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Dynamic Relationship between Economic Policy Uncertainty and Housing Market Returnsin Japan

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Abstract

This paper examines dynamic interactionsbetween economic policy uncertainty and the housing market returns for Japan using quarterly data running from 1990Q1through 2012Q4. Specifically, the study adopts the BEKK-GARCH model to test for causality-in-mean and i-variance between economic policy uncertainty and housing market returns. The sample period is divided into two namely - pre-crisis (1990Q1 through 1999Q4) and post-crisis period (2001Q1 through 2012Q4) in order to assess the impact of the Asian financial crisis. The results provide evidence of causality-in-mean from economic policy uncertainty to housing returns for pre-crisis period. Similarly, the show evidence of causality-in-mean from housing returns to economic policy uncertainty for post-crisis period. The results further reveal evidence of bi-directional causality-in-variance between economic policy uncertainty and housing market for the full sample period and the pre-crisis period. However, there is evidence of causality-in-variance from housing market returns to economic policy uncertainty for the post-crisis period. The empirical findings of this study suggest that investors should take into consideration economic policy uncertaintieswhen forming their investment portfolios.

Keywords: Economic policy uncertainty; housing market returns; causality-in-mean, causality-in-variance

JEL classification: C32; G10; G12, G18, R30.

1. Introduction

This paper explores the relationship between economic policy uncertainty (EPU) and housing market returns for Japan. A clear understanding of the relationship between economic policy uncertainty and the housing market is important to investors, policymakers, and financial institutions. Economic policy has implications for the real estate market. Similarly, volatility in the real estate market will unarguably influence government's policy choices and thus promotes economic policy uncertainty. During the 80's in Japan, the real estate and stock prices were immensely over-priced and inflated. By the early 90's Japan witnessed a collapse in its housing and stock market. These events were exacerbated by overheated economic activity coupled with an uncontrolled money supply and credit expansion. The confidence in the economy led the Bank of Japanto ease monetary policy. Economy Policy Uncertainty and declining asset prices resulted in the accumulation of non-performing assets loans in Japan. Stock market in Japan during this period was largely driven by the asset market, most specifically land prices. The rise in land prices led to an increase in stock market indices. Higher asset prices motivated investors to speculate on stock prices. Bank of Japan began to tighten its monetary policy which seems to affect stock prices.

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Lending cost accelerated coupled with slowdown in land prices. Despite all these, borrowing activities were increased by banks and funding from capital market increased substantially regardless of the effects and progress of financial deregulation. Money supply continued to increasein spite of the Bank of Japan's effort to control it through tightened monetary policy. Against this backdrop, financing of the corporate and household sector were also increased. However, as asset prices continued to decline, consumer confidence began to plummet due to its impact on household disposable income.

Some of the avenues through which uncertaintiesinfluence housing prices have been discussed in the literature. For instance, Berkovec (1989) points out that housing can be viewed as both a consumption and an investment good. As such, demand for housing can be derived from the utilityfunctions of economic agents facing consumption and portfolio choices. According to Giavazzi and McMahon (2012), as aconsumption good, the demand for housing will be negatively impacted by uncertainty about futureemployment, income, and wealth, as households increase savings for precautionary purposes. For most households, home purchases tend to be their largest singleasset. It will not therefore be unreasonable to assume that housing investment decisions have significant effect on the long-term wealth and consumption levels of households. In times of uncertainties household may likely defer investments in housing. Pastor andVeronesi (2011) maintain that the presence of uncertainty increases the cost of finance. Similarly,Gilchrist, Sim, and Zakrajsek (2011) suggest that uncertainty improves the likelihood of defaults on loans. In the context of households, uncertainty increases the cost of mortgages through high risk premium.Unarguable, the likelihood of defaults on mortgages and foreclosures increases with uncertainty relative to employment and income.

This studydiffers from the earlier studies on the impact of economic policy uncertainty on the housing markets in a number of ways. First, the present study extends the debate on theimpact of economic policy uncertainty on housing marketto Japan. Second, to the best knowledge of the authors, this is the first study to examine the existence of causality-in-mean and in-variance relative to the relationship between economic policy uncertainty and housing market returns using the BEKK-GARCH(1,1) model. The study finds evidence of causality in-mean from economic policy uncertainty to housing market returns in Japan for the pre-crisis period. The study also finds evidence of causality-in-mean from housing market returns to economic policy uncertainty for the post-crisisperiod. However, there is evidence of bi-directional causality-in-variance between economic policy uncertainty and housing market returns for the full sample and post-crisis periods. The findings of the study highlights the importance of economic policy uncertainty in predicting movements in the housing markets.

The remainder of this paper is organized as follows: Section 2 reviews the literature. Section 3 discusses themethodology. Section 4 presents thedata and the descriptive statistics. Section 5 provides the empirical results. Section 6 offers theconclusions and the policy implications of the study.

2. Literature Review

Interest in the relationship between economic policy and housing returns continue to persist as evidenced by the amount of literature in this topic. This is important because housing is one of the single most important investment a household makes, and it is estimated that the average household in the United States spends close to 30 percent of its income on housing. The housing market affects all aspects of the economy when the multiplier effects are taken into consideration. Initial studies explored the relationship between individual economic variables such as monetary policy, unemployment or poverty on housing return. With the recent housing market meltdown beginning in 2006, interest has shifted to the effects of policy uncertainty on housing returns.The impact of policy uncertainty on housing market returns has been studied in both developed and emerging economies (Miller and Peng, 2006; Miles, 2008; Barros et al., 2015, Antonakakis et al., 2015; Guirguis et al., 2015; Antonakakis and Floros, 2016; El Montasser et al, 2016).

Housing is one of the major expenditures made by the average household in many developed economies. In 2014, the average household spent about 28.5% of its income on housing in the United States, 26.6% in the United Kingdom, and 23.6% in Japan (Brett 2017). This represents the highest spending on a single item in these countries. Factors affecting housing values therefore would have great impact on spending by households and the economy in general.

Uncertainties surrounding any of the determinants of housing values will impact housing values themselves (El Montasser, Ajmi, Chang, Simo-Kengne, Andre, & Gupta, 2016). The implication is that uncertainties about future economic policies will affect housing price volatility.

Households view housing as a hedge during times of economic uncertainties. For instance, during high inflationary periods or macroeconomic uncertainties, savings are moved from liquid money to fixed assets, particularly housing. The relationship between policy uncertainty and housing values appears to be more complicated than originally believed. In their study, El Montasser, Ajmi, Chang, Simo-Kengne, Andre, and Gupta, (2016) found a bi-directional relationship between economic policy uncertainty and real housing prices in France and Spain, and a uni-directional causality from economic policy uncertainty to real housing prices in Canada, Germany and Italy, and a reverse causality between the two variables in the United States and United Kingdom. Cesa-Bianchi, Cespedes, and Rebucci, (2015) also found that housing prices grow faster, and are more volatile in emerging economies than in advanced economies. This indicates the need to study this relationship further in other countries to better understand the relationship between economic policy uncertainty and housing values.

The impact of economic policy uncertainty has been studies in various economic decision-making situations (Antonakakis, Gupta, & Andre, 2015). The problem with studies of policy uncertainty and housing values is the use of different measures of economic policy uncertainty by researchers. Sweet, Ozimek, and Asher, (2016) argued that policy uncertainty is difficult to measure, making the task of accurately quantifying policy uncertainty's impact on the economy difficult. Many earlier policy impact studies measure economic policy uncertainty in terms of the dates of events such as elections (Bernhard and Leblang 2006). Interest in quantifying the impact of economic policy uncertainty on the economy has led economists to incorporate a new measure in form of constructed indices for their studies. In their study, Cesa-Bianchi, Cespedes, and Rebucci, (2015) explored the relationship between economic policy uncertainty, measured by global liquidity shocks, and housing prices in both advanced and emerging economies. Antonakakis, Gupta, and Andre, (2015) on the other hand used an economic policy index developed by Baker, Bloom, and Davis (2012) and found a strong impact of lagged-EPU on housing values, implying a persistent effect of EPU over housing values over time. Schweitzer and Shane (2011) studied the effect of policy uncertainty on the hiring and capital investment of small businesses in the United States for the 1986 to 2011 period. They found statistically significant negative effects of policy uncertainty on small business owners' plans to hire and make capital expenditures. Krol (2014) extended the application by exploring the impact of general economic uncertainty on exchange rate volatility. To better study the impact of economic policy uncertainty, Baker et al. (2013) and Brogaard and Detzel (2012) constructed indices of economic policy uncertainty that measure the continuous evolution of economic policy uncertainty through time for the United States and other countries.

3 Methodology

This study uses the Phillips-Perron (Phillips-Perron, 1988) unit root procedures to determine the order of integration for the economic policy uncertainty and housing market return variables.In the interest of brevity, these unit root procedures will not be discussed here given that they have been extensively applied in the literature. The study adopts the BEKK-GARCH model to test for both causality in-mean and in-variance between economic policy uncertainty and housing market returns. The conditional mean equation takes the form following VAR model:

$$\chi_t = \lambda_t + \sum_{i=1}^{\rho} \theta_i \chi_{t-i} + \upsilon_t \qquad (1)$$

Where χ_t = (x_{1t},x_{2t}), x_1 and $x_2$stand for economic policy uncertainty and housing market returns, respectively. The parameter vector of the mean equation (1) is given by λ=(λ_1, λ_2) and the autoregressive term θ_i. $\upsilon_t = (\upsilon_1, \upsilon_2)$ represents the residual vector. In general, the residual vector is bivariate and normally distributed with conditional variance-covariance matrix given by:

$$H_t = \begin{bmatrix} h_{11t} & h_{12t} \\ h_{21t} & h_{22t} \end{bmatrix} \qquad (2)$$

$$H_t = C'_0 C_0 + \begin{bmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{bmatrix}' \begin{bmatrix} \varepsilon^2_{1,t-1} & \varepsilon_{1,t-1}\varepsilon'_{2,t-1} \\ \varepsilon^2_{1,t-1}\varepsilon'_{2,t-1} & \varepsilon^2_{2,t-1} \end{bmatrix} \begin{bmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{bmatrix} \begin{bmatrix} B_{11} & B_{12} \\ B_{21} & B_{22} \end{bmatrix}' H_{t-1} = \begin{bmatrix} B_{11} & B_{12} \\ B_{21} & B_{22} \end{bmatrix} \qquad (3)$$

Equation (2) is the dynamic process of H_t as a linear function of its own past value H_{t-1},in conjunction with the past values of the squared innovations ($\upsilon^2_{1,t-1}, \upsilon^2_{2,t-1}$).

This model allows the conditional variances and covariances of economic policy uncertainty and housing market returns to influence each other. The researcher using this model is able to test the null hypothesis of spillover effects in one or both directions. One of the attractive features of the BEKK modelinvolves its ability to ensure that the variance-covariance matrix is positive definite.

The parameters of the multivariate BEKK-GARCH model are to be estimated by maximizing the log likelihood function as follows:

$$L_{norm} = -\tfrac{1}{2}\left[m\log(2\pi) + \log(|H_t|)\varepsilon'_t H_t^{-1}\varepsilon_t\right] \quad (4)$$

*Wherem*is the number of conditional mean equations and $\varepsilon_t$represents *m* vector of the residuals from the mean equation.

3.1Testing for Causality-in-Variance

The residual cross-correlation function (CCF) procedure proposed by Cheung and Ng (1996) and extended by Hong (2001) was used by most of the earlier studies in testing for causality-in-mean and -in-variance. The CCF involves two steps. In step one, univariate GARCH models are estimated and both the standardized and squared residuals are recovered. In the second step, causality-in-mean is tested by using the cross-correlation coefficients between the standardized residuals. On the other hand, causality-in-variance is tested by using the cross-correlation coefficients between the squared standardized residuals.

Dijk, et al. (2005) documents that the CCF tends to provideinconsistent results regardingthe existence of causality-in-variancewhen there are structural breaks in the data generating process.Caporale et al. (2002) proposed an alternative model based on the estimation of a multivariate GARCH framework. Using this framework, the researcher can test for causality-in-varianceby restricting the relevant conditional variance parameters to zero. Caporale et al. (2002) points out that causality can emerge in either direction by sequentially constraining the matrices *A11* or *B11* to be upper and lower triangular. Hafner and Herwartz (2004) show that the multivariate GARCH framework proposed by Caporale et al. (2002) possessesgood power properties and robust to model misspecification. The multivariate GARCH framework can be used to simultaneously test the null hypotheses of no causality-in-variance from $x_{1t}$to x_{2t}(i.e. H_0: $A_{12} = B_{12} = 0$) and no causality-in-variance from x*2t* to x*1t,* (i.e. H0: A21 = B21 = 0). Pantelidis and Pittis (2004) contend that causality-in-variance tests are mostly likely to suffer from size distortions, especially when causality-in-mean effects are not taken into consideration. To mitigate this weakness, this study employs the VAR specification of equation (1) to test for causality- in- mean.

3.2 Data and Description Statistics

This study uses quarterly data on economic policy uncertainty and housing market returns for Japan for the period running from 1990Q1 to 2012Q4. The data on economic policy uncertainty were retrieved fromwww.policyuncertainty.com.The economic policy uncertainty data are based on the work of Baker et al., (2015). The data on real housing prices are obtained from the house price database developed by Cesa-Bianchi et al. (2015). The housing prices data can be downloaded at: https://sites.google.com/site/ambropo/publications.To assess the impact of the Asian financial crisis, the sample period is divided into two including pre-crisis (1990Q1 through 1999Q4) and post-crisis period (2001Q1 through 2012Q4). The housing market returns were obtained by the transformation: HR = ln(LMR_t) – ln(HMR_{t-1}). The economic policy uncertainty variable was expressed in natural logarithms as JEPU = ln (EPU).

Table 1: Descriptive Statistics and Unit Root Test Results

	Full Sample Period		***Pre-Crisis***		***Post-Crisis***	
	1990Q1 – 2012Q4		1990Q1 – 1999Q4		2000Q1 – 2012Q4	
Statistic	HR	JEPU	HR	JEPU	HR	JEPU
Mean	-0.007	97.831	-0.006	94.336	-0.009	100.519
Maximum	0.028	177.286	0.028	163.170	-0.001	177.286
Minimum	-0.020	44.684	-0.020	44.684	-0.019	55.686
Std. Dev.	0.007	28.539	0.010	28.276	0.004	28.721
Skewness	2.043	0.741	1.704	0.653	-0.269	0.817
Kurtosis	12.041	3.177	7.683	2.753	2.602	3.410
Jarque-Bera	373.189***	8.536**	54.511***	2.949	0.972	6.153**
Probability	0.000	0.014	0.000	0.229	0.615	0.046

***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.HR = housing market returns and LEPU = natural logarithm of Economic Policy Uncertainty.

Table 2: Phillips-PerronUnit Root Test Results

Series	**t-stat**	**Lag(s)**	**1%CV**	**5%CV**
Panel A: Full Sample Period (1990Q1 – 2012Q4)				
HR	-6.554***	3	-4.063	-3.461
JEPU	-6.238***	3	-4.063	-3.461
Panel B: Pre-Crisis Period (1990Q1 – 1999Q4)				
HR	-4.751***	1	-4.063	-3.461
JEPU	-5.196***	2	-4.063	-3.461
Panel B: Post-Crisis Period (2000Q1 – 2012Q4)				
HR	-3.994**	4	-4.063	-3.461
JEPU	-4.978***	3	-4.063	-3.461

***and** indicate significance at the 1% and 5% level, respectively. HR = housing market returns and LEPU = natural logarithm of Economic Policy Uncertainty.

Table 1 displays the descriptive statistics for economic policy uncertainty and housing market returns for thefull sample and the two subsamples pre- and post-Asian financial crisis period. The mean values for housing market returns are all less than zero in all of the sample periods. For instance, the mean value of housing market returns is -0.007% for the full sample period. The mean values of the economic policy uncertainty variable are 97.831, 94.336 and 100.519, respectively for the full sample, pre-crisis and post crisis sub-periods. The standard deviations for housing market returns are close to zero. On the other hand, the standard deviations for the economic policy uncertainty variable varied from a high of 28.721 for the post-crisis period to a low of 28.276 for the pre-crisis period. The nonzero skewness and high excess kurtosis (over 3) observed for the economic policy uncertainty and housing market return variablessuggest that the two series are inconsistent with normal distributions. The minimum and maximum statistics suggest that both housing market returns and the economic policy uncertainty variable have fluctuated for the time period under study. For instance, the returns for All REITs ranged from a minimum of -30.23 to a maximum of 27.97 percent. The Jarque-Bera statistics for economic policy uncertainty and housing market returns reject the null hypothesis of normality at least, at the 5% significance level with the exception of JEPU and HR in the pre- and post-crisis sub-periods, respectively.

4 Empirical Results

The study uses the Phillips-Perron unit root test presented in Table 2 to determine the time series properties of economic policy uncertainty and housing market returns. The optimal lags were determined through the Modified Akaike Information Criterion (MAIC). The unit root test results indicate that economic policy uncertainty and housing market returns have zero order of integration. The test statistics reject the null hypothesis of a unit root in all of the sample periods, at least at the 5 percent level of significance. For instance, the test statistic for economic policy uncertainty and housing market returnsfor the full sample period are -6.238 and -6.554 while the critical value at the 1 percent level is -4.063.

Having established that the economic policy uncertainty and housing market return variables are level stationary, the study next uses the GARCH models to test for causality in-mean and in-variance. Akaike Information Criterion was used to determine that GRACH(1,1)-BEKK was most appropriate for both the mean and conditional variance equations. The estimates between economic policy uncertainty and housing market returnfrom the BEKK-GARCH(1,1) model for the three sample periods are displayed in Table 3. The results presented in Panel A of Table 3 reveal that housing market returns are significantly positively affected by their first (HR_{t-1}) and second (HR_{t-2}) lagged values at least at the 5 percent level for full sample period.

However, housing market returns are significantly affected by their second lagged value (HR_{t-2}) in the pre-crisis period and by their first lagged(HR_{t-1}) value in the post- crisis period. The results show that economic policy uncertainty does not have mean effect on housing market returns in the full and post-crisis periods, as the regression coefficients on ($LEPU_{t-1}$) and ($LEPU_{t-2}$) are not statistically significant at the conventional levels. However, in the pre-crisis sample period, economic policy uncertainty has significant impact on the mean ofhousing market returns given that the regression coefficients on ($LEPU_{t-1}$) and ($LEPU_{t-2}$) are statistically significant at the 1 percent level. These results provide evidence of mean spillover from economic policy uncertainty to housing market returns in the pre-crisis but not in the full and post-crisis sample periods.Turning next to the results from the mean equation for economic policy uncertainty, it can be seen that housing market returns do not have significant effect on LEPU as the regression coefficients on (HR_{t-1}) and (HR_{t-2}) are not statistically significant in all of the sample periods. These results suggest that there is no mean spillover effect from housing market returns to economic policy uncertainty. However, economic policy uncertainty is affected by its first lagged value since the regression coefficient on ($LEPU_{t-1}$) is statistically significant at the 1 percent level in all of the sample periods.

Table 3: BEKK-GARCH (1,1) Estimates (Housing Market Returns and Economic Policy Uncertainty)

	Full Sample Period		Pre-Crisis		Post-Crisis	
	1990Q1 – 2012Q4		1990Q1 – 1999Q4		2000Q1 – 2012Q4	
Series	Parameter	*t*-Statistic	Parameter	*t*-Statistic	Parameter	*t*-Statistic
Panel A: Mean Equations						
Constant	-0.006	-0.732	-0.001**	-2.435	0.004	0.597
$HR_{\{t-1\}}$	0.193**	2.197	-0.057	-0.953	0.522***	4.112
$HR_{\{t-2\}}$	0.247***	3.249	0.341***	5.705	0.153	1.276
$LEPU_{\{t-1\}}$	0.001	0.412	-0.003***	-8.733	-0.002	-1.201
$LEPU_{\{t-2\}}$	0.000	-0.153	0.002***	7.005	0.000	0.109
Constant	2.517***	4.581	1.916***	65.404	3.224***	4.539
$HR_{\{t-1\}}$	-5.772	-1.058	4.229	1.091	0.065	0.006
$HR_{\{t-2\}}$	8.177	1.543	-1.753	-0.489	19.073	1.590
$LEPU_{\{t-1\}}$	0.429***	4.380	0.569***	51.330	0.409***	3.104
$LEPU_{\{t-2\}}$	0.018	0.178	-0.007	-0.812	-0.077	-0.655
Panel B: Variance Equations						
C(1,1)	-0.001	-0.743	0.000	0.179	0.002***	5.810
C(2,1)	0.238***	9.061	-0.173***	-5.664	-0.049	-0.724
C(2,2)	0.000	0.000	0.000	0.000	0.000	0.000
A(1,1)	0.120	0.644	0.040	0.341	0.806***	4.160
A(1,2)	-21.361**	-2.229	31.900***	3.319	24.456*	1.708
A(2,1)	0.009***	4.237	-0.017***	-5.974	0.001	0.569
A(2,2)	-0.188	-1.174	0.380**	2.154	-0.121	-0.655
B(1,1)	0.829***	10.926	0.496***	5.747	-0.136	-0.701
B(1,2)	11.213	0.930	8.793	1.088	58.062***	4.632
B(2,1)	0.001	0.285	0.001	0.446	-0.001	-0.203
B(2,2)	0.054	0.121	-0.321	-1.366	-0.275	-0.845

***, ** and * indicate significance at the 1%, 5% and 10% level, respectively. HR = housing market returns and LEPU = natural logarithm of Economic Policy Uncertainty

The results from the variance equation are displayed in Panel B of Table 3. The coefficients A(1,2) and B(1,2) denote the spillover effect from housing market returns to economic policy uncertainty. Similarly, the coefficients A(2,1) and B(2,1) reveal the spillover effect from economic policy uncertainty to housing market returns. The results show that housing market returns respond to their own shocks and conditional volatility since either the coefficient A(1,1) or B(1,1) is statistically significant at the 1 percent level in the full sample and both sub-periods. However, economic policy uncertainty responds to its own shocks and conditional volatility only in the pre-crisis periodgiven that the coefficients A(2,2) is statistically significant at the 5 percent level.

There results provide evidence of spillover effect from economic policy uncertainty to housing market returns in all of the sample periods as either the coefficient A(1,2) or B(1,2) is statistically significant at least at the 5 percent level. Conversely, evidence of spillover effect from economic policy uncertainty to housing market returns is indicated only for the full sample and the pre-crisis periods, since the coefficients A(2,1) is statistically significant at the 1 percent significance level.

4.1 Diagnostic Test Results

Tables 4A and 4B present a battery of diagnostic tests including the Ljung-Box Q-test for serial correlation in residuals, ARCH in residuals, Ljung-Box Q-test for serial correlation in squared residuals, the sign and size tests. The Ljung-Box Q-test results presented in Panels A and B of Table 4B suggest that the null hypothesis of no serial correlation in the residuals should be, accepted in both the equations for housing market returns and economic policy uncertainty. In each of these cases, the *p*-value exceeds the conventional levels of significance. Similarly, the results for the *F*-test of no ARCH versus ARCH effect in the residuals indicate that the null hypothesisshould not be rejected based on the test statistics and their associated*p*-values presented in Panels A and B of Table 4A. Similar results aresuggested by the McLeod-Li, Turning Points, Difference Sign and Rank diagnostic tests.Table 4B presents the diagnostic test results on the squared residuals from both the housing market returns and economic policy uncertainty equations.

Table 4A: Diagnostic Tests onResiduals

	Full Sample Period 1990Q1 – 2012Q4		Pre-Crisis 1990Q1 – 1999Q4		Post-Crisis 2000Q1 – 2012Q4	
	Test Statistic	*P-Value*	*Test Statistic*	*P-Value*	*Test Statistic*	*P-Value*
Panel A: Housing Return Equation						
Ljung-Box Q(5)	9.112	0.110	4.649	0.460	6.944	0.225
McLeod-Li(5)	3.489	0.625	3.444	0.632	4.658	0.459
Turning Points	-0.254	0.800	-0.533	0.594	1.708*	0.088
Difference Sign	-0.365	0.715	1.124	0.261	-1.698*	0.090
Rank Test	0.595	0.552	2.276	0.023	1.113	0.266
ARCH(5)	0.721	0.610	0.452	0.808	1.427	0.236
Panel B: Economic Policy Uncertainty Equation						
Ljung-Box Q(5)	2.691	0.748	4.119	0.532	5.889	0.317
McLeod-Li(5)	6.415	0.268	4.777	0.444	2.850	0.723
Turning Points	0.000	1.000	-1.333	0.183	0.683	0.494
Difference Sign	-0.730	0.465	-3.372	0.001	0.728	0.467
Rank Test	0.730	0.465	-1.465	0.143	-1.113	0.266
ARCH(5)	1.473	0.208	1.018	0.427	0.407	0.841

* indicates significance at the 10% level

Table 4B: Diagnostic Tests on Residuals Squared

	Full Sample Period 1990Q1 – 2012Q4		Pre-Crisis 1990Q1 – 1999Q4		Post-Crisis 2000Q1 – 2012Q4	
	Test Statistic	*P-Value*	*Test Statistic*	*P-Value*	*Test Statistic*	*P-Value*
Panel A: Housing Return Equation						
Ljung-Box Q(5)	3.489	0.625	3.444	0.632	4.658	0.459
McLeod-Li(5)	1.088	0.955	1.700	0.889	1.679	0.892
Turning Points	-1.016	0.310	1.066	0.286	-1.025	0.305
Difference Sign	0.000	1.000	0.000	1.000	-0.243	0.808
Rank Test	-0.057	0.955	-0.602	0.547	1.715I*	0.086
ARCH(5)	0.252	0.935	0.452	0.808	0.360	0.873
Panel B: Economic Policy Uncertainty Equation						
Ljung-Box Q(5)	6.415	0.268	4.777	0.444	14.746	0.142
McLeod-Li(5)	2.578	0.765	1.324	0.933	3.253	0.975
Turning Points	-1.524	0.128	-1.333	0.183	-1.025	0.305
Difference Sign	1.461	0.144	-1.686	0.092	-0.243	0.808
Rank Test	-0.602	0.547	-1.439	0.150	-1.414	0.158
ARCH(5)	0.585	0.712	0.215	0.953	0.139	0.982

* indicates significance at the 10% level

The Ljung-Box Q-test results on the squared residuals suggest that the null hypothesis of no serial correction should be accepted for both housing market returns and economic policy uncertainty, as the test statistics are statistically insignificant. The results for the *F*-test of no ARCH versus ARCH effect in the squared residuals indicate that the null hypothesisshould not be rejected based on the test statistics and their associated*p*-values presented in Panels A and B of Table 4B.Similar results are indicated by the McLeod-Li, Turning Points, Difference Sign and Rank diagnostic tests. Taken together, the results from the various diagnostic tests indicate that the specified equations for the housing market returns and economic policy uncertainty possess the attributes of good models. Simply put, these results indicate that the estimated equations are correctly specified.

4.2 Causality-in-Mean and Causality-in-Variance Test Results

Table 4presents the Granger causality-in-mean and causality-in-variance test results between housing market returns and economic policy uncertainty for the three sample periods. Panel Aof Table 4 displays the causality-in-mean test results. The results provide evidence of mean spillover from housing market returns to economic policy uncertainty in the post-crisis period, as the test statistic 4.418 is statistically significant at the 10 percent level. However, in the full and pre-crisis periods, there was no evidence of causality-in-mean from housing market returns to economic policy uncertainty.The results also showevidence of causality -in-mean from economic policy uncertainty to housing market returns in the post-crisis period, given that the test statistic 238.639 is statistically significant at the 1 percent level. However, there was no evidence of mean spillover from economic policy uncertainty to housing market returns in the full sample period and post-crisis sub-period. The results for the causality-in-variance tests from the variance equations are presented in Panel B of Table 5.

Table 5: CausalityTest Results

	Full Sample Period		Pre-Crisis		Post-Crisis	
	1990Q1 – 2012Q4		1990Q1 – 1999Q4		2000Q1 – 2012Q4	
Hypothesis	*Chi-Sq. Stat*	*P-Value*	*Chi-Sq. Stat*	*P-Value*	*Chi-Sq. Stat*	*P-Value*
Panel A: Causality-in-Mean						
No causality-in-mean from HR to LEPU						
H_0: $HR_{t-1} = HR_{t-2} = 0$	2.449	1.291	1.291	0.524	4.418*	0.100
No causality-in-mean from LEPU to HR						
H_0: $LEPU_{t-1} = LEPU_{t-2} = 0$	0.170	0.919	238.639***	0.000	1.610	0.447
Panel B: Causality-in-Variance						
No causality-in-variance from LEPU to HR						
H_0: A(2,1) = B(2,1) = 0	18.080***	0.000	36.092***	0.000	0.411	0.814
No causality-in-variance from HR TO LEPU						
H_0: A(1,2) = B(1,2) = 0	5.325*	0.070	11.251***	0.003	26.091***	0.000

***, ** and * indicate significance at the 1%, 5% and 10% level, respectively. HR = housing market returns and LEPU = natural logarithm of Economic Policy Uncertainty

These results were obtained by constraining the matrices A11 and B11 to be upper triangular or lower triangular which allows causality to emerge in one direction at a time. The results show evidence of causality-in-variance from economic policy uncertainty to housing market returns in the full sample period and the pre-crisis sub-period. The test statistics 18.080 and 36.092, respectively for the full sample and pre-crisis period are statistically significant at the 1 percent level. Similarly, there is evidence of causality-in-variance from housing market returns to economic policy uncertainty in all of the three sample periods. The test statistics 5.325, 11.251 and 26.091, respectively for the full sample, pre-crisis and post-crisis periods, are statistically significant at least at the 10 percent level.

These results provide evidence of bi-directional causality-in-variance between economic policy uncertainty and housing market returns for the full sample period and the pre-crisis sub-period. However, there the results show that causality-in-variance runs from economic policy uncertainty to housing market returns in the post-crisis period.

5 Conclusions and Implication

This paper has used the BEKK-GARCH(1,1) model to investigate the existence of causality in-mean and in-variance between housing market returns and economic policy uncertainty for Japan. The Phillips-Perron unit root tests were used to determine the order of integration for housing market returns and economic policy uncertainty. To assess the impact of the Asian financial crisis, the sample was divided into namely pre-crisis crisis (1990Q1 to 1999Q4) and post-crisisperiod (2001Q1 to 2012Q4). The results from the Phillips-Perron unit root tests reveal that housing market returns and economic policy uncertainty have zero order of integration. Based on the results from the Phillips-Perron unit root tests, the BEKK-GARCH(1,1) models were estimated using the levels of the two series. The results from the BEKK-GARCH(1,1) models provide evidence of causality in-mean from housing market returns to economic policy uncertainty in the post-crisis period but not in the full sample and pre-crisis period. However, there was evidence of causality in-mean from economic policy uncertainty to housing market returns only in the pre-crisis period. The results also provide evidence of Granger-causality in-variance from economic policy uncertainty to housing market returns for the full sample period and pre-crisis period, but not in the post-crisis period. The results also show evidence of causality-in-variance from housing market returns to economic policy uncertainty in all of the three sample periods. In all, the results indicate that the impact of the variances of housing market returns on economic policy uncertainty endured the Asian financial crisis. This finding indeed reflects spillover effect from the housing market to the wider Japanese economy.It also collaborates the conventional wisdom that recessions caused by housing market crisis are usually deeperand more protracted. The effect of economic policy uncertainty on housing market returns did not extend past the pre-crisis period. Our results highlight the importance of the housing marketin influencing economicpolicy choicesin Japan. This information is crucial to real estate investors, policymakers and financial institutions as it enables them to predict the impact of economic policy uncertainty on housing market.

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