論　説

Monetary Policy and Residential Housing Bubbles in Japan: a quantile regression approach.

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Abstract:

Employing quantile regression approach, this paper examines the relationship between monetary policy and housing bubbles using residential property market data in Japan from 2008-2015. The results show that the change in monetary policies significantly affected the housing returns when the returns are at average and high levels, such as in cities of Tokyo, Nagoya, Osaka and Aichi prefecture. However, there was none of such effect at the national level. Regarding of the adjustment of house prices to new monetary information, at the national level the new monetary information is reflected when the housing returns are at the average level. However, in some cities such as Nagoya, Osaka and Tokyo, the information is reflected when the housing returns are at the low level. These findings have not been documented in literature and will be useful for policy makers as well as property investors in Japan.

Keywords: quantile regression, Japan, residential property market, monetary policies.

1. Introduction

Real estate market in Japan had a bubble and exploded late 1980s. The housing price index increased more than 70 times from 1955 to 1989, while the stock price rapidly increased more than 100 times in this period. Saito (2003) concluded that the bubble was caused by three reasons: the myth that land prices in Japan would never decrease, the poor monetary policies, and the undisciplined real estate lending. Some other studies, such as Basile & Joyce (2001a) and Stone & Ziemba (1993), indicated that housing bubbles in Japan were caused by not only monetary policies shocks but also by productivity growth, population growth, and land supply (Ito, 1993), or an intolerable inequality in Japanese

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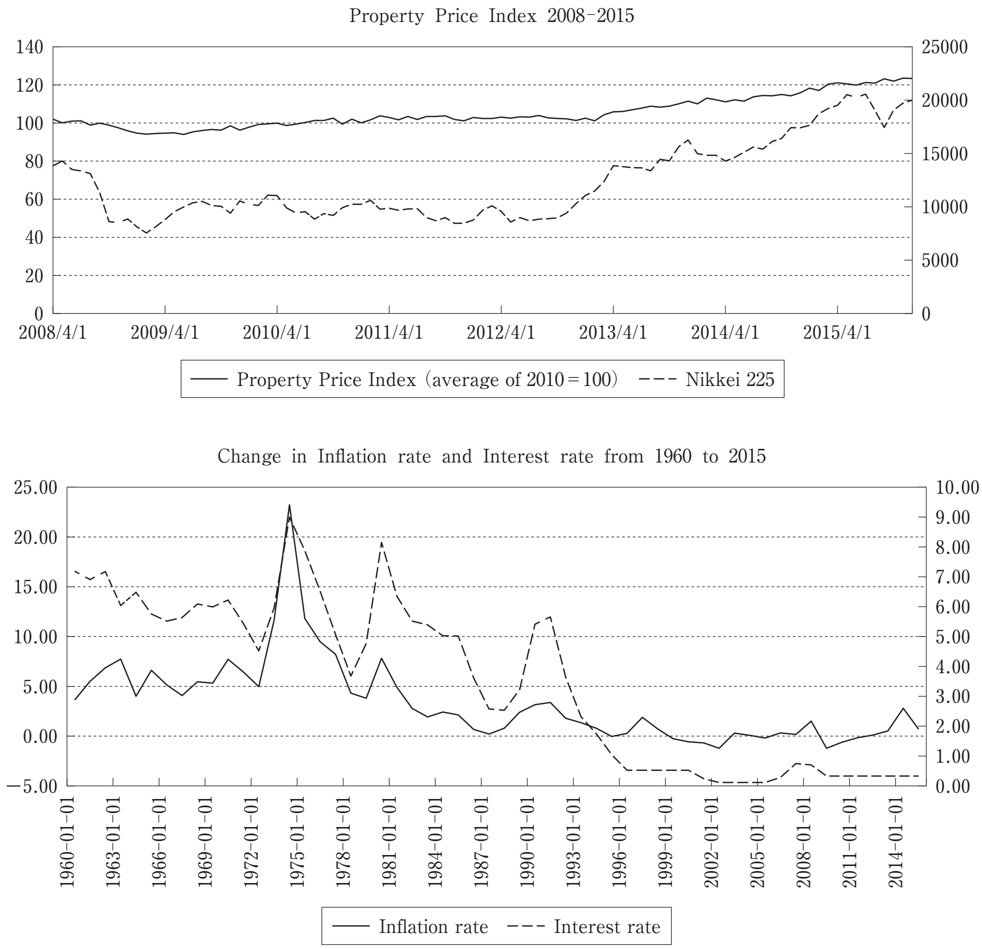
Figure 1: Plots of Property Price Index, Inflation rate, Interest rate and Nikkei 225



society.

Early this new millennium, the Bank of Japan cut interest rates further to 0.1% and began expanded monetary policy in the form of the quantitative easing (QE). At the same time, Japan Real Estate Investment Trust (J-REIT) market came into operation and the new listed investment funds brought a series of new operations in the real estate market. Trillions of yen inflowing to real estate market led to a mini "boom" in 2006. However, the global financial crisis in 2008 drove foreign investors out of the Japanese real estate market. Property prices in Tokyo again reduced but were not as low as to the level of 2002. In the following period from 2008 to 2015, given the inflation and interest rate went down, the real estate market gradually went up at the same time with the Japanese stock market as plotted in Figure 1.

The uptrend of the Japanese property price index and the downtrend of inflation and interest rates have raised a question of whether the monetary policies in Japan affected the housing prices, thus leading to a housing bubble. This paper will employ the quantile regression to examine the relationship between housing bubbles and monetary policies in Japan.

The rest of this paper is organized as follows. Next section is literature review on the relationship between property market and monetary policies. Section 3 is methodology, followed by section 4 of data and empirical results. Chapter 5 will be conclusions.

2. Literature review

The relationship between real estate market and monetary policies is of interest for numerous studies. The real estate market is influenced by monetary policies in the way that theoretically when the monetary supply increases, the interest rate decreases, house prices and housing returns increase. Berlemann & Freese (2013) found that the positive interest rate shocks have adverse effects on house and condominium prices. Apergis, Simo-Kengne, & Gupta (2014) indicated the increase in consumption due to house price appreciation is smaller than that generated by the rise in stock prices. Some previous studied indicated the very close, positive relationship between house prices and monetary policies, such as in Stone & Ziemba (1993).

In Japan, Ito (1993) stated that land price are determined by the fundamental variables such as productivity growth, population growth, and land supply. However, Okumura (1997) indicated that the fluctuations in housing investment during the 1970s occurred as a result of a decline in productivity caused by the 1973 oil crisis, with its downward trend in the first half of the 1980s being due to the decrease in the growth rate of Japan's adult population. Stone & Ziemba (1993) found that not only the movements in interest rates but also both the price levels and the return from land are fundamental factors which would lead to changes in land price. Basile & Joyce (2001b) found a different result that the stock market bubble was determined by its own past and also influenced the land market bubble, accounting for a significant proportion of the variance of the land market bubble. Neither output, nor the money supply nor the lending variable was significant in the causality tests or in explaining the variation of the two asset bubbles. However, there are some evidences of monetary policies effect to the land market bubble as written in Basile & Joyce (2001a).

The popular phrase in the property agent society is "location, location, and location". This indicates that the location is the most important factor influencing the property price. Krueger (1989) agreed that the property purchase was determined by the value of the land, not the building. Krueger (1989) also found that the primary variable is location, for example, the distance to central Tokyo, the distance to train station, and the prestige of the area. Hence, the bubbles might not occur on nationwide, whereas probably sharp price movements were concentrated in particular areas. Prices go up prominently for particular properties, but not so much for other properties, and as a result, price inequality across properties increases（Ohnishi, Mizuno, Shimizu, & Watanabe, 2013）.

By sector, the industrial property typically is higher in return than office building but it needs operation cost. Hence, the return of the property is an account of the property price. It is interesting that there is an inverse relationship between the importance of investment considerations at the household level, and the importance of the wealth aspect of housing at the aggregate level（Haavio & Kauppi, 2013）. The less the households see the home as an investment, the more the asset aspect of housing moulds the socioeconomic make-up of jurisdictions and the pattern of sorting. Krainer, Spiegel, & Yamori（2010）also found that after the collapse of stock prices in Japan in 1990, both commercial and residential real estate values fell dramatically.

It can be seen that there are mixed conclusions on the relationship between house prices and monetary policies in literature. And, to the best of our knowledge, there was no paper verifying this relationship in the Japanese market. This paper fills in the gap by examine the relationship between house prices and monetary policies in the Japanese residential property market using quantile regression approach. The findings reveal that the change in monetary policies significantly affected the housing returns when the returns are at average and high levels, in some big cities such as in Tokyo, Nagoya, Osaka and Aichi prefecture. However, there was none of such effect at the national level.

3. Methodology

We followed Tsai（2015）and Scherbina & Schlusche（2014）in defining a positive bubble which is occurring when housing price exceeds the discounted value of expected future cash flows（CF）:

$$HP_t^f > E_t\left[\sum_{\lambda=t+1}^{\infty}\frac{CF_\lambda}{(1+r_t)^{\lambda-t}}\right] \tag{1}$$

where r is the appropriate discount rate.

In other words, the housing price can be device into two components: the fundamental value and bubbles. They argue that if r_f can be the proxy variable of the discount rate, the house price is equal to the sum of the discount cash flow and the present value of the future bubbles values:

$$HP_t^f = E_t\left[\sum_{\lambda=t+1}^{\infty}\frac{CF_\lambda}{(1+r_t)^{\lambda-t}}\right] + \lim_{T\to\infty} E_t\left[\frac{B_{t+T}}{(1+r_f)^T}\right] \tag{2}$$

Assume further that the bubble grows at a rate r_b, such that $B_T=B_t(1+r_b)^{T-t}$. It is possible to conclude that the bubble component of the price can exist without bursting only if $r_b=r$. Therefore, the existence and growth of the bubble will be determined by monetary policies that influence the risk-free rate.

According to Equation (2), the change in the total house price can be divided into three parts as follows:

$$\Delta HP_t=\Delta HP_t^f+\Delta B_t=\Delta HP_t^f+B_t-B_{t-1}$$
$$=\Delta HP_t^f-(HP_{t-1}-HP_{t-1}^f)+B_t \quad (3)$$

The persistence of steadily rising real estate prices defines positive bubble growth, which results in the serial correlation of house prices. Let the bubble component replace the degree of serial correlation:

$$\Delta HP_t=\Delta HP_t^f-(HP_{t-1}-HP_{t-1}^f)+\Delta HP_{t-1} \quad (4)$$

Equation (4) can also be modified to be a simple error correction model:

$$\Delta HP_t=\alpha\Delta HP_t^f-\beta(HP_{t-1}-HP_{t-1}^f)+\gamma\Delta HP_{t-1} \quad (5)$$

In Equation (5), if HP^f is replaced with HP^* which is the equilibrium value of the house price determined by monetary policy, then it will be this study's error correction model. α, the degree of serial correlation, will show the persistence of price changes and the possibility of a bubble exists. Whereas, β is the degree of mean reversion, which is always negative and γ is the indicator of prices to current shocks or the adjustment of prices to current monetary shocks.

This study employs traditional ordinary least-squares estimation and quantile regression to investigate differences in house prices in Japan. The quantile regression equation for housing prices is as follows:

$$\Delta HP_t=X'_t.\phi+u_t$$

Where HP_t is the housing price index, X_t is a regressor matrix, ϕ is the coefficient we want to estimate and u_t is the error term.

4. Data and empirical results

The paper uses the dataset of national and region house pricing indices in Japan from April 2008 to December 2015. The house pricing indices from the three big cities in Japan, namely Tokyo, Nagoya and Osaka will also be taken into consideration. The data was

Table 1: The summary of housing price indices, interest rate, and money supply

	National	Hokkaido	Tohoku	Kanto	Hokuriku	Chubu	Kinki	Chugoku
Mean	101.2338	103.5955	107.6031	100.7973	101.726	98.25581	101.803	101.3269
Median	100.39	102.83	106.31	100.35	100.95	97.26	101.29	101.52
Standard Deviation	2.5251	4.7969	6.6301	2.8676	4.7962	3.4249	2.5117	3.4273
Kurtosis	−0.19941	0.0616	−1.25358	−0.14155	1.089913	2.090498	0.234001	−0.65797
Skewness	0.7646	0.6753	0.2932	0.6697	0.8109	1.4762	0.7894	−0.15131
Minimum	97.26	96.23	97.95	96.03	91.72	93.49	97.34	94.07
Maximum	107.92	117.21	121.66	108.65	116.56	109.44	109.12	108.82

	Shikoku	Kyushu-Okinawa	Tokyo	Nagoya	Osaka	Aichi	Money supply (M2)	Interest rate
Mean	99.5825	104.1376	100.7927	99.4283	101.7186	99.4075	8.16E+14	0.117441
Median	99.13	103.72	100.43	98.67	101.1	98.81	8.09E+14	0.082
Standard Deviation	4.0929	4.5155	3.0480	2.9532	2.6146	3.1055	5.56E+13	0.113881
Kurtosis	0.9835	−0.7901	−0.22438	2.3017	0.0098	1.2002	−1.09902	7.502145
Skewness	0.9280	−0.0045	0.6671	1.4715	0.6583	1.0698	0.2568	2.9948
Minimum	91.89	93.42	95.28	95.32	97.27	94.74	7.30E+14	0.059
Maximum	111.66	114.08	108.75	110.41	109.97	110.29	9.19E+14	0.509

extracted from The Japanese Ministry of Land, Infrastructure, Transport, and Tourism. The money supply and interest rate data are retrieved from the World Bank database.

Table 1 shows that the mean house prices in some regions are higher than the national index, however the indices in Chubu, Kanto and Shikoku are lower than the national index. The highest regional index is from Tohoku area. The house pricing index in Tokyo is highest, followed by that of Osaka and Nagoya.

The results from ordinary least squares estimation in Table 2 show that the house prices in Japan fluctuated and cannot reflect new information.

Table 3 shows the coefficient α estimated by using various quantiles. Coefficient α is used to observe the degree of self-related housing returns. It exhibits that when house price fluctuations in Japan and in each region show low or high housing returns, coefficient α is low and insignificant. This finding indicates that the house price in previous period does not influence the current price in Japan.

Table 4 shows the coefficient β, which is used to examine whether house price fluctuations exhibit mean reversion, estimated by various quantiles. In this table, most of house prices in each region are inconsistent and insignificant. At national level, Hokkaido, Chugoku and Tohoku, the coefficients are insignificant, meaning that there was no mean reversion. While, in the remaining regions, the coefficients are significant at the middle or high level of housing returns. This indicates that the significant change in money policies

Table 2: The estimated results of ordinary least squares

Model: $\Delta HP_t = \alpha \Delta HP_{t-1} + \beta(HP_{t-1} - \mathrm{HP}^*_{t-1}) + \gamma \Delta \mathrm{HP}^*_{t-1} + \varepsilon_t$

	National		Hokkaido		Tohoku		Kanto	
	Estimate	t-value	Estimate	t-value	Estimate	t-value	Estimate	t-value
α	−0.43	−3.512***	−0.1668	−1.803	0.283	0.428	0.703	2.366*
β	−0.012	−1.779	−0.042	2.975**	−0.424	−5.072***	−1.304	−110.5***
γ	0.3	345.9***	0.586	161.69***	0.595	20.6***	0.0121	1.082
Adjusted R^2		0.9992		0.9966		0.9255		0.9932

	Hokuriku		Chubu		Kinki		Chugoku	
	Estimate	t-value	Estimate	t-value	Estimate	t-value	Estimate	t-value
α	0.14	0.76	0.32	1.28	0.31	1.48	0.29	1.44
β	−1.24	−61.2***	−1.23	−95.43***	−1.28	−113.4***	−1.31	−75.9***
γ	0.03	1.558	−0.003	−0.263	0.02314	2.209*	0.0134	0.81
Adjusted R^2		0.9778		0.9907		0.9938		0.9859

	Shikoku		Kyushu/Okinawa		Tokyo		Nagoya	
	Estimate	t-value	Estimate	t-value	Estimate	t-value	Estimate	t-value
α	0.272	1.407	0.31	1.198	0.05	0.16	0.21	0.87
β	−1.28	−61.3***	−1.309	−68.6***	−1.3	−95.9***	−1.27	−90.9***
γ	0.004	0.242	0.03	1.69	0.03	2.378*	0.007	0.53
Adjusted R^2		0.9786		0.9827		0.991		0.98

	Osaka		Aichi	
	Estimate	t-value	Estimate	t-value
α	0.34	1.705	0.354	2.074*
β	−1.26	−113.1***	−1.28	−106.8***
γ	0.022	2.091*	0.006	0.59
Adjusted R^2		0.9937		0.9927

Note: where HP_t is the national or regional housing price index at time t, HP-t is the equilibrium value of house price determined by money policy. α stands for the degree of serial correlation which shows the persistence of price changes and the possibility of existence of a bubble. β stands for the degree of mean reversion; γ stands for the contemporaneous adjustment of prices to current monetary shocks. *** and ** denote statistical significance at the 1% and 5% level, respectively*

significantly affected the housing returns when the returns are at average and higher level.

Table 5 shows the coefficient γ estimated by various quantiles. This coefficient is used to analyse whether house prices adjust to new monetary information. At national level, the coefficients are significant in the middle return level, indicating that the new monetary information is reflected when the housing returns are at average. There are some areas that the information is reflected when the housing returns are at the low level, such as Hokkaido, Kyushu-Okinawa, Nagoya, Osaka and Tokyo. Especially, there are some areas that the information is not reflected, such as Tohoku and Kinki.

Table 3: The estimated results of quantile regression（self-related behaviour-α）

Model: $\Delta HP_t=\alpha\Delta HP_{t-1}+\beta(HP_{t-1}-\mathrm{HP}^{*}_{t-1})+\gamma\Delta\mathrm{HP}^{*}_{t-1}+\varepsilon_t$

Region	Quantile	Coefficient	T-Statistic
National	0.1	−0.29	−0.001
	0.2	−0.23	−0.13
	0.3	−0.25	−0.18
	0.4	−0.33	−0.23
	0.5	−0.36	−0.18
	0.6	−0.37	−0.27
	0.7	−0.35	−0.13
	0.8	−0.49	−0.02
	0.9	−0.06	0.13
Hokkaido	0.1	−0.06	0.09
	0.2	−0.13	0.07
	0.3	−0.14	0.01
	0.4	−0.14	0.04
	0.5	−0.15	0.015
	0.6	−0.16	0.027
	0.7	−0.15	0.01
	0.8	−0.19	0.015
	0.9	−0.15	0.003
Tohoku	0.1	−0.28	−0.89
	0.2	−0.19	−0.09
	0.3	−0.13	−0.04
	0.4	−0.1	−0.04
	0.5	−0.02	0.04
	0.6	0.01	0.07
	0.7	1.09	0.19
	0.8	−0.53	−0.005
	0.9	−0.48	0.43
Kanto	0.1	0.92	1.68
	0.2	1.21	2.11
	0.3	0.58	1.68**
	0.4	0.66	1.07
	0.5	0.44	1.20
	0.6	0.58	0.97
	0.7	0.50	1.10
	0.8	0.47	1.14
	0.9	0.28	1.07
Hokuriku	0.1	0.33	1.12
	0.2	0.56	0.89
	0.3	0.44	0.83
	0.4	0.26	0.58
	0.5	0.14	0.30
	0.6	−0.03	0.49
	0.7	−0.06	0.42
	0.8	−0.20	0.25
	0.9	−0.26	0.01
Chubu	0.1	0.42	1.80**
	0.2	0.60	1.19
	0.3	0.42	0.88
	0.4	0.18	0.78
	0.5	0.22	0.57
	0.6	0.21	0.72
	0.7	0.34	0.77
	0.8	0.05	0.69
	0.9	0.24	0.52
Kinki	0.1	0.35	1.29
	0.2	0.34	0.78
	0.3	0.49	0.68
	0.4	0.19	0.88
	0.5	0.23	0.79
	0.6	0.34	0.77
	0.7	0.25	0.63
	0.8	0.29	0.60
	0.9	0.32	0.88
Chugoku	0.1	0.24	1.24
	0.2	0.47	0.86
	0.3	0.38	1.03
	0.4	0.32	0.86
	0.5	0.32	0.65
	0.6	0.31	0.50
	0.7	0.21	0.53
	0.8	−0.09	0.20
	0.9	−0.22	0.79
Shikoku	0.1	0.59	0.73
	0.2	0.41	0.79
	0.3	0.41	0.67
	0.4	0.27	0.50
	0.5	0.28	0.68
	0.6	0.33	0.78
	0.7	0.34	0.71
	0.8	0.37	0.81
	0.9	−0.26	1.24
Kyushu. Okinawa	0.1	0.99	1.05
	0.2	0.58	1.04
	0.3	0.23	0.70
	0.4	0.08	0.87
	0.5	0.06	0.79
	0.6	0.18	0.57
	0.7	−0.31	0.36
	0.8	−0.17	0.05
	0.9	−0.14	0.29
Tokyo	0.1	0.12	1.91**
	0.2	−0.55	0.83
	0.3	−0.30	1.04
	0.4	0.03	0.84
	0.5	0.02	0.44
	0.6	0.18	0.62
	0.7	0.19	0.92
	0.8	0.22	1.15
	0.9	−0.29	0.20
Nagoya	0.1	0.24	1.15
	0.2	0.41	0.69
	0.3	0.07	0.67
	0.4	0.09	1.12
	0.5	0.41	0.74
	0.6	0.36	0.72
	0.7	0.22	0.68
	0.8	0.09	0.54
	0.9	−0.18	1.03
Osaka	0.1	0.55	1.60
	0.2	0.63	1.13
	0.3	0.24	1.09
	0.4	0.27	0.72
	0.5	0.31	0.54
	0.6	0.16	0.67
	0.7	0.08	0.41
	0.8	0.16	0.53
	0.9	0.25	0.77
Aichi	0.1	0.17	0.59
	0.2	0.15	0.67
	0.3	0.37	0.67
	0.4	0.49	0.79
	0.5	0.50	0.84
	0.6	0.37	0.87
	0.7	0.40	0.87
	0.8	0.49	0.69
	0.9	0.45	0.83

*Note: where HP_t is the national or regional housing price index at time t, HP^*-t is the equilibrium value of house price determined by money policy. α stands for the degree of serial correlation which shows the persistence of price changes and the possibility of existence of a bubble. β stands for the degree of mean reversion; γ stands for the contemporaneous adjustment of prices to current monetary shocks. *** and ** denote statistical significance at the 1% and 5% level, respectively*

Table 4: The estimated results of quantile regression (mean reversion behaviour-β)

Model: $\Delta HP_t=\alpha\Delta HP_{t-1}+\beta(HP_{t-1}-\mathrm{HP}^*_{t-1})+\gamma\Delta\mathrm{HP}^*_{t-1}+\varepsilon_t$

Region	Quantile	Coefficient	T-Statistic
National	0.1	−0.01	0.13
	0.2	0.00	0.01
	0.3	0.00	0.01
	0.4	0.00	0.01
	0.5	0.00	0.00
	0.6	0.01	0.01
	0.7	−0.04	0.01
	0.8	−0.05	0.01
	0.9	−0.08	−0.01
Hokkaido	0.1	−0.04	0.12
	0.2	−0.01	0.09
	0.3	−0.03	0.03
	0.4	−0.02	0.00
	0.5	−0.02	0.00
	0.6	−0.03	−0.01
	0.7	−0.06	−0.01
	0.8	−0.07	−0.05
	0.9	−0.06	−0.03
Tohoku	0.1	−0.02	0.02
	0.2	−0.02	0.02
	0.3	−0.01	0.00
	0.4	0.00	0.01
	0.5	−0.01	0.01
	0.6	−0.02	0.00
	0.7	−0.04	0.02
	0.8	−0.03	0.01
	0.9	−0.04	0.06
Kanto	0.1	−1.30	−0.83
	0.2	−1.31	−1.05
	0.3	−1.31	0.07
	0.4	−1.31	0.47
	0.5	−1.31	1.79e+308***
	0.6	−1.32	−1.32
	0.7	−1.32	−1.32
	0.8	−1.32	−1.32
	0.9	−1.32	−1.32
Hokuriku	0.1	−0.99	−0.86
	0.2	−1.09	−0.32
	0.3	−1.15	0.26
	0.4	−1.26	0.78
	0.5	−1.27	1.12
	0.6	−1.27	1.88**
	0.7	−1.28	−1.28
	0.8	−0.73	−1.28
	0.9	−0.38	−1.19
Chubu	0.1	−1.24	−0.73
	0.2	−1.24	−0.25
	0.3	−1.25	0.20
	0.4	−1.25	0.91
	0.5	−1.25	1.79e+308***
	0.6	−1.25	−1.25
	0.7	−1.25	−1.25
	0.8	−1.26	−1.26
	0.9	−1.26	−1.26
Kinki	0.1	−1.17	−0.96
	0.2	−1.28	−1.05
	0.3	−1.28	0.08
	0.4	−1.29	0.40
	0.5	−1.29	1.79e+308***
	0.6	−1.25	−1.25
	0.7	−1.29	−1.29
	0.8	−1.30	−1.30
	0.9	−1.20	−1.27
Chugoku	0.1	−1.11	−0.93
	0.2	−1.19	−0.98
	0.3	−1.33	0.04
	0.4	−1.33	0.51
	0.5	−1.33	1.08
	0.6	−1.34	−1.34
	0.7	−1.34	−1.34
	0.8	−0.77	−1.33
	0.9	−0.50	−1.24
Shikoku	0.1	−1.00	−0.86
	0.2	−1.04	−0.31
	0.3	−1.12	0.23
	0.4	−1.30	1.04
	0.5	−1.31	1.68**
	0.6	−1.31	1.7E+308***
	0.7	−1.31	1.79e+308***
	0.8	−1.32	1.79e+308***
	0.9	−0.52	1.79e+308***
Kyushu. Okinawa	0.1	−1.23	−0.80
	0.2	−1.32	−0.44
	0.3	−1.33	0.01
	0.4	−1.33	0.27
	0.5	−1.33	0.51
	0.6	−1.23	0.70
	0.7	−0.41	1.7E+308***
	0.8	−0.33	1.79e+308***
	0.9	−0.25	1.79e+308***
Tokyo	0.1	−1.24	−1.00
	0.2	−1.31	−0.54
	0.3	−1.32	0.13
	0.4	−1.32	0.26
	0.5	−1.32	1.05
	0.6	−1.32	1.7E+308***
	0.7	−1.33	1.79e+308***
	0.8	−1.33	1.79e+308***
	0.9	−0.90	1.79e+308***
Nagoya	0.1	−1.23	−0.87
	0.2	−1.28	−0.98
	0.3	−1.28	0.26
	0.4	−1.28	0.67
	0.5	−1.29	1.7E+308***
	0.6	−1.29	1.79e+308***
	0.7	−1.29	1.79e+308***
	0.8	−1.29	1.79e+308***
	0.9	−1.24	1.79e+308***
Osaka	0.1	−1.26	−0.93
	0.2	−1.27	−0.97
	0.3	−1.27	0.22
	0.4	−1.28	0.75
	0.5	−1.28	1.7E+308***
	0.6	−1.28	1.79e+308***
	0.7	−1.28	1.79e+308***
	0.8	−1.28	1.79e+308***
	0.9	−1.29	1.79e+308***
Aichi	0.1	−1.28	−0.36
	0.2	−1.29	−0.83
	0.3	−1.29	0.27
	0.4	−1.30	1.19
	0.5	−1.30	1.7E+308***
	0.6	−1.30	1.79e+308***
	0.7	−1.30	1.79e+308***
	0.8	−1.30	1.79e+308***
	0.9	−1.31	1.79e+308***

*Note: where HP_t is the national or regional housing price index at time t, HP^*-t is the equilibrium value of house price determined by money policy. α stands for the degree of serial correlation which shows the persistence of price changes and the possibility of existence of a bubble. β stands for the degree of mean reversion; γ stands for the contemporaneous adjustment of prices to current monetary shocks. *** and ** denote statistical significance at the 1% and 5% level, respectively*

Table 5: The estimated results of quantile regression (contemporaneous adjustment-γ)

Model: $\Delta HP_t=\alpha\Delta HP_{t-1}+\beta(HP_{t-1}-\mathrm{HP}^*_{t-1})+\gamma\Delta\mathrm{HP}^*_{t-1}+\varepsilon_t$

Region	Quantile	Coefficient	T-Statistic
National	0.1	0.30	0.30
	0.2	0.30	0.30
	0.3	0.30	−0.11
	0.4	0.30	1.79e+308***
	0.5	0.30	1.79e+308***
	0.6	0.30	1.79e+308***
	0.7	0.30	0.38
	0.8	0.30	0.30
	0.9	0.30	0.30
Hokkaido	0.1	0.58	1.79e+308***
	0.2	0.58	1.79e+308***
	0.3	0.59	1.79e+308***
	0.4	0.59	1.79e+308***
	0.5	0.59	1.79e+308***
	0.6	0.59	1.61
	0.7	0.59	0.59
	0.8	0.59	0.59
	0.9	0.59	0.59
Tohoku	0.1	0.76	−0.04
	0.2	0.76	0.75
	0.3	0.76	0.57
	0.4	0.77	0.89
	0.5	0.76	0.77
	0.6	0.76	0.76
	0.7	0.76	0.77
	0.8	0.07	0.77
	0.9	0.02	0.77
Kanto	0.1	−0.01	1.79e+308***
	0.2	0.00	0.00
	0.3	0.00	0.00
	0.4	0.01	0.01
	0.5	0.01	1.79e+308***
	0.6	0.01	1.92**
	0.7	0.01	1.15
	0.8	0.02	0.02
	0.9	0.02	0.02
Hokuriku	0.1	0.99	0.08
	0.2	0.63	−0.01
	0.3	0.41	0.01
	0.4	0.01	3.85***
	0.5	0.01	2.14***
	0.6	0.02	1.63
	0.7	0.03	1.24
	0.8	0.02	0.64
	0.9	0.02	0.02
Chubu	0.1	−0.03	−0.03
	0.2	−0.02	−0.02
	0.3	−0.01	−0.01
	0.4	−0.01	−0.35
	0.5	−0.01	1.79e+308***
	0.6	0.00	2.84***
	0.7	0.00	1.47
	0.8	0.00	0.00
	0.9	0.00	0.00
Kinki	0.1	0.40	0.05
	0.2	0.01	0.01
	0.3	0.01	0.01
	0.4	0.02	0.01
	0.5	0.02	1.65
	0.6	0.00	1.47
	0.7	0.02	0.85
	0.8	0.02	0.41
	0.9	0.03	0.03

Region	Quantile	Coefficient	T-Statistic
Chugoku	0.1	0.64	−0.02
	0.2	0.40	−0.01
	0.3	−0.01	−0.01
	0.4	0.00	2.77***
	0.5	0.00	1.60
	0.6	0.00	1.50
	0.7	0.01	1.12
	0.8	0.01	0.43
	0.9	0.01	0.01
Shikoku	0.1	0.95	−0.03
	0.2	0.83	1.7E+308
	0.3	0.59	1.79e+308***
	0.4	−0.02	2.89***
	0.5	−0.01	1.91**
	0.6	−0.01	1.55
	0.7	−0.01	1.31
	0.8	0.00	0.98
	0.9	0.01	0.01
Kyushu. Okinawa	0.1	0.26	1.7E+308
	0.2	0.00	1.79e+308***
	0.3	0.01	1.79e+308***
	0.4	0.01	1.79e+308***
	0.5	0.01	3.00***
	0.6	0.02	1.99***
	0.7	0.01	1.49
	0.8	0.01	0.40
	0.9	0.01	0.01
Tokyo	0.1	0.23	1.7E+308
	0.2	0.03	1.79e+308***
	0.3	0.02	1.79e+308***
	0.4	0.02	1.79e+308***
	0.5	0.02	2.10***
	0.6	0.03	1.44
	0.7	0.03	0.97
	0.8	0.04	0.24
	0.9	0.02	0.04
Nagoya	0.1	0.12	1.7E+308
	0.2	−0.01	1.79e+308***
	0.3	−0.01	1.79e+308***
	0.4	0.00	1.79e+308***
	0.5	0.00	1.88**
	0.6	0.00	1.38
	0.7	0.00	0.98
	0.8	0.01	0.42
	0.9	0.01	0.01
Osaka	0.1	0.00	1.7E+308***
	0.2	0.01	1.79e+308***
	0.3	0.01	1.79e+308***
	0.4	0.01	1.79e+308***
	0.5	0.02	1.79e+308***
	0.6	0.02	2.51***
	0.7	0.02	1.21
	0.8	0.02	0.03
	0.9	0.03	0.03
Aichi	0.1	−0.01	1.7E+308***
	0.2	−0.01	1.79e+308***
	0.3	0.00	1.79e+308***
	0.4	0.00	1.79e+308***
	0.5	0.01	1.79e+308***
	0.6	0.01	1.79e+308***
	0.7	0.01	1.93**
	0.8	0.01	0.01
	0.9	0.02	0.02

Note: where HP_t is the national or regional housing price index at time t, HP-t is the equilibrium value of house price determined by money policy. α stands for the degree of serial correlation which shows the persistence of price changes and the possibility of existence of a bubble. β stands for the degree of mean reversion; γ stands for the contemporaneous adjustment of prices to current monetary shocks. *** and ** denote statistical significance at the 1% and 5% level, respectively*

5. Conclusions

This paper uses residential property market data in Japan from 2008-2015 to examine the relationship between monetary policies and housing bubbles.

Using ordinary least square estimation, this paper finds that fluctuation in house prices exists during the examined period. The results obtained from the quantile regression approach show that the change in monetary policies significantly affected the housing returns when the returns are at average and high levels, such as in cities of Tokyo, Nagoya, Osaka and Aichi prefecture. However, there was none of such effect at the national level. Regarding of the adjustment of house prices to new monetary information, at the national level the new monetary information is reflected when the housing returns are at the average level. However, in some cities such as Nagoya, Osaka and Tokyo, the information is reflected when the housing returns are at the low level. These findings confirm a relationship between monetary policies and housing prices or bubble in Japan. These have not been documented in literature and will be useful for policy makers when implementing monetary policies as well as investors who want to participate in the Japanese residential property market.

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