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Earthquake Risk and Housing Rents: Evidence from the Tokyo Metropolitan Area[1] [2]

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Abstract: This paper estimates the extent of earthquake risk aversion in housing rents using a 1998 hazard map compiled by the Tokyo Metropolitan Government. These rents reflect not only earthquake risk generally, but also the interaction between the earthquake-resistant quality of construction and the relative risk aversion of households. The paper's main findings are as follows. First, housing rents are substantially lower in risky areas than in safe areas, even after controlling for other possible effects. Second, the rent of an apartment built prior to 1981, the year before the Building Standard Law was amended to enhance the earthquake-resistant quality of buildings, is discounted more substantially in risky areas than those built after this date. In addition, according to a cost-benefit analysis based on these estimation results, investment in earthquake-proof structures is profitable for landlords who own older wood-framed apartment buildings in risky areas given the current level of the government subsidy introduced in 2002.

Keywords: earthquake risk, risk aversion, housing rent, hazard map.
JEL classification: R14, R22, G11.

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1. Introduction

The risk aversion of households and firms towards earthquake risk may be inferred from real estate data in two ways. First, land prices may reflect an earthquake risk premium as compensation, because risk-averse agents tend to avoid land with a high degree of earthquake-related danger. Second, housing rents may also reflect information concerning the degree of the earthquake-resistant quality of construction, in that risk-averse agents may prefer more solidly built structures as well as geographically safer places. This paper empirically examines the latter issue, while a companion paper (Nakagawa, Saito, and Yamaga, 2004) addresses the former.

There have been few empirical studies on the effect of earthquake risk on land prices in the field of urban and regional economics. Among those undertaken, Beron et al. (1997) compare the residential prices in the San Francisco Bay area before and after the 1989 Loma Prieta Earthquake. Their study suggests that residents revised the assessment of earthquake risk after the earthquake occurred. Brookshire et al. (1985) find significant impacts on land pricing after the disclosure of a hazard map constructed by the State Government of California. In addition, they show that the estimated decline of residential prices due to earthquake risk is quite consistent with what is implied for risk-averse behavior by expected utility theory. Nakagawa et al. (2004) empirically address the effect of earthquake risk on land pricing using the index of earthquake risk compiled for the entire metropolitan area by the Tokyo Metropolitan Government (Bureau of City Planning, 1998). They demonstrate that land prices are low in areas with substantial exposure to earthquake risk, and examine the consistency of the estimated magnitude of earthquake risk premiums under the expected utility hypothesis.

On the other hand, and to our best knowledge, there have been no empirical studies concerning the effect of earthquake risk on housing rents. This paper empirically examines the extent to which earthquake risk is reflected in housing rents in the Tokyo Metropolitan Area, adopting the same earthquake risk index as used by Nakagawa et al. (2004). In particular, we pay attention to how the effect of earthquake risk on housing rents depends on the structure of the rented house. We find that earthquake risk is reflected in housing rents to a large extent even after controlling for other possible effects on housing rents; that is, housing rents are substantially lower in the areas with exposure to earthquake risk. We also find that the effect of earthquake risk on housing rents depends largely on the robustness of the rented houses. For the purposes of estimating the latter, we exploit the fact that the Building Standard Law was amended in 1981 to enhance the earthquake-resistant quality of buildings, and that a building constructed after 1981 needed to conform to the new standard of earthquake-resistant quality. According to our estimations, the rent of houses built prior to 1981 is discounted more substantially in risky areas than that of houses built after 1981.

These findings have important policy implications for the construction of earthquake-proof measures in Japan. For example, the Architectural Institute of Japan (1997) documented that 95% of the buildings that collapsed in the Great Hanshin-Awaji Earthquake (January, 1995) were constructed under the old building code, while wooden houses suffered more than other types of structure. According to the Housing Bureau (2001), few of such wooden apartments are subject to on-site assessment of earthquake-resistant quality, and one quarter of wood-framed houses would indeed be rated as having extremely high exposure to the risk of housing collapse. From the viewpoint of disaster countermeasures, it is then important to renovate buildings constructed in risky areas under the old code.

Our investigation also suggests that disaster prevention investment against earthquake risk may be beneficial for owners of rented houses. We take as a case the subsidy for the antiseismic system improvement that started in 2002, and examine whether apartment owners would benefit from an increase in apartment rents due to investment in earthquake-resistance measures. Under this system of subsidies, the Japanese government provides subsidies to cover 7.7% of renovation costs. According to our cost–benefit analysis, the investment in earthquake-proof structures would indeed be profitable for landlords who own older wood-framed apartments in risky areas. This case study may then serve as an important example of how policy measures use market evaluation (pricing of housing rents in this particular case) as an instrument to promote disaster prevention in a decentralized manner.

This paper is organized as follows. Section 2 presents the empirical specification, and reports the estimated results. Section 3 examines whether investment in antiseismic systems is beneficial for landlords on the basis of cost-benefit analysis. Section 4 concludes by discussing the policy implications for disaster countermeasures.

2. Data and estimation results

2.1 Data

Following a standard hedonic pricing approach, this section investigates the impact of earthquake risk on housing rents. As described below, we collect a set of explanatory variables, including an index of earthquake risk, as well as variables concerning the characteristics and location of rental houses.

2.1.1 Earthquake risk indexes

While the Tokyo Metropolitan Government has compiled an earthquake hazard map about every five years since 1975, it released the most elaborate earthquake hazard map on a seven-digit postcode basis for the entire Tokyo metropolitan area (except for western rural areas) in March 1998 (Bureau of City Planning, 1998). This data has been made available through the Tokyo Metropolitan Government website since 1998.[3] Importantly, the construction of the earthquake risk index in the 1998 version is not an assessment of specific damage by a predicted earthquake. It is rather an assessment of the comparative vulnerability of finely divided regions (on a seven-digit postcode basis) in terms of: (i) potential damage to buildings due to initial earthquake shocks; (ii) potential damage to buildings due to consequent fires; (iii) potential human injuries due to initial earthquake shocks; and (iv) potential human injuries due to consequent fires. Each index classifies the degree of riskiness according to five ranks, from Rank 1 (safest) to Rank 5 (riskiest). We add this ascending risk scale of 1 to 5 to the list of explanatory variables in the rent pricing function.

Our study uses the 1998 version of the risk index of potential damage to buildings due to initial earthquake shocks (the building collapse risk). A major reason for adopting the building collapse risk among the four indexes is that this index mainly considers: (a) the quality of the ground structure; and (b) earthquake-resistant properties of constructions in the ground area. More particularly, the risk index is lower if the ground of an affected area is solid, or if robust constructions are built on an affected area. Among the 2,893 divided ground areas, 1,257 areas belong to Rank 1; 1,003 to Rank 2; 466 to Rank 3; 131 to Rank 4; and 36 to Rank 5. Among the sample of housing rents described in the next subsection, 21,853 rented housing are located in Rank 1; 35,670 in Rank 2; 19,007 in Rank 3; 5,014 in Rank 4; and 972 in Rank 5.

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[3] The latest version is available from the web site; www.toshiseibi.metro.tokyo.jp/bosai/chousa_5/home.htm (in Japanese).

2.1.2 Housing rents and characteristics

This study adopts housing rents and characteristics available from Recruit (2002), which is the largest web-accessible rental housing information database in Japan. This dataset includes not only housing rents (on an offer price basis), but also detailed information about rental housing characteristics. We use the dataset of monthly housing rents in the Tokyo Metropolitan Area collected as at the end of January 2002 by Recruit (2002).

Following the existing literature on the hedonic pricing approach applied to Japanese cities (for example, Gao and Asami, 2001; Kanemoto and Nakamura, 1986; and Kanemoto et al., 1996), we collect the following variables from Recruit (2002) as explanatory variables, thereby controlling for possible effects on housing rents. These include: the walking time (bus time) from home to the nearest station, floor space, building age, the number of floors, and a first floor dummy in addition to a set of dummy variables of types of building and construction materials used. Furthermore, a set of cities (or wards) and nearest commuter lines as dummy variables may control for environmental effects on housing rents other than earthquake risk. In addition, we calculate the travel time from the nearest station to Tokyo Station, according to the 2000 train timetable.[4] The travel time to Tokyo Station is often regarded as a good measure of commuting convenience in the Tokyo Metropolitan Area.

In this dataset, there are two types of buildings, fireproof and nonfireproof, and three types of construction materials: steel-framed, steel-reinforced concrete, and wood-framed construction. As discussed earlier, the Building Standard Law was amended in 1981. Consequently, any apartment building constructed after 1981 has to conform to a new standard of earthquake-resistant quality. To control for the effect of this

[4] For this purpose, we use a software package, which is provided by VAL Institute (http://val.co.jp).

amendment on housing rents, we introduce a dummy variable that takes a value of one for apartment buildings constructed after 1981, otherwise zero.

We also include the interaction term between the earthquake risk index and the new building standard dummy variable, given the possibility that the impact of earthquake risk on housing rents may be different between under the old and new standards of earthquake-resistant quality. We also consider the possibility that the impact of earthquake risk on housing rents may differ according to buildings' construction materials by adding interaction terms between the earthquake risk index and the dummies for construction material.

Given the above construction of explanatory variables, the coefficient on the risk index multiplied by a construction-type dummy represents the risk impact under the old standard, while the coefficient on the risk index multiplied by a construction-type dummy and a new standard dummy corresponds to the difference in the risk impact between under the new and old standards.

Table 1 presents descriptive statistics for the major study variables used in this study.

2.2 Estimation Results

Table 2 presents the results of an OLS estimation[5] based on two types of specification, entitled Model I and Model II. Except for the earthquake index and dummy variables, all independent variables, including housing rents as a dependent variable, are expressed in logarithmic form. All reported standard errors are robust with respect to heteroscedasticity.

[5] We check the robustness of our estimation results using Box-Cox transformation as an alternative specification. The validity of our results in Table 2 is still supported by this more general functional form.

According to the results of Model I, all estimated coefficients on the travel time to Tokyo Station, the road distance to the nearest station, and floor space are generally reasonable in sign at the 1% level of significance. One interesting observation is that the number of floors is significantly positive (the higher the floor, the higher the rent), while the estimated coefficient on the first floor dummy variable is also significantly positive (implying that a room on the first floor also has extra value). According to the estimated coefficients on the variables associated with housing types, the rent of buildings with fireproof construction is significantly higher than that of those with nonfireproof construction. In addition, the rent of houses constructed under the new standard is significantly higher than of those constructed under the old standard.

With respect to the effect of the earthquake risk index on housing rents, all coefficients on the indexes associated with the buildings under the old standard are significantly negative, despite differences across construction types, namely steel-framed, steel-reinforced concrete, and wood-framed. These results suggest that the rent of a house built on lower risk ground is substantially higher than that of a house built on higher risk ground. The impact of housing rents with respect to the risk index is highest for wood-framed housing (-0.0286), and lowest for steel-reinforced concrete housing (-0.0079). That is, the rent of a house of the least robust structure is most sensitive to earthquake risk.

In comparison between houses built under the new standard and under the old standard, the risk sensitivity is almost the same under the old and new building codes for both steel-framed and steel-reinforced concrete housing. As in the case of wood-framed, however, the risk sensitivity under the new standard is substantially lower than that under the old standard, as the estimated coefficient on the interaction term among the risk index, the wood-framed dummy, and the new standard dummy is positive at 1%

level of significance. An F-test of the zero-sum of the estimated coefficients on wood-framed under the old standard (-0.0286) and under the new standard (0.0371) is rejected at the 1% level of significance. That is, the riskier the index, the higher the housing rent under the new standard. This finding is discussed later in this section.

The estimation results based on Model I indicate that the introduction of the new standard has greatly enhanced the quality of wood-framed construction in earthquake-hazardous areas. To investigate this aspect in more detail, we treat the quality of construction of wood-framed housing more explicitly. For this purpose, Model II introduces an interaction term between the logarithm of building age and the risk index, in addition to the set of explanatory variables used in Model I.

As shown in the second column of Table 2, all estimated coefficients, other than those associated with the risk index, do not substantially differ between Model I and Model II. Figure 1, on the other hand, highlights the effect of building ages on the risk impact of wood-framed housing rents using the results of Model II. As shown, a building of less than 21 years of age is subject to the new standard introduced in 1981, while a building older than 21 years is subject to the old standard. Note that the dataset used records housing rents as at January 2002.

As shown in Figure 1, there are four interesting features with respect to the risk impact of wood-framed housing rents. First, there is a downward jump at the age of 21. As pointed out earlier, this discontinuity in the impact indicates that the new building code has substantially enhanced the earthquake-proof quality of wood-framed buildings. Second, despite whether the building was constructed under the old or new standard, the value of the risk impact coefficient decreases in building age. Third, the risk impact curve of buildings under the old standard is steeper than that of buildings under the new standard, implying that risk impact is more sensitive to building age under the old standard. Fourth, the risk impact of building under the new standard is positive. The final point may indicate that the quality of wood-framed buildings under the new standard is fairly high in more hazardous areas.

Table 3 presents the predicted housing rent according to building age for a room on the first floor of a wood-framed and nonfireproof apartment building located in the riskiest area (Rank 5) in Sumida Ward for both models. In addition, we assume the following conditions: the walking time to the nearest station is nine minutes, the travel time to Tokyo Station is 30 minutes, and the floor space is 30 square meters. In Model I, the predicted rent of the building under the new standard is about 33.6% higher than that under the old standard. On the other hand, in the Model II specification, the percentage difference between the former and the latter ranges from 26.3% to 57.3%. These calibrated rents are used for the cost-benefit analysis of earthquake-proof investment in Section 3.

As a final remark, we explore the possibility that the earthquake risk index may pick up effects other than earthquake risk, and that it generates a seeming relationship with housing rents. In particular, the risk index may act as a proxy for environmental variables such as amenity and convenience. We argue against this on the following basis.

First, if this were the case, the estimated coefficients on the risk index should not depend on the type of building construction. It is difficult to believe that the effect of environmental factors other than earthquake risk on housing rents would interact with the type of building construction. Second, our well-prepared list of explanatory variables is able to control for environmental effects on housing rents to a great extent. The walking/bus travel time to the nearest station and the travel time to Tokyo Station act as a proxy for degrees of commuting convenience. As is well recognized in the existing literature, dummy variables of cities (wards) and commuter lines can control for segmentation effects on housing rents due to income classes. Finally, Nakagawa et al. (2004), who analyze the effect of earthquake risk on land pricing, demonstrate that the same risk index yields quite reasonable effects on land prices as well. Together, these qualify the validity of the current index as being representative of earthquake risk alone.

3. Cost-benefit analysis of an antiseismic system improvement of housing

3.1 Averaged evaluation of an antiseismic system improvement

Using the estimation results from Section 2, this section estimates the net profits of a landlord when an antiseismic system improvement of housing is implemented. More specifically, the net present value of future cash flows to a landlord profit (*NPV*) is calculated as the difference between an increase in housing rents due to an antiseismic system improvement and its implementation cost:

$$NPV = \sum_{t=1}^{m} \frac{Y_t}{(1+i)^t} - C \,, \tag{1}$$

where Y_t denotes the increase in housing rents at period t due to earthquake-proof investment, i is the discount rate (the real interest rate), and C is the cost of antiseismic system improvements. We calculate whether the net present value (*NPV*) is positive.

According to the System of National Accounts compiled by the Agency of Economic Planning, the life of residential buildings is approximately 42 years. As a 22-year-old apartment building in 2002 is adopted as the reference case, the life remaining is twenty years (m). It also means that this old apartment block was built under the old building code. We then assume that an increase in housing rents due to antiseismic improvements corresponds to the estimated difference in rents under the old and new building codes. The real interest rate (i) is assumed to be the average mortgage rate adjusted by the consumer price index between 1987 and 1999 in Japan, or 3.52% per annum.

We now conduct a cost-benefit analysis of antiseismic improvements for the above type of apartment building. As shown below, the overall net benefit to a landlord is still negative despite the government subsidy introduced in 2002. According to the estimation results of Model I concerning the rented houses built from 1982 and those built before 1981, landlords of rented houses would receive, on the weighted average of all types of constructions (including steel-framed, steel-reinforced concrete, and wood-framed), an 11.5% increase in apartment rents due to antiseismic system improvements. Because the average monthly housing rent of a 22-year-old house located in Tokyo is 68,374 yen per unit in 2002 consumer prices (Statistics Bureau, 1998), the present value of increases in future rents would amount to about 1,339,000 yen. According to the Housing Bureau (2001), the average antiseismic system improvement cost (C) is around three million yen per unit in 2002 consumer prices. The government subsidy covers 7.7% of renovation costs. Given these assumptions, the net present value of antiseismic improvements attributed to the landlord would be negative, or -1,430,000 yen[6], despite the government subsidy.

3.2 Cost-benefit analysis of wood-framed apartment building

As demonstrated in the earlier section, however, the risk sensitivity of housing rents depends largely on the fragility of construction, and there is a substantial difference in rents of wood-framed apartment buildings under the old and new building codes. Thus, the net benefit to a landlord might be positive for old wooden apartment

[6] The corresponding calculation is $1{,}339{,}000 - 3{,}000{,}000 \times (1 - 0.077) = -1{,}430{,}000$.

buildings located in areas with high exposure to earthquake risk. We explore such a possibility by a cost-benefit analysis of antiseismic system improvements designed for a 22-year-old wood-framed apartment building under exactly the same assumptions as those used in Table 3. That is, the reference apartment unit is 22 years old on the first floor of a wood-framed and nonfireproof building located in Sumida Ward. In addition, we assume the following: the walking time to the nearest station is nine minutes, the travel time to Tokyo Station is 30 minutes, and the floor space is 30 square meters.

Table 4 reports the calibrated net profit to a landlord for the case without any subsidy, column (2), and the case with the government subsidy amounting to 7.7% of antiseismic system improvement costs under existing laws, column (3). The difference in wood-framed housing rents before and after earthquake-proof renovation (reported in column (1)) is calculated in the same way as in Table 3. For example, the figures reported in the Rank 5 rows of Table 4 (19.94) correspond to those in the rows of 22 years of Table 3.

As shown in column (2), for relatively safe areas (Rank 1, 2, 3), net profits to a landlord are negative in all cases without subsidy. Even with the government subsidy, net profits are not positive. According to the calculation based on Model I, however, net profit is positive for the riskiest area without any subsidy; that is, the net gain is 394,600 yen for the Rank 5 area. As shown in column (3), with the government subsidy, even Rank 4 area yield positive net profits. The cost-benefit analysis based on Model II is a little more pessimistic. Nevertheless, the net profit for the Rank 5 area is positive with the government subsidy (22,950 yen). This cost-benefit analysis then proves that the antiseismic system improvement of wood-framed apartment buildings in areas with high exposure to earthquake risk would be beneficial to landlords in terms of net present value.

4. Conclusion

As shown in Section 3, with government subsidies the landlord who owns an old wood-framed apartment building in a risky area would benefit from investment in earthquake-resistance measures, mainly because of the substantial improvement in housing rents. Nevertheless, few landlords have voluntarily exploited this opportunity. Indeed, instead of voluntary actions by landlords, local governments often designate some apartment owners, and force them to renovate their rented apartments.

One major reason for this apparent unwillingness of landlords to renovate their apartments is that tenants are heavily protected under the Tenant Protection Law in Japan. That is, it is difficult for landlords who are interested in renovating their buildings to cancel existing lease contracts, even with long periods of notice. Once a tenant opposes renovation for earthquake-resistance purposes, landlords are subject to court decisions. Such aspects of the Tenant Protection Law might make the antiseismic system improvement more costly than that estimated in Section 3.

As shown by research on the Great Hanshin-Awaji Earthquake, including that conducted by the Architectural Institute of Japan (1997), houses with inferior earthquake-resistant quality triggered large negative externalities in the neighborhood. For example, broken fragile houses blocked transportation networks, thereby preventing effective fire fighting and, by severing lifelines, they made recovery more difficult. In this regard, improvements in the earthquake-resistant quality of apartment building would not only benefit apartment owners directly, but would also indirectly benefit other neighborhood residents. In consideration of these externalities, it is then crucial to construct an environment in which landlords easily and voluntarily renovate their own apartments for earthquake-resistance purposes. With additional subsidies to landlords, and Tenant Protection Law deregulation, the positive externalities of investment in disaster prevention may then be fully exploited.

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Table 1: Descriptive Statistics of Dependent and Independent Variables

Variables	Mean	Standard Deviation
Housing rents (yen)	122167.50	25671.82
Earthquake risk (%)		
Rank 1 area (safest)	26.48	
Rank 2 area	43.23	
Rank 3 area	23.03	
Rank 4 area	6.08	
Rank 5 area (riskiest)	1.18	
Fireproof building dummy	0.78	0.42
New standard building dummy	0.88	0.33
Bus time (minutes) (1)	0.31	1.99
Walking time (minutes)	7.41	4.32
Travel time to Tokyo Station (minutes)	50.54	11.98
Floor space (square meters)	38.47	22.04
Building age (years)	11.47	8.24
Floor number	3.20	2.84
First floor dummy	0.24	0.43
Building structure dummy		
Steel-framed	0.19	0.39
Steel-reinforced concrete	0.65	0.48
Wood-framed	0.15	0.36

(1) The share of bus users is 2.69%. The average bus time conditional on the bus usage as commuting is 11.42 minutes.

Table 2: Estimation Results of Rent Pricing Functions

	Model I		Model II	
Constant (old standard and nonfireproof)	9.1261***	(0.0138)	9.1240***	(0.0138)
Fireproof dummy	0.0605***	(0.0021)	0.0608***	(0.0021)
New standard dummy	0.1043***	(0.0040)	0.1057***	(0.0040)
Risk index × steel-framed dummy	-0.0127***	(0.0024)	-0.0124***	(0.0024)
Risk index ×steel-reinforced concrete dummy	-0.0079***	(0.0017)	-0.0077***	(0.0017)
Risk index × wood-framed dummy	-0.0286***	(0.0020)	0.1519***	(0.0221)
Risk index × wood-framed dummy × building age			-0.0551***	(0.0067)
New standard × risk index × steel-framed dummy	-0.0032*	(0.0024)	-0.0035	(0.0024)
New standard × risk index × steel-reinforced concrete dummy	0.0027	(0.0018)	0.0024	(0.0018)
New standard × risk index × wood-framed dummy	0.0371***	(0.0021)	-0.1398***	(0.0221
New standard × risk index × wood-framed dummy × building age			0.0535***	(0.0068)
Bus time	-0.0753***	(0.0015)	-0.0753***	(0.0015)
Walking time	-0.0315***	(0.0008)	-0.0315***	(0.0008)
Travel time to CBD	-0.0953***	(0.0033)	-0.0951***	(0.0033)
Floor space	0.7317***	(0.0011)	0.7315***	(0.0011)
Building age	-0.0345***	(0.0005)	-0.0341***	(0.0005)
Floor number	0.0519***	(0.0013)	0.0520***	(0.0013)
First floor dummy	0.0192***	(0.0018)	0.0191***	(0.0018)
Adjusted R square	0.92		0.92	
F-value	7145.40		7043.57	
Number of observations	82516		82516	

(1) The figures in parenthesis are heteroscedasticity-robust standard errors.
(2) *** and * indicate the 1% and 10% levels of significance, respectively.
(3) The estimated coefficients of the dummy variables of wards/cities and railroad lines are not reported.
(4) The constant term represents the following base conditions: the building is old standard and nonfireproof and is located near the station of Oedo Line in Sumida Ward.

Table 3: Predicted Housing Rents of Wood-Framed and Nonfireproof Apartment Buildings Located in the Riskiest Area (unit: thousand yen)

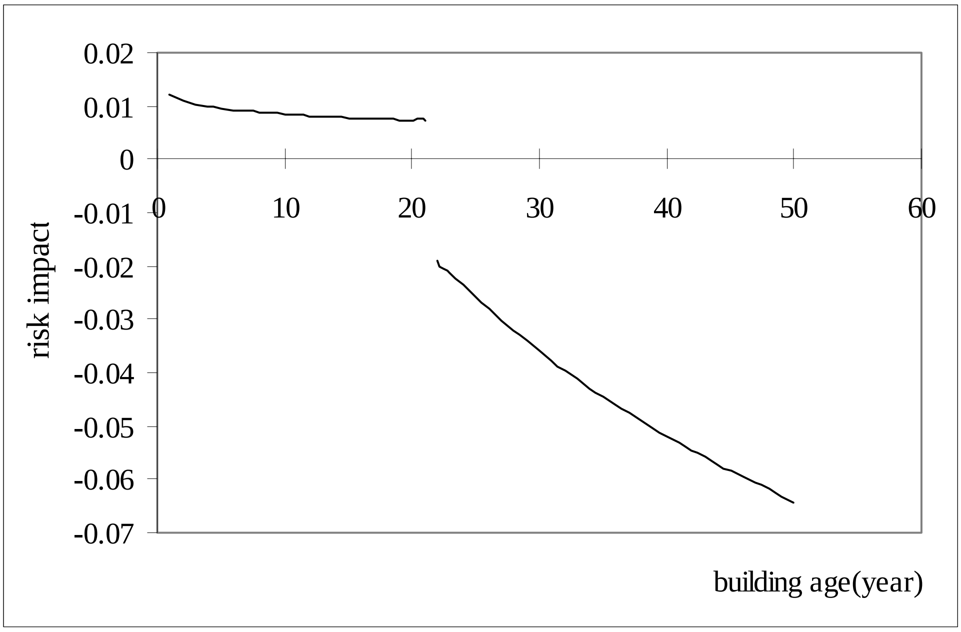
	Model I			Model II		
Building age (year)	New standard	Old standard	Difference	New standard	Old standard	Difference
1	88.20			89.73		
5	83.44			83.86		
10	81.47			81.44		
21	79.41			78.94		
22	79.28	59.34	19.94 (33.6%)	78.78	62.38	16.40 (26.3%)
30	78.44	58.70	19.74 (33.6%)	77.76	56.66	21.10 (37.2%)
40	77.66	58.12	19.54 (33.6%)	76.83	51.84	24.99 (48.2%)
50	77.07	57.68	19.39 (33.6%)	76.11	48.38	27.73 (57.3%)

The housing rent is calculated for a room on the first floor of a wood-framed and nonfireproof apartment located in the Rank 5 area in Sumida Ward. The following characteristics are also assumed: the walking time to the nearest station is nine minutes, the travel time to Tokyo Station is 30 minutes, and the floor space is 30 m^2.

Table 4: Cost–benefit Analysis of Antiseismic System Improvements of Wood-Framed Apartment Buildings (unit: thousand yen)

			Net profits to landlord	
		Differences in housing rents	0% subsidy	7.7% subsidy
		(1)	(2)	(3)
Model I	Rank 1	10.10	-1280.57	-1049.57
	Rank 2	12.64	-848.16	-617.16
	Rank 3	15.12	-425.96	-194.96
	Rank 4	17.55	-12.28	218.72
	Rank 5	19.94	394.6	625.60
Model II	Rank 1	9.42	-1396.33	-1165.33
	Rank 2	11.19	-1095.01	-864.01
	Rank 3	12.95	-795.38	-564.38
	Rank 4	14.69	-499.17	-268.17
	Rank 5	16.40	-208.05	22.95

Figure 1: Risk Impact of Housing Rents with respect to Building Age



The risk impact is calculated from the coefficients on the risk index and the interaction term between the logarithmic building age and the risk index for the wood-framed building under the old and new building codes.