The Formation of Residential Property Prices in Japan: A Comparison of Different Monetary Policy Regimes

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Abstract

Three residential property prices in Tokyo, Nagoya, and Osaka co-move across the long-term equilibrium in both the first and second periods under study. The first period is prior to the introduction of a strong non-traditional monetary policy. The Bank of Japan (BOJ) adopts a comprehensive easing policy during this time. The second period is after the introduction of a strong non-traditional monetary policy. There is a difference in terms of transmissions between the first and second periods. No causality is found in the first period, but causality from Tokyo to Osaka is found in the second period. The three residential property prices move together but independently in the first period. After the BOJ introduces strong non-traditional monetary policies, such as QQE and the NIRP, the three residential property prices move together through the transmission from Tokyo to Osaka in the second period. This is due to the way in which monetary policies enacted by the BOJ cause price increases for residential properties, especially in Tokyo.

Keywords: Co-movement, Monetary Policy, Residential Property Price, Transmission.

1. Introduction

The purpose of this paper is to investigate the formation of residential property prices in Japan by analyzing co-movement and transmission in three major regions: Tokyo, Nagoya, and Osaka.[1] The entire sample period is divided into two. The first period is prior to the introduction of a strong non-traditional monetary policy. The Bank of Japan (BOJ) adopts a comprehensive easing

[1] The regions of Tokyo, Nagoya, and Osaka are at the prefectural level. Nagoya is the capital city of the Aichi prefecture.

policy during this time. The second period is after the introduction of a strong non-traditional monetary policy. The BOJ introduces "quantitative and qualitative easing (QQE)" on April 4, 2013. After winning a majority in the Lower House election on December 16, 2012, Mr. Shinzo Abe was elected to a second term as the prime minister of Japan. He advocates Abenomics, a portmanteau of "Abe" and "economics", which is based upon three pillars: fiscal stimulus, aggressive monetary easing, and structural reform. QQE is introduced in accordance with Abenomics.

The BOJ introduced the "negative interest rate policy (NIRP)" on January 29, 2016, and "yield curve control (YCC)" on September 21, 2016, while maintaining the NIRP. They indicate that the "target of the 10-year Japanese Government Bond (JGB) yield is around 0%". They also strengthen the framework for continuous powerful monetary easing, while maintaining the NIRP and YCC.[2]

This paper makes four original contributions to the extant literature. First, this paper is the first to analyze the formation of residential property prices in Japan in the form of co-movement and transmission. Second, the entire sample period is divided into two. The latter half includes strong non-traditional monetary policies, such as QQE and the NIRP. Third, this paper analyzes the residential property prices in three major regions: Tokyo, Nagoya, and Osaka. Fourth, this paper is the first to use the Residential Property Price Index, compiled by the Ministry of Land, Infrastructure, Transport and Tourism, in an analysis of the formation of residential prices in Japan.

The remainder of this paper is structured as follows. Section 2 contains a literature review. Section 3 describes the data used in this study and provides summary statistics. Section 4 discusses the methodology of the study. Section 5 indicates the study's results. Section 6 presents the conclusion.

2. Literature Review

So far, related studies analyzing the co-movement and transmission of real estate focus on markets other than Japan. Kuang and Wang (2018) suggest that culture similarities affect house price co-movement via information dissemination efficiency and investment conduct consistency.

[2] For details of monetary policy, see BOJ (2010), BOJ (2013), BOJ (2016a), BOJ (2016b), and BOJ (2018).

In addition, housing supply elasticity and government participation are able to mitigate house price contagion. Liow et al. (2019) find that the examined real estate market co-movement is a multi-scale phenomenon. The co-movement within and across the three Great China markets is unstable and the pattern of the relationship is non-uniform across various time scales.

Miao et al. (2010) conclude that, in terms of volatility linkages, there is a considerable amount of transmission in the East between New York, Boston, and Washington, DC, and innovations in the housing markets of Miami, Los Angeles, and San Francisco play an influential role within their respective regions. Yunus (2019) concludes that short-term analyses suggest bi-directional causality and indicate that shocks to one real estate sector have a much more severe and persistent impact on other real estate sectors during post-crisis periods, in comparison to pre-crisis periods.

Related studies analyzing the co-movement and transmission of real estate investment trusts (REITs) focus on markets other than Japan, except for Ito (2018), who concludes that three REIT markets in different property sectors do not co-move before the introduction of aggressive monetary policies in Japan. REITs and real estate markets have been sluggish since the impact of the Lehman shock and the Great East Japan Earthquake. They move almost independently, with just a few mutual transmissions.

Chiang (2010) examines the co-movement of equity REIT prices in the US, with results that indicate that the co-movement of equity REIT prices within the same property type has strengthened during the new REIT era. The results also indicate that, all else being equal, a high level of institutional participation, a low level of insider ownership, and a high level of market capitalization are associated with a high level of within-property-type price synchronicity.

Anderson and Beracha (2011) investigate the co-movement of monthly returns in regard to the security of US REITs headquartered in the same state. Their empirical analysis suggests that security for REITs headquartered in the same state experiences co-movement among its market returns, similar to the co-movement among returns of the common stocks of firms headquartered in the same city. However, despite the return co-movement among geographically clustered REITs, locally-biased REIT portfolios do not appear to be less efficient than geographically diverse REIT portfolios.

Zhou (2012) extends the REIT literature on international market connections by introducing a time-scale dimension. Specifically, the study applies the maximum overlap discrete wavelet transformation (MODWT) to seven major global REIT markets and investigates the connections among returns and volatilities at different time scales. The findings suggest strong scale-dependency in terms of the market connections. Specifically, the connections among returns generally increase with the time scale, implying that portfolio diversification is the most efficient at short time horizons.

Akash and Sandip (2017) extend the literature on the financial performance of REITs by examining whether or not US REIT returns are impacted by global REITs and other real estate subsectors, such as the US Real Estate Index (USRE) and the US Mortgage Finance Index (USMF). They also explore the issue of volatile transmission and the asymmetric effects of volatile spillover on US REIT returns from innovation originating in other real estate subsectors and in regard to global REITs. The results suggest that US REITs are impacted by USRE and USMF returns.

3. Data

The monthly data used for the analysis are provided by Datastream. The Residential Property Price Index is used to indicate real estate prices. According to the Ministry of Land, Infrastructure, Transport and Tourism, it is an index of prices of residential properties (residential plots of land and unit ownership buildings) nationwide that is calculated based on the data accumulated through the System to Provide Real Estate Transaction Price Data (Land General Information System), operated by the MLIT, with the quality of each property adjusted using a hedonic approach. The regions chosen for the analysis of this paper are Tokyo, Nagoya, and Osaka.

The entire sample period from April 2008 to August 2019 is divided into two. The first period, Sample A, is from April 2008 to March 2014. The second period, Sample B, is from April 2014 to August 2019. The monetary policies in Samples A are weak non-traditional policies, such as comprehensive easing. The monetary policies in Sample B are QQE and the NIRP. The descriptive statistics of the data are provided in Table 1. The movements of the property prices are provided in Figure 1.

Table 1

Figure 1

4. Methodology

4.1 Unit Root Test

As empirical analyses from the mid-1980s through to the mid-1990s show that such data as interest rates, foreign exchanges, and stocks are non-stationary, it is necessary to check whether or not the data used in this paper contain unit roots. The Augmented Dickey-Fuller (ADF) test and the Kwiatowski-Phillips-Schmidt-Shin (KPSS) test are used to do so.[3] The ADF defines the null hypothesis as “unit roots exist” and the alternative hypothesis as “unit roots do not exist”. Fuller (1976) provides a table for the ADF test. The KPSS test defines the null hypothesis as “unit roots do not exist” and the alternative hypothesis as “unit roots exist”. First, the original data are checked to verify whether or not they contain unit roots. Next, the data with initial differences are analyzed to determine whether or not they have unit roots, to confirm that they are $I(1)$ processes.

4.2 Johansen Co-Integration Test

The Johansen co-integration test is used to investigate the co-movement among three TSE REIT Property Sector Indexes. Johansen (1988) advises conducting an analysis with the k-order VAR model. Here, the VAR model is presented with the k order against vector X_t with p variables. All the p elements of X_t are considered to be $I(1)$ variables; u_t is an error term with a mean of zero; λ is a constant term.

$$X_t = \Pi_1 X_{t-1} + \cdots + \Pi_k X_{t-k} + \lambda + u_t \qquad (1)$$

Trace and maximal eigenvalue tests are conducted to analyze the relationships among three residential property prices in Tokyo, Nagoya, and Osaka. Critical values at the 5% level from Osterwald-Lenum (1992) are used.

4.3 Granger Causality Test

Granger (1969) originally proposed a causality test. According to his method, non-stationary data are usually transformed into stationary data to avoid problems occurring in regard to spurious regression. Toda and Yamamoto (1995) developed a new method for the Granger causality test, which directly uses non-stationary data. This procedure has been found to be superior to the original Granger causality test because it avoids potential bias associated with unit roots.

According to a method proposed by Toda and Yamamoto (1995), the trend term t and $p + 1$ (the

[3] See Dickey and Fuller (1979), Dickey and Fuller (1981), and Kwiatkowski et al. (1992).

original lag plus one) should be added for the estimation. As outlined below, these three equations are used to test causalities among three residential property prices in Tokyo, Nagoya, and Osaka. For example, Equation (2) checks if Nagoya and Osaka Granger-cause Tokyo. The Akaike Information Criterion (AIC) standard is used for the original number of lags.

$$Tokyo_t = k_0 + \lambda_t + \sum_{i=1}^{p+1} \alpha_i Nagoya_{t-i} + \sum_{i=1}^{p+1} \beta_i Osaka_{t-i} + u_t \qquad (2)$$

$$Nagoya_t = k_0 + \lambda_t + \sum_{i=1}^{p+1} \alpha_i Tokyo_{t-i} + \sum_{i=1}^{p+1} \beta_i Osaka_{t-i} + u_t \qquad (3)$$

$$Osaka_t = k_0 + \lambda_t + \sum_{i=1}^{p+1} \alpha_i Tokyo_{t-i} + \sum_{i=1}^{p+1} \beta_i Nagoya_{t-i} + u_t \qquad (3)$$

5. Results

5.1 Unit Root Test

First, ADF and KPSS tests are conducted on the original series. The results do not eliminate the doubt that the original data have unit roots because both tests show non-stationarity. The results are shown in Table 2 and Table 3.

Table 2

Table 3

Next, ADF and KPSS tests are conducted using the data with initial differences. The results show that all variables are stationary. Thus, it is appropriate to assume that all of the variables used for the analysis are non-stationary I (1) variables and to conclude that the non-stationary time series can be used. The results are shown in Tables 4 and 5.

Table 4

Table 5

5.2 Johansen Co-Integration Test

The Johansen co-integration test is conducted for three variables. One co-integration relationship is found in both Samples A and B. Three residential property prices in Tokyo, Nagoya, and Osaka move together in long-term equilibrium. These results are shown in Table 6.

Table 6

5.3 Granger Causality Test

Granger causality tests are conducted using the method proposed by Toda and Yamamoto (1995). No causality is found in Sample A. One occurrence of causality from Tokyo to Nagoya is found in Sample B. The results are shown in Table 7.

Table 7

6. Conclusion

The purpose of this paper is to investigate the formation of residential property prices in Japan by analyzing co-movement and transmission in three major regions: Tokyo, Nagoya, and Osaka. The entire sample period is divided into two. The first period is before the introduction of a strong non-traditional monetary policy. The BOJ adopts a comprehensive easing policy during this time. The second period is after the introduction of a strong non-traditional monetary policy.

Three residential property prices in Tokyo, Nagoya, and Osaka co-move in long-term equilibrium in both the first and second periods. There is a difference in terms of transmission between the first and second periods. No causality is found in the first period, but causality from Tokyo to Osaka is found in the second period.

Three residential property prices move together, but independently, in the first period. After the BOJ introduces strong non-traditional monetary policies, such as QQE and the NIRP, three residential property prices move together through the transmission from Tokyo to Osaka in the second period. This is because monetary policies by the BOJ cause price increases for residential properties, especially in Tokyo.

This paper analyzes residential property prices in three major cities. There is room to analyze the prices of residential properties in rural areas. There is potential for future studies to examine commercial properties in this respect.

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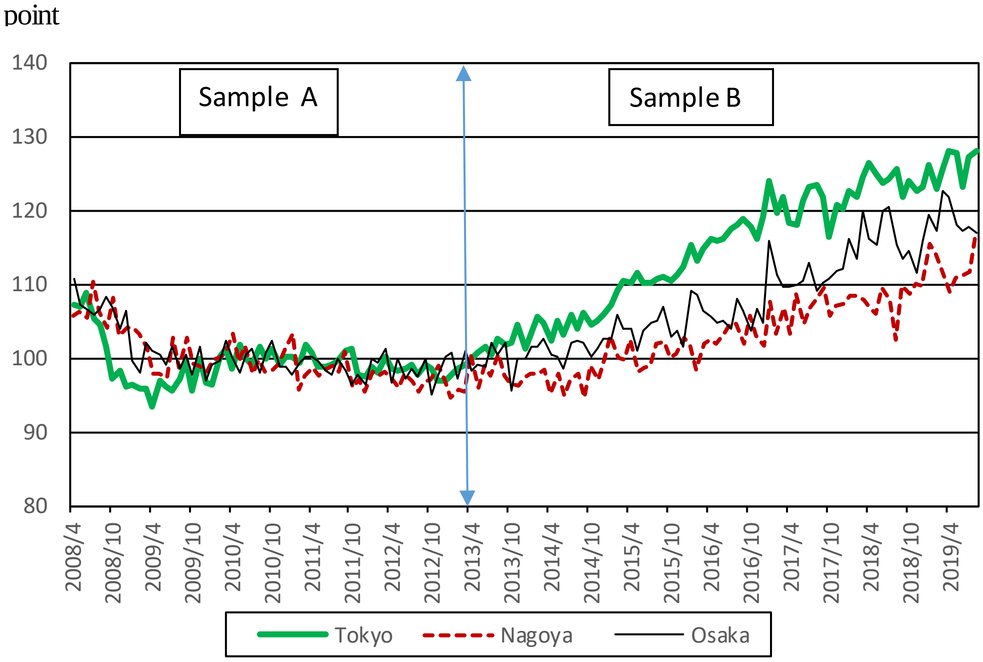
Figure 1Residential Property Price Index



Notes: Data source is Ministry of Land, Infrastructure, Transport and Tourism.
Sample A is from April 2008 to March 2013.
Sample B is from April 2013 to August 2019.

Table 1 Descriptive statistics

Variable	Average	SD	Min	Max	Median
Sample A					
Tokyo	99.30	2.89	93.38	108.96	99.00
Nagoya	99.80	3.47	94.79	110.29	98.81
Osaka	100.41	3.25	95.12	110.78	99.87
Sample B					
Tokyo	114.82	8.67	99.95	128.11	116.32
Nagoya	103.49	5.30	94.74	116.97	102.63
Osaka	107.94	6.85	95.53	122.62	106.46

Notes: Sample A is from April 2008 to March 2013.
Sample B is from April 2013 to August 2019.
Tokyo, Nagoya and Osaka are Property Index in each region.

Table 2 ADF test - original series

Variable	Without Trend	With Trend
Sample A		
Tokyo	-0.358	-0.967
Nagoya	-1.014	-6.867*
Osaka	-1.138	-8.110*
Sample B		
Tokyo	-2.085	-7.746*
Nagoya	-1.582	-7.746*
Osaka	0.980	-5.761*

Notes : * indicates significance at the 5 % level.

5% critical values are -2.86(Without Trend) and -3.41(With Trend）.

Sample A is from April 2008 to March 2013.

Sample B is from April 2013 to August 2019.

Table 3 KPSS test - original series

	Lag=3		Lag=12	
Variable	η_μ	η_τ	η_μ	η_τ
Sample A				
Tokyo	0.498*	0.359*	0.355*	0.092
Nagoya	3.592*	0.297*	0.797*	0.128
Osaka	2.689*	0.525*	0.643*	0.177*
Sample B				
Tokyo	7.432*	0.600*	1.190	0.205*
Nagoya	6.554*	0.225*	1.159	0.142
Osaka	6.755*	0.308*	1.154	0.175*

Notes: * indicates significance at the 5 % level.

5% critical values are 0.463(level stationary), 0.146 (trend stationary).

$\eta_\mu$indicates level stationarity. η_τ indicates trend stationarity.

Sample A is from April 2008 to March 2013.

Sample B is from April 2013 to August 2019.

Table 4 ADF test - first differenced series

Variable	Without Trend	With Trend
Sample A		
⊿Tokyo	-6.754*	-5.619*
⊿Nagoya	-13.275*	-11.639*
⊿Osaka	-7.315*	-9.661*
Sample B		
⊿Tokyo	-12.469*	-11.803*
⊿Nagoya	-9.189*	-9.472*
⊿Osaka	-12.872*	-11.486*

Notes : * indicates significance at the 5 % level.
5% critical values are -2.86(Without Trend) and -3.41(With Trend）.
Sample A is from April 2008 to March 2013.
Sample B is from April 2013 to August 2019.

Table 5 KPSS test - first differenced series

	Lag=3		Lag=12	
Variable	η_μ	η_τ	η_μ	η_τ
Sample A				
Tokyo	0.116	0.054	0.199	0.105
Nagoya	0.014	0.011	0.086	0.070
Osaka	0.103	0.016	0.412	0.088
Sample B				
Tokyo	0.014	0.010	0.066	0.050
Nagoya	0.057	0.012	0.295	0.070
Osaka	0.011	0.051	0.011	0.052

Notes: * indicates significance at 5 % level.
5% critical values are 0.463(level stationary), 0.146 (trend stationary).
$\eta_\mu$indicates level stationarity. η_τ indicates trend stationarity.
Results showing signicance at 5 % are not significant at 1 % level.
Sample A is from April 2008 to March 2013.
Sample B is from April 2013 to August 2019.

Table 6 Johansen cointegration test

Null	Alternative	Test Statistics	Critical Value		Test Statistics	Critical Value	
		Maximal Eigenvalue T	5%	10%	Trace Test	5%	10%
Sample A							
r = 0	r = 1	46.429*	22.00	19.77	61.937*	34.91	19.77
r ≦1	r = 2	11.267	15.67	13.75	15.500**	19.96	13.75
r ≦2	r = 3	4.240	9.24	7.52	4.240	9.24	7.52
Sample B							
r = 0	r = 1	20.541**	22.00	19.77	37.720*	34.91	19.77
r ≦1	r = 2	11.401	15.67	13.75	17.179**	19.96	13.75
r ≦2	r = 3	5.777	9.24	7.52	5.777	9.24	7.52

Notes: *,** indicates significance at 5 % and 10% level.
Critical values are from Osterwald-Lenum (1992).
Sample A is from April 2008 to March 2013.
Sample B is from April 2013 to August 2019.

Table 7 Granger causality test

Variables	Test Statistics
Sample A	
Tokyo →Nagoya	1.304
Tokyo →Osaka	1.387
Nagoya → Tokyo	1.999
Nagoya → Osaka	1.473
Osaka →Tokyo	0.733
Osaka →Nagoya	0.611
Sample B	
Tokyo →Nagoya	0.483
Tokyo →Osaka	3.828*
Nagoya → Tokyo	1.326
Nagoya → Osaka	1.747
Osaka →Tokyo	1.233
Osaka →Nagoya	1.831

Notes: * indicates significance at the 5 % level.
As for the number of lags, one is added to AIC selection.
Sample A is from April 2008 to March 2013.
Sample B is from April 2013 to August 2019.