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Housing Bubble in Japan and the United States*

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-Abstract-

Japan and the United States have experienced the housing bubbles and subsequent collapses of the bubbles in succession. In this paper, these two bubbles are compared and the following findings are obtained.

Firstly, upon applying twenty years of past data from Japan to the "repeat-sales method" and the "hedonic pricing method", which are representative methods for calculating house prices, it was found that the timing at which prices bottomed out after the collapses of the bubbles differed depending on the two methods. The timing for bottoming out as estimated by the repeat-sales method delayed when compared to the estimate using the hedonic pricing method, by 13 months for condominiums and by three months for single-family homes. This delay is caused by the depreciation effect of building not being processed appropriately by the repeat-sales method. In the United States, the S&P/Case-Shiller Home Price Indices are representative house prices indices, which use the repeat-sales method. Therefore, it is possible that the timing for bottoming out is estimated to be delayed. As there are increasing interests in the timing for bottoming out of the US housing market, there is a risk that the existence of such a lag in cognition causes the increase of uncertainty and the delay in economic recovery.

Secondly, when looking at the relationship between the demand for houses and house prices based on the time-series data, there is a positive correlation between the two elements. However, upon conducting an analysis using the panel data, which is based on data in units of prefectures or states, there is no significant relationship between the demand for houses and house prices in both Japan and the United States. In this sense, it is hard to explain whether there is a bubble and the size of the

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bubble according to prefecture (state) using demand elements. This suggests that it is possible that the concept of demographics having an impact on the demand for houses, which thus caused the house prices to increase, is not effective in explaining the price fluctuations in neither Japan nor the United States.

Thirdly, when looking at the co-movement between the house prices and rent, a phenomenon which the rent almost does not fluctuate at all even when the significant change of house prices change in the process of the formation and collapse of a bubble was confirmed for both Japan and the United States. Its background is that landlords and tenants have formed long-term contractual relationships so that both parties can save on various transactional costs. In addition, the imputed rent of one's home is not assessed using market prices in Japan, which is an aspect to weaken the co-movement. A lack of co-movement causes a phenomenon in Japan and the United States where consumer prices that include this rent as an important element do not increase since rent does not increase even if housing prices increase during a bubble period. Thus, it results in a delay towards a shift to tighten credits. Since rent prices do not move together with the house prices even after house prices decrease after the collapse of the bubble, a phenomenon which consumer prices do not decrease was observed. This served as a factor for the delay in a shift towards monetary relaxation. Rent prices are an important variable that serves as a node between asset prices and prices of goods and services. It is necessary to increase the accuracy with which it is measured.

JEL Classification code: R21, R23, R31

Key Words: Housing Bubble, House Price Index, House Demand, Rent Rigidity

I. Introduction

This paper's objective is to find similarities and differences between the Japanese and US housing markets by comparing Japan's largest postwar real estate bubbles in the 1980s and U.S. housing bubbles since 2000 that have reportedly caused the worst financial crisis since the 1929 Great Depression. While various points have been made about the housing bubbles, this paper attempts to specify the following points.

Our first interest is in international comparison of real estate prices. When comparing these prices of major industrial countries, we have been interested in what extent housing prices rose and declined in Japan and the United States in their respective bubble periods and how long these bubbles took to be resolved. At a glance, everyone may believe that it would be easy to answer these questions. As noted by Nishimura and Shimizu (2002), however, it is very difficult in Japan. This is because Japan has not developed reliable information infrastructure that allows housing price fluctuations to be observed over time. For example, "official land prices" released by the Ministry of Land, Infrastructure, Transport and Tourism and the urban land price compiled by the Japan Real Estate Institute, which are generally in public, cover only land prices excluding building prices. These indicators represent appraisal prices estimated by real estate appraisers. As noted by Nishimura and Shimizu (2002), and Shimizu and Nishimura (2006) and (2007), therefore, the price data do not represent market prices but shows the strong biases. In order to compare housing price fluctuations in Japan and other countries, we must collect market price data in Japan and estimate housing price indexes in the same method as adopted in other major industrial countries including the United States. For this paper, we have used a consistent method to estimate price indexes for international comparison.

Our second interest is the factors behind housing price fluctuations. Particularly, we are interested in the influences that housing demands on prices. Mankiw and Weil (1989) paid attention to housing demand changes and forecast that U.S. housing prices would decline 47% in real terms over 20 years to 2007. In and after 2000, however, the unprecedented levels of housing bubbles hit the Unites States. Great housing demands backed by subprime mortgages have been cited as a factor behind the bubbles. Does the housing demand exert influences on housing prices? If the supply is flexible, any demand increase may be adjusted in the housing market soon without any sharp price hikes. If demand determines housing prices, housing demands as measured for each population unit may decline fast to push down housing prices substantially in Japan where population has been decreasing. In a bid to answer the question, we collect or estimate regional housing demands and housing price indexes in Japan and the United States and look into the factors behind housing price fluctuations through cross-section and panel analyses.

Our third interest is in the relationship between housing prices and rent prices. Not a small number of people have attributed the fast housing price hikes and subsequent declines to monetary policy failures. They stated that a delay in a switch to monetary tightening in the second half of the 1980s allowed the bubbles to grow larger and that the delay in a switch to the monetary easing to amplify adverse impacts of the bubble collapse in the first half of the 1990s. In a rebuttal to these statements, some people have argued that the central bank, which is required to stabilize prices of goods and services, inevitably made no monetary policy switch in the absence of major fluctuations in consumer prices from the second half of the 1980s to the first half of the 1990s. A key question regarding this debate is why consumer prices changed little. If consumer prices had soared substantially in the second half of the 1980s, the Bank of Japan could have tightened monetary policy. If consumer prices had declined in the second half of the 1990s, the BOJ could have switched to easing promptly then. Consumer prices changed little then because rents changed little. While house transaction prices as asset prices posted wildest-ever fluctuations, housing rents as a component of the consumer price index remained stable in general. Why were housing prices decoupled from rents? This is the third matter of interest to us in this paper. The paper is structured as follows. In Section II, we collect and put in order a wide range of housing market data for the Tokyo metropolitan region and estimate housing price indexes for international comparison with the repeat-sales method adopted in the United States and the hedonic method used by mortgage banks and the government in Britain. In Section III, our analysis focuses on demand factors among those behind price fluctuations. In Section IV, we analyze the relationship between housing prices and rent prices. Section V presents this paper's conclusion.

II. Comparison of Japanese and U.S. housing prices

II-1. Housing price indices

We now begin with collecting housing price indices in major industrial countries. We here use housing price indices available on a terminal of financial information service Bloomberg. At present, three estimation methods are used for computing housing price indices published in major industrial countries.

For example, the S&P/Case-Shiller Home Price Index as one of the representative U.S. housing price indices and the University of Hong Kong All Residential Price Index are computed with the repeat-sales method. Britain's traditional Halifax and Nationwide house price indices[1] and Japan's Recruit Residential Price Index are estimated with the hedonic method. The German house transaction price index (Kaufwert fuer Bauland) and the Australian housing price index are

[1] In Britain, the government's Land Registry and Department of Community and Local Government publish housing price indices. The former applies the repeat-sales method and the latter the mixed adjustment method. The mixed adjustment method is basically the same as the hedonic method. Since the history of the mixed adjustment method is shorter, the Halifax house price index is used as an underlying asset for derivatives.

computed as average or median prices.

The repeat-sales and hedonic methods are used for adjusting housing prices for quality.

Since all houses are different, only transaction prices of houses with different performances and characteristics are the price data that can be observed in the market. With the repeat-sales method, the houses that have been traded repeatedly are sampled for computing a price index. The hedonic price method uses all transactions price data to control pricing elements and estimate price indices.

Following are specific steps for estimating housing price indices:

First, we would like to discuss the repeat-sales method. The price of home *h* is assumed to depend on its characteristics and a specific time for sale. The characteristics are assumed to remain unchanged over time. Their influence on the price of the home is also assumed to be unchanging. In this case, a home price model can be shown as follows:

$$\ln P_{ht} = \sum_{k=1}^{K} \beta_k X_{hk} + \sum_{s=1}^{T} \delta_s D_s + \varepsilon_{ht} \qquad (1)$$

In this equation, P_{ht} represents the price of home *h* at time *t*. Here, home *h* is assumed to emerge at a changing time repeatedly. X_{hk} is the variable of characteristics *k* of home *h*, which is assumed to remain unchanged over time. Relevant parameter β_k is also assumed to remain unchanged. D_S is a time dummy. The dummy is put at 1 for the sale date -- $s = t$ -- and at 0 for any other date. Always, $D_1 = 1$ (constant term). δ_s is a parameter regarding the time dummy. It is supposed that home *h* was sold at t_1 and t_2 during the estimation period covering $t = 1,2,\ldots,T$. Equation (1) is used to compute the price as follows:

$$\ln P_{ht_1} = \sum_{k=1}^{K} \beta_k X_{hk} + \delta_1 + \delta_{t_1} + \varepsilon_{ht_1}$$

$$\ln P_{ht_2} = \sum_{k=1}^{K} \beta_k X_{hk} + \delta_1 + \delta_{t_2} + \varepsilon_{ht_2}$$

Based on the above, the price change of P_{ht_2} / P_{ht_1} is computed as follows:

$$\ln(P_{ht_2} / P_{ht_1}) = \delta_{t_2} - \delta_{t_1} + \left(\varepsilon_{ht_2} - \varepsilon_{ht_1}\right) \qquad (2)$$

The price change under this model is determined only by the sale date difference, irrespective of the home's characteristics. The following equation is formed as a model to estimate home price changes regarding sale data at different dates for various homes:

$$\ln(P_{ht_2} / P_{ht_1}) = \sum_{s=1}^{T} \delta_s D_s + \mu_h \qquad (\mu_h \text{ is a disturbance term}) \tag{3}$$

Here, D_s is a time dummy put at 1 for the second sale date ($s = t_2$), -1 for the first sale date ($s = t_1$) and 0 for any other date. Time dummy parameter δ_s represents a price index for each date. This is a typical repeat-sales model representing the traditional repeat-sales index.

The hedonic method is used as follows to estimate housing price indexes:

It is supposed that data regarding home prices and characteristics are pooled for the entire estimation period covering $t = 1,2,\cdots,T$ and that n_t represents the number of data for each time. A home price estimation model for this case takes the following form:

$$\ln P_{it} = \sum_{k=1}^{K} \beta_k X_{ikt} + \sum_{s=1}^{\tau} \delta_s D_s + \varepsilon_{it} \tag{4}$$

$t = 1,2,\cdots,T$

$i = 1,2,\cdots,n_t$ (*i* represents an ordinal numeral among n_t data cases for time *t*)

P_{it} : Price of home i at time *t* (This does not mean that home i emerges at each time, but that home i represents No. i out of data for time *t*)

β_k : Parameter for home characteristics k

X_{kit} : Variable of characteristics k of home i for time *t*

δ_s : Time dummy parameter for time s

D_s : Always 1 (constant term) for $s = 1$. In $2 \le s \le T$, the time dummy is put at 1 for $s = t$ and 0 for any other time.

ε_{it} : Disturbance term

The housing price index is computed as follows. Price $\hat{P}_t$ of a home with a characteristics variable at $\{X_k\}$ $(k = 1,2,\cdots,K)$ is:

$$\ln \hat{P}_t = \sum_{k=1}^{K} \hat{\beta}_k X_k + \hat{\delta}_1 + \hat{\delta}_t \tag{5}$$

$$\ln \hat{P}_1 = \sum_{k=1}^{K} \hat{\beta}_k X_k + \hat{\delta}_1$$

Here, $\hat{\beta}_k$, $\hat{\delta}_1$ and $\hat{\delta}_t$ are the estimated parameters. Therefore, the $\hat{P}_t / \hat{P}_1$ housing price index for time *t* based on the standard for $t = 1$ is:

$$\ln(\hat{P}_t / \hat{P}_1) = \hat{\delta}_t$$

The price index change from time $t-1$ to time t can be given as[2]:

$$\ln(\hat{P}_t / \hat{P}_{t-1}) = \hat{\delta}_t - \hat{\delta}_{t-1} \quad (6)$$

Estimation method differences are attributable to differences between available housing price data in various countries. The above equation indicates that the repeat-sales index allows a housing price index to be computed with only sale prices and dates given. However, an index cannot be computed without characteristics variables (X_k) under the hedonic method.

Housing data development gaps have imposed restrictions on the housing price index computation.

The estimation method differences are assumed to lead housing price indexes to have their respective biases and have made international comparison difficult. Therefore, it was attempted to standardize indexes. In 2006, an international workshop (OECD-IMF Workshop on Real Estate Price Indexes, 6 - 7 November 2006)[3] took place to study the feasibility of the standardization. The workshop was outlined by Diewert (2007).

Housing price index computation issues are summarized as follows, according to Diewert (2007) and other earlier studies:

It has been pointed out that the repeat-sales method has two problems: i) the sample selection bias (Clapp and Giaccott (1992)) problem arising from the so-called lemon theory that houses for repeat-sales are qualitatively different from other houses sold in the market (defective homes were sold more frequently and therefore comprise a disproportionate share of repeat-sales samples), and ii) the problem of responses to real qualitative and structural changes under the repeat-sales method presumption that home characteristics and their parameters remain unchanged between sale dates （Case and Shiller (1989)).

Diewert (2007) paid attention to the latter problem, particularly.

The presumption that a house does not change in quality during the period between the first and second sale dates is too strong in any country. Specifically, any house could be extended or subjected to new housing investments during the period between the first and second sale dates. In this case, the house for the first sale may be viewed as different from that for the second sale, even though the latter originates from the former. Such problem is called the renovation problem. Even in the absence of new housing investments during the period between the first and second sale dates,

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[2] The hedonic price index estimated in this way is called the structurally restricted hedonic model based on the precondition that the structure remain unchanged throughout the estimation period. As a model based on the precondition of structural changes, there is an unrestricted hedonic model. See Shimizu, Takatsuji, Ono and Nishimura (2007) for details.

[3] See Diewert (2007) for details.

the housing price may depreciate over time. This is called the depreciation problem. The two problems are easily expected to bring about major biases. In Japan, however, the renovation problem is less likely as the renovation investment market is underdeveloped. As the life of Japanese houses is described as relatively shorter, the depreciation problem in Japan may be stronger than that in the United States.

The largest problem with the hedonic method for the estimation of housing price indexes is iii) the omitted variables bias (as pointed out by Case and Quigley (1991), and Ekeland, Heckman and Nesheim (2004)). This means that indexes computed with the method could have some bias because it is difficult to collect all home characteristics variables (X_k) that include unobservable environmental variables. Another problem likely to happen is iv) the structural change problem (as pointed out by Case, Pollakowski and Wachter (1991), and Shimizu, Takatsuji, Ono and Nishimura (2007)). This means that some considerations must be given to structural changes of houses since the housing market over a long period of time is subject to the analysis.

While the two methods have their respective problems, a study has indicated that differences between the hedonic and repeat-sales price indexes are narrower for a longer period of time subject to analysis (Clapp and Giaccotto (1998).

As for problem i) for the repeat-sales method, all sale data are not necessarily collected or estimated for the hedonic method as well. Therefore, the sample selection bias problem exists in the hedonic method, although the problem is smaller than for the repeat-sales method. Both the repeat-sales and hedonic methods have a structural change problem regarding problems ii) and iv). However, the renovation and depreciation problems are peculiar to the repeat-sales method. Problem iii) is peculiar to the hedonic method.

Having these problems in mind, in this study, we collected home sale price data in the Tokyo metropolitan region (covering Tokyo, Kanagawa, Chiba and Saitama Prefectures) and estimated housing price indexes with methods for the traditional repeat-sales index proposed by Bailey, Muth and Nourse (1963) for the Case/Shiller-type repeat-sales index[4)] modified by Case and Shiller (1989) and adopted by S&P, and for the hedonic index (Table 1). Figures 1 and 2 compare the indexes estimated for condominiums and single-family homes in the Tokyo metropolitan region.

[4)] Case&Shiller proposed a model to make modifications in consideration of the fact that error variances expand as the period between sale dates grows longer. Specifically, the equation (3) is estimated in the first phase to get the error term. In the second phase, the square of the error term is regressed by the constant term and the period between the first and second sales to get the error parameter. This is an error left after the period between sale dates is adjusted. Error parameters estimated in this way are used to give weights to samples for GLS (generalized least squares) estimation. For more specifics, see Case and Shiller (1989).

Table 1 Hedonic function estimation results

Estimation Method OLS

Dependent Variable

Price or Rent per square meter

Independent Variables

Variables	Condominium(Asset Price)		Single Family(Asset Price)		Condominium(Rent Price)	
	coefficien	t-value	coefficien	t-value	coefficien	t-value
Constant	4.658	153.088	6.238	724.872	9.184	34.256
FS : Floor space (m²)	0.020	23.880	0.114	92.490	-0.262	-1139.460
GA : Ground Area (m²)	-	-	-0.332	-262.450	-	-
Age :Age of	-0.168	-426.170	-0.064	-206.060	-0.027	-360.550
TS : Time to the nearest station: (minutes)	-0.098	-207.420	-0.112	-113.390	-0.076	-331.890
Bus:Bus Dummy	-0.185	-33.710	0.098	7.610	-0.010	-3.350
Car:Car Dummy	-	-	-0.616	-30.700	-	-
Bus×TS	0.023	10.820	-0.084	-18.590	0.018	13.690
Car×TS	-	-	0.154	16.030	-	-
TT : Travel Time to Central Business District (minutes)	-0.067	-105.680	-0.109	-83.770	-0.078	-283.790
Top:Top of Building	0.013	5.460	-	-	-	-
BeforeConstruction	-0.085	-126.640	-	-	-0.122	-256.050
Steel Dummy	0.018	33.620	-	-	0.082	200.050
Balcony Area	0.029	69.850	-	-	-	-
Road Width	-	-	0.143	70.240	-	-
Private Road	-	-	0.003	8.580	-	-
Land only Dummy	-	-	0.039	6.440	-	-
Old house	-	-	-0.086	-36.020	-	-
New Construction	-	-	-0.121	-69.330	-	-
1986/01-2008/12	n=714,506		n=1,540,65		n=2,066,14	
Adjusted R-square=	0.857		0.861		0.785	

Figure 1 Repeat-sales and hedonic price indexes: condominiums

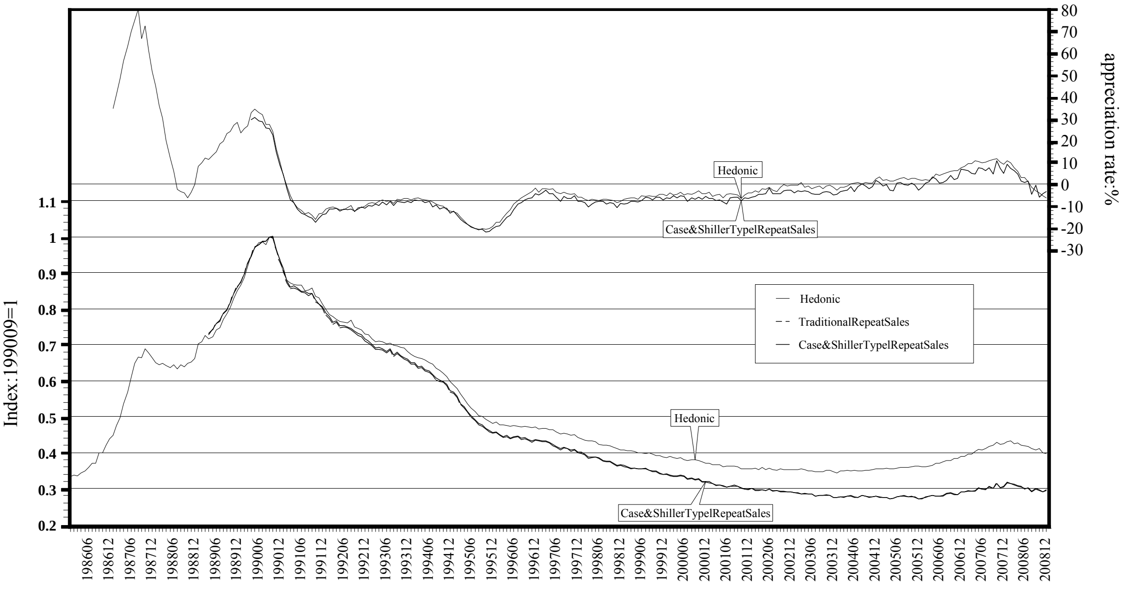
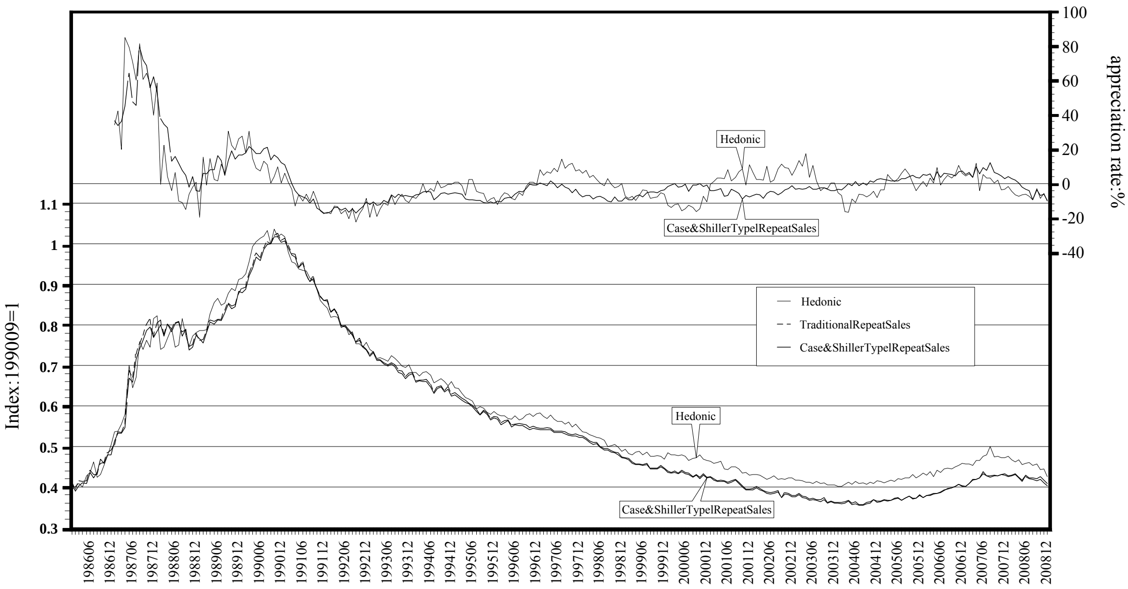


Figure 2 Repeat-sales and hedonic price indexes: single-family homes



Since we paid attention to the decline from the peak, we adopted the condominium price index's peak in September 1990 as the standard (1 for September 1990) and observed the index's changes.

First, we would like to observe changes in condominium prices. From 1986 to the 1990 peak, the index soared some 2.6-fold. In five years after the peak, the index fell back fast to the same level as in 1986. Later, it declined slowly. Here, the repeat-sales price index indicated a faster decline than the hedonic price index. This may be because the repeat-sales price index contains the depreciation problem. The effect of the problem might have reduced the index further.

Subsequently, we observed changes in prices of single-family homes. As it is almost the same case with condominiums, the single-family home price index shot up 2.7-fold from 1986 to September 1990. It turned downward in 1990 and seemed about to stop falling in 1997. But it fell further at the same pace and stabilized at the 1986 level in and after 2003. Compared with the condominium price index, the single-family home price index took a longer time of more than 10 years to reach the stabilization stage. The difference between the hedonic and repeat-sales price indexes is not as large as that for the condominium price index. Single-family home prices feature a greater weight of land prices, reducing the effects of the depreciation problem.

II-2. Causality of Housing Prices in Major Cities

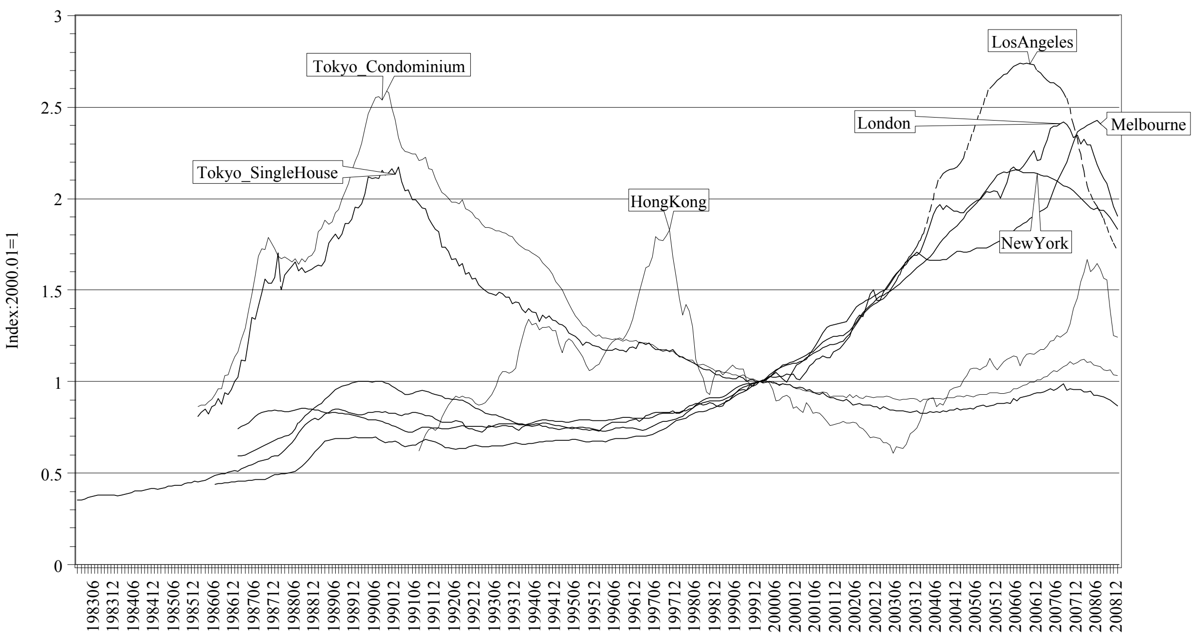
In this section, we compared housing price indexes in Los Angeles, New York, Hong Kong, London and Melbourne using estimated price indexes. Since attention is paid to the recent housing price changes, the index is set at 1 for January 2000 (Figure 3).

Prices in the Tokyo metropolitan region in 2000 were similar to the levels in September 1986 for condominiums and in January 1987 for single-family homes.

The price changes in Tokyo and Hong Kong differed from those in the other cities, although the prices showed similar changes in Los Angeles, New York, London and Melbourne. We can suspect that the hike in Los Angeles might have been almost the same as seen in Tokyo in the 1980s, although the absence of data in and before 1986 in Tokyo makes a simple comparison difficult. Specifically, the price index in Los Angeles soared 2.73-fold from the standard year of 2000 to July 2006 when the index reached the peak. In the Tokyo metropolitan region, the housing price index rose 2.7-fold from the standard year of 1986 to September 1999. The index took 45 months to reach the peak. In Los Angeles, the index took 67 months to rise 2.7-fold. This means that the Los Angeles home price index took 22 more months than the Tokyo index to soar 2.7-fold.

The price decline in Tokyo was slower than the hike. In Los Angeles and London, however, the decline was faster. Even in Tokyo, the decline was fast in the first three years after bubbles burst. However, the fall slowed later. How price falls will change in the future in Los Angeles and London will attract attentions.

Figure 3 Changes in Housing Prices in Major Cities



Here, we computed the Granger Causality to look into links between housing price changes in these cities. Computation results are as follows[5]:

Tokyo_Single → Tokyo_Condo
Tokyo_Condo → Tokyo_Single
London → Los Angeles
London → New York
London → Melbourne
Los Angeles → New York
Los Angeles → London
Los Angeles → Melbourne

Paying attention to statistically significant links as listed above, we can find that housing prices in London and Los Angeles had influences on that in New York and Melbourne. These results cannot simply lead to a conclusion that housing price fluctuations in London and Los Angeles affected other markets. As no control is made on the strength of links between economic markets, the causality of housing markets alone is not detected. If the causality exists between these markets with housing price fluctuations in London and Los Angeles having phenomenal effects on the prices in other markets, it may indicate the possibility of the housing prices in New York and Melbourne being linked to the prices of London and Los Angeles.

We would like to pay attention to the burst of bubbles in Tokyo, Los Angeles and New York[6] here.

After the financial crisis triggered by the subprime mortgage problem, the stock and other market participants, and policymakers are waiting for a housing market upturn. If the depreciation problem accompanying the repeat-sales method emerges, however, we may misjudge the upturn timing. Theoretically, we may use individual U.S. data to compute and compare repeat-sales and hedonic price indexes to specify the problem. In the United States, however, house characteristics data for estimation of hedonic indexes have yet to be developed. Under such situation, we have no choice but depend on the repeat-sales price index alone.

Therefore, we attempted to specify the problem by comparing indices estimated with the repeat-sales and hedonic methods using Japan's housing price data.

Paying attention to the fast housing price hike in the 1980s and the subsequent plunge, we found that the hedonic price index turned up in May 2004 and that the repeat-sales price index

[5] These indicators were analyzed based on first-order differences as the unit root test reaffirmed the existence of unit roots. The F-test was conducted as the causality examination. A null hypothesis denying any causality was rejected at the significance level of 1%.
[6] Monthly consumer price indexes are used to determine the real-term housing price indexes.

turned up in June 2005, 13 months slower than the hedonic index. For single-family homes, the hedonic price index turned up in August 2004 and the repeat-sales price index in November 2004, three months later. For condominiums, the hedonic price index fell from 1 for September 1990 to the bottom of 0.33 before the upturn and the repeat-sales index dropped to 0.26. For single-family houses, the hedonic index declined to 0.37 and the repeat-sales index went down to 0.31. These data have many implications.

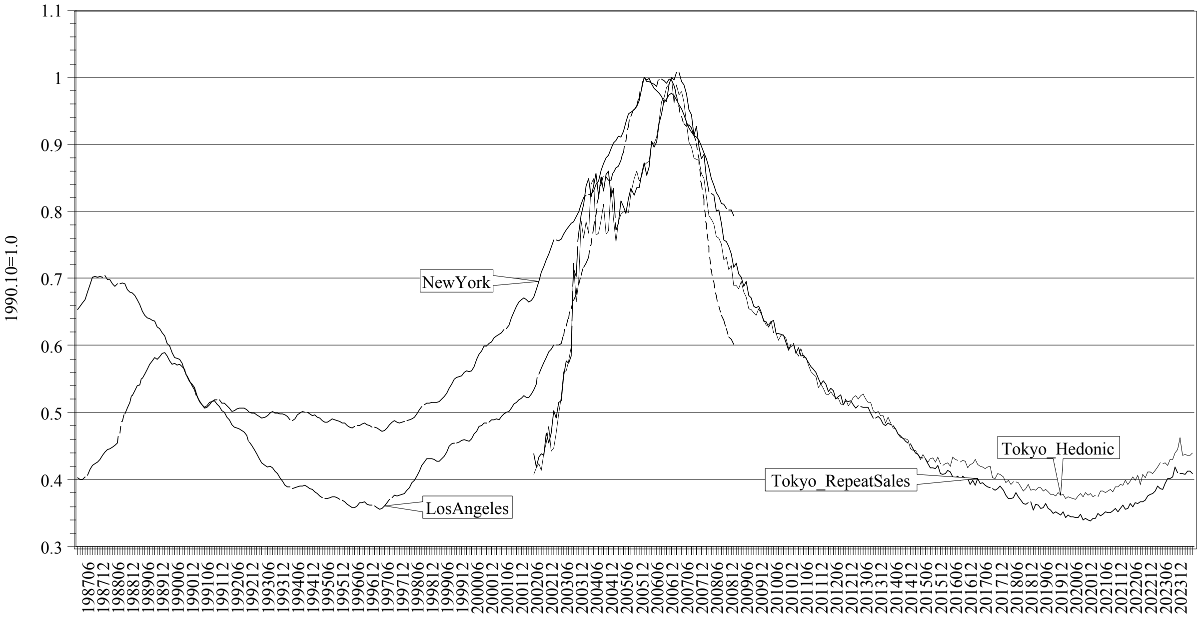
The repeat-sales index structurally has the depreciation problem. Using this index to observe the market, we may have a lag in finding the upturn point after the decline. When many people are waiting for a housing price upturn as at present, any misjudgment on the timing for the upturn may delay an economic recovery. Particularly, there is a 13-month lag between the hedonic and repeat-sales indexes for condominiums. The lag represents a significant problem.

The S&P/Case-Shiller housing price index as the representative U.S. home price indicator is estimated with the repeat-sales method. Therefore, the identification of a bottoming-out point may lag behind an actual upturn. The index can also lead us to underestimate the housing prices.

We estimated an upturn point for the case where home prices in Los Angeles or New York are corrected at the same speed as in Tokyo (Figure 4). Prices in Los Angeles have been corrected faster than in Tokyo. However, those in New York have been corrected more slowly than in Tokyo. If Los Angeles prices are deemed to fall at the same speed as Tokyo prices, an upturn may be expected to come in April 2020. The January 2000 level may be reached in October 2014. At present, prices have been corrected faster in Los Angeles than in Tokyo and more slowly in New York.

Learning lessons from Japan's delayed response to the bubble burst, the United States has quickly taken the economic stimulus measures. Therefore, the home price correction speed heavily depends on effects of these policy measures. Many people are waiting for a faster housing market recovery.

Figure 4 U.S. Housing Price Outlook



II-3. Changes in Japanese and U.S. Region-by-Region Housing Prices

In this section, we would like to pay attention to region-by-region housing price changes. Our hypothesis here is that housing price changes might have differed from region to region during the Japanese and U.S. bubble periods.

As for the United States first, we pay attention to the state-by-state housing price indexes published by the Federal Housing Finance Agency (FHFA), which had formerly been called the Office of Federal Housing Enterprise Oversight (OFHEO). The indexes have been estimated with the repeat-sales method. They have been published since 1975.

In Japan, however, there are not any region-by-region housing price indexes adjusted for quality covering the entire country. Instead of such indexes, therefore, we use the public land prices that are published by the Ministry of Land, Infrastructure, Transport and Tourism on January 1 every year, which have been used for many earlier studies. The fact that they are appraisal prices of lands is problematic. In Japan where land prices account for greater shares of housing prices, however, we believe that land prices can be adopted as a substitute for housing prices.

Earlier studies using the public land prices, including Shimizu (2004) and Saita et al (2004), developed the price indexes by averaging annual changes for samples for which latest and year-earlier prices were available.

Compared with market prices, public land prices have unignorable biases. This is because they are appraisal or valuation prices. Appraisal prices are determined by the appraisers. When market prices are fluctuating, therefore, there are the so-called “valuation error” and “smoothing” problems (Shimizu and Nishimura (2006)). One reason for these problems is that changes at sample points subject to continuous appraisal are underestimated during volatile market price moves. Specifically, appraisers who usually fail to detect initial price hikes may give lands prices that are lower than the market prices. When they detect price hikes and adjust appraisal prices to the market levels, price changes at sample points subject to continuous appraisal may be overestimated. Therefore, the appraisers give lands lower-than-market prices in a bid to adjust fluctuations. If appraisal prices deviate far from market prices, coordination at sample points subject to continuous appraisal becomes impossible. Then, sample points may be changed[7)]. This procedure may allow annual changes to be gradually adjusted.

The appraisal prices just after the sample changes are the closest to market prices since no constraints are imposed on pricing. As far as the price changes from the year-before levels are used, however, data at the new sample points cannot be used. Saita et al (2004) proposed a weighted average land price index that uses year-on-year price changes and gives weights according to prices. However, biases are unavoidable as far as the year-on-year price changes are used.

For this study, therefore, we estimated hedonic functions for each prefecture using all public land price data. Estimation results are shown in Table 2. In estimating the hedonic functions, we used not only home location variables -- area (area) (square meters), front road width (RW) (meters), distance to the nearest station (ts) (meters), presence or absence of sewerage systems (gesui) (dummy1 for presence or 0 for absence), presence or absence of running water (sui) (dummy1 for presence or 0 for absence), and presence or absence of town gas (gas) (dummy1 for presence or 0 for absence) -- but also coordinates for all locations. In order to take regional characteristics into account, we also acquired coordinates for all locations and used the accessibility (TT) [8)] (meters) to a commercial center in each prefecture, coordinates (UX and UY) and their squares (UXX and UYY) as explaining variables[9)].

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7) More than 90% of land price sample points are subject to continuous appraisal. From 1979 to 1982, however, more than 20% of samples were replaced. In 1983, more than 50% were replaced. In the period of 1993-1995, after the burst of the bubbles, appraisal prices failed to be adjusted to sharp hikes during the bubble period and fastly declines after the period. Therefore, some 30% of the samples were replaced in 1993 and 1994. In 1995 alone, 13% of the samples were replaced. Such large-scale replacements can cause sample selection biases at points for continuous appraisal. Real estate appraisers valuate housing prices by comparing transaction cases. Therefore, it is systematically difficult to estimate rates of changes. Price levels may thus be estimated more accurately. In this sense, it is better to use price level indicators.

8) For each prefecture, we allowed buffers to emerge from the location for the highest public land price and defined the mesh center with the highest office density as the commercial center.

9) The model taking the coordinates into account is called "polynominal expansion model" as proposed by Jackson (1979). See Shimizu and Karato (2007) for details.

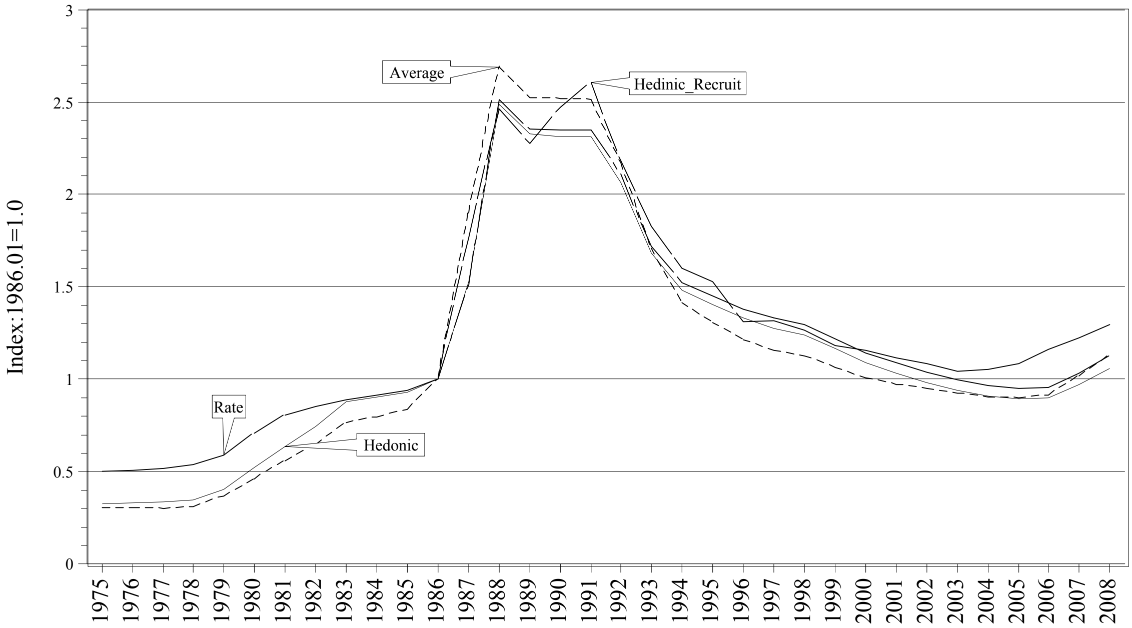
Table 2 Prefecture-by-prefecture Hedonic Function Estimation Results

No	Prefecture	area	rw	ts	tt	gesui	sui	gas	UX	UY	UXX	UYY	cp1	cp3	cp6	cp7	tm	Number of Samples	adjusted R^2
1	Hokkaido	-1.180	0.179	-0.051	-0.409	0.288	0.004	0.415	-6.221	-24.091	0.022	0.276	-0.108	-0.275	0.878	-0.951	Yes	24,565	0.814
2	Aomori	-1.245	0.418	-0.038	-0.236	0.187	0.325	0.441	0.360	-0.919	-	-	-0.216	-0.034	0.339	-0.732	Yes	4,965	0.835
3	Iwate	-1.149	0.016	0.035	-0.321	0.217	0.086	0.256	0.530	-63.865	-	0.805	-0.117	-0.010	-	-0.589	Yes	3,153	0.827
4	Miyagi	-1.108	0.237	-0.112	-0.365	0.143	0.232	0.180	0.284	0.040	-	-	-0.079	-0.037	-	-0.592	Yes	10,350	0.895
5	Akita	-1.157	0.150	-0.074	-0.396	0.230	0.199	0.196	0.574	-151.022	-	1.896	-0.054	0.506	-	-0.776	Yes	3,300	0.867
6	Yamagata	-1.259	0.234	-0.054	-0.342	0.220	-	0.303	-0.177	-42.895	-	0.560	-0.056	-	-	-0.691	Yes	3,126	0.867
7	Fukushima	-1.135	0.135	-0.028	-0.193	0.165	0.398	0.257	0.050	-80.239	-	1.076	-0.001	0.139	-0.387	-0.839	Yes	8,462	0.851
8	Ibaragi	-1.216	0.181	-0.111	-0.140	0.206	0.148	0.330	-0.428	-0.274	-	-	-0.091	-	0.325	-0.710	Yes	14,836	0.877
9	Tochigi	-1.257	0.221	-0.050	-0.244	0.151	0.312	0.235	-0.204	-0.651	-	-	-0.021	-	-	-0.369	Yes	8,752	0.879
10	Gunma	-1.142	0.279	-0.062	-0.063	0.271	0.258	0.179	-0.264	-0.168	-	-	0.008	-	-	-0.455	Yes	7,188	0.839
11	Saitama	-1.039	0.145	-0.148	-0.173	0.109	-0.100	0.110	0.231	-2.411	-	-	-0.026	0.244	0.301	-0.599	Yes	28,425	0.943
12	Chiba	-1.096	0.120	-0.168	-0.283	0.077	0.307	0.261	-1.646	1.430	-	-	-0.055	-0.042	-	0.074	Yes	27,654	0.864
13	Tokyo	-0.871	0.144	-0.125	-0.724	0.086	0.089	0.186	-0.578	-0.560	-	-0.001	0.012	0.135	-0.349	-3.136	Yes	50,333	0.923
14	Kanagawa	-0.919	0.096	-0.107	-0.038	0.040	0.024	0.122	0.782	0.947	-	-	-0.008	-0.054	-0.195	-0.589	Yes	41,470	0.931
15	Niigata	-1.309	0.369	-0.131	-0.331	0.112	-0.082	0.316	-0.418	-11.409	-	0.150	-0.108	-	-	-0.797	Yes	7,386	0.851
16	Toyama	-1.080	0.242	-0.062	-0.179	0.294	0.103	0.231	-0.583	1.121	-	-	-0.110	-	-	-0.325	Yes	3,941	0.839
17	Ishikawa	-1.170	0.175	-0.057	-0.414	0.157	0.212	0.146	-0.604	-165.220	-	2.257	0.026	-	-0.044	-0.407	Yes	3,903	0.849
18	Fukui	-1.057	0.168	-0.129	-0.318	0.070	-0.106	0.124	-0.335	-0.935	-	-	-0.020	-	-	-1.107	Yes	2,090	0.858
19	Yamanashi	-1.143	0.215	-0.039	-0.155	0.028	0.335	0.158	1.087	0.627	-	-	-0.017	-	-0.078	-0.349	Yes	2,774	0.936
20	Nagano	-1.370	0.113	-0.062	-0.281	0.330	0.812	0.142	-0.122	90.043	-	-1.247	-0.085	0.460	0.202	-0.424	Yes	5,125	0.844
21	Gifu	-1.062	0.204	-0.047	-0.213	0.193	0.010	0.154	-0.323	0.771	-	-	-0.052	0.066	0.129	-0.559	Yes	6,207	0.893
22	Shizuoka	-1.154	0.116	-0.070	-0.125	0.131	-0.082	0.258	0.080	0.118	-	-	-0.058	0.159	-	-0.455	Yes	13,103	0.882
23	Aichi	-1.013	0.267	-0.066	-0.417	0.146	-0.051	0.131	0.623	-0.449	-	-	-0.033	-0.141	-0.314	-0.383	Yes	33,687	0.931
24	Mie	-1.116	0.329	-0.071	-0.040	0.060	0.155	0.318	0.212	-59.555	-	0.853	-0.032	-0.016	-	-0.635	Yes	8,298	0.885
25	Shiga	-1.310	0.395	-0.074	-0.158	0.111	0.092	0.268	-1.340	0.532	-	-	-0.085	-0.198	-0.490	-0.669	Yes	5,431	0.910
26	Kyouto	-0.994	0.270	-0.080	-0.318	0.134	0.830	0.241	1.174	1.080	-	-	0.004	-0.165	-0.188	-1.101	Yes	12,672	0.932
27	Oosaka	-0.965	0.221	-0.129	-0.342	0.083	-0.003	0.186	0.009	0.691	-	-	-0.031	0.040	-	-0.847	Yes	34,854	0.944
28	Hyougo	-0.983	0.201	-0.123	-0.062	0.077	0.106	0.380	0.911	-70.375	-	1.000	-0.110	-0.020	-	-0.930	Yes	25,911	0.875
29	Nara	-1.060	0.255	-0.133	-0.049	0.054	0.387	0.247	-1.254	2.115	-	-	-0.100	-	-0.572	-0.342	Yes	8,399	0.899
30	Wakayama	-1.094	0.168	0.014	-0.158	0.151	0.205	0.156	0.032	-0.225	-	-	-0.022	-0.171	-	-0.413	Yes	3,049	0.878
31	Tottori	-1.199	0.561	-0.182	-0.177	0.103	-0.670	0.158	-0.298	-0.233	-	-	-0.063	-0.102	-	-0.941	Yes	1,946	0.859
32	Shimane	-1.054	0.133	-0.094	-0.290	0.089	-	0.228	-0.680	-50.651	-	0.724	-0.038	-	-	-0.656	Yes	2,215	0.790
33	Okayama	-1.232	0.156	-0.086	-0.266	0.110	0.079	0.236	-0.444	-0.258	-	-	-0.110	-	-	-0.616	Yes	7,396	0.880
34	Hiroshima	-1.083	0.197	-0.103	-0.329	0.114	0.237	0.279	0.265	-0.905	-	-	0.002	0.097	-	-0.729	Yes	12,160	0.855
35	Yamaguchi	-1.143	0.146	-0.048	-0.010	0.022	0.366	0.402	0.330	0.399	-	-	-0.058	-	-	-1.079	Yes	5,714	0.817
36	Tokushima	-1.018	0.117	-0.037	-0.303	0.062	0.065	0.237	-0.573	-0.327	-	-	0.090	-	-	-0.063	Yes	2,518	0.929
37	Kagawa	-1.142	0.247	-0.163	-0.264	0.011	0.254	0.256	-0.626	0.088	-	-	-0.097	-	-	-0.462	Yes	2,866	0.913
38	Ehime	-1.240	0.306	-0.077	-0.208	0.180	-0.125	0.251	0.307	34.366	-	-0.518	-0.108	-0.263	-	-0.498	Yes	4,405	0.861
39	Kouchi	-1.232	0.284	-0.038	-0.272	0.218	0.176	0.195	0.304	34.104	-	-0.527	0.051	-	-	-0.292	Yes	2,644	0.890
40	Fukuoka	-0.992	0.157	-0.072	-0.434	0.280	0.182	0.232	0.611	-55.140	-	0.821	-0.035	0.635	0.039	-0.954	Yes	17,948	0.870
41	Saga	-1.294	0.153	-0.062	-0.186	0.094	0.096	0.200	0.243	1.040	-	-	-0.120	-	-0.181	-0.774	Yes	2,001	0.887
42	Nagasaki	-0.919	0.685	-0.006	-0.211	0.101	0.143	0.374	-0.298	-9.789	-	0.148	-0.012	-	-0.384	-0.831	Yes	4,922	0.815
43	Kumamoto	-1.222	0.311	-0.033	-0.265	0.116	0.199	0.315	-0.147	-0.607	-	-	-0.009	-	-	-0.349	Yes	5,186	0.901
44	Ooita	-1.139	0.418	-0.097	-0.232	0.106	0.695	0.254	-0.640	-0.765	-	-	-0.085	-	-	-0.040	Yes	4,496	0.856
45	Miyazaki	-1.168	0.125	-0.057	-0.273	0.259	0.140	0.244	0.634	-52.347	-	0.816	-0.038	-	-	-0.520	Yes	4,397	0.896
46	Kagoshima	-1.122	0.108	-0.092	-0.384	0.095	-	0.330	-0.264	1.593	-	-0.028	-0.064	-	-	-0.590	Yes	4,799	0.885
47	Okinawa	-1.225	0.318	0.015	-0.367	0.112	-0.067	0.006	-2.586	48.458	-	-0.873	-0.043	0.070	-	-1.261	Yes	3,348	0.929

We compared the hedonic price index (Hedonic) and the average value (Average) as estimated in this way, the price index (Rate) as computed based on year-on-year changes at points for continuous survey, and the single-family home price index (HPI) as estimated based on market price data in the previous section (Figure 5). The standard is 1 for the base year of 1986. Excluding the Average, all indicate the same trend from 1986. From the HPI using the market price data, however, the other indicators had major deviations in 1992[10].

[10] Shimizu and Nishimura (2006) confirmed a similar deviation. The valuation error problem in the year was the most conspicuous.

Figure 5 Comparison of Estimated Housing Price Indexes: Tokyo

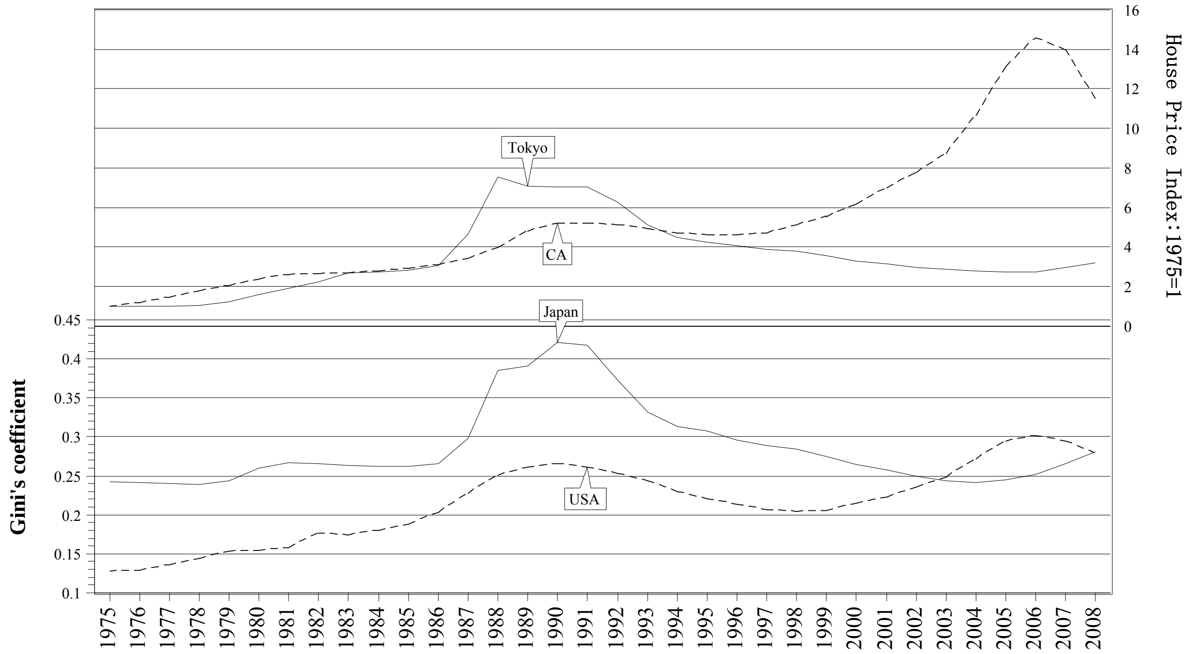


For years before 1986, the comparison of the HPI with the other indicators is impossible in the absence of the HPI using the market price data. Among the other indicators, the hedonic index and the average show similar trends and the Rate based on year-on-year price changes deviates upward from the other. The deviation indicates errors accompanying sample replacements. Therefore, we adopted the hedonic index based on public land prices on the precondition of such bias.

Estimated prefecture-by-prefecture price indexes are converted into level indicators with the estimated price index, based on the average housing prices in 1985. The U.S. FHFA home price index is based on 1 for the base year. We used the median home value in the Census of Housing by the U.S. Census Bureau in 1985 to convert the home price index into a level indicator. In order to find region-by-region trends and changes in gaps between regions, we computed and compared Gini's coefficients (Figure 6) [11]. In Japan, the degree of inequality rose substantially from 1986 to 1990 and declined toward 2004. The movements were similar to land price fluctuations in Tokyo, indicating Japan's bubbles emerged in limited regions including Tokyo to expand gaps between regions.

[11] Gini's coefficient is based on the Lorenz curve to measure the degree of inequality. Coefficients range from 0 to 1. The coefficient at 0 indicates complete equality. Higher coefficients mean higher degrees of inequality.

Figure 6 Regional Gini's Coefficients for Japanese and U.S. Housing Prices



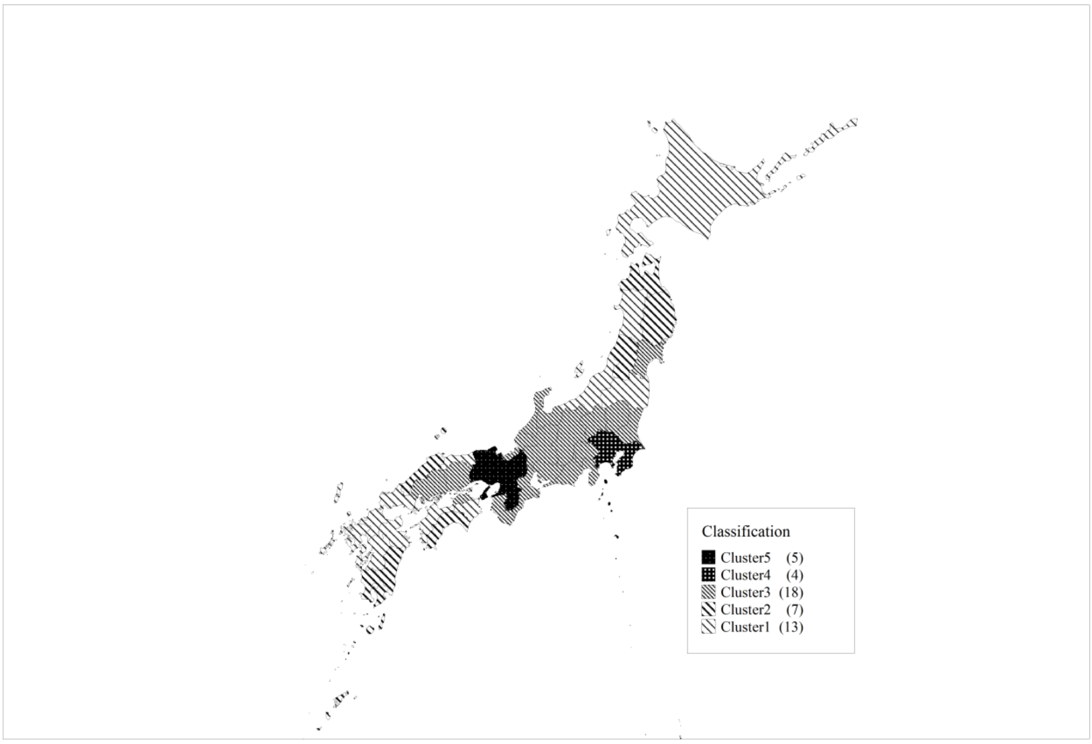
In the United States, the degree of inequality had been lower than that in Japan before rising at the time of emergence of the housing bubbles in the 2000s. The Gini's coefficient and the California housing price index changed synchronously. As seen in Japan, major price fluctuations in some states extended the gaps between regions. This means that housing price fluctuations were not seen evenly on a nationwide basis but limited to some regions in Japan and the United States.

In order to observe spatial relationships between housing price fluctuations, we used regional housing (land) prices' year-on-year changes to conduct a cluster analysis with the market divided into clusters. With Ward's method, we divided the market into five clusters by the squared Euclidean distance[12)].

In the Japanese market during the bubble period in the 1980s, residential land prices rose first in Cluster 4 and next in Clusters 5 and 3. Cluster 4 represents the Tokyo metropolitan region and Cluster 5 covers the Osaka metropolitan region. Cluster 3 represents the surroundings of these metropolitan regions (Figure 7). The distribution of regional clusters indicates that they are spatial clusters.

[12)] Using the dendrogram and squared Euclidean distance, we confirmed that it is statistically significant to divide the Japanese or U.S. market into five clusters.

Figure 7 Changes in Cluster-by-Cluster Residential Land Prices: Japan



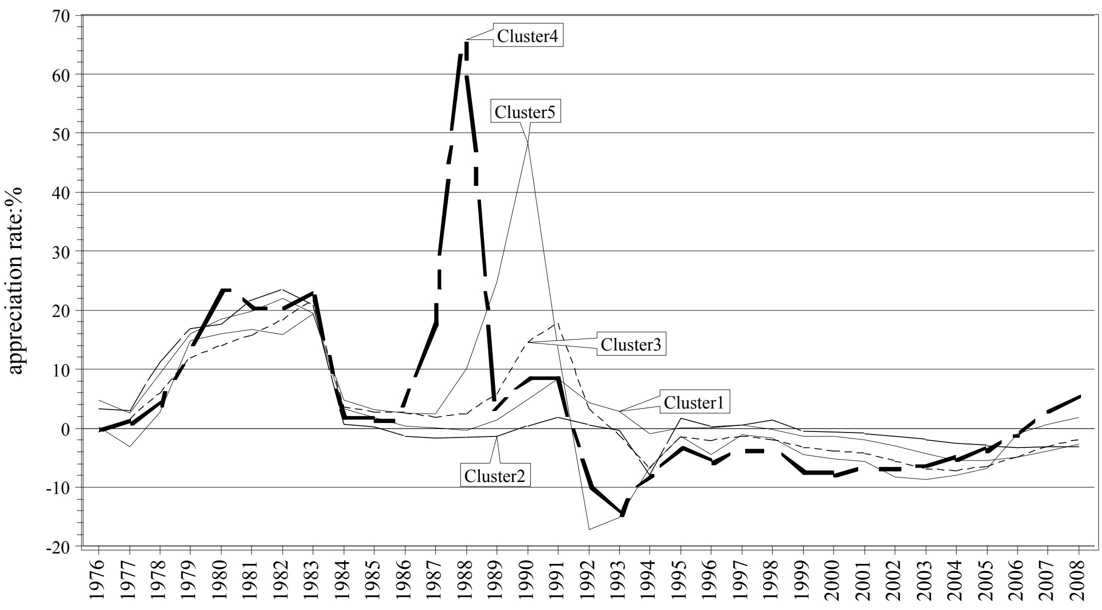
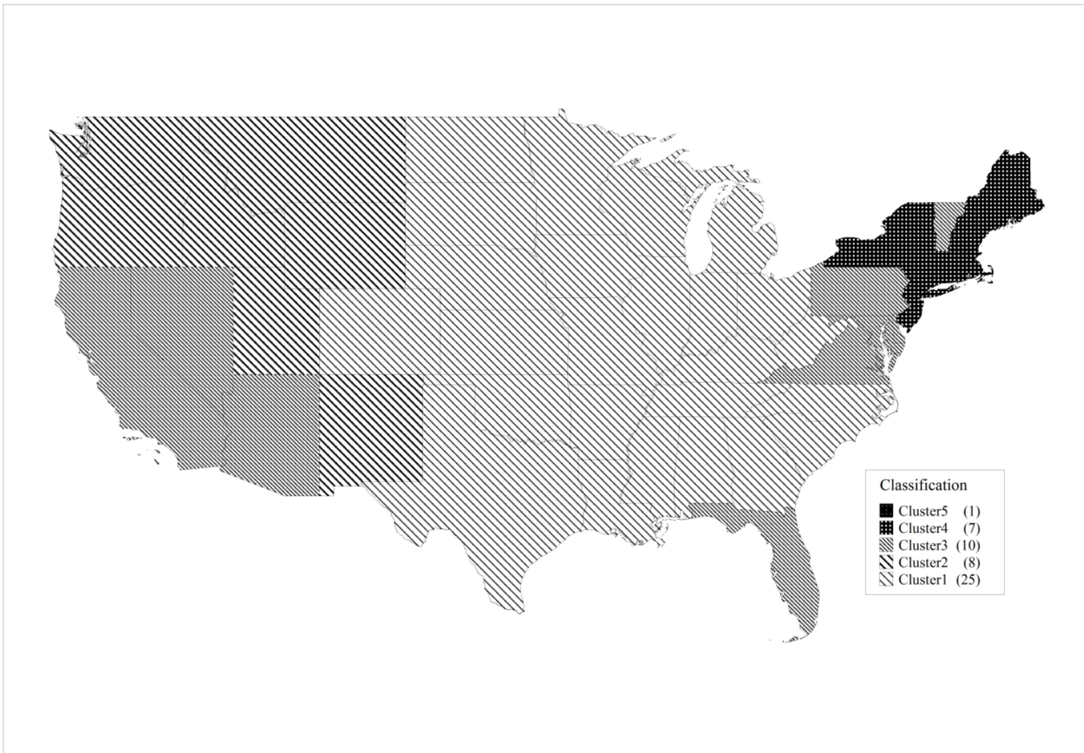
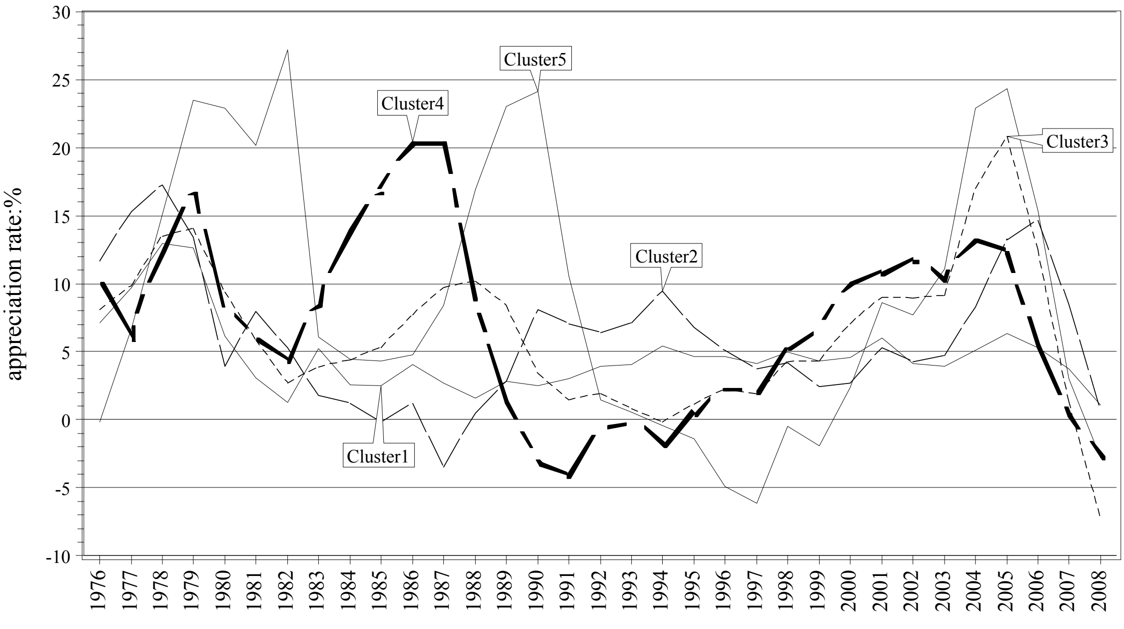


Figure 8 Changes in Cluster-by-Cluster Residential Land Prices: U.S.





In a similar way, we conducted a cluster analysis of U.S. states. Cluster 5 covers only Hawaii that has the special distance from the U.S. mainland and has indicated residential land price fluctuations independent from other states (Figure 8). Cluster 3 logged the fastest residential price hike in recent years, covering California and other western states, Florida and eastern states containing metropolises. Cluster-by-cluster price fluctuations in the United States are not so different from that in Japan. Spatial links exist in both countries. These findings indicate that housing price fluctuations have spatial links in a country of any structure.

III. Factors behind Housing Price Fluctuations

III-1. Market efficiency and housing supply

When observing housing price fluctuations in major countries, we confirmed that fluctuations in Japan were totally different from those in the United States, Britain and Australia. However, it may be natural to suspect that even though housing price fluctuations are different, some common structural factors may exist behind such fluctuations. This means that as housing market supply/demand structures differ from country to country or region to region, national or regional markets must be analyzed according to such different conditions.

Past housing market studies are classified into three groups – a) studies aimed at verifying housing market efficiency to check the presence or absence of bubbles, b) studies focusing on housing supply elasticity, and c) studies paying attention to housing demand changes.

If a housing market is efficient, all market information will be reflected in prices. Therefore, the expected rate of return may have no serial correlation. We can confirm such characteristics by allowing the expected rate of return to regress to the past rate and by checking whether all relevant regression coefficients are 0[13)]. Case and Shiller (1989) and Abraham and Hendershott (1992) cited the representative past studies that have verified the efficiency of the U.S. housing market. Case and Shiller (1989) empirically demonstrated that housing price indexes have serial correlations with rates of return. Abraham and Hendershott (1992) demonstrated that rates of return would not continue rising forever but follow a mean reversion in which they regress to fundamentals over time.

In Japan, Inoue, Ide and Nakagami (2002), and Inoue, Shimizu and Nakagami (2009) tested the market efficiency statistically. Inoue, Shimizu and Nakagami (2009) used the Meese and Wallace (1994) approach to test the efficiency of municipal condominium markets in the Tokyo metropolitan region. As a result, they demonstrated that the housing market is foreseeable over a short term in the metropolitan region where serial correlations cannot be denied in 70% of

[13)] An analysis using past data of the explained variables is called the weak efficiency test. An analysis explaining variables including past data of explained variables and other data made available to market participants is called the semi-strong efficiency test. For details, see Inoue, Shimizu and Nakagami (2009).

municipalities and that the housing market is efficient with no serial correlations existing with rates of return in regions far away from central Tokyo. In addition, their long-term efficiency tests indicated that the long-term present value relation has been established. These findings are consistent with Meese and Wallace (1994) that analyzed 16 cities in the suburbs of San Francisco.

Based on these findings of past studies, this study pays attention only to demand structures of the market in the analysis.

Home ownership patterns in Japan and the United States reportedly indicate that people in the United States generally purchase houses for their occupation at lower ages than in Japan. This is because the U.S. rental houses market has been developed for low-income people under social policy and the houses have been built mostly in locations where security and other living conditions are worse. Therefore, we can conclude that the U.S. society features potentially strong demand for owner-occupied houses. In Japan, demands for owner-occupied houses is large as the quality of rental houses is bad.

The U.S. housing price spike from 2000 reportedly originated from the great housing demand that emerged on an increase in Hispanic and other immigrants in such regions as California. Generally, immigrants including many less creditworthy people with lower income cannot borrow conventional mortgage loans when purchasing houses. In a bid to prevent a recession in the wake of the 11September, 001 terrorist attacks on the United States, the U.S. Federal Reserve eased monetary policy, making it easier for people to purchase houses. In addition, mortgage-backed financial products (CDO, MBS or CMBS) with high ratings were developed in the mortgage market and demand was rising for such products. Then, incentives emerged for mortgage loan borrowers and lenders to develop subprime and other mortgage loans for low-income people. Under such situations, highly rated financial products backed by subprime mortgages were provided massively in the investment market. As a result, investment money from throughout the world flew into the U.S. housing market, accelerating housing bubbles (Kobayashi and Yasuda (2008)).

In Japan in the 1980s, massive investment money flew into the real estate market as the interest rates remained low for a long time amid the yen’s fast appreciation after the 1985 Group of Seven Plaza agreement to drive down the dollar against other major currencies. The investment money flow has been cited as a factor behind real estate bubbles (Inamoto, Hasegawa, Sudo and Shimizu (1995)).

Even if housing demand expands for any reason, however, elastic housing supplies may prevent any housing price spike. Over a mid to long term, a demand increase may be adjusted by supplies with housing prices being stabilized. In this respect, Kearl (1979), Poterba (1984), DiPasquale and Wheaton (1994) are cited as explicit studies on the housing supply mechanism, proposing flow and stock-flow models. The stock-flow model was proposed to simultaneously analyze asset and service portions of the housing market. The model focuses on how elastically supply is adjusted upon the market's deviation from equilibrium. Particularly, the model explicitly takes into account the characteristics of housing stock that cannot be adjusted quickly. This is because housing market adjustments take much time as there are transactions costs as well as time lags between housing starts and its supply. The stock-flow model proposed by DiPasquale and Wheaton (1994) treats housing investment as the function of housing prices and indicates that supply is adjusted by prices determined in the asset market.

In Japan, Inoue, Shimizu and Nakagami (2009) estimated impacts of housing supply constraints in housing bubbles in the 1980s. The study empirically demonstrated that housing supply's elasticity to prices was extremely limited when bubbles emerged and that the asset taxation system and land utilization regulations were responsible for the limited elasticity.

In addition, there are many studies that analyzed the effects of the taxation system on housing supply (Izu and Shimizu (1983)).

For example, Yamazaki (1992) and Kanemoto (1994) paid attention to the effects of a freeze on the land capital gains tax. Tanaka and Shimizu (1992) points out that Japan's taxation system is based on the precondition of rising land prices and can distort the distribution of resources amid land price declines. Yamazaki (1999) pays attention to the fact that real estate assets are more advantageous than financial assets due to the non-neutral taxation system and points out that the fact brings about a distortion of land utilization between generations.

Some analyses explicitly took into account the housing supply mechanism's relationship with the used home market when looking into the mechanism at micro levels. For example, Wheaton and Lee (2009) indicated that the ratio of sales to inventories has close relations with housing price fluctuations.

III-2. Housing demand and prices

Mankiw and Weil (1989) is a representative study paying attention to housing demand changes. In order to analyze the effects of baby booms and bursts on the future U.S. housing demand, the study estimated age-by-age housing demand with individual data, paid attention to age-by-age population changes and predicted the future housing prices. As a result, the study indicated that housing prices would decline 47% from 1987 to 2007 in real terms. Social interests grew in the study because it predicted the sharp price decline. In 1991, the Regional Science and Urban Economics published reports criticizing Mankiw and Weil (1989). Apart from the estimation problem, these critical reports pointed out: a) that housing demand changes affect the rental house market rather than housing prices, b) that housing demand changes are adjusted by housing supply and have no effect on prices as housing supply is elastic over a long term, and c) that housing demand in a year alone does not affect housing prices as housing prices change upon forecasts of housing demand changes[14].

Based on these criticisms, Ootake and Shintani (1994) and Ootake and Shintani (1996) in Japan computed and forecast housing demand using an indicator similar to the one proposed by Mankiw and Weil (1989). They indicated that demographic factors exert influences on housing stock, but not on housing (residential land) prices.

These studies paid attention to changes in baby-boomers. This means that a country's population emerges only domestically unless immigrants come from abroad. Since baby births are easily expected to lead to future housing demand, these studies attempted to use population trends for predicting the housing market over a long term.

When the Ministry of Land, Infrastructure, Transport and Tourism developed a five-year housing development program and when think tanks made future predictions, they paid attention to people aged between 30 or 35, and 44 as the first house-purchasing group (Ono and Shimizu (1996)). This means they tacitly presume that the first house-purchasing group can invigorate the housing market. Those in their 50's are known as the second house-purchasing group over recent years[15].

Given that many analyses are provided on house-purchasing age groups, it may be appropriate to suppose that housing demand affect housing prices. Long-term predictions are more accurate for population than for other economic indicators. If population-based housing demand is found to have a significant relation with housing prices, it may be significant that long-term predictions can be made. Then, we would like to build (?) on Mankiw and Weil (1989) to compare relations between population-based demand changes and price fluctuations in Japan and the United States. When prices' relationships with demand factors are analyzed, regional characteristics must be added to spatial units for the analysis. Mankiw and Weil (1989) attracted attention due to not only the large predicted price decline but also the fact that the Texas housing market was overheated with housing prices declining in New England just before the study's publication. Japan's housing bubbles originated in the Tokyo metropolitan region and spilled over to the Osaka metropolitan region and major rural cities, as indicated by the analysis in Section 2.

This means that if there are differences between regions, a region-by-region analysis will be necessary, while Mankiw and Weil (1989) and Ootake and Shintani (2004) have analyzed macro housing price fluctuations in the United States or Japan.

Then, we analyzed the relationship between housing demand and prices in each prefecture in Japan and each state in the United States.

First, we paid attention to the demographic trends regarding housing demand. Mankiw and Weil (1989) focused on housing demand by age group. This means that when housing demand is defined, considerations should be given not only to simple population numbers and but also a

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14) See Hamilton (1991) and Hendershott (1991).

15) The Recruit Housing Research Institute (2006) (2007) focused on housing demand among baby-boomers and their children, indicating that these generations have the largest impact on the housing market.

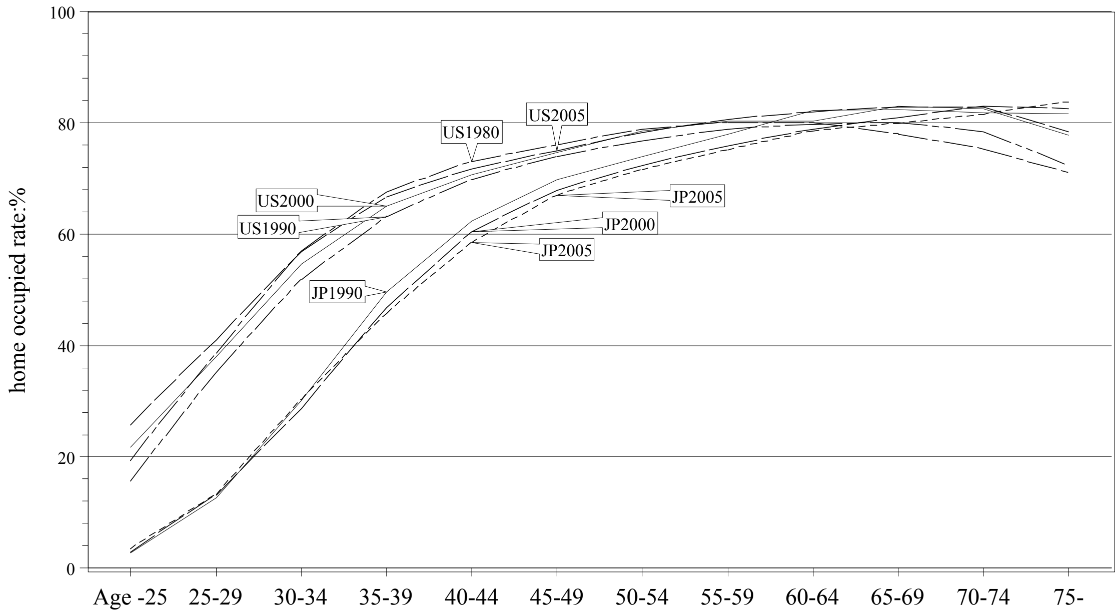
population breakdown.

Japanese and U.S. birth statistics[16)] indicate that Japan had a major baby boom just after the war and the second baby boom in the 1970s. Those who were born during the baby boom periods led to great housing demand later. In the United States, a baby burst came as the total fertility rate fell sharply[17] after the baby boom following the war. Mankiw and Weil (1989) paid attention to this point. From the second half of the 1980s to the 1990s, an echo baby boom emerged in the United States. In addition, birthrates have increased until recent years.

Mankiw and Weil (1989) forecast a 47% real decline in housing prices toward 2007, which failed to meet the results. The failure may be attributable to not only an increase in immigrants as noted by Kobayashi et al (2007) but also the birthrate increase.

Next, we paid attention to owner-occupied home rates by age group (Figure 9). In a country, births may lead to housing demand as babies grow into adults. Figure 9 indicates owner-occupied home rate changes according to ages of householders. This shows that the owner-occupied rate increases fast as householders enter the age group between 35 and 44.

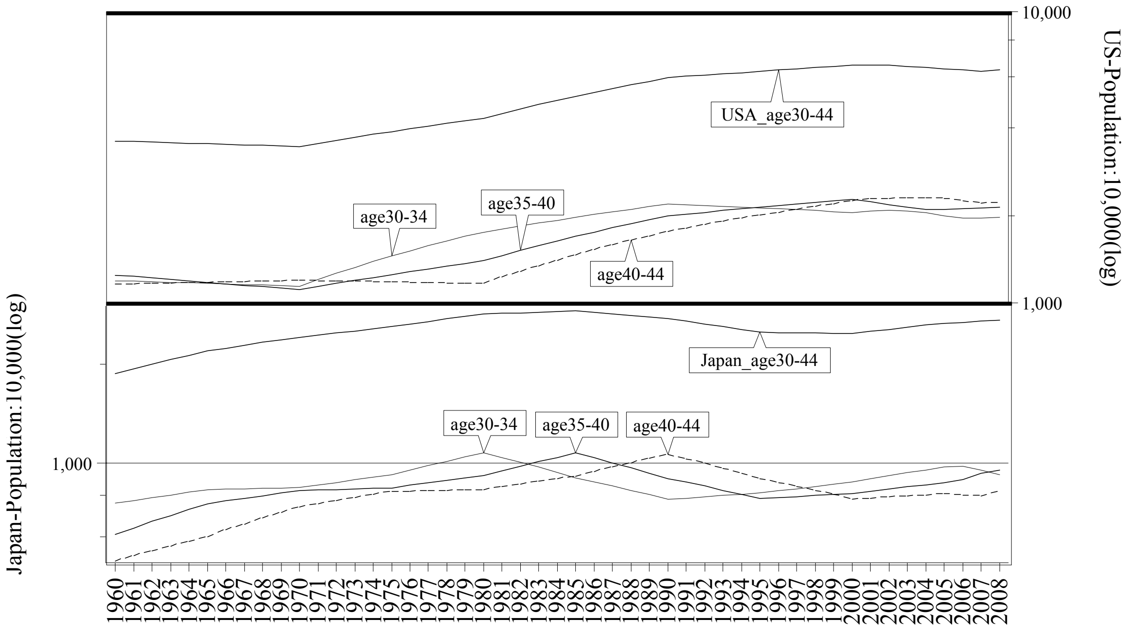
Figure 9 Changes in Japanese and U.S. Owner-Occupied Home Rates by Age Group



16) Population statistics are available in the Population Survey Report by the Ministry of Health, Labour and Welfare in Japan and in the "National Vital Statistics Reports" by the National Center for Health Statistics in the United States.

17 The total fertility rate was slipped below 2 in the United States in 1973 and in Japan in1975.

Figure 10 Changes by Age Group between 35 and 44 in Japan and U.S.



Source: Constructed from Mankiw and Weil (1989) and Ootake and Shintani (1994)

As the rental house market is underdeveloped in the United States, housing demand emerges even at the age of 25. Housing demand emerges most conspicuously for the age group between 30 and 44, somewhat younger than in Japan. These trends have remained unchanged in Japan and the United States since 1980. At ages just before 60, the Japanese and U.S. owner-occupied house rates become identical.

Next, we observed population changes for five-year age groups between 35 and 44 (Figure 10). In Japan, baby-boomers were 35 to 40 years old during the bubble period in the 1980s. Population between 35 and 44 peaked then. Particularly, the age group between 35 and 44 posted a remarkable increase. The age group declined as bubbles burst. Over recent years, however, first baby-boomers' children entered the age group between 30 and 34 and participated in the housing market. In the absence of any population inflow including immigration in Japan, the peak of baby-boomers changes over time.

In the United States, the age group between 30 and 44 increased sharply toward 2001. But all three age groups – between 30 and 34, between 35 and 40, and between 40 and 44 – increased, while a single specific age group increased in Japan. This means that immigrations' effects were great in the United States in contrast with Japan where domestic births themselves are reflected in population changes in any age group.

As shown above, the age group between 35 and 44 peaked in 1985 toward the bubble period, exerting a great demand shock on the housing market. The recent housing price hike came as second baby-boomers' housing demand emerged. In the United States, the age group between 30 and 44 increased sharply toward the peak in 2000 due to growing immigrants as well as baby-boomers.

Here, we would like to consider housing demand in detail again.

Mankiw and Weil (1989) computed housing demand for each age more strictly based on individual data, as follows:

In the first phase, housing demand (*Hj*) per family is assumed to approximate a total of family members' age-based hosing demand and defined as follows:

$$H_j = \sum_{j=1}^{N} D_j \qquad (7)$$

Hj is housing demand of the *j*th family member and *N* is the number of family members. Each individual's housing demand is assumed as an age function so that equation (8) is set as follows:

$$H_j = \alpha_0 Dummy0 + \alpha_1 Dummy1 + \cdots + \alpha_i Dummy_i \qquad (8)$$

Dummy 0 is a dummy variable that stands at 1 for the age of 0.

Equations (7) and (8) are developed into the following definition:

$$H_j = \alpha_0 \sum Dummy0_j + \alpha_1 \sum Dummy1_j + \cdots + \alpha_i \sum Dummy_{ij} \qquad (9)$$

Housing demand αi, estimated in this way for each age (*i*), is multiplied by age-by-age population in year *t* to estimate macro housing demand in year *t* (10).

$$D_t = \sum_i \alpha_i N(i,t) \qquad (10)$$

The α_i estimate is available in Mankiw and Weil (1989). In a similar way, housing demand in Japan has been computed and published by Ootake and Shintani (2004).

Our study introduces another simple housing demand indicator. Mankiw and Weil (1989) reported that final housing price projection model estimation results using a housing demand indicator estimated with individual data were not different from those using adult population data. But adult population covers a wide range from young people in their 20's to elderly people after retirement. If an age-by-age breakdown of population remains unchanged, no major errors may emerge. In Japan where population ages fast, however, some problems may arise with the analysis of the relationship between the housing market and population.

We then paid attention to owner-occupied house rates for five-year age groups as discussed earlier. Demand of cohort *j* for owner-occupied houses in period *t* in each five-year age group is assumed to emerge according to an increase in the owner-occupied house rate that comes on a five-year age rise, as indicated by the equation (11). This means the rate increase is assumed to represent demand for owner-occupied houses emerging in the relevant age group.

$$D_{j,i,t} = \sum_{j=1}^{p} O_{i,j,t} \quad P_{i,j,t} \qquad (11)$$

Di,j,t : Owner-occupied house demand of cohort *j* in region *i* in period *t*

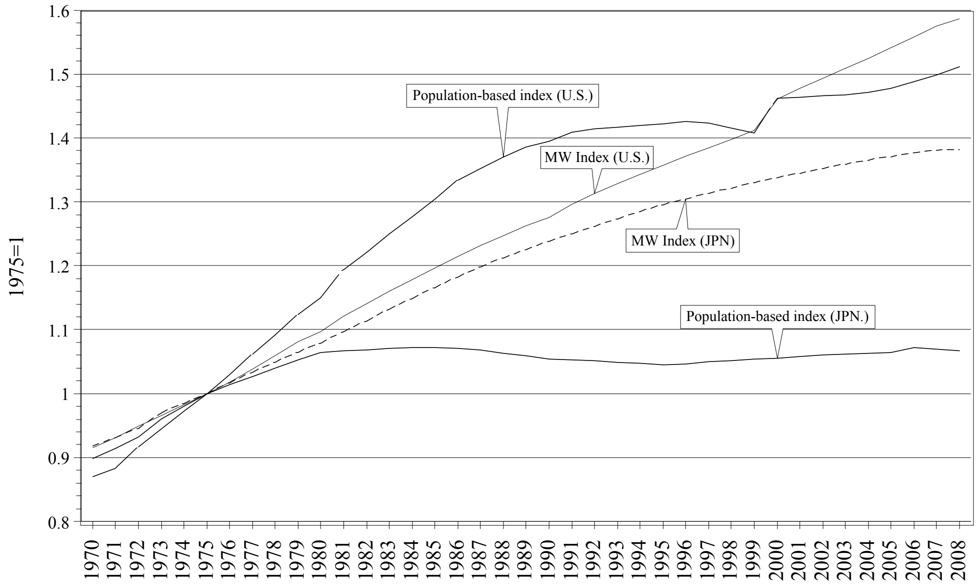
Oi,j,t : Owner-occupied house rate for cohort *j* in region *i* in period *t*

Pi,j,t : Population of cohort *j* in region *i* in period *t*

This indicator (hereinafter, called the owner-occupied house rate) is limited to the owner-occupied house market, representing a strong assumption. Since the owner-occupied house rate increases on inheritance as well, an increase in the rate is difficult to be simply attributed to new demand for owner-occupied houses. But this indicator can give considerations to structural changes over time and is more advantageous than the Mankiw indicator that measures demand only at the time when individual data are available. In this sense, it is significant to consider changes in multiple demand indicators.

Here, housing demand that has been computed by using housing demand parameter αi estimated in Mankiw and Weil (1989) or Ootake and Shintani (2004) and present population data is compared with demand estimated according to the cohort-by-cohort owner-occupied house rate (Figure 11).

Figure 11 Changes in Japanese and U.S. Housing Demand Indicators



While the Mankiw indicator for Japan rose simply over time, the owner-occupied house demand indicator rose sharply toward 1980, peaked out in 1985, declined later and soared again on the influence of baby-boomers' children in and after 2000.

While the Mankiw indicator for the United States soared simply over time, the owner-occupied house demand indicator rose sharply toward 1990 and has still kept an upward trend over the past years.

The comparison indicates that the Mankiw indicator serves as a proxy variable representing a simple trend. One apparent reason for this indication is that the Mankiw indicator is estimated according to the age and age-by-age population and simply rises in line with the entire society's aging both in Japan and the United States.

Finally, we pay attention to the financial markets. Housing prices are easily assumed to have close relations with household income levels (Gallin (2006)). Since house purchases are mostly financed by mortgage loans, house-purchasing capacity as macro housing demand is influenced by interest rates on mortgage loans as well as household income levels. Looking at major Japanese and U.S. interest rates, we find that the average ratio of lending of Japanese banks declined from more than 8% in 1980 to less than 4% during the bubble period and soared in the 1990s. The rate fell fast after the bubbles' burst and stood at levels below 3% in 2006. A similar trend was seen in the United States. Looking at the trend in and after 2000, we find that interest rates on short-term financial products carrying floating rates were below 3% after global terrorist attacks in 2002. We should take note of the fact that such financial market changes allowed housing demand to increase by cutting the burden of interest rate payments on house purchasers.

III-3. Region-by-region housing demand and prices

Cross-section analysis

We used region-by-region cross-section data to confirm effects of housing demand changes on housing prices in Japan and the United States on a macro basis. Figures 12, 13 and 14 indicate the relationship between housing demand indicators – a) the age group for purchase of owner-occupied houses (the age group between 35 and 44 in Japan and between 30 and 44 in the United States), b) the Mankiw indicator, and c) five-year changes of the owner-occupied house demand indicator (a three-year change for the 2005-2008 period) – and changes in housing price indexes (the FHFA home price index for the United States and the hedonic index using public land price data for Japan). As a whole, the Mankiw indicator for Japan seems to have a positive correlation with housing price changes. On a period-by-period basis, however, we see no signification correlation. This means a seeming correlation.

Such simple analysis indicates that housing demand and prices have no specific relations at any time in Japan or the United States. Then, we paid attention to the Japanese and U.S. bubble periods – from 1985 to 1990 in Japan and from 2000 to 2005 in the Unites States. In the earlier analysis, the relationship between housing demand and prices indicated that none can deny the existence of an identity bias. This means a regional housing price hike can dampen regional housing demand. When housing prices rise in Tokyo, those who have housing demand while failing to buy houses at prices in Tokyo may purchase houses in Kanagawa, Saitama and Chiba Prefectures surrounding Tokyo. This assumption is based on the fact that the increase in the owner-occupied house rate for age groups was stable over time in Japan and the United States (Figure 9) (even amid housing price spikes, the owner-occupied house rate for each age group did not decline).

Figure 12 Relationship between Housing Demand and Prices: Population by Age Group

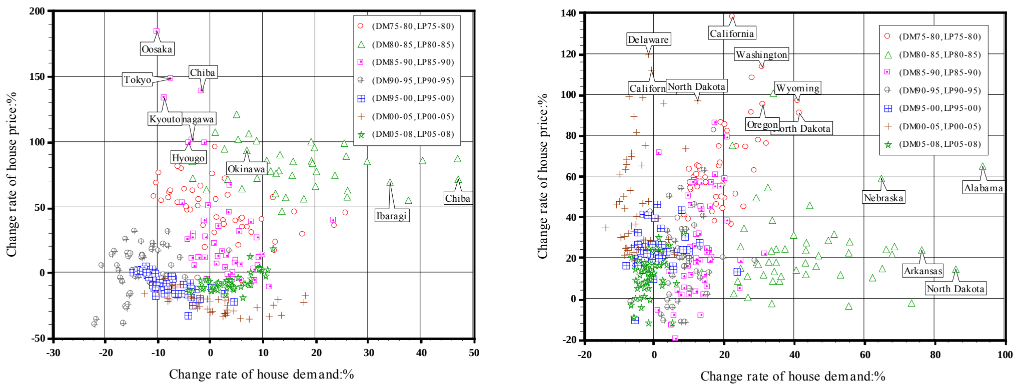


Figure 13 Relationship between Housing Demand and Prices: Mankiw Indicator

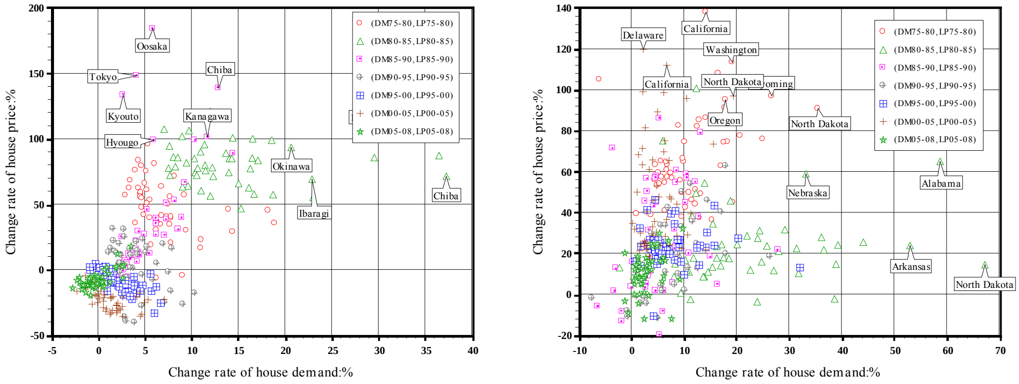
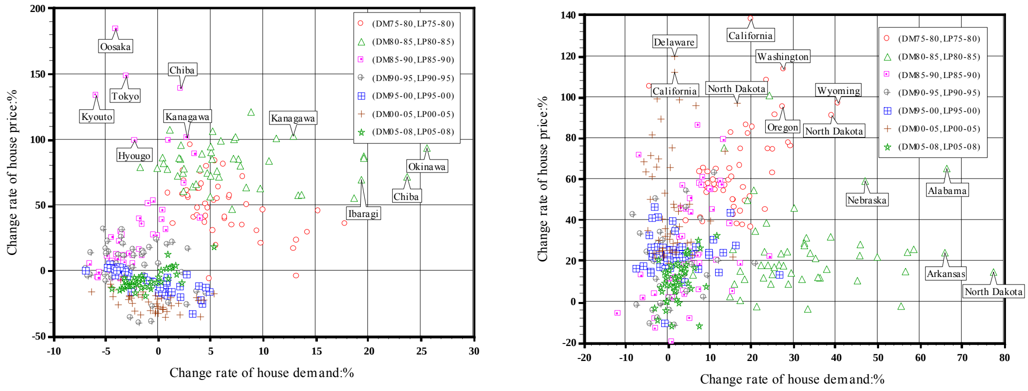


Figure 14 Relationship between Housing Demand and Prices: Owner-occupied House Demand Indicator



As indicated by the equation (12), a population mix in region i in Japan in 1985 is supposed to have determined housing demand in 1990. With an assumption that no population inflow into the region was seen, it was confirmed whether a demand change affected housing prices. In this way, effects of housing demand on housing prices can be confirmed. In the United States, similarly, a population mix in region i in 2000 is assumed to determine housing demand in 2005, as indicated by the equation (13).

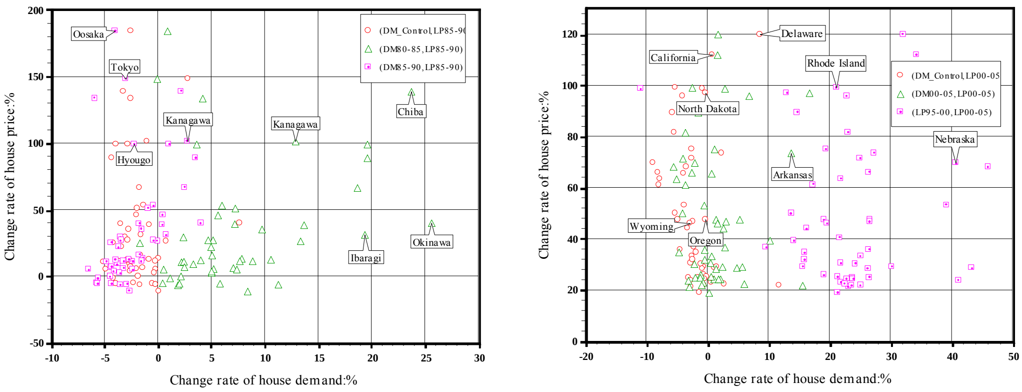
$$D_{j,i,1990} = \sum_{j=1}^{p} O_{i,j,1990} \quad P_{i,j,1985} \qquad (12)$$

$$D_{j,i,2000} = \sum_{j=1}^{p} O_{i,j,2000} \quad P_{i,j,1995} \qquad (13)$$

Figure 15 indicates the relationship among a) a housing demand change for a case where housing price hikes' effects to push down local housing demand are controlled, b) a change in the owner-occupied house rate during the same period as observed earlier, and c) housing demand and price changes one period (five years) ago.

Even in the case where the identity bias was taken into account, we found no significant relationship between housing demand and a housing price hike. In Japan as a whole, demands for owner-occupied houses posted the growth highest ever until 1985, when bubbles emerged. In the United States, such demand also scored the highest ever growth toward 2000 when bubbles emerged. We also looked at housing demand indicators with lags taken into account. Nevertheless, we found no specific relationship between housing demand and price changes.

Figure 15 Relationship between Housing Demand and Prices: Bubble Period



Dynamic panel analysis

The cross-section analysis of five-year periods including bubble periods in Japan and the United States found no statistically significant relationship between housing demand based on population indicators and housing prices. Then, we used panel data for all periods in each region for an analysis.

Here, we estimated the vector autoregressive model as the most primitive estimation model for the dynamic panel analysis. The estimation model is as follows:

$$P_{i,t} = \alpha_0 + \sum_k \alpha_k P_{i,t-k} + \sum_k \beta_k D_{i,t-k} + \phi_1 X_{i,t} + e_{1i,t}$$

$$D_{i,t} = \gamma_0 + \sum_k \gamma_k P_{i,t-k} + \sum_k \lambda_k D_{i,t-k} + \phi_2 X_{i,t} + e_{2i,t} \qquad (14)$$

$P_{i,t}$: Housing price in region i at time t

$D_{i,t}$: Housing demand in region i at time t

$X_{i,t}$: Fundamentals

In this section, we used the earlier estimated owner-occupied house demand indicator as a housing demand variable. With the fundamentals as conditioning variables, we used real GDP in

Japan and the United States, an average lending rate in Japan and a mortgage rate in the United States. Changes from the previous year (gr*) were estimated for housing prices, housing demand indicators and real GDP. Differences (dRate) were estimated for interest rates.

As the presence of unit roots for housing demand variables, housing prices and GDP has been confirmed through a unit root test[18], we adopted first-order differences of year-to-year changes. As a result, we could convert all indicators into stationary time series data. Estimation results are shown in Table 3.

For both Japan and the United States, a model for the second period's lag order was estimated as the most optimum model in the model selection based on the Akaike information criterion. For each model, a null hypothesis putting an estimate at 0 was subjected to the F-test. As a result, a null hypothesis was rejected at the significance level of 1%.

We then estimated impulse response functions in a bid to look into the effects of housing demand on housing prices. The impulse response functions were estimated along with each period's flow (Figures 16 and 17) and accumulated response functions (Figures 18 and 19). As indicated by these figures, housing demand's effects on housing prices are extremely small or null.

In addition, the variance decomposition of prediction errors indicated that 94% of housing prices in Japan and 98% in the United States fluctuated independently.

Given the above analyses, housing demand growth has exerted little effect on housing prices on a regional basis in Japan and the United States. This finding is consistent with the results of the Ootake and Shintani (2004) analysis using the Mankiw indicator for Japan as well as the Engelhardt and James (2001) analysis for the Canadian case. Indications are that as any housing market has regional characteristics, it is important to conduct any analysis prudently even if any significant relationship between housing demand and prices is found for a country on a macro basis. This apparently means that the hypothesis that demographic movements exert influences on housing demand to boost housing prices has turned out to not be necessarily effective as a result of the analyses of regional changes in Japan and the United States.

[18] The Levin-Lin test was adopted for the panel unit root test.

Table 3 VAR Model Estimation Results

	VAR Estimate : Japan		VAR Estimate : USA	
	grHousePriceIndex	grHouseDemand	grHousePriceIndex	grHouseDemand
Constant	0.000	0.000	-0.001652	0.001226
	(0.0020)	(0.0001)	(0.0013)	(0.0004)
grHPI(Lag1)	0.611	0.000	0.03407	-0.009078
	(0.0259)	(0.0012)	(0.0237)	(0.0085)
grHPI(Lag2)	-0.130	-0.005	0.066647	0.391596
	(0.0247)	(0.0012)	(0.0631)	(0.0228)
grHD(Lag1)	-2.994	0.850	0.066647	0.391596
	(0.6973)	(0.0344)	(0.0631)	(0.0228)
grHD(Lag2)	4.274	0.048	-0.237661	0.269695
	(0.6712)	(0.0331)	(0.0620)	(0.0224)
dRate	0.014	0.000	-0.011743	0.004687
	(0.0022)	(0.0001)	(0.0010)	(0.0003)
grGDP	0.418	-0.001	0.353377	0.092434
	(0.0615)	(0.0030)	(0.0277)	(0.0100)
F-statistic	196.877	1240.132	240.292	241.092
Log likelihood	1882.096	5983.415	2822.327	4375.800
Akaike AIC	-2.751	-8.770	-3.680	-5.711

Figure 16 Relationships between Housing Prices and Demand 1: Japan

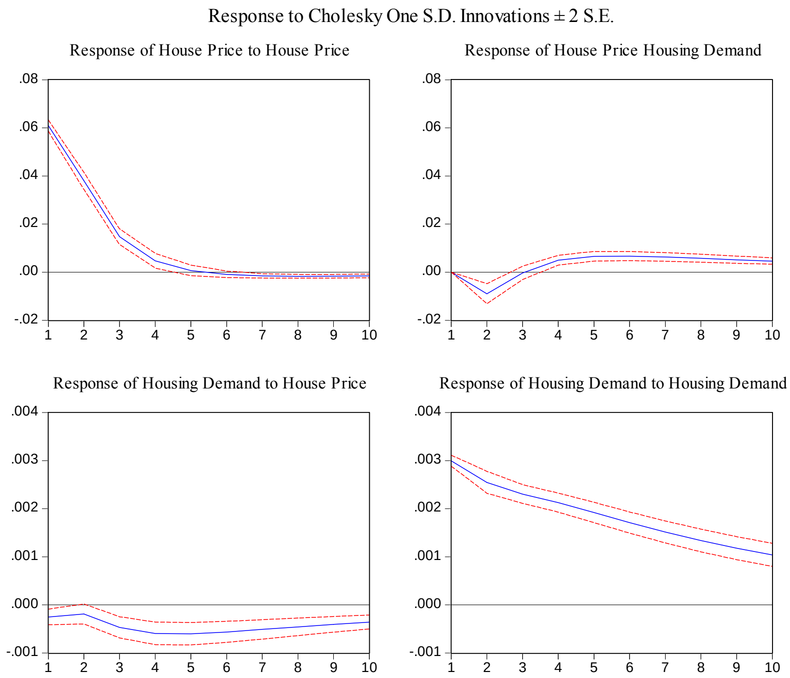


Figure 17 Relationships between Housing Prices and Demand 2: U.S.

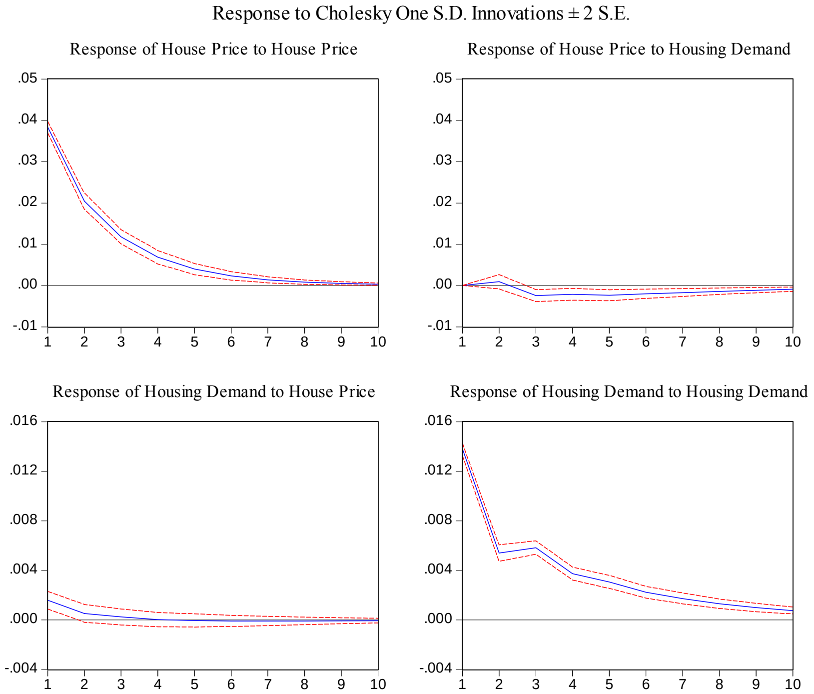


Figure 18 Relationships between Housing Prices and Demand 3: Japan

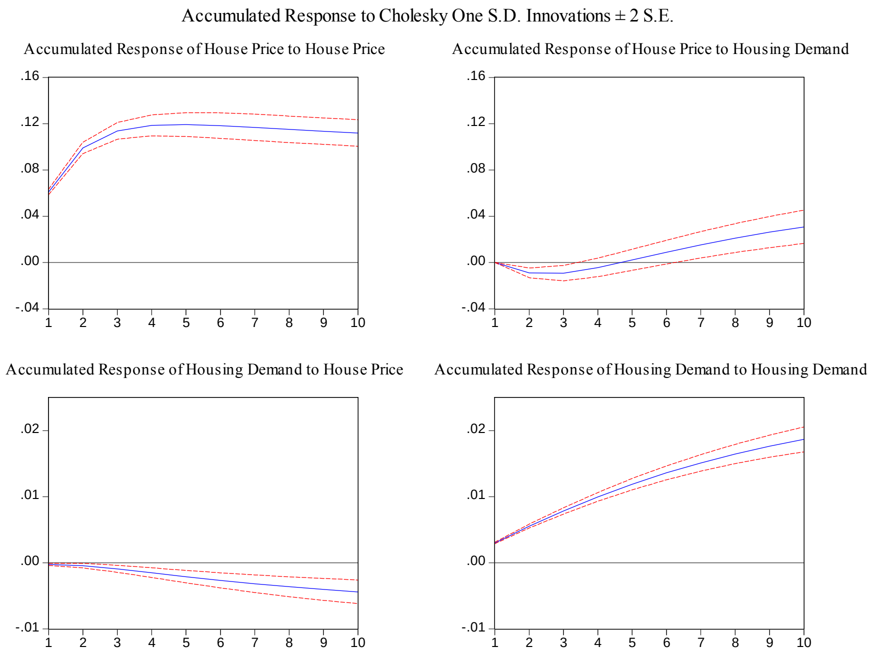
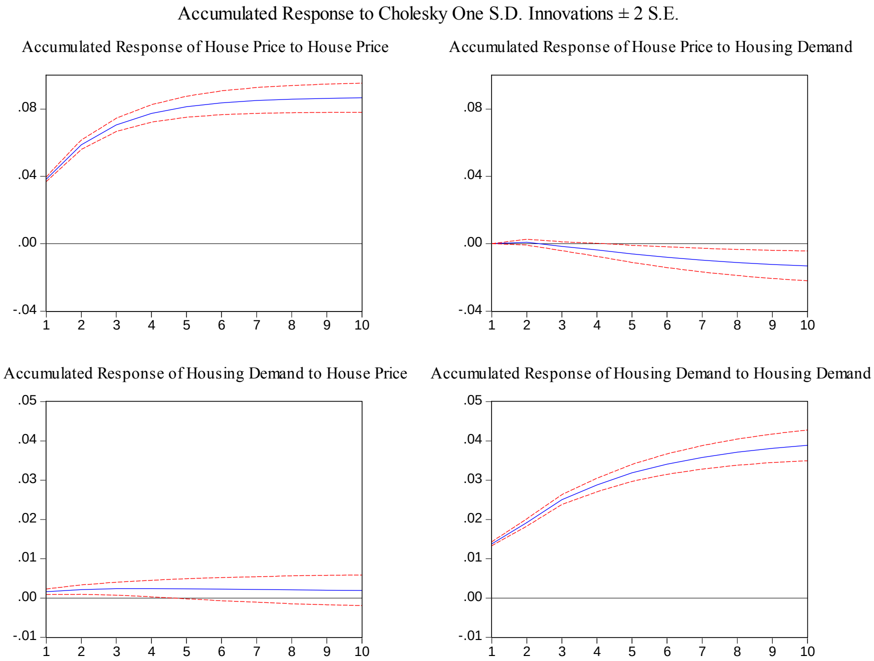


Figure 19 Relationships between Housing Prices and Demand 4: U.S.



IV. Housing prices and rents

Our analysis has so far focused on housing price fluctuations. In fact, housing price fluctuations exert effects on the economy through various channels. More precisely, however, relative prices between housing and other assets prices and goods/services prices are the variables that should be observed. Even if both assets and goods/services prices (and wages) double, the assets price hike alone may have little impact on the economy. In reality, however, housing prices posted substantial hikes and declines both in Japan and the United States while goods/services prices represented by consumer price indexes moved little. Why? Given the substantial hikes and declines in housing prices, this section looks into why the substantial housing price fluctuations did not spill over to goods/services prices.

Housing rents are the most important variable for an analysis of the spillover effects on goods/services prices attributed to housing price fluctuations. Housing services account for more than a quarter of consumers' typical consumption in Japan and the United States. Therefore, if housing price hikes spill over to housing rents, consumer prices may soar. Goodhart (2001) said housing rents are a joint between assets and goods/services prices.

In order to understand why housing price fluctuations fail to spill over to consumer prices, we may have to check how housing price fluctuations spill over to housing rents. Figure 20 shows how housing rents as a component of the consumer price index (CPI rent) in Japan changed when bubbles emerged and burst. As indicated by the figure, the CPI rent has had little link to housing prices. A housing rent index ("new rent" in Figure 20), as estimated with the hedonic method, indicates a weak link to housing prices. The housing rent index is measured from the properties listed on Recruit Co.'s housing information magazines, representing new rents applied to new lease agreements concluded upon tenant replacements. In contrast, the CPI rent covers the rents for renewal of agreements involving no tenant replacement. The CPI rent covers both new and renewal rents. Figure 20 indicates that new rents have some link to housing prices while renewal rents have no link to housing prices. Figure 21 shows changes in the U.S. CPI rent, indicating a trend similar to the one observed in Japan.

Figure 20 Comparison of Housing Prices and Rents: Tokyo

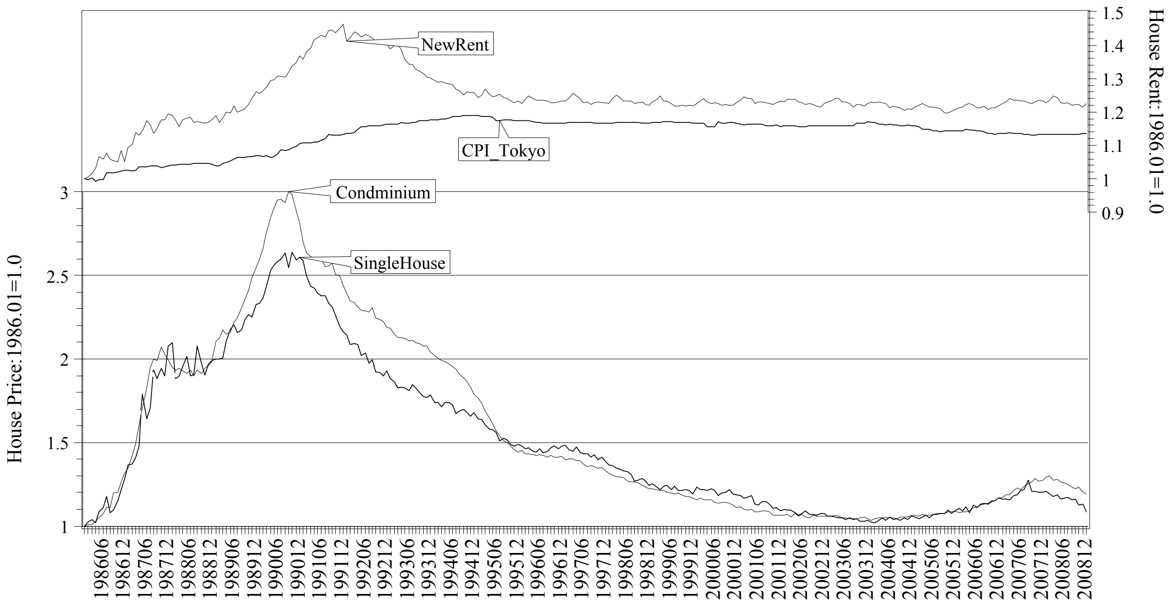
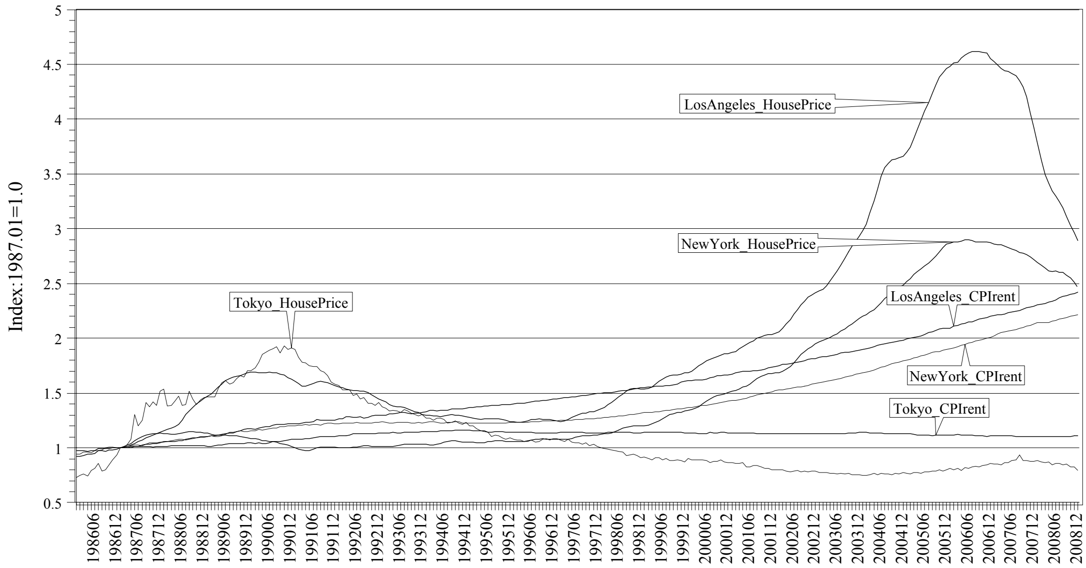


Figure 21 Comparison of Housing Prices and Rents in Major Japanese and U.S. Cities



Let us look into characteristic differences between new and renewal rents in line with Shimizu et al (2008). Figure 22 indicates whether rents for new tenants are the same as for outgoing tenants at some rental houses with rents deviating from market prices. The horizontal axis of the figure indicates how much rents deviated from market prices just before tenant replacements. The vertical axis indicates the probability of new rents differing from those for outgoing tenants. The horizontal axis's 0 matches the level just below 0.7 on the vertical axis, meaning that about 70% of new rents differ from old ones with the remaining 30% left unchanged when old rents have no deviation from market prices. If old rents have greater positive deviations from the market prices, the probability of rents being revised may be higher. The greater the old rents' excess over market prices is, the higher the probability of rents being revised. The tendency is even more conspicuous for a case where rents are lower than market prices. The horizontal value of -40% (rents are 40% less than market prices) matches 0.9 on the vertical axis, meaning that rents for houses meeting the condition (lower rents than indicated market prices) are mostly revised.

Figure 22 New Rent Revision Probability

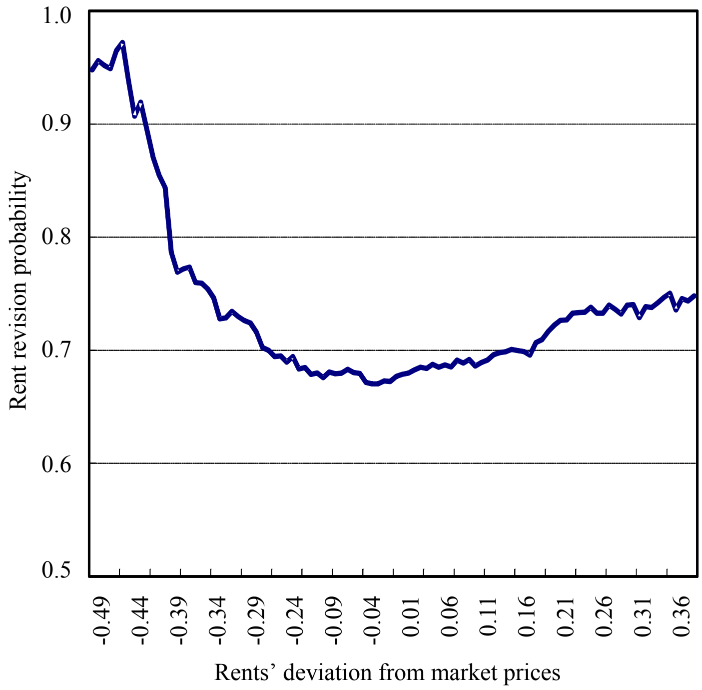
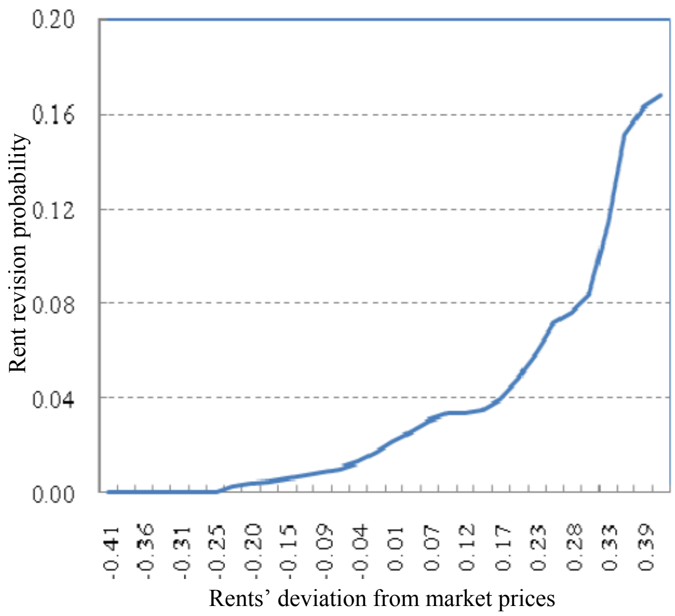


Figure 23 Probability of Revision of Rents for Continued Contracts



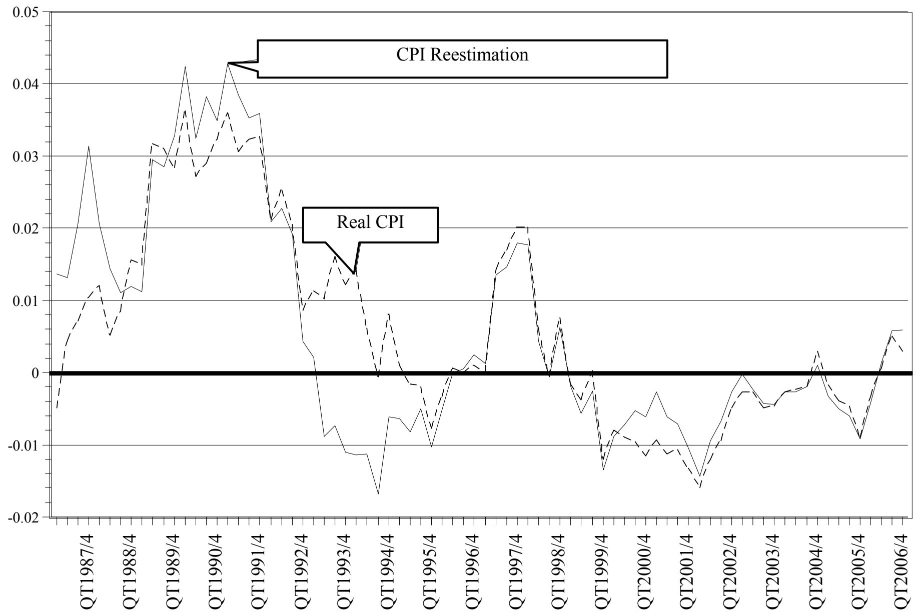
In this way, new rents tend to come closer to the market prices, although this is not the case necessarily for renewal rents. Figure 23 indicates the probability of renewal rents, instead of new rents in Figure 22, being revised. The two figures show that renewal rents have less revision probability than new rents. This means that when tenants renew lease agreements with house owners, rents tend to be left unchanged. Figure 23 shows that the rent revision probability's peak fell short of reaching 20%. This means that rents remained unchanged at more than 80% of houses subjected to the renewal of lease agreements. House owners and tenants can save costs for searching new lease agreement partners by renewing their agreements. Such incentives are interpreted as contributing to the long-term relationships between house owners and tenants. Scrutinizing Figure 23, we can find that the rent revision probability, though remaining in a low range, tends to rise when rents have a positive deviation from (or exceed) the market prices. When rents have a negative deviation from (or slip below) market prices, such tendency is not seen. This apparently indicates that the legal system including the Land and House Lease Law protects tenants and makes it difficult for house owners to propose rent hikes even if rents slip below market prices.

Summarizing the above findings, we can conclude that long-term relationships between house owners and tenants, as well as legal regulations, have made it difficult for renewal rents to come closer to market levels while there is some mechanism for new rents to come closer to market prices. This is one of the reasons for the absence of any close link between the CPI rent and housing prices. As noted by Shimizu et al (2008), the absence is also attributable to a method for measuring the CPI rent. The CPI rent includes a conventional rent and an imputed rent representing the price of housing services that a house owner receives. In Tokyo, for example, the conventional rent portion accounts for about 20% of the total rent and the imputed rent for about 80%. The imputed rent thus captures the greater part of the total rent. Conceptually, the imputed rent is a rent level that a house owner can receive when leasing the house in the rental house market today. Therefore, the imputed rent always matches the market price. For example, Diewert and Nakamura (2008) defined the imputed rent as "the services yielded by the use of a dwelling by the corresponding market value for the same sort of dwelling for the same period of time." When measuring the CPI rent, however, the Ministry of Internal Affairs and Communications collects data of real rents applied to apartment and other houses since market prices are practically difficult to survey. As noted above, such rent data include renewal rents that deviate from market prices and have little link to housing prices. Therefore, the CPI rent that substitutes renewal rents for the imputed rent has little links to housing prices.

How serious is the problem in practice? Shimizu et al (2008) estimated the imputed rent using market prices measured through Recruit data. Specifically, the study replaced the imputed rent out of all CPI components with the new imputed rent index, left the other CPI components untouched and computed a New CPI. Estimation results shown in Figure 24 indicate that the New CPI inflation rate exceeded the Real CPI inflation by more than 1 % during the bubble period in the second half of the 1980s. When the bubbles burst in the first half of the 1990s, the New CPI inflation was some 2 % less than the Real CPI inflation. Particularly, it is interesting to see the timing for the start of deflation. The New CPI inflation became negative in early 1993, about two years before the real CPI inflation turned negative in 1995. The estimation indicates that the replacement of imputed rent data with a more desirable indicator contributes to increasing housing prices' link to the CPI.

The Bank of Japan has frequently been criticized for the delay of its monetary tightening to allow the expansion of bubble to accelerate. A delay in its monetary easing after the burst of the bubbles reportedly contributed to prolonging the later economic slump. Given these arguments, our analysis results indicate that the improvement of the rent measurement accuracy is indispensable for appropriate monetary policy management. The absence of any close link between assets and goods/services prices has made monetary policy management difficult in Japan. This is the same case as that in the United States at present. Given that the U.S. CPI rent measurement might have some problems, the U.S. government and central bank may have to pay attention to not only the CPI but also to assets prices in their policy management.

Figure 24 CPI Reestimation



V. Conclusion

Japan and the United States have experienced the housing bubbles and subsequent collapses of these bubbles in succession. In this paper, the Japanese and U.S. bubbles are compared and the following findings are obtained.

Firstly, upon applying twenty years of past data from Japan to the “repeat-sales method” and the “hedonic method”, which are representative methods for calculating house prices, it was found that the timing at which prices bottomed out after the collapses of the bubbles differed depending on the two methods. The timing for bottoming out as estimated by the repeat-sales method delayed as compared to the estimate using the hedonic method, by thirteen months for condominiums and by three months for single-family homes. This delay is caused by the depreciation of buildings not being processed appropriately by the repeat-sales method. In the United States, the S&P/Case-Shiller Home Price Indices are representative house prices indices; these indices use the repeat-sales method, and it is possible that the timing for bottoming out is estimated to be delayed. As there are increasing interests in the timing for bottoming out of the U.S. housing market, there is a risk that the existence of such a lag in cognition causes the increase of uncertainty and the delay in economic recovery.

Secondly, when looking at the relationship between house demand and house prices based on time-series data, we find there is a positive correlation between the two. However, a cross-section analysis using prefectural or state data indicated no significant relationship between house demand and house prices both in Japan and the United States. In this sense, it is not possible to explain the presence or absence of bubbles and the size of bubbles in each prefecture (state) using demand elements. This suggests that the story that demographic movements exert influences on housing demand to boost housing prices may not necessarily be effective in explaining the price hikes during the bubble period. In our dynamic panel analysis in which Japanese and U.S. VAR models were estimated for comparison with various statistical data, we confirmed little impact of housing demand on housing prices. Consequently, the cross-section analysis for the bubble period and the panel analysis of region-by-region data over more than twenty years failed to find any impact of demographic changes representing housing demand on housing prices.

Thirdly, we checked whether there was any link between housing prices and rents and confirmed a phenomenon that rents moved little despite wild fluctuations in housing prices in the process of the formation or collapse of bubbles for both Japan and the United States. Its background behind is that house owners and tenants have formed long-term contractual relationships so that both parties can save various transaction costs. In addition, the imputed rent of one’s home is not assessed with market prices in Japan. This also weakens the link. The absence of the link caused a phenomenon in Japan and the United States where consumer prices including rents as an important element did not increase since rents did not rise despite housing price hikes during a bubble period. This phenomenon resulted in the delay in a shift to tightening of credit. Since rents did not move together with housing prices even after housing prices decreased after the collapse of the bubbles, a phenomenon where consumer prices did not decrease despite housing price declines was observed. This served as a factor behind a delay in a shift to monetary relaxation. As rents are an important variable that serves as a joint between assets and goods/services prices, it is necessary to increase the accuracy with which they are measured.

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