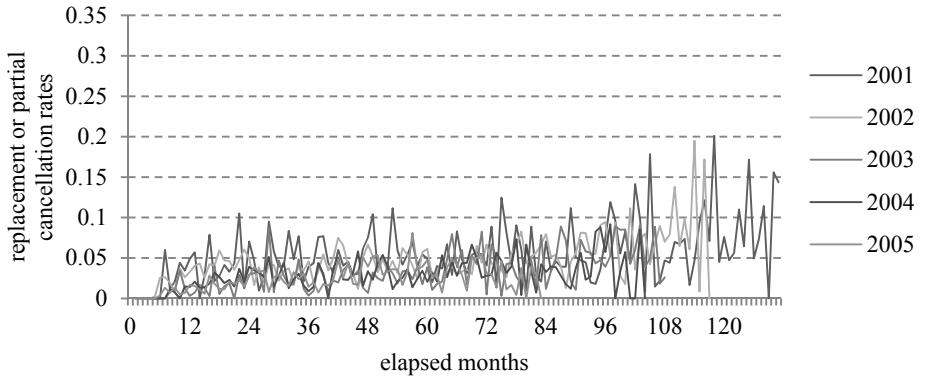


Figure5. Replacement or partial cancellation rates of the JHF disclosure (2001-2005)

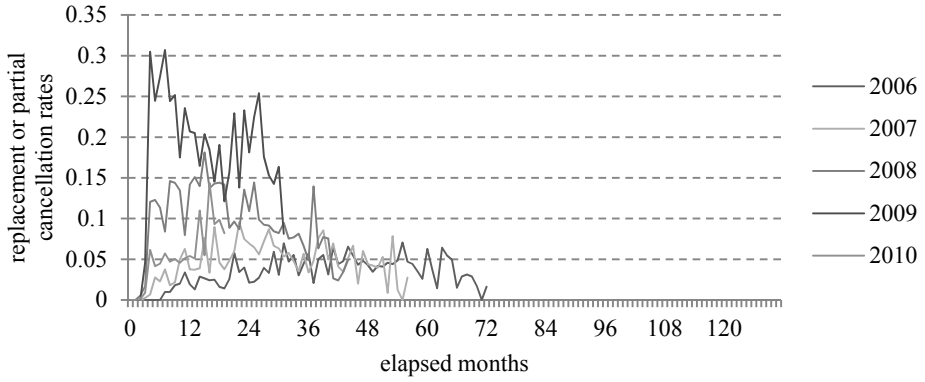


Figure6. Replacement or partial cancellation rates of the JHF disclosure (2006-2010)

With regard to the prepayments and defaults situation for housing loans at financial institutions other than JHF, while these are managed by each individual institution, this information has not been aggregated and released to the public. Therefore, it would appear that, at present, we are not able to get a complete view based on public information.

In December 2009, the Act on Temporary Measures to Facilitate Financing for Small and Medium-Sized Enterprises, etc. came into effect. One of the aims of this act was to encourage financial institutions to make changes to loan conditions for applications made by small and medium-sized enterprises and by mortgage borrowers. The limitation of the act was subsequently extended by one year, and it is now effective until March 31, 2013. Between December 2009 and September 30, 2011, a total of approximately 218,000 applications (about 3.3 trillion yen) were made across all business types, and changes to loan conditions were made for approximately 170,000 applications (about 2.6 trillion yen).[6]

2.5. Trends in research and consulting for the risk management of housing loans

Moriizumi (2003) takes a general view of mortgage instrument choice as an analysis of family budget behavior regarding mortgages, focusing on examples of empirical analysis in the US. She points out that, in plotting a course for future analysis, in Japan, there is no "data released publicly on the issuance and balance of fixed rate mortgage (FRM) and adjustable rate mortgage (ARM) loans," and there is no "data on household mortgages that could be used in estimates." Ichijo and Moridaira (2006) estimate prepayments using the proportional hazards model. They use data from individual

[6] Source: "*Chuushou Kigyou Kinyuu Enkatsuka Hou ni Motodzuku Kashitsuke Jouken no Henkou-tou no Joukyou nitsuite*" (Changes in Loan Conditions based on the SME Financing Facilitation Act and other Conditions), Financial Services Agency (January 20, 2012).

private-sector financial institutions for the period from January 1995 to June 2000. Kutsuzawa (2008) analyzes the product choice, prepayments and refinancing behavior of mortgage users, based on data collected through his own Internet survey. He uses multinomial logit analysis on the choice of borrowing and refinancing of loans, and he uses the proportional hazards model for estimation of prepayments and delinquency.

The Bank of Japan (2007) provides an outline of an econometric model of credit risk and prepayment risk, and shows an image of profit management and stress simulation. The Bank of Japan (2008) makes a tentative calculation of the profitability of housing loans provided by banks during the 2003-2007 period, and conducts regression analysis using information on obligor properties disclosed by the JHF. In terms of risk management issues seen from a macro perspective, reference is made to the "risk of changes in the macroeconomic environment increasing the borrower default rate." The Bank of Japan (2011) regards the term structures of default probability and prepayment as important for gaining an understanding of the lifetime earnings needed for ensuring the profitability of housing loans. It presents a summary of a logit regression model and survival analysis, and explains a number of important points. As stated at the outset of this paper, it makes several comments, including that: there are few noticeable examples of macroeconomic factors having been incorporated directly into a model because the model would become increasingly complex; and the impact of significant stress events like the Great East Japan Earthquake are difficult to assess in analyses using ordinary models.

In research and business related to the risk management of housing loans, as pointed out by Moriizumi (2003), as well as measurement techniques, there needs to be data for analysis. However, it has been pointed out that, in most cases, the data is scattered throughout several businesses affiliated with financial institutions or surety companies and the like, and so, more often than not, data has not been accumulated properly.[7] Amid this, a Credit Risk Data Consortium has been built to communalize the mortgage data of several financial institutions and to realize more sophisticated credit risk analysis as well as benchmark analysis (comparison between own bank and other banks). In fact, a large database has been built and is being used in the consulting business.

2.6. Family budget circumstances

Sato (2012) uses individual data from the National Survey of Family Income and Expenditure to look at the family budgets of households that are paying mortgages. The rest of this section is an excerpt of the key results.

Of the total 50,010,000 households (including one-person households), 22%, or 11,040,000 households have mortgages. Looking at a breakdown of the number of households with mortgages by type of household, there were approximately 8,350,000 wage-earner households, approximately 1,910,000 non-wage-earner households and approximately 780,000 unemployed households.

Looking at each type of household, in the 15 year period between 1994 and 2009, the annual income of wage-earner households decreased by 14%, and their disposable income decreased by 12%. Nevertheless, their repayment of loans for house and land purchases increased by as much as 30%, and as a result, their mortgage repayment ratio actually reached 1.5. Their savings decreased by 14%, and their liabilities for house and land purchases increased by a considerable 40%.

As for unemployed households, in the 15 year period between 1994 and 2009, their annual income decreased by 19%, and their disposable income decreased by a hefty 36%. Their repayment of loans for house and land purchases increased by 21%, and as a result, their mortgage repayment ratio reached about 2.0. Their dissavings increased from 81,000 yen to 125,000 yen.

[7] Source: "*Juutaku Roon no Shuueki Risuku Kanri Koudouka*" (Sophistication of Earnings Risk Management for Housing Loans), Mitsubishi Research Institute.

We can confirm that the family budget circumstances of households with mortgages have continued to change, and it would appear that this has been partly due to the change in loan conditions for about 170,000 loans (about 2.6 trillion yen) as a consequence of the Financing Facilitation Act.

Table1. Family budgets of households who are paying mortgages

household type		1994 (a)	1999	2004	2009 (b)	changed rate (b/a×100-100)
wage-earner households	annual income (10 thousand yen)	904	889	802	778	-13.9
	disposable income (10 thousand yen)	48.6	49.0	45.3	42.7	-12.1
	consumption expenditure (10 thousand yen)	37.5	35.7	33.4	31.8	-15.3
	repayment of housing loans (10 thousand yen)	5.6	6.6	7.0	7.2	29.8
	housing loans repayment ratio (%)	11.4	13.5	15.5	16.9	47.6
	savings total (10 thousand yen)	996	1004	913	856	-14.1
	liabilities total (10 thousand yen)	1151	1495	1572	1588	38.0
	liabilities for house and land purchases (10 thousand yen)	1095	1432	1513	1535	40.2
	dissavings (10 thousand yen)	-0.6	0.3	0.2	-0.5	-13.2
	householder's age	45.9	46.0	45.9	46.0	0.2
unemployed households	annual income (10 thousand yen)	605	552	512	493	-18.5
	disposable income (10 thousand yen)	27.5	26.7	20.0	17.6	-36.0
	consumption expenditure (10 thousand yen)	29.2	28.1	25.8	25.1	-14.3
	repayment of housing loans (10 thousand yen)	4.2	6.0	4.7	5.1	21.4
	housing loans repayment ratio (%)	15.2	22.6	23.7	28.8	89.5
	savings total (10 thousand yen)	1587	1489	1367	1124	-29.2
	liabilities total (10 thousand yen)	846	785	854	925	9.3
	liabilities for house and land purchases (10 thousand yen)	808	754	812	890	10.1
	dissavings (10 thousand yen)	-8.1	-12.5	-11.5	-12.5	53.9
	householder's age	62.5	63.2	65.3	65.4	4.6

Sato(2012)

3. Analysis of the Impact of Family Budgets

3.1. Outline of the correction of estimates from the Internet survey

The repayment behavior of households is at the root of the problem for mortgages. Before we can begin to investigate the effects that environmental changes, such as interest rates and income, have on current housing loans, we must first gain an understanding of the circumstances of individual family budgets (disposable income, savings, etc.) and of the details of their housing loans (interest rates, repayment amounts, etc.).

It would be difficult to use data on the housing loans of individual institutions in research, and even if it could be used, not everything could be covered. In particular, it needs to be kept in mind that many different financial institutions other than city banks are also involved in housing loans, and so there is the difficult problem of how to acquire data to use in analysis.

In terms of government statistics on housing loans, there are two surveys conducted by the Ministry of Internal Affairs and Communications (MIC) Statistics Bureau: the Family Income and Expenditure Survey and the National Survey of Family Income and Expenditure. With either survey, we are able to see amounts for mortgage payments and outstanding mortgage debt among the figures for family budgets, savings and debt. The Family Income and Expenditure Survey is a monthly survey of trends, which uses a small sample of households. The National Survey of Family Income and Expenditure is a relatively large structural survey with a five-year cycle. It is purported that this survey allows for analysis broken down into detailed classifications of geographical areas and household structures (Yoshizoe (2004)). However, it does not survey the details of housing loans, such as the lending financial institution or the interest rate type.

At the Japan Housing Finance Agency (JHF) and the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), several questionnaire surveys on housing loans have been conducted previously which also include financial institutions, interest rate types and so forth. The subjects surveyed (periods of time, financial institutions) and the survey items (which do not allow for an understanding of family budget circumstances) are limited, and so it is difficult to directly surmise the effects that interest rate fluctuations and changes in the employment situation have on housing loans.

A possible solution could be to conduct an independent survey designed to grasp the family budget and housing loan circumstances. However, coupled with people's heightened sense of privacy protection, asking questions about people's detailed family budgets, savings and debt through general postal surveys or door-to-door surveys and getting them to respond would be fraught with considerable difficulty. A realistic option could be to make use of Internet surveys, which have been increasing in popularity in recent years given the convenience and the costs involved in conducting them. In fact, Internet surveys have been used for various surveys of mortgage users conducted at the JHF, and also by Kutsuzawa (2008).

However, since Internet surveys involve a non-random selection from a panel of individuals offering to cooperate in surveys, they have the problem of having a survey bias. Recently, though, progress has been made in examining methods for using propensity scores to make better inferences about a population based on an Internet survey. The propensity score is an idea proposed by Rosenbaum and Rubin (1983), and has been used as a technique for approximating results from a non-randomly selected sample to those that could be obtained by performing a random assignment. Hoshino and Maeda (2006) conducted an Internet survey for some of the questions from one of Japan's representative social surveys—the Japanese General Social Survey (JGSS)—and by using a propensity score, they show that good corrections are possible.

Sato (2012) designed and conducted an Internet survey, which simultaneously asks about family budgets and the details of housing loans,[8] and then used the National Survey of Family Income and Expenditure and a propensity score to correct the estimates. By comparing this against the results of other surveys, including the National Survey of Family Income and Expenditure, I have been able to confirm that results can be obtained which are, for the most part, appropriate.

Sato (2012) uses the following procedure for making estimates: using the sample secured in the Internet survey and the sample from the National Survey of Family Income and Expenditure, utilize a propensity score to numerically express the difference in the propensity for covariates (items common to the Internet survey and the National Survey of Family Income and Expenditure) to appear, and then make corrections so that the sample secured in the Internet survey more closely resembles the sample from the National Survey of Family Income and Expenditure, before applying an aggregation factor for the National Survey of Family Income and Expenditure.

The propensity score e_i can be expressed as

$$e_i = Pr(z_i = 1|x_i)$$

being the probability of z_i (Internet survey = 1, National Survey of Family Income and Expenditure = 0) being 1 when the covariate data is x_i. The probability of z_i being 1 can be represented using a logistic regression model with k covariates x_i included as explanatory variables. It is said that, in order to greatly increase the weight of survey respondents that would otherwise have a small propensity score estimate if the expression was used without change, applying a conversion to the effect that any scores less than a specific threshold should be made the same as the threshold will produce more stable results.[9] Sato (2012) assumes the threshold to be 0.1.

$$e_i = \begin{cases} e_i\ (e_i \geq 0.1) \\ 0.1(ohterwise) \end{cases}$$

From the results of the Internet survey $E(y_{web}|z=1)$, the value to be estimated is $E(y_{web}|z=0)$ in the event the object item was answered in the National Survey of Family Income and Expenditure. Hoshino (2009)[10] express this as

$$\hat{E}(y_{web}|z=0) = \frac{\sum_{i=1}^{n} z_i \frac{1-e_i}{e_i} y_{web\ i}}{\sum_{i=1}^{n} z_i \frac{1-e_i}{e_i}}$$

Here, given that it would be excluded from the real calculation when $z_i = 0$, if we subtract the reciprocal of the odds of the propensity score, as the weight for correction $w_i=(1-e_i)/e_i$, correction can be made using the following formula. Note, the index w refers to the number of samples in the Internet survey.

$$\hat{E}(y_{web}|z=0) = \frac{\sum_{i=1}^{w} w_i \times y_{web\ i}}{\sum_{i=1}^{w} w_i}$$

Since the propensity of the difference in estimates of the Internet survey and the National Survey of Family Income and Expenditure vary depending on the type of household (wage-earner, non-wage-earner, unemployed), in order to prevent the model from becoming complicated, logistic regression analysis has been conducted for each type of household, and annual income, loan repayment amounts,

[8] The survey form is included in the materials at the end of this paper.
[9] Source: Hoshino (2009), p.182.
[10] Source: Hoshino (2009), p177.

savings, loan balances and (for wage-earner households and unemployed households) disposable income have been added to the covariates.

When using the propensity score to revise the estimates, since the sample number of the National Survey of Family Income and Expenditure for each assignment will no longer be accurately reproduced, this error will end up being included when estimating the number of households. For instance, when finding the total value of mortgage balances for each type of financial institution, this error would lead to the problem of the amount being estimated low. Therefore, I have added the process of applying a ratio (about 1.067) to the correction weight found using the propensity score. This ratio is calculated using the total number of households estimated from the correction weight found using the propensity score, 10,340,560, as the denominator, and the total number of households estimated in the National Survey of Family Income and Expenditure, 11,038,846 as the numerator.

The following table shows the final results of the corrected estimation. "NSFIE" refers to the figures from the National Survey of Family Income and Expenditure, and "simple correction" refers to when simple corrections have been made from the recovery ratios of each assignment. It can be confirmed that estimates have been corrected using a propensity score in a way which is for the most part, appropriate. Gaps in the figures for "current savings balance" have been corrected particularly well. For a comparison between the corrected estimates and existing statistical data, see Sato (2012).[11]

Table2. Estimation results of the Internet survey using a propensity score

household type	source	annual income	consumption expenditure	repayment of housing loans	savings total	liabilities for house and land purchases	housing loans repayment ratio	householde r's age	estimated household number
wage-earner	**NSFIE**	**778.1**	**42.73**	**7.20**	**855.7**	**1534.9**	**0.169**	**46.2**	**8,351,156**
	simple correction	767.2	37.13	8.07	530.6	1634.1	0.217	46.2	8,620,850
	correction using propensity scores	**768.5**	**41.57**	**8.03**	**876.4**	**1564.9**	**0.193**	**47.0**	**8,236,070**
non-wage-earner	**NSFIE**	**886.6**	**-**	**8.09**	**1422.9**	**1645.2**	**-**	**55.3**	**1,905,747**
	simple correction	701.7	41.63	9.30	967.1	1421.2	0.223	53.4	1,597,160
	correction using propensity scores	**784.1**	**44.57**	**9.37**	**1352.7**	**1444.2**	**0.210**	**52.3**	**2,034,206**
unemployed	**NSFIE**	**493.1**	**17.62**	**5.08**	**1124.3**	**890.1**	**0.288**	**65.4**	**781,944**
	simple correction	461.1	25.87	7.06	902.6	954.3	0.273	62.0	634,449
	correction using propensity scores	**471.2**	**23.91**	**6.11**	**1145.4**	**875.0**	**0.256**	**60.5**	**768,571**
total	**NSFIE**	**776.7**	**33.57**	**7.21**	**972.6**	**1508.3**	**0.215**	**49.1**	**11,038,847**
	simple correction	739.6	37.13	8.19	616.6	1563.0	0.221	48.2	10,852,458
	correction using propensity scores	**750.7**	**40.9**	**8.14**	**982.9**	**1494.6**	**0.199**	**48.92**	**11,038,846**

Sato(2012)

[11] For example, in a comparison between the balance of housing loans for each financial institution (compiled by JHF) and the corrected estimates from the Internet survey, whereas the total for the JHF summary was 175 trillion yen, the total for the Internet survey was 165 trillion yen. As for the balance of outstanding loans at domestic banks, whereas it was 104 trillion yen according to the JHF summary, it was 110 trillion yen for the Internet survey. That is, the variance was ±6%. However, in contrast to the JHF's balance of outstanding loans at 21 trillion yen, it was somewhat less according to the Internet survey at 18 trillion yen. Similarly, balances of credit associations, agricultural cooperatives and so forth also appeared to be lower in the Internet survey. Nevertheless, overall, none of the figures were widely different, and it has been concluded that the estimates made were, by and large, appropriate.

3.2. Method of impact analysis[12]

Table 3 lists the variables used in the impact analysis. The flow of the impact analysis from family budgets was designed as follows in line with the abbreviations in the table. Impact analysis is conducted by units of individual data obtained in the survey.

Table3. Variables and abbreviations which are used for impact analysis

Classification	item	abbreviations
Family Budgets	Monthly income	a
	nonconsumption expenditure	b
	disposable income	c
	consumption expenditure	d
savings	current savings balance	s
housing loans	type of interest rate	t
	(1：variable-rate, 2：fixed-to-adjustable-rate, 3：fixed-rate)	
	mode of repayment	h
	（1：repayment of both interest and principal in equal installments, 2：repayment of principal in equal installments）	
	interest rate	r
	monthly loan repayment amount	l
	loan balance	z
environmental changes	rate of change in income	ε
	rate of change in nonconsumption expenditure	β
	rate of change in consumption expenditure	δ
	rate of change in loan repayment amount	θ
determination	years required for full repayment	q
	determination result（0：possible to repay、1：difficult to repay）	h1～h3

○ **Determination method**

1st determination (sustainability of repayment)

If the difference between disposable income c and consumption expenditure d is larger than the monthly loan repayment amount l, repayments can be sustained. If the difference between disposable income c and consumption expenditure d is smaller than the monthly loan repayment amount l, then make adjustments to the family budget.

$$h1 = \begin{cases} 0\ (c - d > l) \\ 1\ (otherwise) \end{cases}$$

2nd determination (adjustment of family budgets)

If the difference between disposable income c and the maximum consumption expenditure g, which is set according to the regional division and the number of household members, is larger than the monthly loan repayment amount l, determine that repayments can be sustained. If the difference between disposable income c and the maximum consumption expenditure g is smaller than the monthly loan repayment amount l, then move toward the dissaving determination.

$$g = \begin{cases} g(d > g) \\ d(otherwise) \end{cases}$$

[12] Impact analysis was implemented using the statistical analysis package R. The R code is included at the end of Japanese version.

$$h2 = \begin{cases} 0\ (c - g > l) \\ 1\ (otherwise) \end{cases}$$

The maximum consumption expenditure *g*, set according to the regional division and the number of household members, uses the 25th percentile value of the FY2009 National Survey of Family Income and Expenditure.[13]

Table4. 25th percentile value of the consumption expenditure

		number of household members				
		one	two	three	four	over five
regional division	Hokkaido	12.8	17.5	20	22.1	22.1
	Tohoku		16.2	19	20.5	23.3
	Kanto		18.8	20.2	23.1	24.6
	Hokuriku		17.9	18.5	20.4	23.2
	Tokai		17.8	19.5	22	24.5
	Kinki		17.4	19.7	20.6	22.4
	Cyugoku		17.4	20.2	20.9	23
	Shikoku		17.2	18.8	20.8	21
	Kyusyu/Okinawa		16.3	20.5	21.2	22.6

3rd determination (room for dissaving)

Conduct a check of whether the difference between the monthly loan repayment amount *l* and the disposable income less maximum consumption expenditure *c-g* can be covered by dipping into savings. The number of years required for full repayment *q* is calculated using the mode of repayment *h*, rate of interest *r*, monthly loan repayment amount *l*, and loan balance *z*.

The monthly dissaving amount *l-(c-g)* is multiplied by the number of years required for full repayment *q*, and this is compared against the current savings balance *s*. If the total amount needed to fully repay the mortgage exceeds the current savings balance, make the final determination result 1, and calculate the overall and category-specific ratio.

$$h3 = \begin{cases} 0\ \left(s \geq \left(l - (c - g)\right) \times q \times 12\right) \\ 1\ (otherwise) \end{cases}$$

At this point, the number of years required for full repayment *q* is calculated using the mode of repayment *h*, rate of interest *r*, monthly loan repayment amount *l*, and loan balance *z*.

If mode of repayment *h=1* (repayment of both interest and principal in equal installments)

$$q = \log\left(\frac{l}{l - z \times \frac{r}{100 \times 12}}\right) \Big/ \left\{\log\left(1 + \frac{r}{100 \times 12}\right) \times 12\right\}$$

If mode of repayment *h=2* (repayment of principal in equal installments)

$$q = z \Big/ \left\{\left(l - z \times \frac{r}{100 \times 12}\right) \times 12\right\}$$

[13] In setting the maximum consumption expenditure, detailed settings corresponding to life stages using household type and age of household head are also conceivable. In this paper, I have adopted the idea that life stages can be viewed instead by the "number of household members" category, and hence, have used the simplified method described in this paper.

The setting of environmental changes is made as follows.

- Setting income (assume a decrease in income)
  Income after change a'_i, current income a, rate of change in income ε

$$a' = a \times \varepsilon$$

- Setting nonconsumption expenditure (assume an increase in income tax, etc.)
  Nonconsumption expenditure after change b', current nonconsumption expenditure b, rate of change in nonconsumption expenditure β

$$b' = b \times \beta$$

- Setting disposable income
  Disposable income after change c', set real income a', set nonconsumption expenditure b'

$$c' = a' - b'$$

- Setting consumption expenditure (assume an increase in consumption tax)
  Consumption expenditure after change d', current consumption expenditure d, rate of change in consumption expenditure δ

$$d' = d \times \delta$$

- Setting the loan repayment amount (assume an increase in interest rates)
  Monthly loan repayment amount after change l', current monthly loan repayment amount l, rate of change θ

$$l' = \begin{cases} l\,(t = 3) \\ l \times \theta(otherwise) \end{cases}$$

3.3. Determination results when no alterations to the environment

First, I looked at the corrected estimates for the determination result in the case where the environment is not changed. The result of the 1st determination was that the difference between disposable income and consumption expenditure was less than the monthly loan repayment amount for approximately 1,250,000 households (11.3%). The survey targeted only one month, and because it is conceivable that there would have been some households whose payments for that particular month were large for one reason or another, we cannot jump to conclusions. Still, it can be suggested that, even at present, there is a considerable number of households that are under pressure to make payment on their mortgages.

Next, we suppose the adjustment of family budgets, that is, households that cut back on their consumption expenditure when they find it difficult to make payment on their mortgages. The result of applying the 25th percentile value of consumption expenditure for each “regional division” and “number of household members” category in the National Survey of Family Income and Expenditure, was that the difference between disposable income and consumption expenditure was less than the monthly loan repayment amount for approximately 300,000 households (2.8%).

Finally, for households that still find it difficult to make payment, we suppose the repayment behavior of dipping into savings. I conducted a check as to whether these households would be able to cover the difference between their monthly loan repayment amount and their disposable income less maximum consumption expenditure, by dipping into their savings. The result showed that about

190,000 households (1.8%) are in a situation where, even if they dip into their current savings, their savings would run out before they completely repaid their mortgage.

This 1.8% is positioned close to the so-called probability of default (PD). Considering that the mortgage repayment ratio in the corrected estimates of the Internet survey is slightly higher than the National Survey of Family Income and Expenditure, and that, just because a household is having difficulty repaying their mortgage, it does not necessarily mean they will default,[14] we can judge the corrected estimates to be a, by and large, appropriate result. If we knew the true value of PD, it would be possible to get a closer approximation by adjusting the maximum consumption expenditure *g*.

Table5. Determination result in the case where the environment is not changed

	number of compensation estimation	%
total number of households	11,038,846	100.0
result of the 1st determination	1,252,342	11.3
result of the 2nd determination	303,931	2.8
result of the 3rd determination	194,485	1.8

Looking at the abovementioned determination results for each “age of household head” category, the result of the 1st determination was that the difference between disposable income and consumption expenditure was less than the monthly loan repayment amount for 20% of households whose head of household is aged 60 or over. The ratio was lowest at 8.1% for households whose head of household is aged 40-49, and about 10% for those aged 50-59 and 39 or younger.

The result of the 2nd determination was that, even after cutting back consumption expenditure to the 25th percentile value calculated for each “regional division” and “number of household members” category, the difference between disposable income and consumption expenditure was less than the monthly loan repayment amount for 5% of households whose head of household is aged 60 or over. For other households, it was about 2%.

The result of the 3rd determination showed that about 2.5% of households whose head of household is aged 60 or over are in a situation where, even if they dip into their current savings, their savings would run out before they completely repaid their mortgage. We can see that the trend varies depending on the “age of household head” category: 1.7% for those aged 40-49 and 50-59, and 1.2% for those aged 30-39.

Table6. Determination result head in the case where the environment is not changed by age of household

age of household head	1st determination	2nd determination	3rd determination	number of household
under 39	10.2%	2.2%	1.2%	1,999,314
40-49	8.1%	2.0%	1.7%	3,671,369
40-59	10.7%	2.6%	1.7%	3,487,035
over 60	20.1%	5.0%	2.5%	1,881,128
total	11.3%	2.8%	1.8%	11,038,846

[14] Support from relatives and evasive action such as cancelling insurance are conceivable, but are not addressed in this paper.

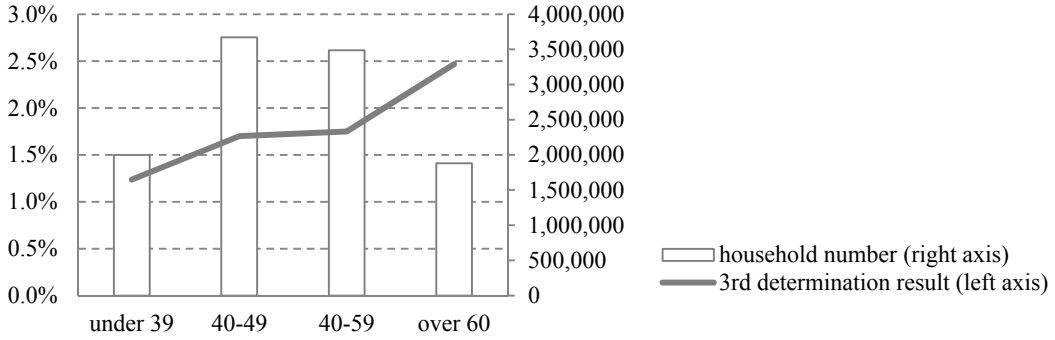


Figure7. Determination result in the case where the environment is not changed by age of household head

Looking at the determination results for each type of household, the result of the 1st determination was that the difference between disposable income and consumption expenditure was less than the monthly loan repayment amount for 38% of unemployed households. The ratio was lowest at 8.2% for wage-earner households, and was about 14% for non-wage-earner households.

The result of the 2nd determination was that, even after cutting back consumption expenditure to the 25th percentile value calculated for each "regional division" and "number of household members" category, the difference between disposable income and consumption expenditure was less than the monthly loan repayment amount for 15% of unemployed households. It was for about 5% for non-wage-earner households, and 0.9% for wage-earner households.

The result of the 3rd determination showed that about 8.4% of unemployed households are in a situation where, even if they dip into their current savings, their savings would run out before they completely repaid their mortgage. We can see that the trend varies significantly depending on the type of household: 3.4% for non-wage-earner households, and 0.7% for wage-earner households. We can infer that, in particular, there are many unemployed households finding it difficult to repay their mortgages.

Table7. Determination result in the case where the environment is not changed by type of household

type of household	1st determination	2nd determination	3rd determination	number of household
wage-earner	8.2%	0.9%	0.7%	8,236,069
non-wage-earner	13.9%	5.5%	3.4%	2,034,205
unemployed	38.3%	15.3%	8.4%	768,571
total	11.3%	2.8%	1.8%	11,038,845

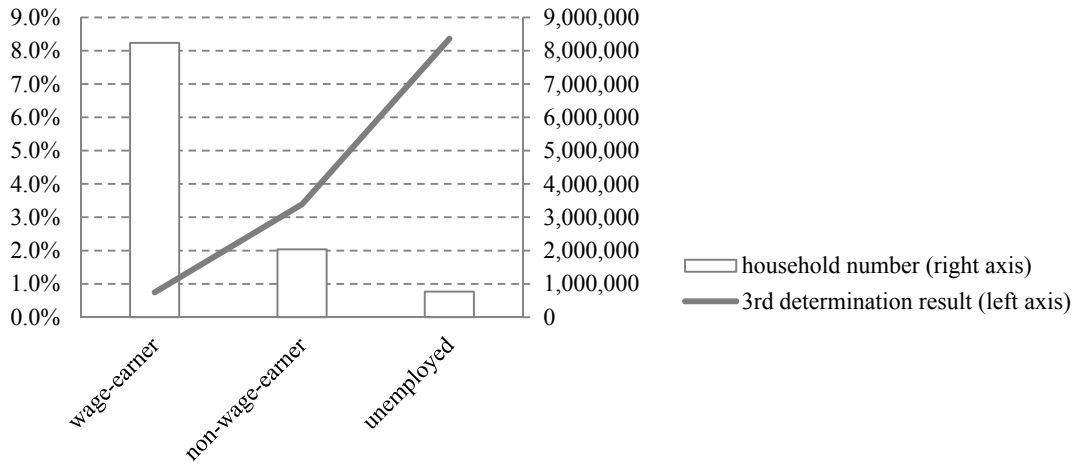


Figure8. Determination result in the case where the environment is not changed by type of household

Looking at the determination results for each "financial institution" category, the result of the 1st determination was that the difference between disposable income and consumption expenditure was less than the monthly loan repayment amount for 11% of "bank" households. It was also 11% for "other" households, and 13.4% for "JHF" households.

The result of the 2nd determination was that, even after cutting back consumption expenditure to the 25th percentile value calculated for each "regional division" and "number of household members" category, the difference between disposable income and consumption expenditure was less than the monthly loan repayment amount for 2.4% of "bank" households. It was about 3% for "other" and "JHF" households.

The result of the 3rd determination showed that about 1.5% of "bank" households are in a situation where, even if they dip into their current savings, their savings would run out before they completely repaid their mortgage. We can see that the trend varies depending on the "financial institution" category: 1.9% for "other" and 2.7% for "JHF."

Taking a more segmented view of sample numbers, whereas it was 1.7% for city banks / trust banks, it was somewhat lower at 1.3% for regional banks / second-tier regional banks. Even within the "other" category, it was a slightly higher value of 2.2% for "credit associations / credit unions."

Table8. Determination result in the case where the environment is not changed by financial institution

financial institution	1st determination	2nd determination	3rd determination	number of household
bank	**11.1%**	**2.4%**	**1.5%**	**7,098,843**
city banks / trust banks	11.0%	2.6%	1.7%	3,741,486
regional banks / second-tier regional banks	11.2%	2.3%	1.3%	3,357,357
JHF	**13.4%**	**3.4%**	**2.7%**	**1,361,165**
other	**11.0%**	**3.2%**	**1.9%**	**2,578,837**
credit associations / credit unions	9.3%	2.7%	2.2%	1,301,205
total	11.3%	2.8%	1.8%	11,038,845

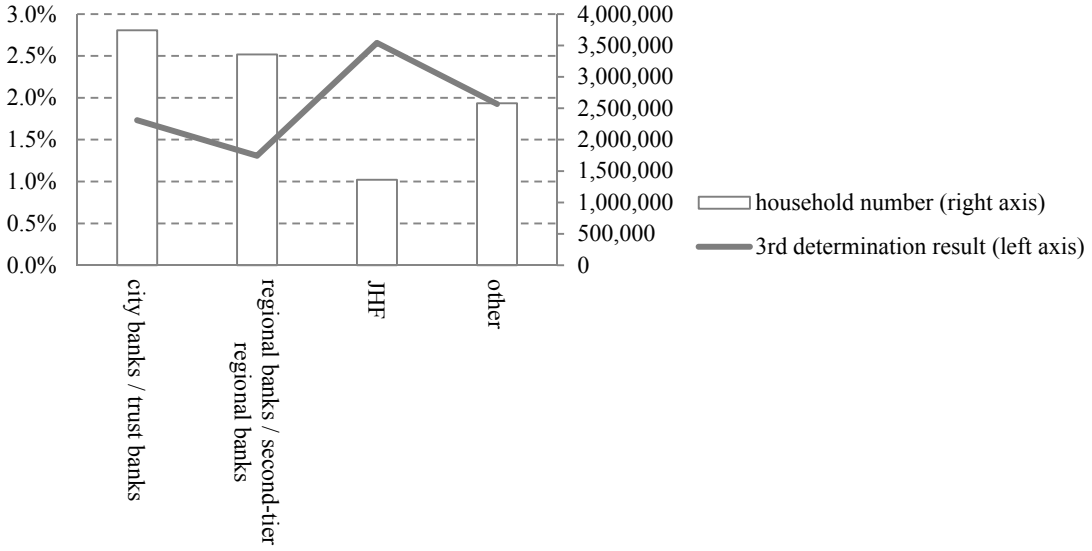


Figure9. Determination result in the case where the environment is not changed by financial institution

In order to look at the determination results for each regional division, I established three divisions: the “Tokyo area” comprised of Tokyo, Kanagawa, Saitama and Chiba; the “Meihanfuku area” comprised of Aichi, Kyoto, Osaka, Hyogo and Fukuoka; and “Other” making up the other provincial areas.

The result of the 1st determination was that the difference between disposable income and consumption expenditure was less than the monthly loan repayment amount for 9% of households in the Meihanfuku area. This was a slightly lower value than the other regional divisions.

The result of the 2nd determination was that, even after cutting back consumption expenditure to the 25th percentile value calculated for each “regional division” and “number of household members” category, the difference between disposable income and consumption expenditure was less than the monthly loan repayment amount for about 2% to 3% of households in each of the regional divisions.

The result of the 3rd determination showed that about 1.3% of households in the Tokyo area are in a situation where, even if they dip into their current savings, their savings would run out before they completely repaid their mortgage. We can see that the trend varies depending on the regional division: 1.6% for the Meihanfuku area, and 2.3% for the “Other areas” division.

Table9. Determination result in the case where the environment is not changed by regional division

regional division	1st determination	2nd determination	3rd determination	number of household
Tokyo area	11.6%	2.5%	1.3%	4,037,490
Meihanfuku area	9.1%	1.9%	1.6%	2,724,503
other	12.5%	3.5%	2.3%	4,276,852
total	11.3%	2.8%	1.8%	11,038,845

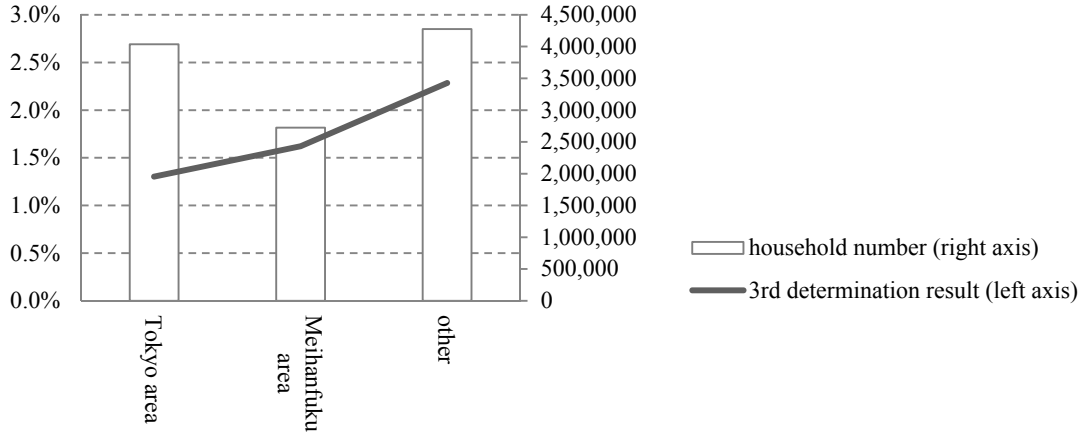


Figure10. Determination result in the case where the environment is not changed by regional division

Looking at the determination results for each type of interest rate for mortgages owed, the results of both the 1st determination and 2nd determination were about the same.

A slight dispersion of results was observed in the 3rd determination. 1.3% of “variable-rate mortgage” households, 1.9% of “fixed-to-adjustable-rate mortgage” households, and 2.4% of “fixed-rate mortgage” households are in a situation where, even if they dip into their current savings, their savings would run out before they completely repaid their mortgage.

Table10. Determination result in the case where the environment is not changed by type of interest rate

type of interest rate	1st determination	2nd determination	3rd determination	number of household
variable-rate	11.5%	2.7%	1.3%	4,741,415
fixed-to-adjustable-rate	11.1%	2.9%	1.9%	4,088,513
fixed-rate	11.4%	2.6%	2.4%	2,208,918
total	11.3%	2.8%	1.8%	11,038,845

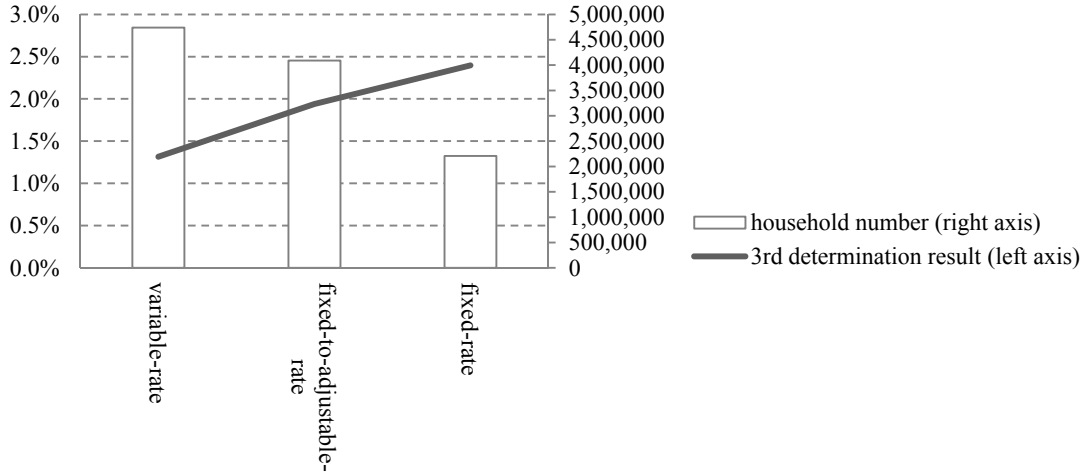


Figure11. Determination result in the case where the environment is not changed by type of interest rate

Looking at the results of the 3rd determination for each year that passes after taking out a mortgage, there is a tendency for determination results to deviate further as more and more time passes. While the number of households during the first few years is high, that number decreases as the years go by. Once 20 years have passed, the number of households is, on the whole, very small.

On conducting polynomial regression, with the number of years passed as the explanatory variable and the determination results for each year as the objective variable, I was able to infer the tendency that determination results worsen for the first 10 to 15 years, and then subsequently the number of households with poor determination results decreases.

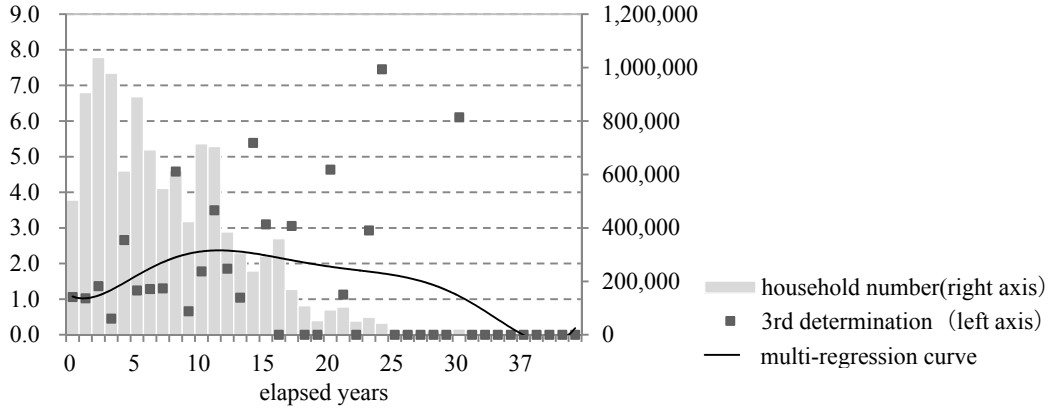


Figure12. Determination result in the case where the environment is not changed by elapsed years

3.4. Impact of decreases in income

Among households with mortgages, disposable income decreased by 12% for wage-earner households and by 36% for unemployed households during the 15 years between 1994 and 2009 (Sato (2012)). It is also expected that incomes will continue to decrease in the future.

Consequently, I conducted an impact analysis, applying a rate of change in income ε of 1 (present situation), 0.95 (5% decrease), 0.9 (10% decrease), 0.85 (15% decrease) and 0.8 (20% decrease).

In the current income situation, the ratio of households determined as having difficulty in making mortgage payments is 1.8%, but if monthly incomes were to decrease by 5%, the ratio would increase 1.7-fold to 3.0%. Likewise, the ratio would increase 2.5-fold for a 10% decrease, 4-fold for a 15% decrease, and 5.9-fold for a 20% decrease. I observed a tendency for the degree of increase in the determination ratio to become stronger, the greater the rate of decrease in monthly income.

Looking at each "age of household head" category, I observed a tendency for the degree of increase in the determination ratio to become stronger as monthly income decreases for households whose head of household is aged 39 or younger.

Looking at each type of household, I confirmed the strong impact on unemployed households when the rate of decrease in monthly income was in the 5% to 10% range.

Looking at each "financial institution" category, although no significant differences were observed, a fairly large impact on "other" was observed when the rate of decrease in monthly income was 5% to 10%, and likewise on "regional banks / second-tier regional banks" when the rate of decrease was 15% to 20%.

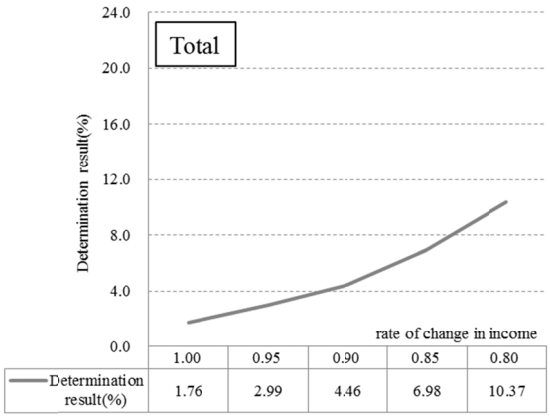
Looking at each regional division, I confirmed the trend for determination results to be worse for the "other areas" in comparison to the Tokyo area (Tokyo, Kanagawa, Saitama and Chiba) and the Meihanfuku area (Aichi, Kyoto, Osaka, Hyogo and Fukuoka). In the "other areas," a somewhat stronger impact on the determination results could be seen when the rate of decrease in monthly income was 5% to 10%.

Looking at each interest rate type, I observed a tendency for the impact to be small for fixed-rate mortgages, and to be large for fixed-to-adjustable-rate mortgages and variable-rate mortgages.

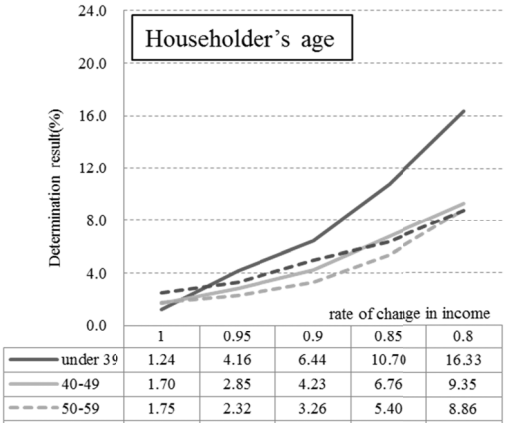
Next, I used a sixth-degree polynomial to estimate the determination results following a decrease in income by plotting them for each year that passes after taking out a mortgage (Figure 14).

With no decrease in income, a curve was estimated, peaking between the 10th and 15th year. Supposing a decrease in income of 5%, the shape of the curve changed, and a curve was estimated which peaked between the 25th and 30th year. Furthermore, supposing income decreased by 10%, this resulted in the determination ratio increasing even among those households for whom few years have passed. When it comes to a 15% decrease in income, the shape of the curve resembled that for the 10% decrease, but with a higher ratio. Finally, in the case of a 20% decrease in income, the ratios increased even higher, peaking at about the 20th year.

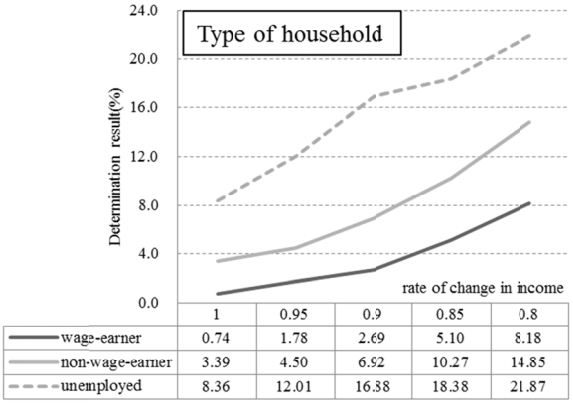
Looking at the determination results in this paper, which are regarded as an indicator approximating defaults, it was suggested that there is a tendency for the shape of the term structure to change as a consequence of a decrease in income.



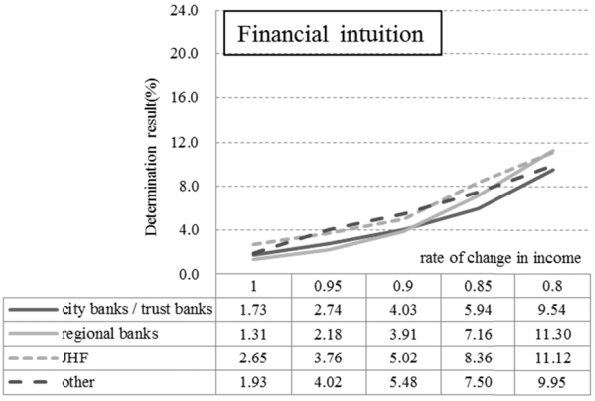
	1.00	0.95	0.90	0.85	0.80
Determination result(%)	1.76	2.99	4.46	6.98	10.37



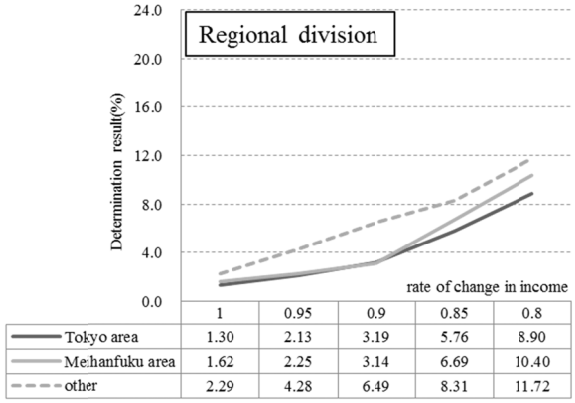
	1	0.95	0.9	0.85	0.8
under 39	1.24	4.16	6.44	10.70	16.33
40-49	1.70	2.85	4.23	6.76	9.35
50-59	1.75	2.32	3.26	5.40	8.86
over60	2.47	3.30	5.00	6.37	8.79



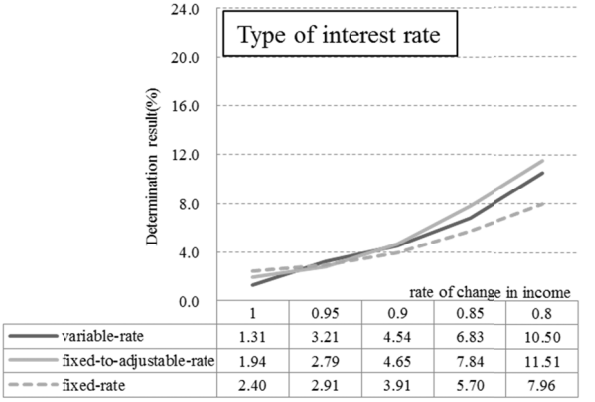
	1	0.95	0.9	0.85	0.8
wage-earner	0.74	1.78	2.69	5.10	8.18
non-wage-earner	3.39	4.50	6.52	10.27	14.85
unemployed	8.36	12.01	16.38	18.38	21.87



	1	0.95	0.9	0.85	0.8
city banks / trust banks	1.73	2.74	4.03	5.94	9.54
regional banks	1.31	2.18	3.91	7.16	11.30
JHF	2.65	3.76	5.02	8.36	11.12
other	1.93	4.02	5.48	7.50	9.95



	1	0.95	0.9	0.85	0.8
Tokyo area	1.30	2.13	3.19	5.76	8.90
Meihanfuku area	1.62	2.25	3.14	6.69	10.40
other	2.29	4.28	6.49	8.31	11.72



	1	0.95	0.9	0.85	0.8
variable-rate	1.31	3.21	4.54	6.83	10.50
fixed-to-adjustable-rate	1.94	2.79	4.65	7.84	11.51
fixed-rate	2.40	2.91	3.91	5.70	7.96

Figure13. Impact of decreases in income

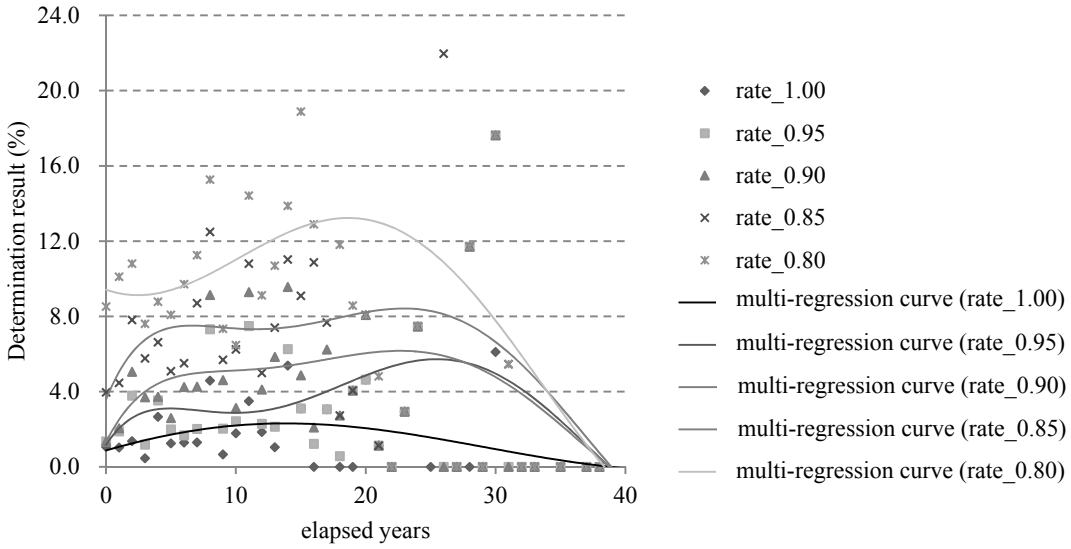


Figure14. Impact of decreases in income by elapsed years

The estimation parameters and coefficients of determination of the polynomial are shown below for confirmation. Note, the variable names of the parameters are as follows.

$$y = a + b \times x + c \times x^2 + d \times x^3 + e \times x^4 + f \times x^5 + g \times x^6$$

At between 0.12 and 0.24, the coefficients of determination are not high, and so we can judge that it would be fairly difficult to recognize a term structure in the determination results in this paper, which approximate defaults. In particular, it would seem that we need to be mindful of the fact that the coefficient of determination is low for the estimated equation in the case where monthly income is decreased by 5%.

If we exclude the estimated equation when there is a 5% decrease in monthly income, we can also see that, in the case of decreases in income, the determination results worsen, with two peaks, one in the short-term at about the fifth year of a mortgage and the other in the long-term at about the 25th year. Even still, it appears that the term structure does change between a rate of decrease of 15% and a rate of decrease of 20%.

Table11. Estimation parameters and coefficients of determination of the polynomial

rate of change in income	a	b	c	d	e	f	g	coefficients of determination
1.00	0.8743	0.1978	-0.0052	-0.0002	5.E-06	1.E-09	-4.E-10	0.1711
0.95	1.1735	1.0562	-0.2018	0.0162	-0.001	9.E-06	-5.E-08	0.1224
0.90	1.3160	1.3778	-0.1991	0.0140	-0.001	7.E-06	-4.E-08	0.1481
0.85	3.5806	1.7217	-0.2751	0.0198	-0.001	1.E-05	-6.E-08	0.2145
0.80	9.4201	-0.2434	0.0520	-0.0003	0.000	3.E-06	-2.E-08	0.2483

3.5. Impact of increases in consumption expenditure

More recently, there has been discussion and debate about temporary tax increases to finance measures for rebuilding areas following the Great East Japan Earthquake (2.1% of the amount of income tax due and 1,000 yen a year for inhabitant tax), as well as an increase in consumption tax as a consequence of rising social security costs. Accordingly, the effects that tax increases have on housing loans are also an issue for examination.

Consequently, I conducted an impact analysis, assuming an increase in consumption tax and establishing cases of a 1-fold, 1.05-fold and 1.1-fold increase in consumption expenditure, as well as assuming increases in income tax and inhabitant tax, establishing cases of a 1-fold, 1.05-fold and 1.1-fold increase in nonconsumption expenditure. It should be noted that, with the establishment of the cases for nonconsumption expenditure, the increase is considerably larger than the size of the current temporary tax increases to finance measures for rebuilding.

Increasing consumption expenditure by 5% raised the determination ratio 1.5-fold, and a 10% increase resulted in a 1.8-fold rise. Increasing nonconsumption expenditure by 5% raised the determination ratio 1.2-fold, and a 10% increase resulted in a 1.4-fold rise. The effect of changes in consumption expenditure is relatively large.

I aggregated the determination results for the age of household head, the type of household, the financial institution, the regional division and the interest rate type, for three cases in which I changed consumption expenditure by 1-fold, 1.05-fold and 1.1-fold while keeping nonconsumption expenditure unchanged. This means smaller changes than the environmental changes of the previous section would be produced, and some very small impact on environmental changes would be seen.

Looking at each “age of household head” category, the impact on the “39 or younger” households was large. A 5% increase in consumption expenditure resulted in a 3-fold increase in the determination ratio. Looking at each type of household, the impact on “unemployed” households was large. A 5% increase in consumption expenditure resulted in a 1.4-fold increase in the determination ratio. Looking at each “financial institution” category, the impact on the “other” households was large. A 5% increase in consumption expenditure resulted in a 1.9-fold increase in the determination ratio.

Looking at each regional division, the impact on the Tokyo area and on “other areas” was large. A 5% increase in consumption expenditure resulted in about a 1.6-fold increase in the determination ratio. In the “other areas,” the determination results were fairly poor to begin with, even without affecting consumption expenditure. Looking at each type of mortgage interest rate, the impact on the “variable-rate mortgage” households was large. A 5% increase in consumption expenditure resulted in about a 2-fold increase in the determination ratio.

While it could be expected that a 5% increase in consumption tax would suppress consumption expenditure, the trial calculation in this paper increased consumption expenditure by 5% compared to the 25th percentile value calculated for each “regional division” and “number of household members” category. It could be suggested that an increase in consumption tax has the potential to have a commensurate effect on the repayment of housing loans.

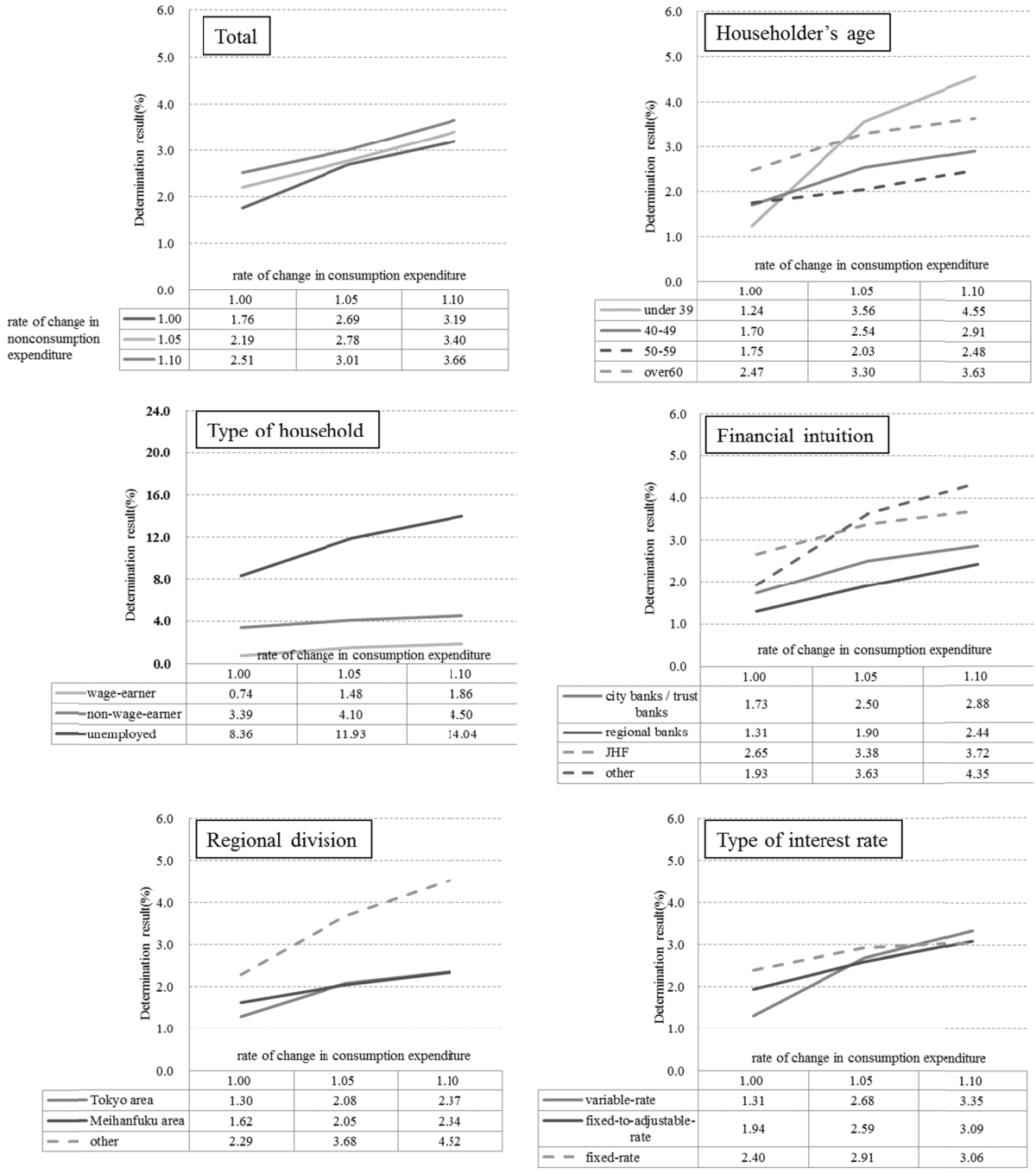


Figure15. Impact of increases in consumption expenditure

I used a sixth-degree polynomial to estimate the determination results following an increase in consumption expenditure by plotting them for each year that passes after taking out a mortgage.

With no change in consumption expenditure, a curve was estimated, peaking between the 10th and 15th year. Supposing an increase in consumption expenditure of 5%, a curve with a different shape could be estimated which peaks between the 25th and 30th year. In the case of a 10% increase in consumption expenditure, the ratios would increase, with the curve keeping a similar shape. However, the coefficients of determination are not high, at 0.11 in the case of a 5% increase in consumption expenditure, and 0.12 in the case of a 10% increase.

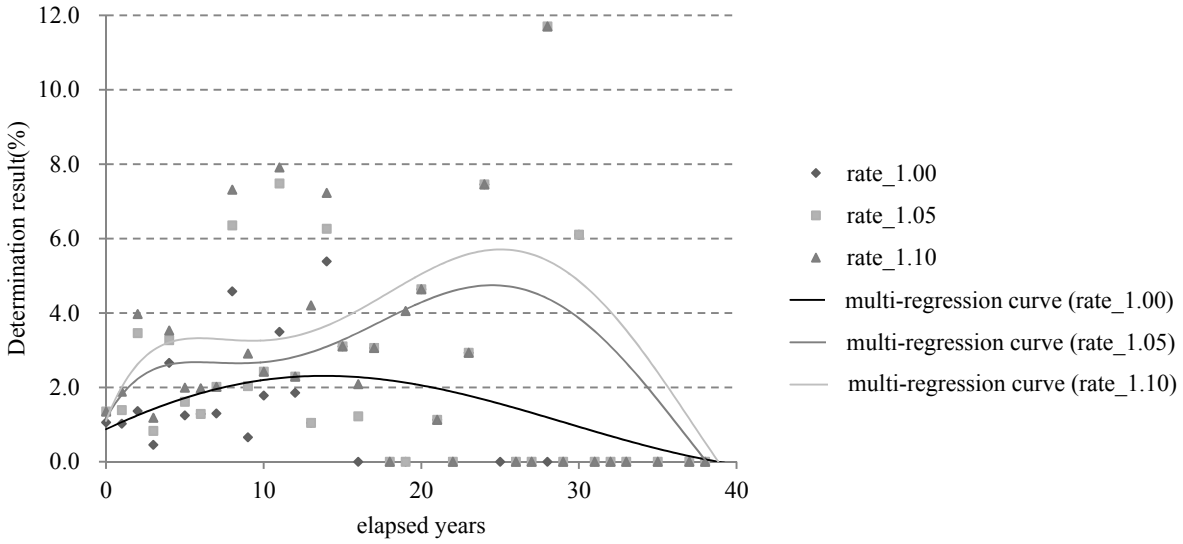


Figure16. Impact of increases in consumption expenditure by elapsed years

3.6. Impact of changes in loan repayment amount

Interest rates for variable interest rate mortgages are reviewed twice a year, but even if the applicable interest rate changes during the term of the loan, the repayment amount is fixed for a period of five years (the five-year rule). The new repayment amount once five years have elapsed is capped at 125% of the repayment amount five years earlier (the 125% rule). However, if interest rates rise, even though the repayment amount may be the same, the amount of interest payable increases and the amount of the principal repayment decreases, and so it results in the pace of mortgage repayments slowing. With fixed-to-adjustable-rate mortgages, the repayment amount during the period of fixed interest rates does not change. However, at the conclusion of the fixed period, the five-year rule and the 125% rule do not apply.[15] With a fixed interest mortgage, the interest rate and the repayment amount are fixed for the entire term of the loan.

During a period of rising interest rates, mortgage repayment amounts do not change instantly. With variable interest rate mortgages, the repayment amount will not increase more than 125% within a five-year period. With fixed-to-adjustable-rate mortgages, the repayment amount will increase at the conclusion of the fixed period. According to the corrected estimates of the Internet survey, the average fixed period is 10.9 years.

In view of the above, I conducted an impact analysis, applying a rate of change θ of 1 (present situation), 1.05 (5% increase), 1.10 (10% increase), 1.15 (15% increase), 1.20 (20% increase) and 1.25 (25% increase) to the repayment amounts of variable interest rate mortgages and fixed-to-adjustable-rate mortgages. The repayment amounts of fixed interest mortgages never change.

If the amount of mortgage repayments increased by 5%, the ratio of households determined as having difficulty in making mortgage payments would increase by 1.37-fold. Likewise, the ratio would increase 1.48-fold for a 10% increase, 1.58-fold for a 15% increase, 1.69-fold for a 20% increase, and 1.86-fold for a 25% increase. I observed a fairly sensitive trend for the first 5% increase.

Looking at each "age of household head" category, I observed an extremely sensitive trend for the first 5% increase for "39 or younger" households. Looking at each type of household, I observed a sensitive trend for the first 5% increase for "unemployed" households. Looking at each "financial

[15] "*Wagakuni no Juutaku Kinyuu no Genjou nitsuite*" (The Current State of Housing Finance in Japan) (January 2010), Housing Bureau, MLIT. http://www.mlit.go.jp/common/000056960.pdf. Last viewed on February 25, 2012.

institution" category, I observed an extremely sensitive trend for the first 5% increase for "other" households.

Looking at each regional division, I observed a sensitive trend for the first 5% increase for households in the Tokyo area. Looking at when the amount of mortgage repayments increased by 10%, I confirmed regional variances: a 1.6-fold increase for the Tokyo area, a 1.3-fold increase for the Meihanfuku area, and a 1.5-fold increase for the "other areas." Looking at each mortgage type, there were no changes for "fixed-rate mortgages" as expected, and I observed an extremely sensitive trend for the first 5% increase for "variable interest rate mortgages."

As for non-bank financial institutions, it would appear that households in the younger age group, who took out variable interest rate mortgages, are significantly affected by changes in the amount of mortgage repayments.

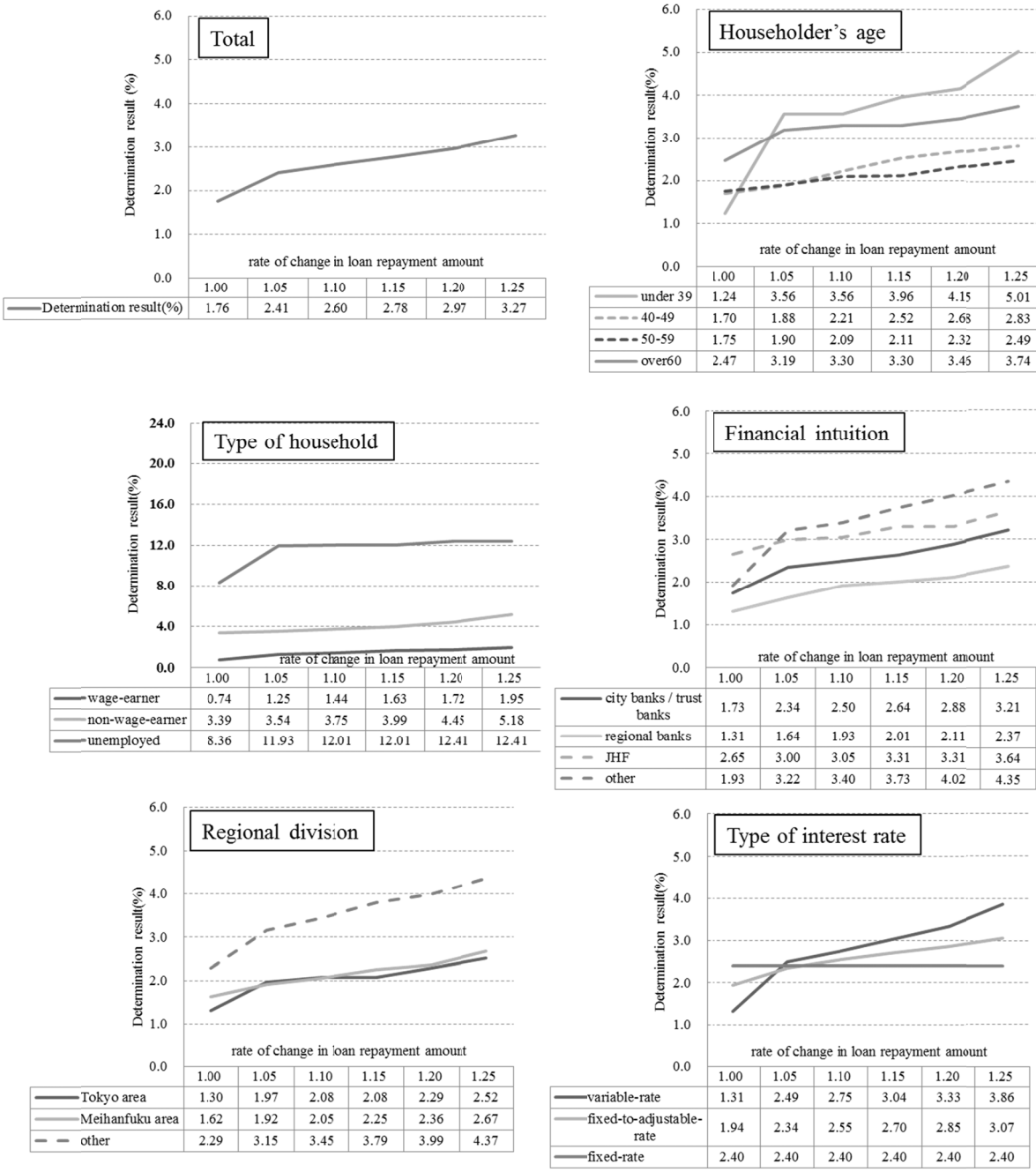


Figure17. Impact of changes in loan repayment amount

I used a sixth-degree polynomial to estimate the determination results following an increase in the amount of mortgage repayments by plotting them for each year that passes after taking out a mortgage.

Supposing the amount of mortgage repayments increased by 5%, a curve with a different shape could be estimated which peaks between the 25th and 30th year. Even if there was a 25% increase, the ratios would increase, with the curve keeping a similar shape. Nevertheless, the coefficients of determination in the estimated equation are not high, at between 0.11 and 0.12. This trend is similar to the effects of a change in consumption expenditure and the effects of a 5% decrease in income.

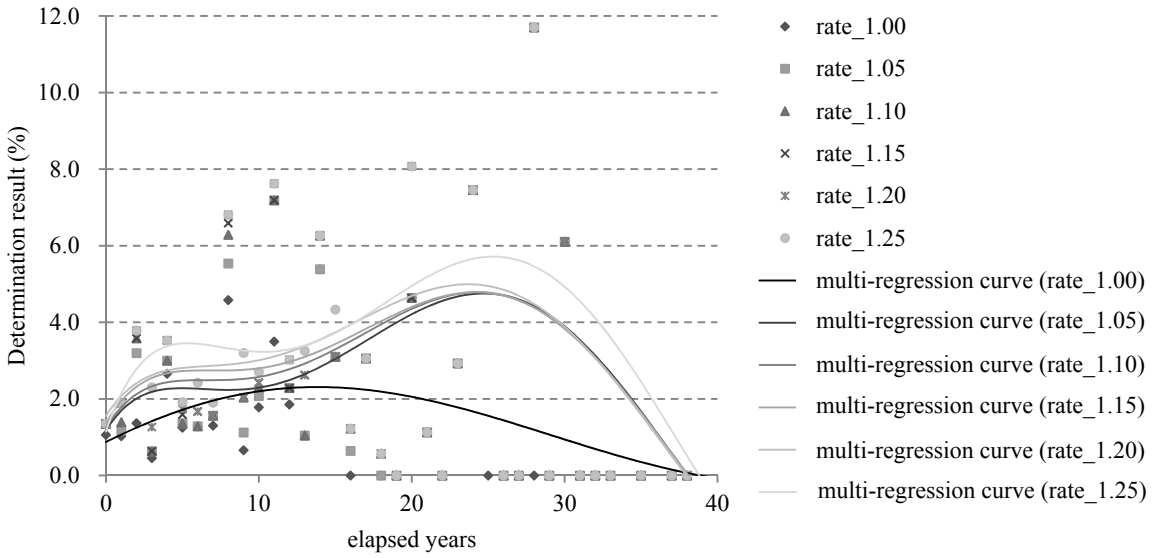


Figure18. Impact of changes in loan repayment amount by elapsed years

3.7. Comparison of impact analysis results

Finally, I organized the effects that environmental changes have on the determination results. I used standard 5% and 10% rates of change, but the size of each amount and the effects of each were varied. If income decreased by 5%, the ratio of households determined as having difficulty in making mortgage payments would increase 1.7-fold. If consumption expenditure increased by 5%, the same ratio would increase 1.53-fold. If nonconsumption expenditure increased by 5%, the ratio would increase 1.25-fold. And if the amount of mortgage repayments was increased by 5%, the ratio would increase 1.37-fold.

If all four indicators were simultaneously changed by 5%, the determination ratio would increase 2.47-fold. Furthermore, if income was decreased by 10%, the amount of mortgage repayments increased by 10%, and both consumption expenditure and nonconsumption expenditure increased by 5%, the determination ratio would increase 4.24-fold.

The result is that the effect that a given environmental change has on mortgage repayments can be judged to be large. And, as seen earlier, taking into account that mortgage payments as a percentage of family budgets are continuing to increase amid ongoing declines in income and disposable income, there is concern that future stress on family budgets will have a considerable effect on mortgage repayments.

Table12. Comparison of impact analysis results

		determination result(%)	rate of change *
no alterations to the environment		1.76	1
rate of change in income (a)	-5%	2.99	1.7
	-10%	4.46	2.53
rate of change in consumption expenditure (b)	5%	2.69	1.53
	10%	3.83	2.17
rate of change in nonconsumption expenditure (c)	5%	2.19	1.25
	10%	2.51	1.43
rate of change in loan repayment amount (d)	5%	2.41	1.37
	10%	2.6	1.48
combination case 1 (a:-5%, b:+5%, c:+5%, d:+5%)		4.35	2.47
combination case 2 (a:-10%, b:+5%, c:+5%, d:+10%)		7.46	4.24

* determination result of when no alterations to the environment was made into the denominator

4. Combination of LTV Assessment and Impact Analysis

In the previous chapter, I determined households that would have difficulty repaying their mortgage as a consequence of stress on their family budget. In this chapter, using data on the structure of dwellings, year of construction, gross floor space and prefecture where located—which were asked in the questionnaire survey—I will calculate house and land asset values, and by comparing this to their present mortgage balance, I will calculated the current "loan to value" (LTV). Furthermore, I will do a trial calculation on the estimated loss for households who are determined as having difficulty in making mortgage repayments, and whose asset value is below their present mortgage balance.

4.1. Setting the construction costs and depreciation rate for houses

I used *The Methods to Estimate of Value of Tangible Fixed Assets* from the 2009 National Survey of Family Income and Expenditure, published by the Ministry of Internal Affairs and Communications (MIC) Statistics Bureau to calculate the construction costs and depreciation rate for houses. In terms of the unit cost, useful life and ratio of remaining value for houses and durable consumer goods, the method shows the construction cost per $1m^2$ for each prefecture and dwelling structure, as well as the depreciation ratio for each dwelling structure and period of construction.

Three divisions have been used for the construction cost per $1m^2$ for each prefecture and dwelling structure as shown in Table 13: "wood construction, fire-resistant wood construction," "steel-frame reinforced concrete structure" and "other."

As for the ratio of remaining value for each dwelling structure and period of construction, I recalculated the given depreciation rate, using 2011 as year 0 for the number of years elapsed, and I plotted these in Figure 19. In the questionnaire survey, respondents had been asked about the year of construction according to four divisions: 2001-2011, 1991-2000, 1981-1990 and 1980 or earlier. Therefore, I calculated the mean value within each division, and decided to apply this as the ratio of remaining value.

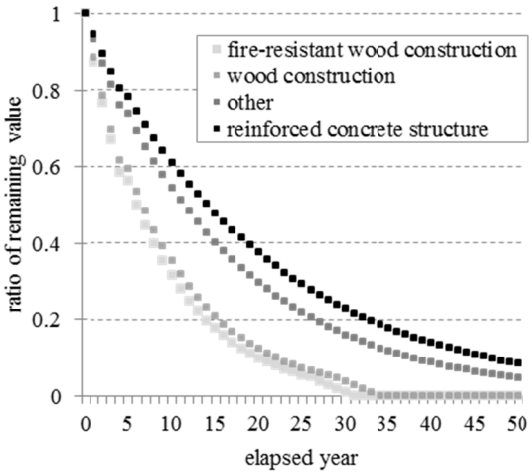
By estimating the residual house values for all households that are paying a mortgage, I calculated a mean of 8,390,000 yen and standard deviation of 5,840,000 yen. With a high depreciation rate in the settings, the asset value of the actual residential structures is underestimated.

Table13. Construction cost per 1m^2 for each prefecture and dwelling structure

Prefecture	Wooden	Reinforced concrete	Other
Hokkaido	148	155	123
Aomori	139	223	123
Iwate	144	180	123
Miyagi	146	174	123
Akita	137	176	123
Yamagata	146	148	123
Fukushima	149	175	123
Ibaragi	154	186	123
Tochigi	155	176	123
Gunma	157	181	123
Saitama	159	204	123
Chiba	161	203	123
Tokyo	178	244	123
Kanagawa	170	223	123
Niigata	155	173	123
Toyama	154	159	123
Ishikawa	156	176	123
Fukui	151	173	123
Yamanashi	166	185	123
Nagano	166	184	123
Gifu	156	184	123
Shizuoka	165	194	123
Aichi	165	191	123
Mie	165	191	123

Prefecture	Wooden	Reinforced concrete	Other
Shiga	156	190	123
Kyoto	168	184	123
Osaka	160	188	123
Hyogo	160	191	123
Nara	163	195	123
Wakayama	151	199	123
Tottori	152	170	123
Shimane	157	178	123
Okayama	163	185	123
Hiroshima	157	186	123
Yamaguchi	158	184	123
Tokushima	139	168	123
Kagawa	151	170	123
Ehime	147	177	123
Kochi	154	172	123
Fukuoka	149	168	123
Saga	147	175	123
Nagasaki	141	171	123
Kumamoto	142	160	123
Oita	147	166	123
Miyazaki	129	155	123
Kagoshima	138	150	123
Okinawa	154	169	123

From "*The Methods to Estimate of Value of Tangible Fixed Assets*"(MIC)



Application rate to questionnaire data

period of construction	fire-resistant wood construction	wood construction	other	reinforced concrete structure
2001-2011	0.588	0.616	0.746	0.787
1991-2000	0.177	0.208	0.396	0.471
1981-1990	0.051	0.073	0.215	0.288
before 1980	0.000	0.003	0.091	0.142

Figure19. Ratio of remaining value for each dwelling structure and period of construction

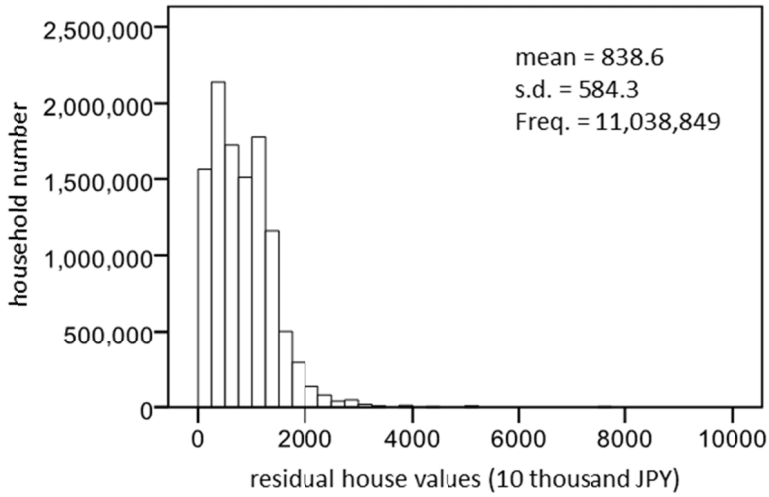


Figure20. Distribution of estimated residual house values for all households that are paying a mortgage

4.2. Calculation of land value

In calculating land value, I used the *Prefectural Land Price Survey Data* provided by the Land Information Center. The Prefectural Land Price Survey surveys and publishes the standard prices of benchmark land once a year, pursuant to the National Land Use Planning Act.[16]

Using the data to look at the national average land value in residential areas, we can see that the value has been continuing to decrease since a peak of 165,400 yen/m^2 in 1990. Slight increases were observed along the way between 2006 and 2008, but the decline resumed in 2009, and as of 2011, the value stood at 68,900 yen/m^2. This trend has been especially prominent in the three major metropolitan areas, and outside of these areas, the changes in land value have been small.

Presuming that the population in Japan will continue to slide, it is conceivable that overall land values in residential areas will also decline. Further examination is required on the degree to which declining land values affect the recovery rate in instances where borrowers are unable to repay their residential mortgage.

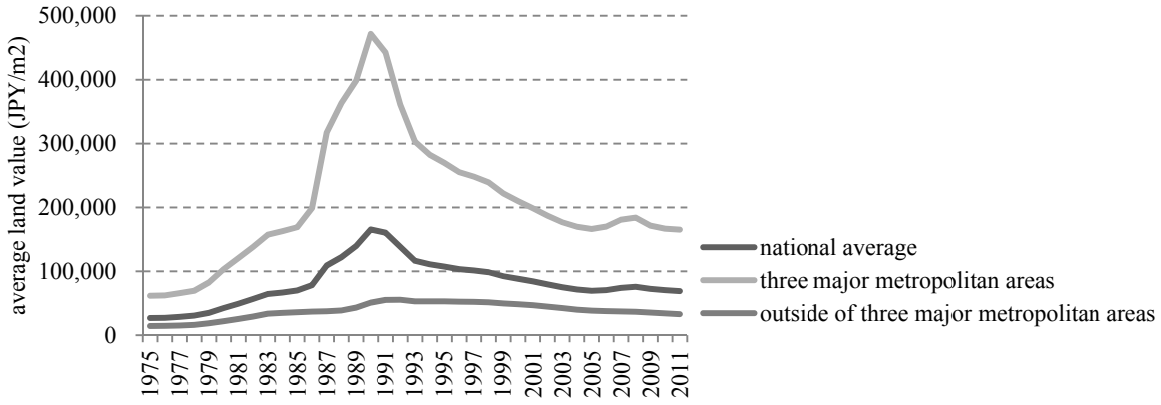


Figure20. Average land value in residential areas

Looking at the prefectural breakdown of average land values in residential areas in 2011, we can see that the deviation in land values is large region to region. Whereas the average is 309,200 yen/m^2 in the Tokyo metropolitan area, it is only half this, or 150,500 yen/m^2, in Osaka Prefecture, and is

[16] See the Land Information Center website for further details.
URL: http://www.lic.or.jp/landinfo/#howuse2 (Last viewed on February 26, 2012).

only 20,000 to 30,000 yen/m^2 in the majority of other prefectures. In considering the recovery rate for residential mortgages, we need to address this regional disparity.

Since the questionnaire survey did not include a question on the area of land, in this paper, based on the 2010 Housing and Land Survey, I have decided to convert gross floor space to area of land for each prefecture and for each type of housing. The ratio is a numerical value, where gross floor space is the denominator and land area is the numerator. It is high for detached houses and low for apartment houses; and it is low for urban centers such as Tokyo and Osaka, but high for other areas.

Calculating the land value of all households that are paying a mortgage resulted in a mean of 14,960,000 yen and a standard deviation of 13,400,000 yen. Looking at the distribution, land values of about 10,000,000 yen are most common, and there is a long tail to the right.

Due to constraints on data, in this paper, I have used the mean value of each prefecture when calculating both the relationship between gross floor space and land area and the relationship between land area and land value. A more detailed calculation of land value would be possible by asking about land area in a questionnaire survey or by asking for detailed location information.

Table14. Prefectural average land values in 2011

Prefecture	Average land value
Hokkaido	18,900
Aomori	20,300
Iwate	26,700
Miyagi	32,800
Akita	17,100
Yamagata	21,100
Fukushima	21,800
Ibaragi	34,900
Tochigi	39,500
Gunma	33,600
Saitama	109,000
Chiba	72,300
Tokyo	309,200
Kanagawa	179,000
Niigata	30,100
Toyama	32,700

Prefecture	Average land value
Ishikawa	43,400
Fukui	34,700
Yamanashi	29,500
Nagano	27,600
Gifu	36,100
Shizuoka	73,700
Aichi	101,200
Mie	34,900
Shiga	52,500
Kyoto	112,100
Osaka	150,500
Hyogo	97,400
Nara	57,400
Wakayama	39,300
Tottori	24,200
Shimane	24,200

Prefecture	Average land value
Okayama	34,700
Hiroshima	53,600
Yamaguchi	28,300
Tokushima	35,400
Kagawa	37,500
Ehime	41,500
Kochi	36,500
Fukuoka	45,800
Saga	22,400
Nagasaki	25,600
Kumamoto	27,400
Oita	27,200
Miyazaki	26,700
Kagoshima	30,500
Okinawa	44,000

(yen/m2)

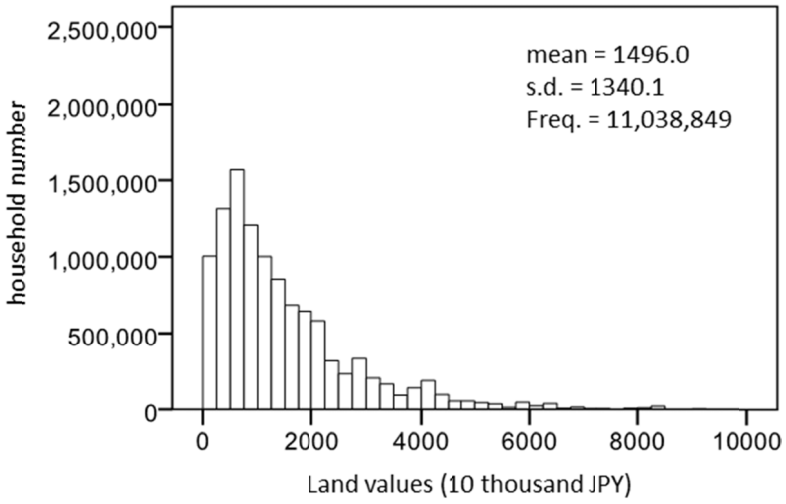


Figure22. Distribution of estimated land values for all households that are paying a mortgage

4.3. Calculation of current LTV

Drawing on the work of the previous sections, I calculated the house and land asset values for each of the samples in the questionnaire survey, based on dwelling structure, year of construction, gross floor space, and prefecture where located. In this section, I will compare this against the current mortgage balance asked in the questionnaire survey, and I will calculate the LTV at the current point.

The LTV is usually a figure used for households taking out new loans at the time of the loan, and is used in deciding whether to approve the loan. Smaller LTVs indicate better recoverability in the event of default, and so a small LTV represents a safe loan for a financial institution. If the appraised value of a house and land is fixed, the LTV will decrease as repayments are made; but in a situation where surety values are declining, this could possibly result in the LTV increasing.

The LTVs calculated in this paper are figures for all households with mortgages as at the time of the survey (October 2010), and include changes in the appraised value of the collateral.

$$current\ LTV = \frac{current\ mortgage\ balance}{estimated\ house\ value + estimated\ land\ value}$$

Calculating LTVs in the manner described above resulted in a mean of 0.87 and a standard deviation of about 0.83. Looking at the distribution shown in Figure 23, most households were below 1, but a considerable number were also confirmed to be above 1. Some households with extremely high figures were also observed.

In order to examine which households have a high LTV, I calculated the mean value, standard deviation and percentile values for each “age of household head” category, each “type of household” category and each “financial institution” category (Table 15).

Looking at each “age of household head” category, the younger the generation, the higher the LTV becomes. Households whose head of household is aged “39 or younger” had a mean of 1.10 and a standard deviation of about 0.81. With residual house values, since the year of construction divisions are broad, we need to be mindful of the fact that the values have been calculated fairly strictly, but a similar trend was also observed for those aged 40-49 and 50-59.

Looking at each “type of household” category, wage-earner households had the highest LTV and unemployed households had the lowest. In the impact analysis, although the determination results for

unemployed households were extremely poor, I confirmed the trend that the majority of unemployed households are progressively repaying their loans.

Looking at each "financial institution" category, although no significant differences were confirmed, I observed a tendency for slightly higher LTVs for "regional banks / second-tier regional banks."

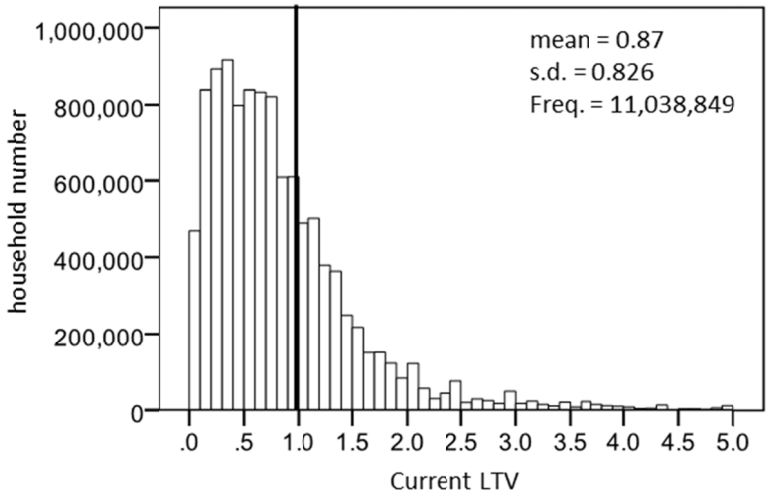


Figure22. Distribution of estimated current LTV for all households that are paying a mortgage

Table15. Distribution of estimated current LTV by household attributes

		age of household head				type of household			financial institution			
		under 39	40-49	50-59	over 60	wage-earner	non-wage-earner	unemployed	city bank / trust banks	regional banks	JHF	other
mean		1.10	1.00	0.77	0.55	0.88	0.84	0.79	0.86	0.91	0.85	0.85
s.d.		0.81	0.99	0.68	0.56	0.77	0.72	1.46	0.91	0.79	0.75	0.79
percentile value	10	0.40	0.27	0.14	0.09	0.20	0.19	0.08	0.16	0.20	0.15	0.16
	20	0.56	0.40	0.25	0.15	0.33	0.30	0.11	0.30	0.34	0.26	0.28
	30	0.66	0.54	0.36	0.20	0.45	0.43	0.19	0.44	0.44	0.35	0.41
	40	0.78	0.66	0.45	0.28	0.59	0.51	0.30	0.57	0.60	0.52	0.51
	50	0.93	0.78	0.58	0.37	0.73	0.65	0.40	0.71	0.74	0.68	0.65
	60	1.07	0.93	0.75	0.51	0.87	0.78	0.53	0.83	0.88	0.81	0.76
	70	1.23	1.11	0.92	0.69	1.06	0.94	0.74	1.01	1.08	1.00	0.98
	80	1.47	1.35	1.17	0.84	1.27	1.23	1.08	1.21	1.30	1.30	1.25
	90	1.99	1.79	1.58	1.19	1.65	1.70	1.79	1.51	1.77	1.68	1.79

4.4. Combination with determination results

Drawing on the work of the previous sections, I calculated the house and land asset values for each of the samples in the questionnaire survey, and by comparing this to their present mortgage balance, I calculated the current LTVs. In this paper, I will examine estimated loss, using the determination results of the previous chapter, the calculated LTVs and appraised values of security.

Looking at the relationship between LTV and the determination results in the case discussed in section 3.3 where the environment is not changed, I confirmed the trend for LTVs to be high for the sample of households determined as having difficulty in making mortgage payments. Looking at percentile values, about 60% of those households determined as having difficulty in making mortgage

payments have an LTV of 1 or less, and so appears that their loan would be able to be recovered even if they defaulted. On the other hand, about 40% of those households determined as having difficulty in making repayments have an LTV in excess of 1, meaning that if they were to default, it would be difficult for financial institutions to recover the full amount of the loan balance, and they could incur losses.

Table16. Current LTV and the determination results where the environment is not changed

determination result (h3)		0 (possible in making mortgage payments)	1 (difficult in making mortgage payments)
mean		0.85	1.75
s.d.		0.74	2.69
percentile value	10	0.17	0.14
	20	0.30	0.25
	30	0.42	0.39
	40	0.56	0.60
	50	0.69	0.76
	60	0.83	1.01
	70	1.02	1.33
	80	1.25	2.08
	90	1.65	3.17

Assuming that loans can be recovered if a household determined as having difficulty in making repayments has a calculated LTV of 1 or less, and that a loss would be incurred if their LTV is in excess of 1, I will calculate the difference between the balance of housing loans in each sample and their appraised value of security, and will treat this as the expected loss amount.

$$appraised\ value\ of\ security = estimated\ house\ value + estimated\ land\ value$$

$$expected\ loss\ amount = \begin{cases} balance\ of\ housing\ loans - appraised\ value\ of\ security & (h3 = 1\ \&1 < LTV) \\ 0 & (otherwise) \end{cases}$$

Using the determination results in the case discussed in section 3.4 where there is a decrease in income, I calculated the expected loss amounts (Table 17). In the case of no changes to the environment, the total expected loss amount was calculated at 732.8 billion yen (relevant households: 78,000), or 0.44% of the 164,985.5 billion yen corrected estimate for total loans, with a mean expected loss of 9,390,000 yen. This indicates the amount of loss which is potential, but has not yet surfaced, for households determined as not being able to make repayments from their family budget and savings at the current point in time.

I calculated the expected loss amount as 1,260.9 billion yen (component ratio: 0.76%) at a 5% decrease in income, 1,767.9 billion yen (component ratio: 1.07%) at a 10% decrease in income, and 3,514.1 billion yen (component ratio: 2.13%) at a 20% decrease in income. Although the increase in the number of such households tends to get larger as income decreases, because the expected loss amount in these cases gets smaller, the total expected loss amount was calculated as tending to increase in proportion to the decrease in income.

Table17. Expected loss amounts using the determination results where there is a decrease in income

rate of change in income	Total expected loss amount		Number of relevant households		mean expected loss
	(ten thousand JPY)	component ratio(%)	household	component ratio(%)	(ten thousand JPY)
1.00	73,276,698	0.44	77,959	0.71	939.9
0.95	126,092,479	0.76	135,133	1.22	933.1
0.90	176,789,296	1.07	195,795	1.77	902.9
0.85	271,300,044	1.64	325,420	2.95	833.7
0.80	351,422,817	2.13	470,134	4.26	747.5
Total	16,498,554,261	100.00	11,038,846	100.00	-

Looking at the expected loss amount for each “age of household head” category, in the case where there are no environmental changes, the largest amount was about 400 billion yen for the “40-49” households. In the case of a 10% decrease in monthly income, while a considerable impact can be confirmed of about 600 billion yen (component ratio: 1.6%) for the “39 or younger” households, about 700 billion yen (component ratio: 1.1%) for the “40-49” households and about 400 billion yen (component ratio: 0.8%) for the “50-59” households, the effect on the “60 or over” households was limited at about 80 billion yen (component ratio: 0.4%). The effect of a decrease in monthly income on expected mortgage losses is larger for the younger age groups (Table 18).

Looking at the expected loss amount for each type of household, in the case where there are no environmental changes, the largest component ratio was for unemployed households at 4.7% (about 300 billion yen). It was extremely low for non-wage-earner households at 0.8% (about 200 billion yen) and for wage-earner households at 0.1% (about 200 billion yen). In the case of a 10% decrease in monthly income, the expected loss amount was about 900 billion yen (component ratio: 0.7%) for wage-earner households, 400 billion yen (component ratio: 1.5%) for non-wage-earner households, and about 500 billion yen (component ratio: 7.2%) for unemployed households. The effect of a decrease in monthly income on expected mortgage losses is larger for wage-earner households (Table 19).

Looking at the expected loss amount for each “financial institution” category, in the case where there are no environmental changes, the component ratio was fairly large for city banks / trust banks at 0.6% (about 400 billion yen), and small for regional banks / second-tier regional banks at 0.2% (about 100 billion yen). In the case of a 10% decrease in monthly income, it was confirmed that the effect on environmental changes varies depending on the “financial institution” category, with city banks / trust banks incurring an expected loss amount of 0.9% of total loans (about 600 billion yen), 0.8% (about 400 billion yen) for regional banks / second-tier regional banks, 1.0% (about 200 billion yen) for the Japan Housing Finance Agency (JHF), and 1.8% (about 700 billion yen) for “other” institutions (Table 20).

Looking at the expected loss amount for each regional division, in the case where there are no environmental changes, the loss would be small in the Tokyo and Meihanfuku areas, but fairly large in the “other areas.” In the case of a 10% decrease in monthly income, in contrast to an expected loss amount of slightly less than 300 billion yen (component ratio: less than 1%) in the Tokyo and Meihanfuku areas, in “other areas,” the loss would increase to about 1.2 trillion yen (component ratio: more than 2%) (Table 21).

Looking at the expected loss amount for each interest rate type, in the case where there are no environmental changes, the expected loss amount would be fairly large for fixed-to-adjustable-rate mortgages and fixed-rate mortgages. In the case of a decrease in monthly income, fixed-rate mortgages appeared to be not affected very much, while a considerable impact was observed for variable-rate mortgages and fixed-to-adjustable-rate mortgages. In the case of a 10% decrease in monthly income, expected loss amounts were calculated at about 700 billion yen (component ratio:

0.9%) for variable-rate mortgages, about 600 billion yen (component ratio: 1.1%) for fixed-to-adjustable-rate mortgages, and about 500 billion yen (component ratio: 1.4%) for fixed-rate mortgages (Table 22).

Finally, I calculated the effects that a decrease in land value would have on the total expected loss amount. I only decreased land values, without making any other environmental changes. In the case of a 5% decrease in land value, the total expected loss amount was about 750 billion yen, and in the case of a 10% decrease in land value, the total expected loss amount was about 770 billion yen. Looking at the component ratios, we can see that the overall effect is limited, with a component ratio of 0.44% in the case where land value does not decrease, and 0.47% in the case of a 10% decrease (Table 23).

Table18. Expected loss amounts in case of decrease in income by age of household head

age of household head	rate of change in income	Total expected loss amount		Number of relevant households	
		(ten thousand JPY)	component ratio(%)	household	component ratio(%)
under 39	1	9,979,211	0.26	13,168	0.66
	0.9	63,011,132	1.62	69,898	3.50
	0.8	121,032,479	3.12	168,824	8.44
	total	3,881,314,272	100.00	1,999,314	100.00
40-49	1	35,099,247	0.56	36,271	0.99
	0.9	68,346,041	1.09	72,315	1.97
	0.8	117,590,675	1.88	160,302	4.37
	total	6,243,831,532	100.00	3,671,369	100.00
40-59	1	21,069,264	0.47	18,989	0.54
	0.9	37,473,841	0.83	39,280	1.13
	0.8	98,888,718	2.19	119,227	3.42
	total	4,514,274,043	100.00	3,487,035	100.00
over 60	1	7,128,976	0.38	9,531	0.51
	0.9	7,958,283	0.43	14,303	0.76
	0.8	13,910,946	0.75	21,781	1.16
	total	1,859,134,414	100.00	1,881,128	100.00

Table19. Expected loss amounts in case of decrease in income by type of household

type of household	rate of change in income	Total expected loss amount		Number of relevant households	
		(ten thousand JPY)	component ratio(%)	household	component ratio(%)
wage-earner	1	17,945,651	0.14	24,073	0.29
	0.9	85,210,550	0.66	89,627	1.09
	0.8	204,247,486	1.58	293,091	3.56
	total	12,888,268,357	100.00	8,236,070	100.00
non-wage-earner	1	23,745,947	0.81	25,108	1.23
	0.9	43,214,149	1.47	50,640	2.49
	0.8	94,889,819	3.23	112,944	5.55
	total	2,937,781,353	100.00	2,034,206	100.00
unemployed	1	31,585,100	4.70	28,777	3.74
	0.9	48,364,598	7.19	55,528	7.22
	0.8	52,285,512	7.77	64,099	8.34
	total	672,504,551	100.00	768,571	100.00

Table20. Expected loss amounts in case of decrease in income by financial institution

financial institution	rate of change in income	Total expected loss amount		Number of relevant households	
		(ten thousand JPY)	component ratio(%)	household	component ratio(%)
city banks / trust banks	1	37,911,315	0.60	36,408	0.97
	0.9	56,796,738	0.90	57,226	1.53
	0.8	97,595,697	1.55	135,804	3.63
	total	6,299,104,850	100.00	3,741,485	100.00
regional banks	1	10,100,355	0.21	19,929	0.59
	0.9	37,249,816	0.79	49,124	1.46
	0.8	96,421,679	2.05	144,854	4.31
	total	4,700,967,542	100.00	3,357,357	100.00
JHF	1	8,118,383	0.45	9,670	0.71
	0.9	17,357,519	0.97	22,438	1.65
	0.8	68,347,737	3.81	77,160	5.67
	total	1,795,367,995	100.00	1,361,165	100.00
other	1	17,146,644	0.46	11,952	0.46
	0.9	65,385,223	1.77	67,007	2.60
	0.8	89,057,704	2.40	112,317	4.36
	total	3,703,113,874	100.00	2,578,839	100.00

Table21. Expected loss amounts in case of decrease in income by regional division

regional division	rate of change in income	Total expected loss amount		Number of relevant households	
		(ten thousand JPY)	component ratio(%)	household	component ratio(%)
Tokyo area	1	4,835,926	0.07	7,140	0.18
	0.9	26,308,658	0.38	23,291	0.58
	0.8	104,417,817	1.51	123,841	3.07
	total	6,925,301,902	100.00	4,037,490	100.00
Meihanfuku area	1	15,208,444	0.38	20,646	0.76
	0.9	28,152,208	0.71	37,583	1.38
	0.8	55,722,410	1.40	92,926	3.41
	total	3,977,335,289	100.00	2,724,503	100.00
other	1	53,232,327	0.95	50,174	1.17
	0.9	122,328,430	2.19	134,921	3.15
	0.8	191,282,590	3.42	253,368	5.92
	total	5,595,917,070	100.00	4,276,853	100.00

Table21. Expected loss amounts in case of decrease in income by type of interest rate

type of interest rate	rate of change in income	Total expected loss amount		Number of relevant households	
		(ten thousand JPY)	component ratio(%)	household	component ratio(%)
variable-rate	1	9,738,322	0.13	19,356	0.41
	0.9	72,184,528	0.94	83,283	1.76
	0.8	158,237,679	2.06	208,381	4.39
	total	7,682,007,679	100.00	4,741,415	100.00
fixed-to-adjustable-rate	1	32,366,819	0.54	33,700	0.82
	0.9	63,342,409	1.07	70,633	1.73
	0.8	143,682,750	2.42	194,872	4.77
	total	5,941,437,983	100.00	4,088,513	100.00
fixed-rate	1	31,171,557	1.08	24,903	1.13
	0.9	41,262,358	1.44	41,879	1.90
	0.8	49,502,387	1.72	66,881	3.03
	total	2,875,108,599	100.00	2,208,918	100.00

Table21. Expected loss amounts in case of decrease in land value

decrease in land value	total expected loss amount	component ratio (%)
0%	73,276,698	0.44
5%	75,059,441	0.45
10%	76,842,184	0.47
total	16,498,554,261	100.0

5. Conclusion

The subprime mortgage problem will be remembered as a risk on housing loans. In the United States, the problem was triggered by mortgage loans devoid of economic rationality lent to subprime borrowers and the rapid increase in delinquencies in 2006-07. As a consequence of their securitization, financial institutions were affected far and wide. It is said that, in Japan, the subprime market basically did not exist because of conservative loan screening (Kurahashi and Kobayashi (2008)), and as seen in section 2.1, the progress of securitization has been limited.

As seen in section 2.2, loans by domestic banks to government and business have decreased, whereas personal loans, and in particular loans for housing finance, have increased. Amid such circumstances, as seen in section 2.6, with the income of households burdened with a mortgage continuing to decrease, and savings also on the decline, the only thing not decreasing is the amount of mortgage repayments. If anything, it is on a slight upward trend. Consequently, the mortgage repayment ratio is also continuing to rise. In my view, one of the concerns in terms of risks on housing loans in Japan is that any further decline in income levels will help cause the middle class, which had previously maintained steady repayments, to become disjointed, and there will be an impact on repayments.

As I stated at the outset and in section 3.1, we cannot begin to investigate the effects that changes in the external environment, such as decreasing incomes and rising interest rates, have on current housing loans, unless we first gain an understanding of the circumstances of individual family budgets

(income, spending, savings, etc.) and of the details of their housing loans (product attributes, amounts of repayment, etc.). Since the state of family budgets cannot be known using merely the financial statements and other information from financial institutions, risk monitoring is preferred which takes into account both the state of housing loans and the state of family budgets.

Additionally, as seen in the first half of Chapter 4, the appraised value of residential structures decreases at a fast pace (values halve in about five years for wooden structures, and in about 10 years for non-wooden structures[17]), and the downward trend in land value continues nationally. Thus, there is also concern about recovery rates when households default on their mortgages.

In this paper, I have used social surveys and statistical techniques to investigate methods for monitoring the risks on housing loans in Japan caused by family budgets. Below I have listed and summarized the main points.

- Looking at social surveys on Japan's housing finance, the Family Income and Expenditure Survey and the National Survey of Family Income and Expenditure, which are both conducted by the Ministry of Internal Affairs and Communications (MIC) Statistics Bureau, allow us to understand the details of family budgets, savings and debt, including mortgage balances and repayment amounts, but not about the product attributes of housing loans. The questionnaire surveys conducted by the Japan Housing Finance Agency (JHF) and the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) allow us to understand the product attributes of housing loans, but not about the details of family budgets, savings and debt.

- Sato (2012) designed and conducted an independent Internet survey, which simultaneously asks about family budgets and the details of housing loans, and then used the National Survey of Family Income and Expenditure and a propensity score to correct the estimates. By comparing this against the results of other surveys, including the National Survey of Family Income and Expenditure, I have been able to confirm that corrected estimations are possible which are, for the most part, appropriate.

- In this paper, I prepared three determination processes for individual samples collected during a questionnaire survey, namely: (1) Sustainability of repayment (check of the relationship between disposable income, consumption expenditure and the amount of monthly mortgage repayments); (2) Adjustment of family budgets (attachment of a maximum consumption expenditure, set according to the regional division and the number of household members); and (3) Dissaving (check of whether a repayment amount, which is still short even after adjusting the family budget, can partially be covered by dipping into savings). Furthermore, by altering the environment, such as income and/or the amount of mortgage repayments, I corrected the estimates using propensity scores, and I estimated the impacts of those changes.

- If income decreases by 10%, the ratio of households determined as having repayment difficulties increased 2.53-fold. If the amount of mortgage repayments was increased by 10% for samples of variable interest rate mortgages and fixed-to-adjustable-rate mortgages, the ratio of households determined as having repayment difficulties increased 1.48-fold. It would appear that this type of impact analysis from family budgets could also serve as a basis for setting default rates to apply in stress tests.

- Combining data on housing attributes and prefecture locations, which were obtained from the questionnaire survey samples, with *The Methods to Estimate of Value of Tangible Fixed Assets* from the 2009 National Survey of Family Income and Expenditure (MIC Statistics Bureau) and the Prefectural Land Price Survey Data (Land Information Center), I calculated house and land asset values, and by comparing this to their present mortgage balance, I calculated the current

[17] See section 4.1.

"loan to value" (LTVs). Then, I performed a trial calculation of estimated losses for households who are determined as having difficulty in making mortgage repayments, and whose asset value is below their present mortgage balance. In the case of no changes to the environment, the total expected loss amount was calculated at 732.8 billion yen, or 0.44% of the 164,985.5 billion yen corrected estimate for total loans. In the case of a 10% decrease in income, an expected loss amount of 1,767.9 billion yen (component ratio: 1.07%) was calculated. This kind of estimation of expected loss amounts based on stress on family budgets has the potential to be helpful in capital adequacy assessments at financial institutions.

- I aggregated the results of the estimated expected loss amounts for each attribute category, and consequently observed the following features: (1) Looking at each "age of household head" category, the effect of a decrease in monthly income on mortgages is larger for the younger 30-39 and 40-49 age groups. Even if the older age groups default, since the balance of their mortgage is small, the expected loss amount is also small. (2) Looking at each "financial institution" category, compared to city banks / trust banks, a decrease in monthly income tends to result in a greater increase in the expected loss amount for regional banks / second-tier regional banks, the JHF and for "other" financial institutions. (3) Looking at each regional division, compared to urban areas such as the Tokyo area (Tokyo, Kanagawa, Saitama and Chiba) and the Meihanfuku area (Aichi, Kyoto, Osaka, Hyogo and Fukuoka), a decrease in monthly income tends to result in a greater expected loss amount for other provincial areas.

Finally, I will list a number of challenges and considerations for the future.

- Further examination is needed regarding the accuracy of corrected estimations using propensity scores. In particular, we need to grasp the effects that sample size has on the results of a corrected estimation. Potential items for consideration regarding Internet surveys are: making the sample size larger; asking about lot size and present abodes in more detail (a more exhaustive estimation can be made for land value); increasing the accuracy of the sample by carefully conducting logical checks when investigating the attributes of family budgets and housing loans; and asking about prepayments in more detail.

- With regard to the risk management of housing loans, a point confirmed in this paper is that obligor properties and mortgage attributes at the time of the loan origination are not the only factors that have a large impact—subsequent changes in family budgets, such as in income and expenditure, can also have a large impact. There is room for further examination on grasping the changes in family budgets after the origination of a loan, even using the econometric models amassed by past studies, such as survival analysis on mortgage delinquency and prepayment.[18] In doing so, it is expected that the acquisition of data would be difficult, and so preparing a synthetic portfolio, like the one in this paper, based on a corrected estimation using social surveys and statistical techniques, could possibly be an effective method. It would also appear that there is room for further examination on the methods used at financial institutions for grasping the changes to family budgets after the origination of a loan.[19]

[18] To the best of my knowledge on past studies, the econometric models of studies thus far basically express backward-looking and historical statistical relationships; and even taking an assumed model as given, it would appear that the effects on mortgages caused by changes in family budgets, etc. could not be fully captured simply by changing the input variables. I would like to point out that statistical relationships of delinquency, prepayment and so forth change due to changes in family budgets, that parameters change even though the model stays the same, and the potential need to change the actual model (component variables, structure, etc.) depending on the data.

[19] In fact, although getting a full understanding of detailed data on family budgets would appear to be difficult, if, for instance, data on bank accounts that are used on a regular basis could be used, an analogical method based on trends in deposits and savings could be conceivable.

- Under the first pillar (minimum capital requirements) of Basel II (the new capital adequacy requirement), if we ignore the balance with other risks and look simply at housing loans, by multiplying the risk weight for residential property of 35% by the minimum capital requirement, we get 2.8% for internationally active banks and 1.4% for domestic banks. Either case would cover 1.07%, which is the ratio of expected losses estimated in this paper if there was a 10% decrease in income. However, when it comes to 2.13%, which is the ratio of expected losses estimated in this paper if there was a 20% decrease in income, this would exceed the 1.4% for domestic banks. Amid fluctuating incomes, interest rates, commodity prices, housing prices and so forth, the effects that the stress on family budgets has on housing loans will constantly change, and so continuous monitoring seems desirable.

- Housing loans are provided by various financial institutions, and their ratio as a percentage of all loans also varies. According to the corrected estimates by Sato (2012), whereas the balance of housing loans at city banks accounts for approximately 53 trillion yen (component ratio: 32%), the amounts at regional banks / second-tier regional banks and other[20] financial institutions are also considerable, at approximately 47 trillion yen (component ratio: 28%) and approximately 37 trillion yen (component ratio: 22%), respectively. In this paper, I have confirmed that the effect on expected loss amounts caused by a decrease in income is larger for regional banks / second-tier regional banks and other financial institutions than it is for city banks / trust banks, and that the effect on expected loss amounts caused by a decrease in income is larger for provincial areas than it is for urban areas. Consequently, profit management and stress testing of housing loans will also need to be strengthened at financial institutions besides city banks which have a high proportion of housing loans.

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[20] Specifically, "other" financial institutions refers to credit associations, credit unions, workers' credit unions, agricultural cooperatives, life insurance companies, nonlife insurance companies, nonbanks and Internet banks.

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Financial Research Center (FSA Institute)
Financial Services Agency
Government of Japan

3-2-1 Kasumigaseki, Chiyoda-ku, Tokyo 100-8967, Japan

TEL：03-3506-6000(ext 3293)
FAX：03-3506-6716
URL：http://www.fsa.go.jp/frtc/english/index.html