*Reitaku Institute of Political Economics and Social Studies*

**Working Report, No.34**

# Investment Characteristics of Housing Market

## -Focusing on the stickiness of housing rent-

Chihiro Shimizu

*13. April.2009*

Reitaku Institute of Political Economics and Social Studies
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-Abstract-

The turmoil in the international financial market since the subprime loan crisis has had a significant effect on the real-estate investment market in Japan, particularly the Japan real-estate investment trust (J-REIT) market. This suggests that the real-estate investment market is becoming part of the financial market. It is necessary to precisely understand the mechanism of risk generation and cash flow in the real-estate market to understand the characteristics of the real-estate investment market.

The purpose of this study is to statistically clarify the characteristics of the five problems that have been recently pointed out as risk factors in the real-estate investment market for housing. Specifically, we have attempted to clarify the following five intrinsic problems, which are considered to be characteristics of the housing market: 1) the return problem, 2) the small-scale investment problem, 3) the risk associated with the adjustment of rent, 4) the key tenant problem, and 5) the inflation problem, all of which have been pointed out to be problems in the housing and retail markets.

Regarding the risk associated with the adjustment of rent, we investigated the actual situation in the housing market by considering the decrease in housing rent with the age of the building and the adjustment of housing rent when a new contract is concluded between a landlord and a new tenant. The results indicated that the yearly rate of decrease in housing rent for nontimbered houses is as high as approximately 6% over the first five years after construction, but decreases to 2.6% over the 5th to 10th years and 2.5% over the 10th to 20th years, indicating that the long-term rate of decrease in housing rent is small. The probability of no change in rent was converted to a yearly value of 0.6585, which means that the revenue from the housing rent of 65% of leasehold properties does not change. This result revealed that housing rent in the Japanese market is extremely sticky compared with that in the US. Regarding the risk associated with the adjustment of rent, the probability of downward adjustment of the housing rent should be considered; however, in most cases, the housing rent is left unchanged. Even when the housing rent is adjusted downward, decreases of more than 10% comprised only 11.2% of all the adjustments. Also note that the occurrence of rent adjustment is random with respect to time; the housing rent market is not strongly affected by the economic environment, in contrast to the market for office buildings; a turnover of residents occurs because of events such as marriage, childbirth, and relocation, regardless of the economic cycle, causing the housing rent to change.

***Key Words*:** REITs, Real Estate Investment Risk, Sticky Price, Hedonic housing price index

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## 1. Background to real-estate investment market

Owing to the turmoil in the financial market since the subprime loan crisis, which started in summer 2007, the structure of the real-estate investment market has drastically changed in Japan and overseas. Not only has the cost of capital procurement increased owing to the turmoil in the international financial market, but also the ideal risk control method of the entire financial system is changing; under such circumstances, the mobilization of capital into the real-estate market has slowed, and only limited capital has flowed into specific areas. There is clear evidence of macroscopic slackness in the market and differentiation in the allocation of funds.

In particular, Japan experienced a substantial decline of stock prices, particularly in the J-REIT market. In October 2008, a residential REIT was driven to bankruptcy.

In the J-REIT market, the decrease in stock prices of REITs of houses and commercial properties has been significant since the middle of 2007, even before the start of the turmoil in the international financial market. The reasons behind this are as follows. In the case of residential REITs, 1) an upward return cannot be expected when the real-estate investment market is active (return problem), and 2) many properties should be involved in REITs to ensure a certain scale of investment because the amount of investment per property is small; as a result, the cost required to examine all of the properties (due diligence cost) is high (small-scale investment problem). In the case of retail REITs, 3) large downward adjustment of housing rents was implemented in Nagoya City (Narumi) in Aichi Prefecture and Narashino City in Chiba Prefecture, indicating the uncertainty of profitability in a market that has been considered to be stable (risk associated with the adjustment of rent), 4) related to 3), because the share of revenue from key tenants in each retail property is large, adjustment of the rent of key tenants will significantly affect the total revenue from the investment (key tenant problem), and 5) the trend of long-term cost-push inflation has

become apparent, increasing the probability of a decrease in profitability (inflation problem).

These problems will remain even when the condition of the financial market recovers, because they are structural problems existing in each real-estate market. Therefore, unless these problems are resolved, it will be difficult for these markets to properly attract investment funds.

However, there are some misunderstandings associated with the above five problems, as explained below. Also, these problems can be seen to be attractive when considered from a different viewpoint or when they are interpreted in terms of an investment fund having different characteristics.

The purpose of this study is to clarify the nature and structure of these five problems and the characteristics of the housing market through a positive analysis.

## 2. Characteristics of housing market

### 2.1. Investment characteristics of housing market

For the return problem, two background issues exist: one is that the adjustment of housing rent seldom occurs, that is, the housing rent is sticky, and the other is that the value of houses decreases with age, causing the house price and housing rent to decrease. However, the first issue can be interpreted as providing the investors with stable revenue. The housing rent does not increase even during an economic upturn, which in turn means that revenue does not significantly decrease when the market stagnates. This is very attractive for investors who seek stable revenue.

Regarding the second issue, i.e., the decrease of both the revenue and house price with increasing age of the building, it is necessary to consider this issue as a risk factor. It is also necessary to precisely understand the rate of decrease in the housing rent, particularly with increasing age of the building, and to develop a portfolio that can

compensate the decrease in the housing rent.

The second problem, the small-scale investment problem, is closely related to the third and fourth problems. The scale of housing investment per apartment is extremely small compared with that of other types of real estate. When this fact is considered paradoxically, the investment can be regarded as diversified. Furthermore, because the scale of each property is small and the investment is also diversified for one apartment block, the key tenant problem observed in retail property funds can be avoided in the case of the housing market. However, regarding the risk associated with the adjustment of rent, which is closely related to the return problem, it has been pointed out that the housing rent is considered sticky only on the basis of the prediction of specialists; no experimental studies on the mechanism of the adjustment of housing rent have been carried out. Considering the fact that in some cases rent in the retail property market, which had been considered to be stable, was adjusted markedly downward, this problem should be discussed on the basis of objective analytical results. If the stickiness is demonstrated and the mechanism underlying the adjustment of housing rent is revealed, we can manage the risks in accordance with the mechanism.

The final problem is the inflation problem. An increase in the prices of commodities decreases consumers' willingness to spend, which has an adverse effect on sales at commercial properties. Demand for commodities with high price elasticity is strongly affected by an increase in prices. In contrast, food and residential services have low price elasticity, in the sense that demand for them does not change significantly when their prices change, i.e., an increase in prices does not have a significant effect on demand.

For long-term funds such as pensions, the major goal of which is to act as an inflation hedge, the management of assets, the performance of which is above the rate of increase of the consumer price index (CPI), is required. Focusing on the constituents

of the CPI basket, housing rent made up 26.3% or approximately one-quarter of the CPI as of 2005. Therefore, it is possible to consider investment in housing rent as being synonymous with investment in the CPI. Assuming that the target of long-term funds is a stable CPI rather than a high upward return, this target can be realized by investing funds in the long-term housing rent market.

In addition, the link between the CPI and economic and financial policies has been strengthening. The central banks of various countries have increased interest rates with increases in CPI, using the CPI as a policy target; this is known as inflation targeting. In this sense, for long-term funds investing in the CPI or in housing rent, which is a major constituent of the CPI, is considered to be an important strategy.

### 2.2. Statistical characteristics of housing market

When the characteristics of the housing market are considered from the viewpoint of the investment market on the basis of the above discussion, the problems in the housing market can be summarized into the following two problems: 1) housing rent depreciation with the age of buildings and 2) the adjustment of housing rent.

The first problem is demonstrated by analyses such as regression analysis[1)]. In this study, the relationship between the age of buildings and housing rent depreciation in the housing rent market is clarified using a similar method.

Next, we focus on the stickiness of housing rent. This topic is very important in the field of macroeconomics and has been reported by many researchers.

For example, housing rent is adjusted at the time of contract renewal in the US. Including new contracts between a new tenant and landlord, and rollover contracts, which are completed when the tenant decides to remain in the same property after the initial contract has ended, an average of 29% cases of housing rent (in terms of the

[1] ) For example, refer to the studies by Housing Research and Advancement Foundation of Japan (2008), and Shimizu, Nishimura, and Karato (2007).

number of transactions) remains unchanged annually in the US[2)]. In particular, it is reported that the percentage of transactions in which the housing rent remains unchanged at a rollover contract is 36%; the housing rent in a rollover contract is more sticky than that in a new contract.

It is expected that a similar tendency can also be observed in Japan. In particular, the housing rent for a rollover contract is not altered during the term of the contract and is rarely altered when the contract is renewed as long as the same resident continues to stay in the property, because the adjustment of housing rent is restricted by the Land Lease and House Lease Law and other factors.

We start by observing macroscale changes in the housing market (3.1), then estimate housing rent depreciation on the basis of the hedonic function formulated in this study (3.2). We then clarify the mechanism behind the adjustment of housing rent (3.3). Finally, the characteristics of the housing market are reevaluated on the basis of the results obtained in this analysis.

## 3. Macroscale changes in housing rent and house prices and the stickiness of housing rent

### 3.1.Macroscale changes in house prices, housing rent, and CPI housing rent

Macroscale changes in housing rent are observed in terms of the changes in house prices and housing rent in the 23 wards of Tokyo.

First, it is necessary to estimate price indices to analyze macroscale changes in housing rent and house prices. Each house is different in terms of specifications and facilities, and it is not possible to find two identical properties. Even if the specifications and facilities are the same, the extent of deterioration will differ if the age of the building differs. In other words, the housing market has a unique feature that no

[2] ) In previous reports, US researchers analyzed the stickiness of housing rent by classifying housing rent into two types of contract, i.e., new and rollover contracts, on the basis of individual data from an American Housing Survey and a questionnaire-based follow-up survey

identical properties exist. In addition to this uniqueness, the advance of technologies related to houses (particularly condominiums) is relatively fast, and the quality of new properties increases with the progress of time. Such characteristics have already been revealed in many previous studies.

To deal with the uniqueness of properties and rapid changes in their quality, the hedonic price method and repeat sales method can be used to estimate house price indices. For example, both the Halifax house price index, which is a typical house price index in the UK, and the Recruit house price index in Japan are estimated by the hedonic price method; while the Case-Shiller house price index, which is a typical house price index in the US, is estimated by the repeat sales method.

In this study, we used the same estimation method as that adopted to estimate the Recruit house price index and the data of the weekly housing advertisement magazines (for housing rent) published by Recruit Co., Ltd. A housing rent index (hereafter, hedonic rent index) and a house price index are estimated from the housing rent at the time of new contracts and house price information, respectively, both of which are provided by Recruit Co., Ltd. The estimated indices and the CPI rent index (Japanese CPI for rent) are compared.

In the series of analyses in this study, the following eight indices are analyzed and compared: 1) nontimbered house price index, 2) timbered house price index (both of which are estimated using the house price data prepared by Recruit Co., Ltd.), 3) hedonic rent index (nontimbered + timbered), 4) nontimbered house hedonic rent index, 5) timbered house hedonic rent index, 6) CPI rent index, 7) timbered house CPI rent index, and 8) nontimbered house CPI rent index (the last two indices are obtained from the breakdown of the CPI rent index). The reason for comparing estimated indices with the CPI rent indices is that the CPI rent index is estimated on the basis of continuously paid housing rent. The revenue from housing rent, which predominantly

determines the performance of real-estate investments, is calculated using the housing rent actually paid by a tenant, rather than the housing rent in the new contract. It is considered that the CPI rent index appropriately reflects these considerations.

The hedonic price method is a method of estimating the price index by formulating the structure of house prices and housing rent using a generalized regression analysis method.

Table 1 summarizes the results of regression analysis to estimate the housing rent for both nontimbered and timbered houses, the nontimbered house price, and the timbered house price. The adjusted values of R2 for the housing rent function, the nontimbered house price function, and the timbered house price function are 0.657, 0.833, and 0.691, respectively. All three models can estimate the price with a relatively high power of explanation.

The nontimbered house hedonic rent index, the timbered house hedonic rent index, and the nontimbered house hedonic rent index for the central business district (CBD), which includes Chiyoda, Chuo, and Minato wards, were estimated using a similar method to that used for the house price index (Table 2).

The changes in the hedonic rent index, nontimbered house price index, and timbered house price index over time are shown in Fig. 1.

Both the nontimbered and timbered house price indices rapidly increased from the first quarter of 1986 to the fourth quarter of 1987; assuming that the index in the first quarter of 1986 is 1, its value in the fourth quarter of 1987 increased to 2.3 for the nontimbered house price index and 2.5 for the timbered house price index. Subsequently, the indices decreased slightly then increased again, and in the fourth quarter of 1990, the nontimbered house price index increased to 3.2 and the timbered house price index increased to 2.6. In similar studies conducted over the same period, the indices were estimated using the actual transaction data of houses in a residential

district, and similar results in terms of the rate of increase and the timing of the peak were obtained[3)].

On the other hand, the hedonic rent index gradually increased from 1986 to 1992; in the second quarter of 1992 it reached its maximum value of 1.39, after which it decreased.

To elucidate the relationship between the hedonic rent and the prices of owned houses, average houses are considered and the rate of return (ratio of estimated housing rent/house price (%), hereafter rent/price ratio) was calculated (Fig. 2). The rent/price ratio exceeded 6% in 1986; after that, because of the increase in house prices, it decreased to less than 3% in 1990. However, with the subsequent decrease in house prices, the ratio increased again and surpassed 6.5% in 2001. With the recent increase in house prices, the ratio again decreased to approximately 5.5% by the end of 2006.

Next, the hedonic rent index, estimated using the housing rents for new contracts, and the CPI rent index are compared (Fig. 3). The hedonic rent index increased by 40% from 1986 to the second quarter of 1992; however, the CPI rent index increased by only 15%. After that, the hedonic rent index decreased but the CPI rent index continued to increase, although the trend in the hedonic rent index has been roughly in agreement with that of the CPI rent index since the fourth quarter of 1994.

To observe the recent trends of these indices, separate estimations are carried out using the timbered and nontimbered house hedonic rent indices. The trend in the nontimbered house hedonic rent index, focusing on central Tokyo, was also analyzed to take into consideration the variations between areas (the results of the regression analysis are summarized in Table 2). Figure 4 shows the nontimbered house hedonic

[3] ) According to the studies by Shimizu and Nishimura (2006)(2007), the long-term land price index is calculated using data from actual transactions of land. The long-term land price index increased by a factor of 2.8 from the first quarter of 1986 to the fourth quarter of 1987. After that, the index decreased and then increased again until the fourth quarter of 1990. Similar tendencies in terms of the degree of increase and the timing of the peak are observed in analyses using different data sources, indicating the robustness of the result.

rent index, timbered house hedonic rent index, nontimbered house CPI rent index, and timbered house CPI rent index, using their values in the first quarter of 2000 as a baseline. The nontimbered house hedonic rent index in central Tokyo (for CBD), the nontimbered house hedonic rent index for the 23 wards of Tokyo, and the timbered house hedonic rent index for the 23 wards of Tokyo decreased by 40, 20, and 10%, respectively, from their peaks to their values in 2000. However, both the nontimbered and timbered house CPI rent indices continuously increased during the period when the hedonic rent index was decreasing. The trends of the nontimbered and timbered house CPI rent indices are similar to those of the hedonic rent indices between 1994 and 2000. In particular, after 2000, the timbered house CPI rent index decreased significantly.

Table 3 summarizes the average annual changes (%) in various indices for different periods as a summary of the above findings. In 1987-1990, the hedonic rent index increased by 5.2%, but the increases in the nontimbered and timbered house CPI rent indices were far smaller, 2.93% and 1.7%, respectively.

Furthermore, between 1991 and 1993, the nontimbered hedonic rent index decreased ; however, the nontimbered and timbered house CPI rent indices increased; these increases continued up to 1996.

As discussed above, the housing rent for new contracts and the hedonic rent index experienced significant increases and decreases during the bubble period and the subsequent collapse of the bubble economy, respectively. However, the CPI rent index gradually continued increasing during the bubble period and did not decrease significantly after the collapse of the bubble economy.

This gradual increase is related to the return problem; however, viewing it from a different perspective, it can be considered that a stable return can be realized by investing in the housing market.

When looking at reports on the housing investment market, indices using the

housing rents for new contracts are frequently referred to[4]). It is considered that the CPI rent index, which is based on actual payments, is more appropriate as an index because the performance of housing investments is not calculated on the basis of the housing rents for new contracts, rather it is calculated as the sum of housing rents of properties in which tenants actually reside.

Why does the CPI rent index markedly deviate from the hedonic rent index, which is based on the housing rent for new contracts? Specialists in the US have commented that this phenomenon is strange for investors in the US.

To understand the background behind this, it is important to observe the mechanism of the adjustment of housing rents. Discussing this problem is also synonymous with examining the problem of the adjustment of rent, which has been mentioned for the retail property market. In the next section, the problem of the adjustment of housing rent, along with the change in housing rent due to depreciation with the age of the building is examined by positive analysis.

### 3.2. Mechanism of changes in housing rent

In observing the mechanism of changes in housing rent, change in housing rent caused by depreciation with the age of the building, in addition to the macroscale changes discussed in section 3.1, should be considered. On the basis of the results of regression analysis, the change in housing rent caused by the deterioration of the building with age is observed (Fig. 5).

The yearly rate of decrease in the housing rent for nontimbered houses is lower than that for timbered houses. Furthermore, the yearly rate of decrease in housing rent in the CBD is small.

The yearly decrease in nontimbered house rent was found to be as large as

[4] ) In the housing rent indices prepared by Recruit Co., Ltd., and the condominium rent index prepared by STB Research Institute Co., Ltd. (http://www.athome.co.jp/news/m_index/images/sample02.pdf), the indices are calculated using housing rents for new contracts.

approximately 6% over the first five years after construction, but to decrease to 2.6% over the 5th to 10th years and 2.5% over the 10th to 20th years, indicating that the rate of decrease in housing rent is low. This finding indicates that only the initial decrease in the housing rent, which is observed over the first several years after the construction of the building, should be controlled. In other words, the decrease in the housing rent does not have a significant effect on the investment in properties in which tenants actually reside.

The above finding indicates the average trend for housing rents in the 23 wards of Tokyo. Figure 6 shows the changes in housing rent with time for seven selected properties as samples.

As shown in Fig. 6, adjustment of the housing rent occurs only at the time of contract renewal; in other words, the housing rent does not change continuously. The important points here are the timing and monetary range of the adjustment of housing rent, for example, the occurrence and the range of risks associated with the adjustment of rent, such as those observed in the retail property market

### 3.3. Frequency of adjustments and stickiness of housing rent

It was found that housing rent, which is determined in the goods and services market, changes very slowly compared with price changes in the asset market. Furthermore, the mechanism of changes in the hedonic rent index, which is determined on the basis of housing rent in new contracts alone, is different from that of the CPI rent index, which is determined on the basis of housing rent for both new and rollover contracts.

The period of lease contracts in the Tokyo metropolitan area is generally two years, during which the probability of rent adjustment is low. In addition, adjustments of housing rents are markedly affected by the institutional constraints imposed by laws

such as the Land Lease and House Lease Law; the adjustment of housing rent, particularly an increase in housing rent, rarely occurs, even at the renewal of a contract, as long as the same tenant lives in the same property (Yamazaki (2000)).

Next, the degree of stickiness of housing rent clarified in the previous study is explained. The weekly change in the housing rent for a certain housing unit *i* in period *t* ($R_{it}$) with respect to the housing rent for the same property in the previous week ($R_{it-1}$) was observed for data obtained from the database prepared by Recruit Co., Ltd. We can obtain the dates at which the former tenant leaves and a new tenant arrives and the range of adjustment of the housing rent from the database. However, it is not possible to observe the adjustments of housing rent at the time of agreement of rollover contracts. According to the analysis of data provided by major property management companies, the adjustment of housing rent can occur at the time of agreement of a rollover contract, although this only happened in approximately 3% of cases. In this sense, in the analysis of data obtained from the database prepared by Recruit Co., Ltd., we should be aware that a constant level of error may be involved in the estimation of $R_{it}/R_{it-1}$, although the error level is thought to be minute.

Figure 7 shows the distribution of weekly rent changes calculated under the assumptions described above (n=18,582,863).

The probability of a housing unit having no change in rent was 0.992, indicating the high potential stickiness of the housing rent. This was converted to a yearly value of 65% ($0.992^{52}$). It has been reported that the yearly value for the US is 29%. The stickiness in the housing rent market in Japan is extremely high.

Regarding the risk associated with the adjustment of rent, the probability of downward rent adjustment is considered. Considering the fact that the adjustment of housing rent is observed in only 35% of properties, this risk is extremely small. In

most cases, housing rents remained unchanged. Also, when the housing rent was adjusted downward, a decrease in rent exceeding 10% accounted for only 11.2% of cases.

The distribution of weekly changes in rent for different time periods is shown in Fig. 8. As shown in the figure, the percentage of adjustment and its distribution have varied markedly over time. In particular, between 1989 and 1991, i.e., a period of rising housing rents, a large peak exists to the right of 1, and the distribution is skewed to the right. For other periods, the distributions are similar, and the frequency of adjustment toward a decrease in housing rent is large.

Figure 9 shows weekly price stickiness in terms of $R_{it}/R_{it-1}$ over time. Except during the bubble period, the weekly price stickiness of housing rent has remained almost constant with an average of approximately 0.992 from 1992 to 2006. This finding suggests that the stickiness of the housing rent estimated in Fig. 7 remains similar, except during exceptional periods such as the bubble period.

Although the above tendency is observed, in the actual management of real estate, factors such as how long tenants continuously reside in a certain property or the reasons for tenants to move in and out are important. The lease contract is generally renewed every two years in Japan. Therefore, it is expected that the adjustment of housing rent is dependent on time (time-dependent pricing).

According to the results of previous studies, the weekly probability of tenant turnover (the former tenant of a property expressing the intention to vacate the property so that it becomes available for lease) is almost constant at 0.0025 for residential periods of 100 weeks to approximately 400 weeks. Viewing this from a different perspective, this figure is converted into a value of stickiness; the weekly probability that a tenant continues to reside in the same property is 0.9975. This figure corresponds reasonably closely to the stickiness of a housing unit having no change in

rent (0.992) in Fig. 7. The stickiness of no rent change can be converted to a monthly value of 0.9900 (0.9924), indicating that the probability of tenant turnover in a given month is approximately 1%.

These results indicate that the occurrence of tenant turnover, which is when the rent is most likely to be adjusted, is independent of time; adjustments usually occur because of events such as marriage, childbirth, and relocation. This means that the housing market is not strongly affected by the economic environment, in contrast to the market for office buildings; rather, tenant turnover is triggered by the above events, which are independent of the business cycle, and the housing rent is adjusted at these times.

## 4. Implications for housing investment market

In this study, the characteristics of the housing market are discussed in terms of the stickiness of housing rent; the degree of stickiness and the mechanism of the adjustment of housing rent are clarified by statistical analysis.

It is considered that the results of the study have the following implications regarding the housing investment market, and that the close link between housing investments and the CPI has several important implications for the management of investments.

### Conclusion 1.Inflation hedge function

For long-term funds, such as pensions, the major goal of which is to act as an inflation hedge, the management of assets, the performance of which is above the rate of increase of the CPI, is required. Focusing on the constituents of the CPI basket, housing rent made up 26.3% or approximately one-quarter of the CPI as of 2005. Therefore, it is possible to consider investment in housing rent as being synonymous

with investment in the CPI. (The correlation coefficient between the general CPI rent index in the 23 wards of Tokyo and the CPI rent index is 0.998 and that between the former and the CPI rent for leased houses under private management is 0.990.) Assuming that the target of long-term funds is a stable CPI rather than a high upward return, this target can be realized by investing in long-term housing rent.

However, the actual investment return is considered as net income, which is calculated by subtracting several costs such as long-term repair expenses from the revenue obtained from housing rent; we should pay attention to changes in these costs. The analysis of several costs associated with investments in property will be discussed in future studies.

**Conclusion 2.Relationship with interest rate risk**

Recently, the link between the CPI and economic and financial policies has been strengthening. The central banks of different countries have increased interest rates whenever the CPI has increased, using the CPI as a policy target; this is known as inflation targeting. In this sense, for long-term funds, investing in the CPI or in housing rent, which is a major constituent of the CPI, is considered to be an important strategy.

**Conclusion 3.Stability of housing rent**

The hedonic rent index, which is determined on the basis of housing rent in new contracts alone, is compared with the CPI rent index for the period of 1986 to 2006, including the bubble period. First, the hedonic rent index increased from 1986 to 1992; assuming that the index in the first quarter of 1986 was 1, in the second quarter of 1992 it reached its maximum value of 1.39, after which it decreased.

Next, when compared with the CPI rent index, the hedonic rent index increased by

40% from 1986 to the second quarter of 1992. However, the CPI rent index increased by only 15%. After that, the hedonic rent index decreased but the CPI rent index continued to increase, although the trend in the hedonic rent index has been roughly in agreement with that of the CPI rent index since the fourth quarter of 1994.

Namely, the CPI rent index gradually increased even during the bubble period and experienced no significant decrease after the collapse of the bubble economy. It is considered that the CPI rent index, which is determined on the basis of actual payments, is more appropriate as an index because the performance of housing investments is not calculated from the housing rents for new contracts, rather it is calculated as the sum of housing rents of properties in which tenants actually reside. In this sense, the gradual increase in the CPI rent index is considered as a return problem. Viewing this from a different perspective, it can be concluded that a stable return can be realized owing to this gradual increase and that the risk of a macroscopic decrease in the housing rent is extremely limited.

**Conclusion4. Problem associated with depreciation with age of building**

Although the risk of a macroscopic decrease in the housing rent is limited, the risk of the housing rent decreasing with the age of the building is considered for each property. We examined this by a hedonic approach, and the results indicated that the yearly rate of depreciation of the housing rent of nontimbered houses is as large as approximately 6% over the first five years after construction, but decreases to 2.6% over the 5th to 10th years and 2.5% over the 10th to 20th years, indicating that the long-term rate of decrease in housing rate is small.

This finding indicates that only the initial decrease in the housing rent, which is observed in the first several years after the construction of the building, should be controlled as a risk factor. In other words, the decrease in the housing rent owing to

the increasing age of the building has a negligible effect on the investment in properties in which tenants actually reside.

However, it is known that the lifetime of residential houses is shorter than that of buildings used for offices. Therefore, it is expected that the long-term costs of repair, maintenance, and operation, which are generated during the period of investment, may significantly vary. The risk associated with this factor should be discussed in future studies.

**Conclusion5. Problem associated with adjustment of rent**

In the commercial facility market, the significant downward adjustment of the rent of key tenants has a significant impact on the total revenue from the investment; therefore, the problem associated with the adjustment of rent has attracted attention. However, in the case of housing, this problem is less likely to occur because the percentage of the revenue from each property is small.

The weekly probability of a housing unit having no change in rent was 0.992. This was converted to a yearly value of 0.6585 (0.99252). This figure indicates that the yearly adjustment of housing rent is observed in only 35% of properties; conversely, revenue from the housing rent of 65% of leasehold properties does not change each year. A previous study reported that the corresponding figure for the US is 29%, demonstrating that the stickiness in the housing rent market in Japan is extremely high.

Regarding the risk associated with the adjustment of rent, the probability of downward rent adjustment should be considered. Considering the fact that the adjustment of housing rent is observed in only 35% of properties each year, this risk is extremely small. In most cases, housing rents remained unchanged. It was also found that when a downward adjustment of housing rent occurred, the percentage of cases in which the decrease in rent exceeded 10% of the original rent was only 11.2% .

**Conclusion6. Independence of economic environment**

Whether the adjustment of housing rent is correlated with or independent of the economic environment is very important in composing a portfolio in combination with other assets such as stocks. The probability of tenant turnover with respect to the residence period was calculated by formulating a hazard function for the residence period.

When the probability of tenant turnover was converted to a monthly value for stickiness, it was 0.9900 (0.9924), indicating that the monthly probability of tenant turnover is approximately 1%. This value is converted to a yearly value of slightly below 12%.

The above results indicate that the occurrence of tenant turnover, which is when the rent is most likely to be adjusted, is independent of time; adjustments of housing rent occur because of events such as marriage, childbirth, and relocation. In other words, the housing market is not strongly affected by the economic environment, in contrast to the market for office buildings. The characteristics of the housing investment market were statistically clarified through the series of analyses explained above.

As a result of the recent turmoil in the international financial market, it is necessary to reconstruct the real-estate investment market from a comprehensive perspective as a target of investment and management in the future. In concrete terms, we should put importance on converting real estate into financial investment products by regarding it as a core asset among a diverse portfolio by fully extracting the investment characteristics of real estate, focusing on the housing market.

For example, in deciding the constituents of a portfolio and the share of each constituent, various factors must be considered: whether to hedge the risk by not choosing investment products that are linked with the financial market should be pursued; whether products that hedge the risk of inflation should be pursued; whether higher return than other operating assets is pursued; or whether high stability is pursued. There are no investment products that satisfy all of the above factors, and investors should clarify their goals when they invest in real estate.

Once the characteristics of a source that induces a flow of revenue are fully understood, the design and development of financial products that extract the advantages of the source using financial techniques are required. We should note that the characteristics that induce a flow of revenue depend on the type of real estate.

We hope that a real-estate financial market in which the attractive properties of the investment market are further enhanced will evolve via the reconstruction of the conventional financial system.

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**Table1. Estimation results of hedonic rent/price: 1986-2006**

| Property Characteristics (in log) | HR(house rent) | | Non-timbered HP(house price) | | Timbered HP(house price) | |
|---|---|---|---|---|---|---|
| | **Coefficient** | **t-value** | **Coefficient** | **t-value** | **Coefficient** | **t-value** |
| Constant | 9.009 | 2193.65 | 4.335 | 555.10 | 5.118 | 562.46 |
| *LA*:Lot Area | — | — | — | — | -0.185 | -194.36 |
| *FS*: Floor space | -0.230 | -601.32 | 0.007 | 5.97 | — | — |
| *RW:Road Width* | — | — | — | — | 0.179 | 144.57 |
| *Age*: Age of building | -0.037 | -281.15 | -0.184 | -333.49 | -0.070 | -165.22 |
| *WT*: Walk Time to the nearest station | -0.039 | -134.03 | -0.061 | -93.28 | -0.137 | -146.88 |
| *TT*: Travel Time to CBD | -0.036 | -85.81 | -0.034 | -36.40 | -0.058 | -50.27 |
| *BD:Bus Dummy* | -0.020 | -1.61 | — | — | -0.201 | -8.59 |
| *BD×WT* | -0.050 | -10.15 | -0.056 | -38.85 | 0.009 | 1.07 |
| *TU*: Total Units | — | — | 0.020 | 37.85 | — | — |
| *RT*: Market reservation time | 0.009 | 38.66 | 0.016 | 34.15 | 0.010 | 21.72 |
| *FF*: First Floor Dummy | -0.043 | -93.52 | — | — | — | — |
| *THD:*Timbered house dummy | -0.049 | -102.25 | — | — | — | — |
| *SD:*South Dummy | — | — | — | — | 0.010 | 12.21 |
| *LD:*Land Dummy | — | — | — | — | 0.035 | 7.82 |
| **Ward (city) Dummy *RDi (i=0,…,I)*** | **Yes** | | **Yes** | | **Yes** | |
| **Railway/Subway Line Dummy *LDj (j=0,…,J)*** | **Yes** | | **Yes** | | **Yes** | |
| **Time Dummy *TDi (i=0,…,I)*** | **Yes** | | **Yes** | | **Yes** | |
| **Adjusted R square=** | 0.657 | | 0.833 | | 0.691 | |
| **Number of Observations=** | 718,811 | | 218,768 | | 338,222 | |

**Table2. Estimation results of hedonic rent: 1990-2006**

| Property Characteristics (in log) | Non-timbered HR(house rent) | | Timbered HR(house rent) | | Non-timbered HR(house rent:CBD) | |
|---|---|---|---|---|---|---|
| | **Coefficient** | **t-value** | **Coefficient** | **t-value** | **Coefficient** | **t-value** |
| Constant | 9.223 | 3371.72 | 9.596 | 1918.49 | 8.859 | 1000.02 |
| *FS*: Floor space | -0.220 | -529.75 | -0.377 | -405.27 | -0.053 | -37.86 |
| *Age*: Age of building | -0.041 | -269.91 | -0.050 | -154.18 | -0.039 | -101.65 |
| *WT*: Walk Time to the nearest station | -0.036 | -113.60 | -0.041 | -68.20 | -0.048 | -39.80 |
| *TT*: Travel Time to CBD | -0.029 | -63.59 | -0.056 | -63.69 | 0.022 | 14.00 |
| *BD:Bus Dummy* | -0.036 | -2.29 | 0.031 | 1.47 | -0.046 | -0.39 |
| *BD×WT* | -0.048 | -7.90 | -0.049 | -6.06 | -0.021 | -0.43 |
| *RT*: Market reservation time | 0.008 | 28.33 | 0.013 | 28.69 | 0.007 | 7.05 |
| *FF*: First Floor Dummy | -0.041 | -70.28 | -0.034 | -52.51 | -0.035 | -10.17 |
| **Ward (city) Dummy *RDi (i=0,…,I)*** | **Yes** | | **Yes** | | **Yes** | |
| **Railway/Subway Line Dummy *LDj (j=0,…,J)*** | **Yes** | | **Yes** | | **Yes** | |
| **Time Dummy *TDi (i=0,…,I)*** | **Yes** | | **Yes** | | **Yes** | |
| **Adjusted R square=** | 0.680 | | 0.695 | | 0.695 | |
| **Number of Observations=** | 532,149 | | 153,625 | | 153,625 | |

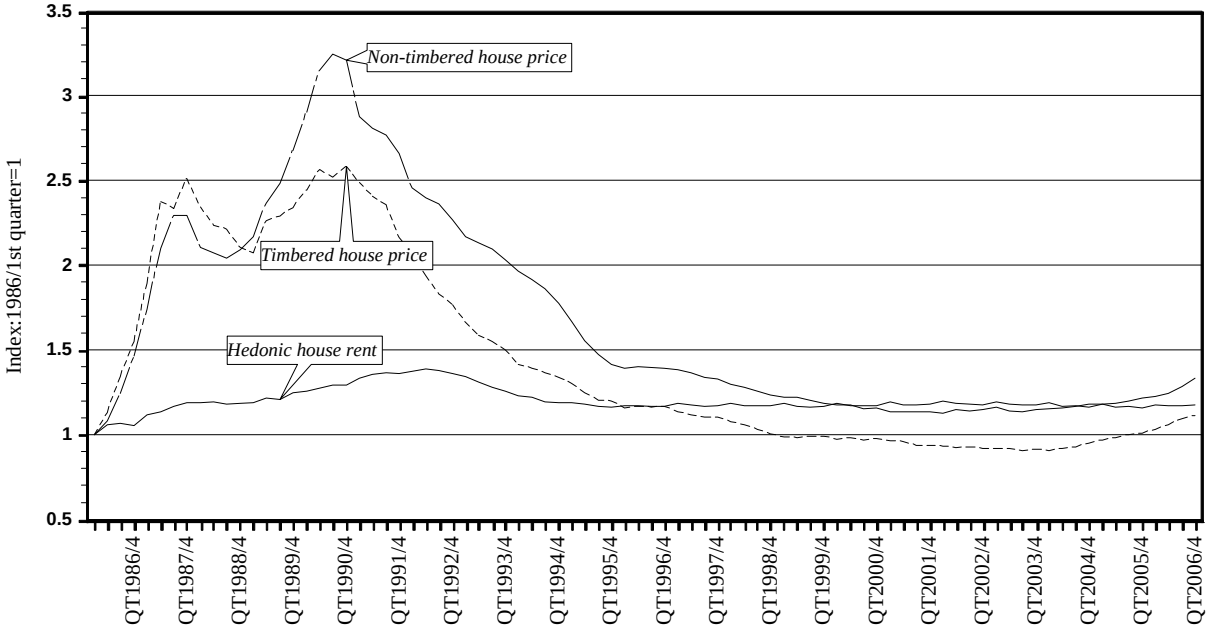


**Figure 1.Trend of house price/rent : 1986/1st quarter～2006/4th quarter**

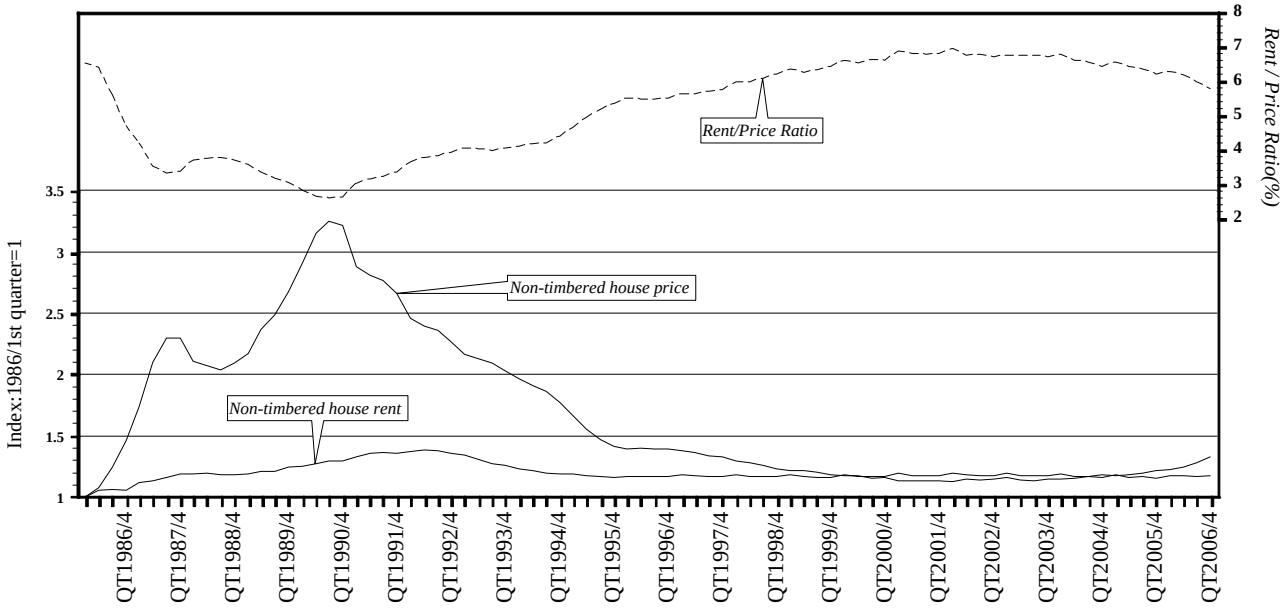


**Figure2. Trend of hedonic house rent index, price index and rent / price ratio (%)**

**: 1986/1st quarter～2006/4th quarter**

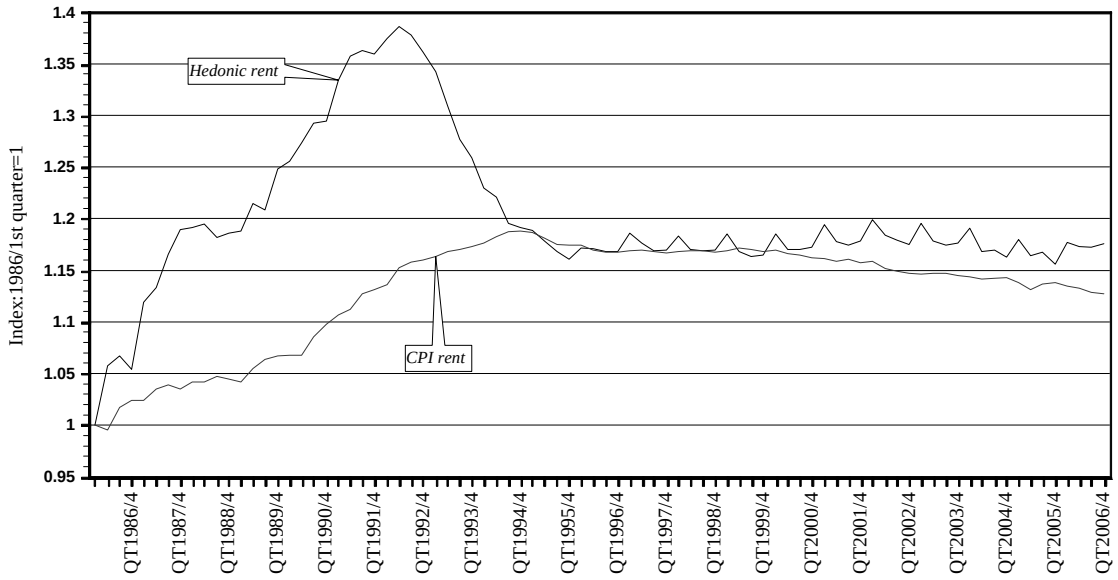


**Figure3.Trend of house hedonic rent and CPI : 1986/1st quarter～2006/4th quarter**

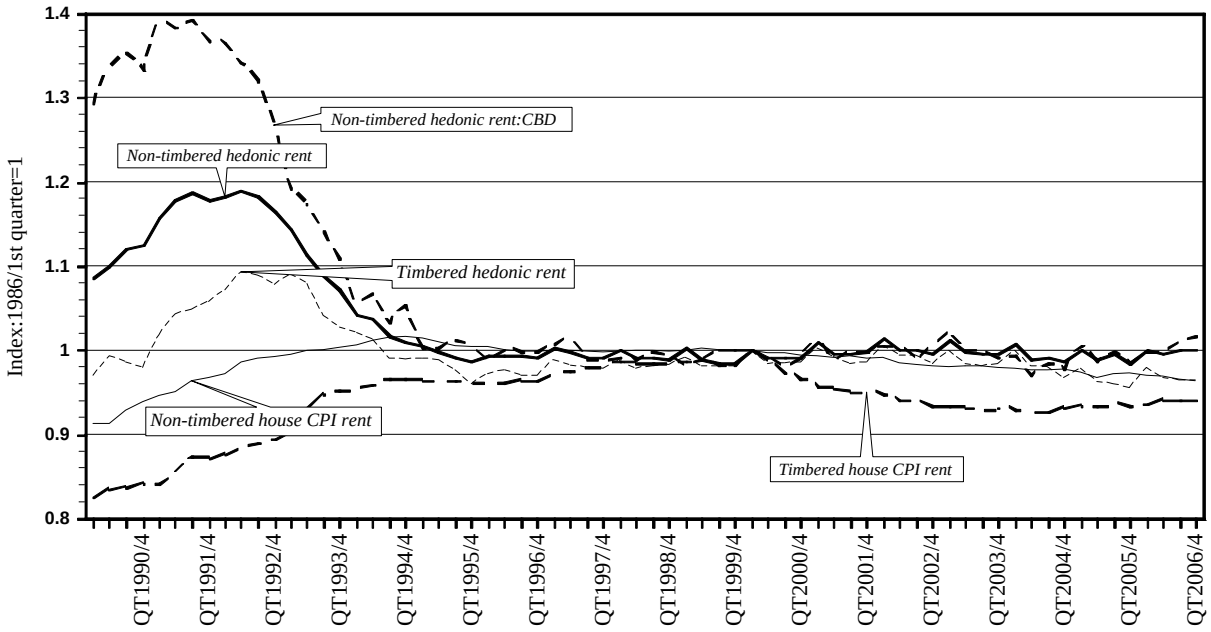


**Figure4. Compare of Hedonic rent index and CPI : 1990/1st quarter～2006/4th quarter**

**Table3. Annual Change of House Price/Rent Index**

| | Non-timbered HP(house price) | Timbered HP(house price) | HR(house rent) | Non-timbered HR(house rent) | Non-timbered HR(house rent):CBD | Timbered HR(house rent) | CPI: HR | CPI:Non-timbered HR | CPI: Timbered HR |
|---|---|---|---|---|---|---|---|---|---|
| 1987-1990 | 27.45% | 19.51% | 5.20% | - | - | - | 2.31% | 2.93% | 1.70% |
| 1991-1993 | -12.34% | -14.62% | 0.46% | -0.11% | -4.59% | 2.55% | 2.93% | 3.79% | 2.68% |
| 1994-1996 | -12.82% | -9.55% | -3.37% | -3.48% | -4.80% | -2.81% | 0.33% | 1.05% | 0.03% |
| 1997-1999 | -4.69% | -5.34% | 0.02% | -0.10% | -0.46% | 0.37% | 0.15% | 1.08% | 0.00% |
| 2000-2002 | -1.89% | -2.13% | 0.39% | 0.42% | 0.64% | 0.38% | -0.77% | -1.84% | -0.52% |
| 2003-2005 | 1.55% | 2.23% | -0.49% | -0.34% | -0.23% | -1.03% | -0.37% | -0.21% | -0.46% |

*Average Rate of Annual Change (%)

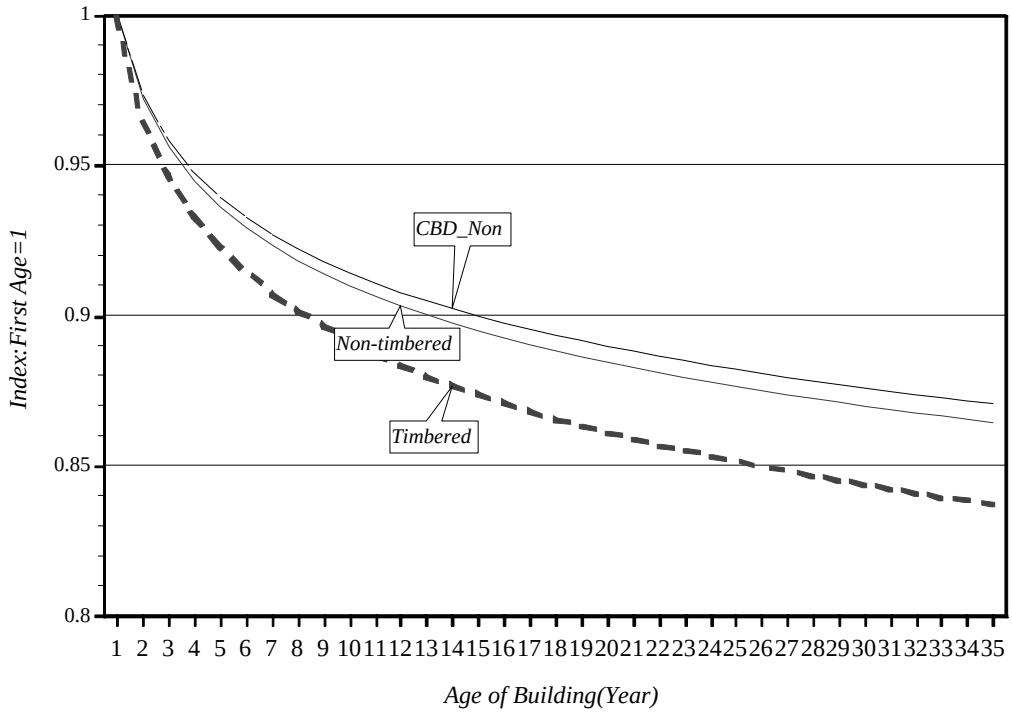


**Figure5. Property Age and Rent Level**

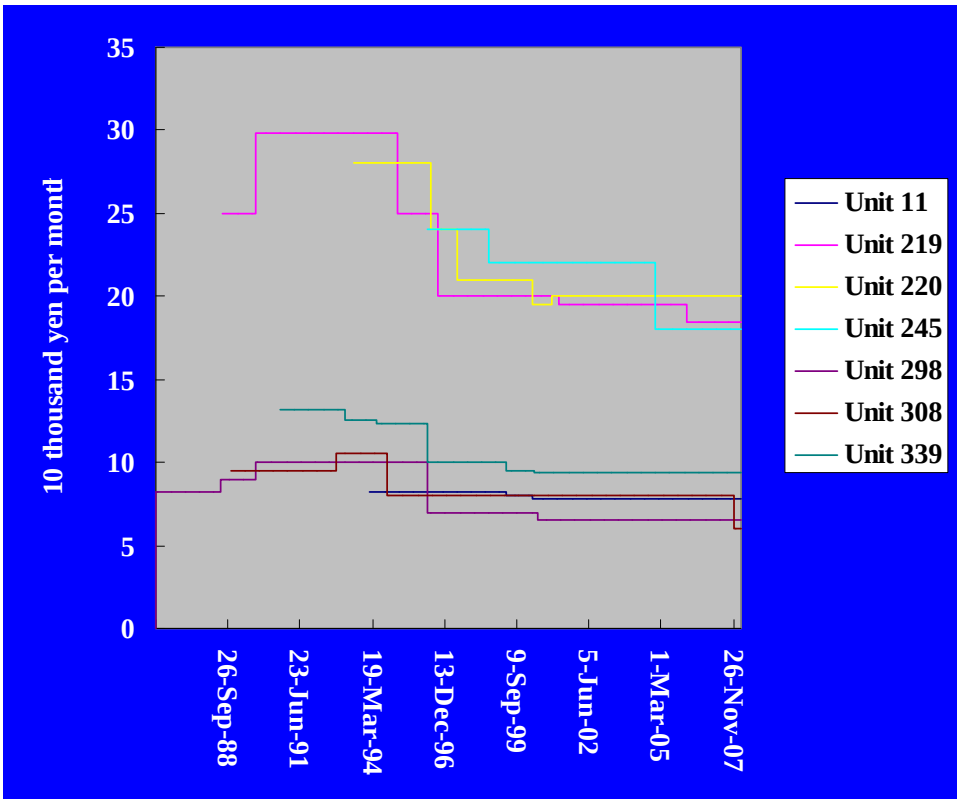


**Figure6. Changes in housing rent with time**

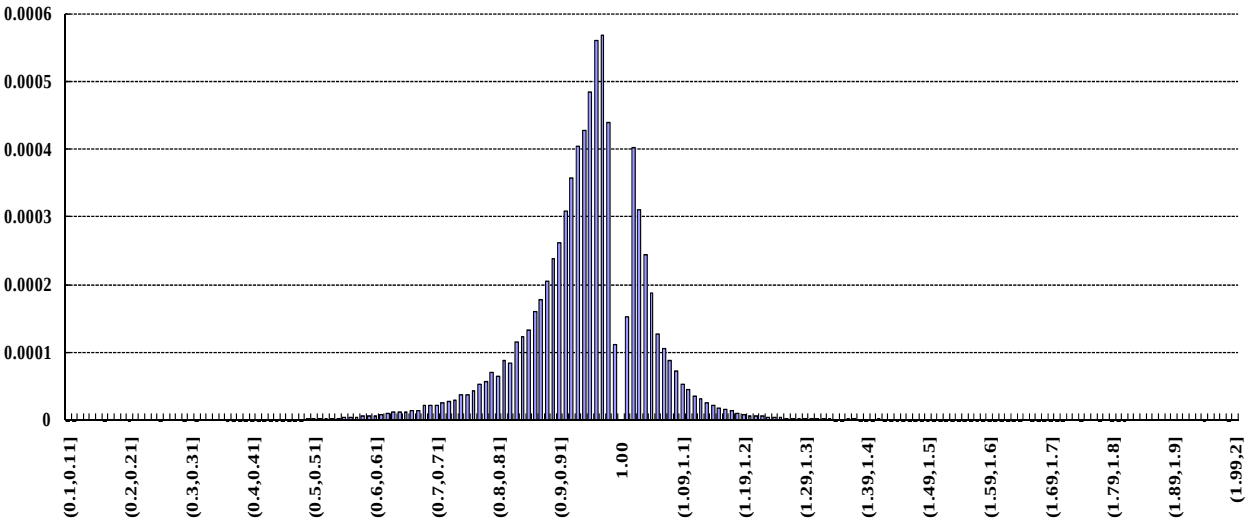


**Figure7. Weekly rent change distribution**

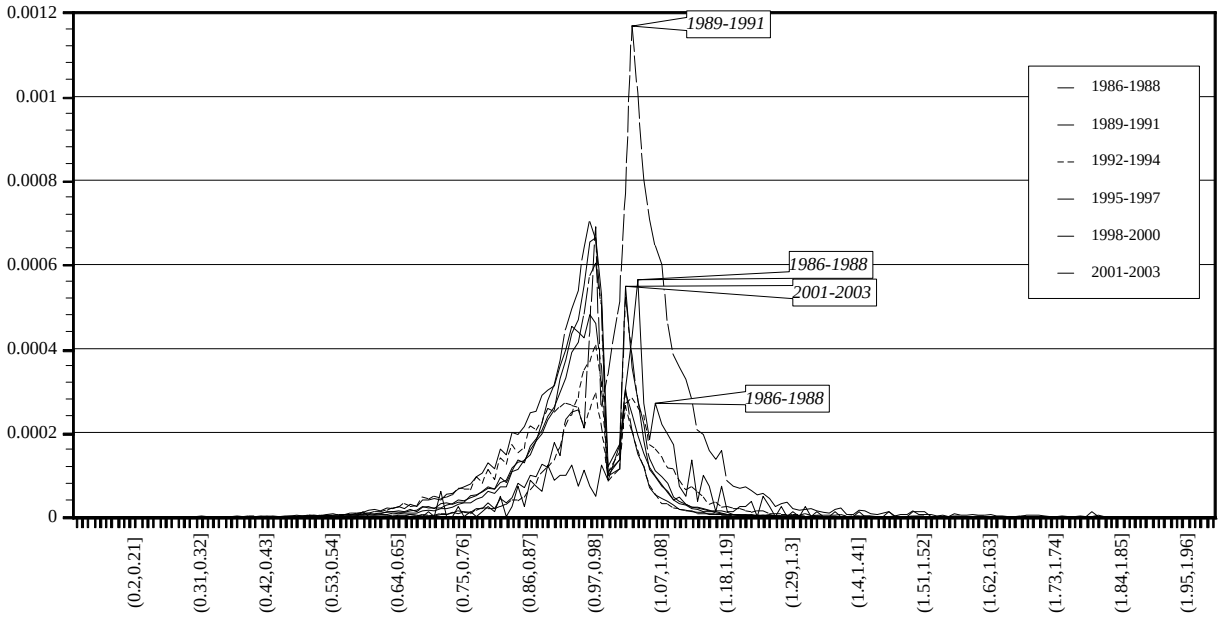


**Figure8. Weekly rent change distribution by Year1**

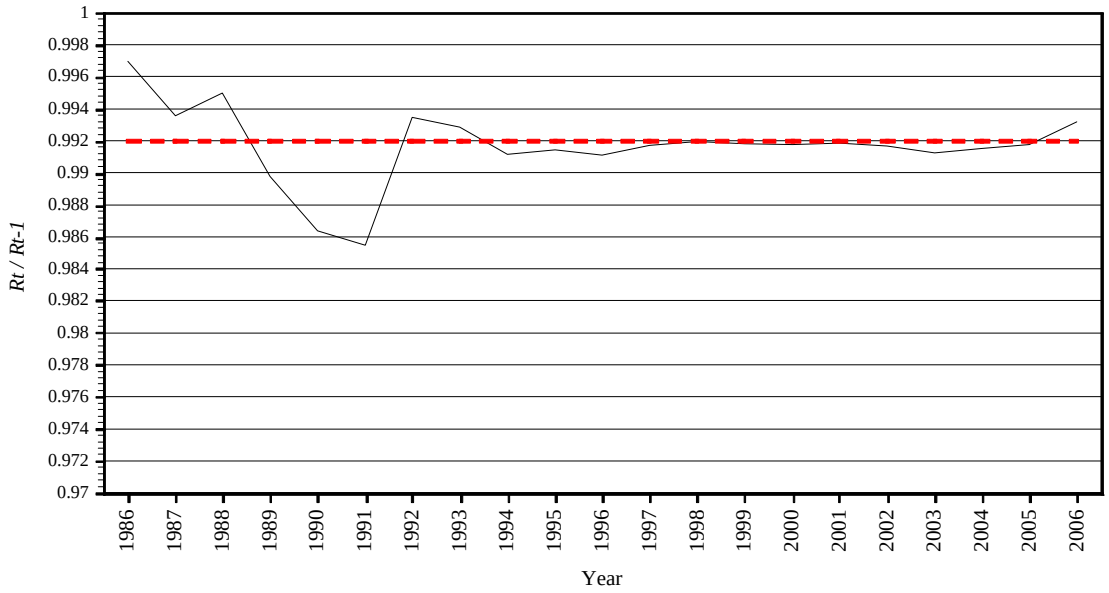


**Figure9. Weekly rent change distribution by Year2**