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Does the Economic Policy Uncertainty of Korea, The U.S., and Japan Affect Korean Housing Prices?

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This study performed an empirical analysis using the Markov regime-switching (MRS) model to determine whether the Economic Policy Uncertainty (EPU) of Korea, the U.S., and Japan affects Korean housing transaction price volatility. The analysis period was from January 1990 to August 2022, and the results are as follows: First, the EPU indices of Korea, the U.S., and Japan had adverse effects on Korean housing prices in Regime 1 with low volatility. Second, The EPU indices of the U.S. and Japan during the period after the Global Financial Crisis (GFC) showed a negative spillover effect in the Korean housing prices, regardless of the business regime; therefore, synchronization among nations increased. Third, this study effectively identified that the effects of EPU on each nation's housing prices were different depending on the period, region, and business regime using the MRS model. Consequently, there is a need to enhance policy implementation forecasting ability considering physical factors, including the EPU index, as a policy goal management indicator for the economic stabilization of the real estate market.

Keywords: housing sales price, EPU (Economic Policy Uncertainty), volatility, impact, Markov regime switching model

1. Introduction

Uncertainty means a situation in which a future situation is challenging to forecast. Uncertainty means risk in economics. Bloom (2014), Baker et al. (2016), and Lee (2018) assert that economic contraction may occur if Economic Policy Uncertainty (EPU) becomes higher within an economy because economic players show a wait-and-see mechanism by postponing investments, consumption, employment, real estate development, and transactions. If uncertainty increases within the economy, various difficulties are engendered, including postponed business promotion, due to high cost and low efficiency and risk-averse entrepreneurs' pursuit of new business fields.

As the real estate markets became open to prevent the deflation of assets after the foreign exchange crisis, the synchronization among nations became higher, and the possibility of one nation's EPU spilling over to other nations likewise increased. The subprime mortgage crisis triggered in the U.S. in 2008 sent a shock to the Korean real estate market and the global financial crisis. The spread of the COVID-19 pandemic considerably slowed down the global economy. The war between Russia and Ukraine threatened the global supply chain, so the real economy, including Korea's recent exports and the world's economy, became much lower than expected. Overall, asserting that uncertainty affects the economy is gaining persuasive power. Because the Korean economic structure is highly foreign dependent, a problem that other nations' EPU will have huge effects on Korean real estate price volatility is raised.

Housing price volatility means a risk to investors and policymakers; therefore, accurate identification of it is not only crucial for timely investments, investment strategies, housing pricing, and portfolio management but essential for policy authorities to execute effective policies proactively. French and Roll (1986) pointed out that stock price volatility is closely related to information. Likewise, housing price volatility can display different responses per business regime depending on the characteristics of information arriving in the housing market. Specifically, housing price volatility occurs depending on the business regime because it reflects ever-changing domestic and foreign information arriving at the housing market. When uncertainty is high, there can be a trend that the forecasting ability of real estate price volatility is massively reduced.

Consequently, investors or policy authorities must identify uncertainty-related information and prevent forecasting ability from declining quickly. However, there are few empirical studies on whether EPU affects housing price volatility depending on the regime and, if so, on what effect level exists.

This study aims to analyse whether the EPU of Korea, the U.S., and Japan affects Korean housing price volatility depending on business regime using the Markov Regime-Switching (MRS) model and to present implications by analysing transition probability and expected duration per regime. The results of this study can make academic contributions in that they provide rich baseline information for the study by drawing a significant relationship between uncertain information and volatility.

In addition, there is a practical benefit that this study can present forecasting models through which the real estate market can be dynamically understood.

Existing studies on the EPU and macroeconomic variables researched relationships between uncertainty and industrial production, employment, investments, stock prices, and foreign exchange. Using the panel VAR model, Christou et al. (2017) reported that the U.S. EPU had adverse spillover effects on Canadian, Australian, Japanese, Chinese, and Korean stock returns. Leahy and Whited (1996), Baum et al. (2008), Stockhammer (2010), and Mody et al. (2012) presented study results that investment decision-making or consumption is postponed until the uncertainty is resolved because uncertainty functions as a risk factor. As a result of researching correlations between uncertainty and non-energy raw materials, including copper, nickel, and coffee, Poncela, Senra, & Sierra (2014) asserted that uncertainty affected raw material price volatility. Baker, Bloom, & Davis (2016) presented empirical analysis results when EPU went up during 2005-2006 and 2011-2012, as follows, using the VAR model: The total investment, industrial production, and employment of the U.S. dropped by 6%, 1.1%, and 0.35%, respectively. According to them, such a phenomenon occurred similarly in 12 nations, including the U.S.

Kim (2018) insisted that the U.S. EPU made Korean stock prices, interest rates, and yen/dollar exchange rates fall, respectively, but made won/dollar exchange rates rise and that the U.S. EPU negatively spilled over to Korean macroeconomic variables. Jeon (2017) analysed the effects of the EPU of Korea, the U.S., and Japan on the crude oil, coffee, and gold prices using the VECM model. He stated that the EPU of Korea and Japan negatively affected international oil prices but positively affected coffee and gold prices. He also asserted that the U.S. EPU had a negative effect on energy, gold, and coffee prices.

Meanwhile, studies on correlations between EPU and housing prices have been conducted to some degree. Choudhry (2020) analysed relationships between EPU and housing prices empirically, targeting 10 cities in England and Wales, and reported that long-term cointegration relations in nine cities and that EPU debilitated housing prices. The result shows that EPU is critical in housing price volatility and demand decisions. Su et al. (2019) analysed the correlations between German housing prices and EPU through the Granger causality test. According to the analysis result, strong causality existed between housing prices and EPU, and the EPU negatively affected housing price volatility significantly. Christophe et al. (2015) analysed the relationship between EPU and housing prices. As a result of the analysis, structural break and non-linear relationships were displayed between EPU and housing prices. They also presented a negative relationship between housing price returns and volatility. According to Mohsen and Seyed (2017), who analysed the relationship between the U.S. housing prices and EPU using the bounds testing approach and Error Correction Model (ECM), the EPU negatively affected housing prices in 24 states for the short term. It was also reported that the short-term effect could influence long-term housing prices in 17 states. Kim et al. (2020) analysed the connection between EPU and housing price fluctuation rate using the connectedness index. It was found that The EPU index affected 3.6% of net connectedness with the national housing price fluctuation rate and 3.4% of net connectedness with the Seoul Metropolitan Area and local housing price fluctuation rates. The analysis result means the EPU index may significantly affect the housing price fluctuation rate. However, finding any study on whether the EPU index affects the housing price fluctuation rate depending on the business regime is challenging.

Differentiation in this study is as follows: First, this study attempted international comparative analysis on whether housing price volatility shows different responses depending on business regimes using the MRS model. Second, this study provided a model to effectively analyse the nonlinear characteristics of housing transaction price time series concerning EPU shock. Third, this study provided insight to dynamically understand the real estate market volatility by analysing the correlations between the EPUs of Korea and the U.S., and the housing prices in Japan and Korea. The composition of this study is as follows: Chapter 2 explains the analysis data and the MRS analysis model. Chapter 3 presents the analysis results, and Chapter 4 presents a discussion. Chapter 5 presents the conclusion.

2. Analysis of Data and Model

2.1. Analysis of Data

The data used in this study are the Korean housing price index and the EPU of Korea, the U.S., and Japan. The Korean housing price index is a nationwide apartment price index announced by KB Bank. This study used the EPU of Korea, the U.S., and Japan, respectively, provided by the Economic Policy Uncertainty website monthly. In Korea, the EPU index has been provided since January 1990.

The EPU index is announced on the Economic Policy Uncertainty website per nation by mainly calculating uncertainty related to such keywords as economic policy, economy, deficit, tax, regulation, government, each nation's central bank, and the Ministry of Economy and Finance, as released from the major press of Korea, the U.S., and Japan (Baker et al. 2016). Korean EPU index is calculated, centered on uncertainty keywords related to economic policy reported in six newspaper articles, including the DongA Ilbo, Korea Economic Daily, Maeil Business Newspaper, and Kyunghyang Shinmun. The EPU time series values have been calculated by standardizing the EPU frequency value calculated by dividing each newspaper company's EPU article count by the total article count in the month concerned per Newspaper Company. The higher the EPU index value is, the higher the EPU is.

Fig. 1 shows the Korean housing index trend and the EPU indices of Korea, the U.S., and Japan. The global financial crisis in September 2008, the European sovereign debt crisis in February 2010, the Impeachment of President Park Geun-hye in 2017, and the COVID-19 pandemic in March 2020 shows the same direction movement as the Korean housing price fluctuation rate.

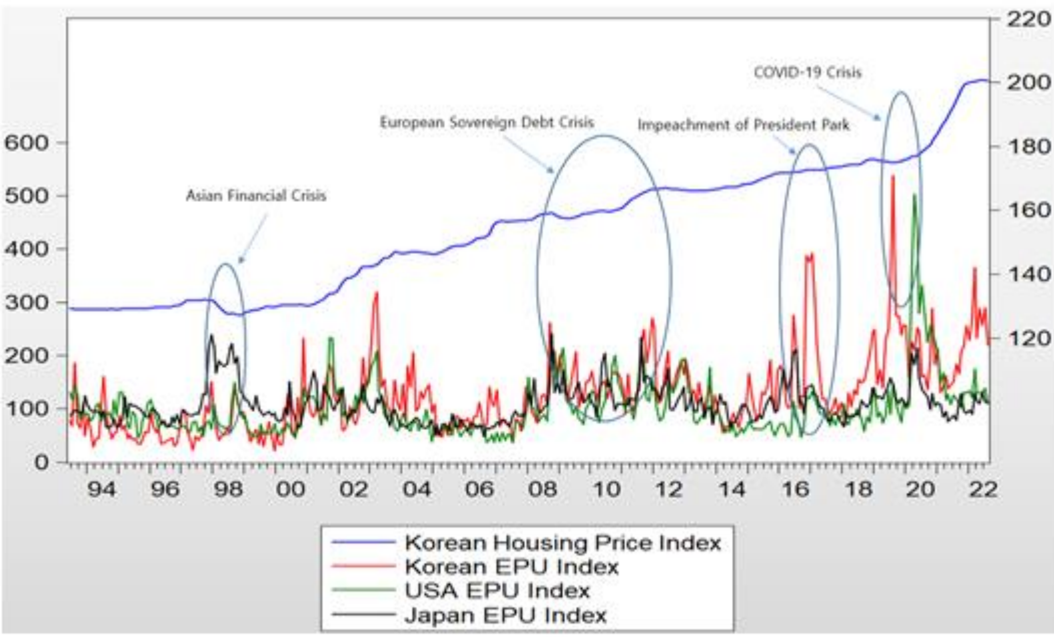

Fig. 1: Trend of the Korean housing prices and the EPU indices of Korea, the U.S., and Japan

Source: Economic Policy Uncertainty website

2.2. Analysis Model

The regime-switching model is a case in which the stochastic process of observation variable is subordinated to non-observation state variable . If the state variable is observable, models can be set to have different parameter values in each business regime using dummy variables. However, observation is impossible in reality, so a quantitative technique to process is required. One quantitative technique is the Hamilton model (Kim and Jang 2003).

This study analyses the effects of EPU indices on each business regime's housing price volatility by applying the Markov regime-switching model presented by Hamilton (1989). The housing transaction price index fluctuation rate ( ) is used for the observation variable indicating the housing market economy. IF the mean and the mean value follow the m order autoregressive process, Park (2010) indicated the two-state Hamilton models as follows.

$$(y_t - \mu_{S_t}) = \phi_1(y_{t-1} - \mu_{S_{t-1}}) + \cdots \phi_m(y_{t-m} - \mu_{S_{t-m}}) + \epsilon_t, \quad \epsilon_t \sim N(0, \sigma^2) \qquad (1)$$

$$\mu_{S_t} = \mu_1 \ \ if\ S_t = 1, \qquad \mu_2 \ \ if\ \ S_2 = 2, \qquad S_t = 1,2$$

If is defined as a discrete probability variable with a value of 1 in the recession regime and 2 in the boom regime, the mean growth rate ( ) has in the contraction regime and in the expansion regime according to . Namely, it is assumed that different mean or is indicated depending on regime and that complies with the deviated portion from the mean in each regime , which is an m order autoregressive process. This study considers the fact that the two-state regime switching model presented by Hamilton (1989) has autocorrelation and estimates using the MRSAR (two-state Markov regime switching autoregression) model (Frühwirth-Schmatter 2006), including the explanatory variable, regardless of the regime and in terms of AR(p). Because Equation 1 is not identified generally, a probability law setting housing market recession or an escape from recession is necessary. One of the methods is to assume that the business fluctuation regime complies with and the independent two-state 1st Markov chain stochastic process regarding all states.

$$\mathrm{P}(S_t = j \big| S_{t-1} = i,\ z_t,\ z_{t-1}, \cdots) = P(S_t = j \big| S_t = i) = p_{ij} \ (2)$$

The above is a general case and is a stochastic process taking a finite N integer whose is . If the process is in the i-state at present, and if the probability exists to belong to j-state (the next time, the process is called the Markov chain.

$$\mathrm{P}(S_t = j \big| S_{t-1} = i) = p_{ij} \qquad (3)$$

$$p_{ij} \geq 0, \qquad \sum_{j=1}^{N} p_{ij} = 1, i, j = 1,2, \ \cdots N$$

p_{ij} can be indicated as a matrix, and it is called a transition matrix or stochastic matrix.

$$\mathrm{P} = p_{ij} = \begin{bmatrix} p_{11}p_{21} \cdots p_{N1} \\ p_{12}p_{22} \cdots p_{N2} \\ \vdots \quad \vdots \ \cdots \ \vdots \\ p_{1N}p_{2N} \cdots p_{NN} \end{bmatrix} \qquad (4)$$

In the case of a 2-state Markov chain where N is 2, the stochastic matrix is as follows:

$$\mathrm{P} = \begin{bmatrix} p_{11} & 1 - p_{22} \\ 1 - p_{11} & p_{22} \end{bmatrix} \qquad (5)$$

In Equation 5, the transition probability   means the probability that the contraction regime revealed during the t-1 period can continue in the t period.   means the probability that the expansion regime revealed in the t-1 period may continue in the t period.   and   are the probabilities that the regime in the t-1 period is to be spilled over to another regime in the t period. The status of transition of the business regime by the two-state 1st Markov chain model is identified using   or   value revealed as a result of estimation results of Equations 1 and 3. If one state continues for a certain period, it is called regime duration, and the period that regime   continues is calculated as . Model estimation is carried out using the maximum likelihood estimator (MLE).

3. Stimation Result

3.1. Data Characteristics

The data stability test is essential to avoid spurious regression in the time series analysis. As a result, ADP and PP tests targeting the housing transaction price index were shown as unstable time series because the null hypothesis that the unit root exists in the level variable is not rejected. Therefore, the logarithmic differencing of the housing price index, multiplying it by 100, and converting it in an increasing/decreasing rate was revealed as stable. The EPU indices of Korea, the U.S., and Japan rejected the null hypothesis in a level variable, so the time series was stable. Therefore, this study used a level variable. The period of data used for analysis was from January 1990 to August 2022, when the EPU index data could be obtained in Table 1, showing the basic statistics of variables.

Table 1: Basic statistics

		Housing Price		**EPU of Korea**		**EPU of the U.S.**		**EPU of Japan**	
Mean		0.3519		126.7		100.9		108.1	
Standard deviation		0.7730		72.5987		54.9552		34.7340	
Skewness		0.5966		1.4341		2.8865		1.2917	
Kurtosis		9.4657		6.4467		16.4677		5.0221	
Jarque-Bera Statistics		630.41		294.04		3140.08		157.40	
Unit root test		Level	1st Differencing	Level	1st Differencing	Level	1st Differencing	Level	1st Differencing
	ADF test	0.7590	-5.8335 ***	-5.2914 ***	-	-5.6513 ***	-	-6.6702 ***	-
	PP test	1.6907	-5.6915 ***	-6.5577 ***	-	-5.5962 ***	-	-6.3581 ***	-

Note:

1. ( ) is the significance level that can reject the null hypothesis.

2. p<0.01***, p<0.05**, p<0.1*

3. Lag for tests was set as 1, including constant.

Concerning the mean of EPU, Korean EPU volatility was higher by 10% or more than that of the U.S. and Japan, so it was relatively unstable. Skewness revealed that the EPU indices of the three nations were skewed distribution in a positive (+) direction, and kurtosis showed distribution with more leptokurtic properties than a normal distribution. Because the housing price returns and Jarque-Bera statistics of the EPU indices of Korea, the U.S., and Japan rejected the null hypothesis at a 1% significance level, they turned out to be non-normal distribution.

Table 2 shows the correlations between the housing price index and the Korean EPU index (KEP), the U.S. EPU index (UEP), and the Japanese EPU index (JEP) prior to analysis. Between the housing price index and KEP, UEP, and JEP, 0.60, 0.29, and 0.10 correlation respectively existed, and all were significant at a 1% significance level.

Table 2: Correlations between housing price and KEP, UEP, and JEP

	Housing Price	KEP	UEP	JEP
Housing Price	1			
KEP	0.6016	1		
	[14.0700*]			
	(0.0000)			
UEP	0.2904	0.5160	1	
	[5.6709*]	[11.2545]		
	(0.0000)	(0.0000)		
JEP	0.1009	0.3729	0.4224	1
	[1.8955*]	[7.5079]	[8.7069]	
	(0.0588)	(0.0000)	(0.0000)	

Note:

1. [ ]: t value, ( ): P value

2. *: significant at 1% significance level

3.2. Estimation Result

3.2.1. Korean MRS Model Estimation Result

This study applied the Markov regime-switching AR (MRSAR) model of Frühwirth-Schmatter (2006) to examine the effects of KEP, UEP, and JEP on Korean housing transaction price volatility, depending on the business regime, and estimated the effects. The regime transition stochastic matrix parameter indicates the probability that the regime transits and AR (p) references the common part not affected by regimes. The MRS estimation result of KEP on housing prices is shown in Table 3.

During the period, KEP was significant at a 1% significance level in Regime 1 with low volatility, negatively affecting the housing price fluctuation rate. However, KEP was not statistically significant in Regime 2 with high volatility, so it did not affect the housing price fluctuation rate. Before and after the GFC, KEP was significant at a 1-10% significance level in Regime 1 with low volatility, negatively affecting the housing price fluctuation rate. However, KEP was not statistically significant in Regime 2 with high volatility, so it did not affect the housing price fluctuation rate. Therefore, KEP negatively affected housing price volatility in the regime with lower volatility compared to the regime with higher volatility.

Table 3: Korean MRS model estimation result

	Entire Period (Jan. 1990-Aug. 2022)		Period Before GFC (Jan. 1990-Dec. 2008)		Period After GFC (Jan. 2009-Aug. 2022)	
	Coefficient	Z-statistic	Coefficient	Z-statistic	Coefficient	Z-statistic
Regime 1						
Constant	0.1047	3.2351***	0.2205	3.4814***	0.1003	2.8509***
KEP	-0.0004	-1.9783***	-0.0021	-3.1777***	-0.0003	-1.6002*
lnσ1	-1.4761	-24.8681***	-1.2207	-11.8882***	-1.8312	-27.6886***
ρ11	3.4833	7.2733***	2.9529	5.7192***	3.3380	6.0808***
Regime 2						
Constant	0.0134	0.0917	0.0294	0.1497	0.3912	1.2029***
KEP	0.0014	1.1169	0.0014	0.7729	0.0011	0.5716
lnσ2	-0.1546	-2.3526***	-0.0382	-0.4879	-1.0975	-6.4951***
ρ21	-2.9569	-5.6960***	-2.8410	-5.5350***	-1.4664	-2.4843***
AR(1)	0.7149	19.8180***	0.6748	12.7445***	0.5993	12.5659***
Log L	-204.83		-196.09		24.73	

Note: 1. p<0.01***, p<0.05**, p<0.1*

3.2.2. The U.S. MRS Model Estimation Result

Table 4 shows the MRS estimation result of the effects of UEP on Korean housing prices. During the entire period, UEP was significant at a 1% significance level in Regime 1 with low volatility, negatively affecting the housing price fluctuation rate. However, UEP was not statistically significant in Regime 2 with high volatility, so it did not affect the housing price fluctuation rate. Before and after the GFC, UEP was significant at a 1% significance level with low volatility, negatively affecting the housing price fluctuation rate. However, UEP was not statistically significant in Regime 2, with high volatility during the entire period of the GFC, and it did not affect the housing price fluctuation rate. However, UEP was significant at a 10% significance level in Regime 2 with high volatility during the period after the GFC, so it negatively affected the housing price fluctuation rate. UEP negatively affected Korean housing price volatility, regardless of the regime, during the period after the GFC, compared to before the crisis. Therefore, it was empirically confirmed that UEP could be spilled over to the Korean housing market.

Table 4: The U.S. MRS model estimation result

	Entire Period (Jan. 1990-Aug. 2022)		Period Before GFC (Jan. 1990-Dec. 2008)		Period After GFC (Jan. 2009-Aug. 2022)	
	Coefficient	Z-statistic	Coefficient	Z-statistic	Coefficient	Z-statistic
Regime 1						
Constant	0.2379	4.2932***	0.5614	5.0237***	0.3305	6.3919***
UEP	-0.0017	-3.0211***	-0.0052	-4.3484***	-0.0026	-5.3171***
lnσ1	-1.5321	-20.7665***	-0.9246	-12.5556***	-1.7160	-22.5830***
ρ11	2.5665	8.3241***	2.8544	5.7733***	3.4356	6.2807***

Regime 2						
Constant	0.4478	2.4084***	0.3625	0.7882	1.0641	6.1900***
UEP	0.0005	0.4018	0.0021	0.5653	-0.0014	-1.8397*
lnσ2	0.1480	2.4732***	0.4424	5.0954***	-0.8542	-6.9541***
ρ21	-2.3077	-7.0578***	-2.2743	-4.0354***	-2.1562	-4.0495***
AR(4)	0.1508	3.9389***	0.0589	1.0759	0.2253	5.0237***
Log L	-311.37		-252.42		-11.03	

Note: 1. p<0.01***, p<0.05**, p<0.1*

3.2.3. Japanese MRS Model Estimation Result

Table 5 shows the MRS estimation result that JEP affects Korean housing prices. During the entire period, JEP was not statistically significant in Regime 1 with low volatility, but it was significant at a 5% significance level in Regime 2 with high volatility, so JEP negatively affected the Korean housing price fluctuation rate. During the period before and after the global financial crisis, JEP was statistically significant at a 10%-1% significance level in Regime 1 with low volatility, and it was statistically significant at 1%-5% in Regime 2 with high volatility. Thus, JEP negatively affected the Korean housing price fluctuation rate, regardless of the regime. JEP negatively affected the Korean housing price fluctuation rate, regardless of the regime before and after the GFC, so it was empirically confirmed that JEP could also be spilled over.

Table 5: Japanese MRS Model estimation result

	Entire Period (Jan. 1990-Aug. 2022)		Period Before GFC (Jan. 1990-Dec. 2008)		Period After GFC (Jan. 2009.-Aug. 2022.)	
	Coefficient	Z-statistic	Coefficient	Z-statistic	Coefficient	Z-statistic
Regime 1						
Constant	0.1290	1.5728	0.2332	2.0755**	0.2930	3.6461***
JEP	-0.0003	-0.3503	-0.0019	-1.6663*	-0.0019	-2.7578***
lnσ1	-1.4559	-22.1254***	-1.3484	-11.2857***	-1.6365	-21.1996***
ρ11	2.6375	8.3803***	1.9303	5.2630***	3.4390	6.1398***
Regime 2						
Constant	1.1953	3.7850***	1.2962	3.3448***	1.6654	6.5185***
JEP	-0.0060	-2.2012**	-0.0076	-2.2086**	-0.0069	-3.8398***
lnσ2	0.1701	2.7908***	0.2682	3.7717***	-1.0139	-7.8639***
ρ21	-2.2658	-6.5235***	-2.1750	-5.1728***	-2.0783	-3.7787***
AR(3)	0.1280	3.3120***	0.0860	2.1730***	0.2518	4.8364***
Log L	-308.99		-256.73		-11.20	

Note: 1. p<0.01***, p<0.05**, p<0.1*

3.2.4. Comparison of Effects of the EPU of Korea, the U.S., and Japan on Korean Housing Prices

Table 6 shows a summary of the comparison of the EPU of Korea, the U.S., and Japan on Korean housing price volatility by period, regime sign [positive (+) or negative (-)], and significance. First, the EPU of Korea negatively affected the Korean housing price volatility statistically by a period only in Regime 1 with low volatility. Second, the EPU of the U.S. negatively affected the Korean housing price volatility in Regime 1 with low volatility statistically during the entire period and before the GFC. However, during the period after the GFC, the EPU of the U.S. negatively affected Korean housing prices, regardless of the regime. Third, the EPU of Japan negatively and significantly affected Korean housing price volatility in Regime 2 with high volatility in the entire period, unlike Korea and the U.S. Fourth, the EUP of the U.S. and Japan negatively and significantly affected the Korean housing price volatility regardless of the regime during the period after the GFC. Thus, it was confirmed that EPU spilled over internationally.

Table 6: Comparison of the effects of the EPU of Korea, the U.S., and Japan on Housing Prices

Classification		Korea			U.S.			Japan		
		Entire Period	Global Financial Crisis		Entire Period	Global Financial Crisis		Entire Period	Global Financial Crisis	
			Before	After		Before	After		Before	After
Regime 1										
Coefficient	Sign	-	-	-	-	-	-	-	-	-
	Significance	Y	Y	Y	Y	Y	Y	N	Y	Y
Regime 2										
Coefficient	Sign	+	+	+	+	+	-	-	-	-
	Significance	N	N	N	N	N	Y	Y	Y	Y

Note:

1. Sign “-” means a negative effect on housing prices, and “+” means a positive effect.

2. Significance Y means statistically significant, and N means statistically insignificant.

3.2.5. Transition Probability and Expected Duration According to Regime

P11 and p22 spillover probabilities according to regime indicate that the boom regime and recession regime continue, with Table 7 showing expected duration and spillover probabilities according to the regime on Korean, U.S., and Japanese EPU shocks. In the entire period of the Korean EPU shock, the probability that Regime 1 (p11) was maintained was 97.02%, and the mean duration was 1/(1-ρ11)=33.57 months. The probability that Regime 2 (p22) was maintained was 95.06%, and the mean duration was 1/(1-ρ22)=20.24 months. Therefore, the probability that the boom regime continues was higher by 1.7-fold than that of the recession regime. When looking at the period before and after the GFC, the period of the recession regime to continue was 20 months during the period before the GFC, but the period of boom regime to continue was estimated to be 18 months, so the recession regime continued 1.1-fold more than the boom regime. During the period after the GFC, the period for the recession regime to continue was 29 months, but the period for the boom regime to continue was estimated to be five months; therefore, the recession regime was to continue 6-fold more than the boom period. This means that the EPU worked negatively for the Korean housing market and that the housing marking was more unstable.

Table 7: Regime transition probability and expected duration

Korea	ρ11	
	ρ22	
	Expected Duration	State 1
		State 2
U.S.	ρ11	
	ρ22	
	Expected Duration	State 1
		State 2
Japan	ρ11	
	ρ22	
	Expected Duration	State 1
		State 2

Regarding the entire period of the U.S. EPU shock, the probability that Regime 1 (p11) was maintained was 92.87%, and the mean duration was 1/(1-ρ11)=14.02 months. The probability that Regime 2 (p22) was maintained was 90.95%, and the mean duration was 1/(1-ρ22)=11.05 months; therefore, the recession regime maintained was 1.3-fold higher than the boom regime. When looking at the period before and after the GFC, the period for the recession regime to continue before the GFC was 18 months, but the period for the boom regime to continue was estimated to be 11 months; therefore, the recession regime was to continue 1.6-fold more. During the period after the GFC, the period for a recession to continue was 32 months, but the period for a boom regime to continue was estimated to be 10 months, so the recession regime was to continue 3.2-fold more than the boom regime. This means that the U.S. EPU negatively shocks the Korean housing market.

Lastly, concerning the entire period of the Japanese EPU, the probability that Regime 1 (p11) was maintained was 93.32%, while the mean duration was 1/(1-ρ22)=10.64 months, so the probability for the recession regime to continue was 1.4-fold higher than that of the boom regime. When looking at the period before and after the GFC, the period for the recession regime to continue was eight months, but the period for the boom regime to continue was estimated to be 10 months, so the boom regime continued 1.3-fold longer. During the period after the GFC, the period for the recession regime to continue was 32 months, but the period for the boom regime to continue was estimated to be nine months, so the recession regime continued 3.6-fold longer. This means that Japanese EPU negatively shocks the Korean housing market. During the period after the GFC, the EPU shocks of the U.S. and Japan continued 2-fold longer in Regime 2 with high volatility compared to the Korean EPU shock.

4. Discussion

Using the MRSAR model, this study empirically analyzed whether the Korean, U.S., and Japanese EPUs significantly affected Korean housing prices statistically. The analysis period was from January 1990 to August 2022. According to the analysis result, Korean, U.S. and Japanese EPU shocks revealed adverse spillover effects on the Korean housing market according to period and business regime; therefore, connectedness among nations deepened. The analysis results of the effects of each nation’s EPU shock on the Korean housing market are as follows: First, the Korean EPU shock negatively affected the Korean housing price volatility at a 10% significance level only in Regime 1, with low volatility in the entire period of and before and after the GFC. The U.S. EPU shock negatively affected the Korean housing volatility at a 1% significance level only in Regime 1, with low volatility in the entire period of and before the GFC. Concerning the period after the GFC, the US EPU shock negatively affected Korean housing price volatility at a 10% significance level, regardless of the business regime.

Regarding the Japanese EPU shock, it negatively affected Korean housing price volatility at a 5% significance level only in Regime 2, with high volatility during the entire period of the GFC. During the period after the global financial crisis, it negatively affected Korean housing price volatility at a 10% significance level, regardless of the regime. The study results partially support the study results of Choudhry (2020), Su et al. (2019), and Christophe et al. (2015).

As for the expected duration according to the regime regarding EPU shock, Korean EPU shock continued 2-fold longer than the U.S. and Japan, regardless of the regime during the entire period. However, during the period after the global financial crisis, the expected duration according to the regime regarding EPU shock, the U.S. and Japanese EPU shocks continued 2-fold longer than that of Korea in Regime 2 with high volatility. This means that the U.S. and Japanese EPU shocks continued longer in the Korean housing market in the boom regime than in the recession regime during the period after the GFC. The study result is that the U.S. and Japanese EPU, after the global financial crisis, spilled over to the Korean housing market, so connectedness among nations is judged to have deepened.

5. Conclusion

The policy implications of this study are as follows: First, it was confirmed that connectedness among nations is gradually going up because EPU shock can be spilled internationally, as the real estate market has been open since the foreign exchange crisis. To sustain the Korean housing market stability and efficient forecasting ability, there is a need to monitor EPU indicators strictly. Second, The U.S. and Japanese EPU shocks continued longer in Regime 2 with high volatility than the Korean EPU shock after the GFC. This could be confirmed with the MRS model that EPU can affect situations differently depending on the business regime. For the robustness of the study, study continuity based on diverse models is required. This study has academic significance in the following aspects: This study presented a model that can effectively capture time series' nonlinear characteristics that cannot explain each real estate market regime's characteristics with the linear model on EPU shocks and provided remarkable insight through which housing market can be dynamically understood for the first time.

Nonetheless, a comparative model analysis on the effects of each business regime's EPU shocks on the Korean housing market and research including various macroeconomic variables that were not attempted can be limitations of the study. These are expected to be performed as future study tasks.

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References

1. Baker, S. R., Bloom, N., & Davis, S. J. (2016). Measuring economic policy uncertainty. Quarterly Journal of Economics, 131(4), 1593-1636. DOI:10.1093/qje/qjw024.
2. Baum, C. F., Caglayan, M., & Talavera, O. (2008). Uncertainty determinants of firm investment. Economics Letters, 98(3), 282-287. DOI:10.1016/j.econlet.2007.05.004.
3. Bloom, N. (2014). Fluctuations in uncertainty. The Journal of Economic Perspectives, 28(2), 153-175. DOI:10.1257/jep.28.2.153.
4. Choudhry, T. (2020). Economic policy uncertainty and house prices: Evidence from Geographical Regions of England and Wales. Real Estate Economics, 48(2), 504-529. DOI:10.1111/1540-6229.12266.
5. Christou, C., Cunado, J., Gupta, R., & Hassapis, C. (2017). Economic policy uncertainty and stock market returns in pacific-rim countries: Evidence based on a Bayesian Panel VAR model. Journal of Multinational Financial Management, 40, 92-102. DOI:10.1016/j.mulfin.2017.03.001.
6. Christophe, A. Lumengo, B. B., & Rangan, G. (2015). The impact of economic policy uncertainty on US real housing returns and their volatility: A nonparametric approach. University of Pretoria Department of Economics Working Paper Series, 82.
7. Dickey, D. & Fuller, W. A. (1979). Distribution of estimates for autoregressive time series with a unit root. Journal of the American Statistical Association, 74(366), 427-431. DOI:10.1080/01621459.1979.10482531.
8. Economic Policy Uncertanity, https://www.policyuncertainty.com
9. French, K. & Roll, R. (1986). Stock return variances: The arrival of information and the reaction of traders. Journal of Financial Economics, 17(1), 5-26. DOI:10.1016/0304-405X(86)90004-8.
10. Frühwirth-Schmatter, S. (2006). Finite mixture and Markov switching models. Springer, Science+Business Media, LLC.
11. Hamiltom, J. D. (1989). A new approach to the economic analysis of nonstationary time series and the business cycle. Econometrica, 57(2), 357-384. DOI:10.2307/1912559.
12. Jeon, J. H. (2017). The impact of economic policy uncertainty on commodity price in Korea, the U.S. and Japan. Journal of International Trade & Commerce, 13(1), 243-262. DOI:10.15722/jds.15.12.201712.41.
13. Kim, N. H. (2018). The impact of U.S. economy policy uncertainty on Korean economic variables. The Korean Journal of Economic Studies, 66(4), 93-132. DOI:10.22841/kjes.2018.66.4.003.
14. Kim, J. Y., Lee, H. S. & Hwang, S. H. (2020). Connectedness between EPU index and Korean housing market returns. Journal of the Korea Real Estate Analysts Association, 26(1), 7-24. DOI:10.19172/kreaa.26.1.1.
15. Lee, S. J. (2018). Economic policy uncertainty in the US: Dois it matter for Korea. East Asian Economic Review, 22(1) 29-54. DOI:10.11644/KIEP.EAER.2018.22.1.337.
16. Leahy, J. V. & Whited, T. M. (1996). The effect of uncertainty on investment: some stylized facts. Journal of Money, Credit and Banking, 28(1), 64-83. DOI:10.2307/2077967.
17. Mody, A., Ohnsorge, F. & Damiano, S. (2012). Precautionary savings in the great recession. IMF Working Paper, WP/12/42.
18. Mohsen, B. O. & Seyed, H. G. (2017). Policy uncertainty and house prices in the United States. The Journal of Real Estate Portfolio Management, 23(1), 73-86. DOI:10.1080/10835547.2017.12089999.

19. Park, H. S. (2010). Analysis of real estate business cycles by using markov switching model. Appraisal Studies, 9(2), 76-77. UCI:G704-SER000010156.2010.9.2.004.
20. Phillips, P. C. & Perron, P. (1988). testing for a unit Root in Time Series Regression. Biometrica, 75, 335-346. DOI:10.2307/2336182.
21. Poncela, P., Senra, E. & Sierra, L. P. (2014). Common dynamics of nonenergy commodity prices and their relation to uncertainty. Applied Economics, 46(30), 3724-3735. DOI:10.1080/00036846.2014.939377.
22. Stockhammer, E. (2010). Financial uncertainty and business investment. Review of Politicial Economy, 22(4), 551-568. DOI:10.1080/09538259.2010.510317.
23. Su, C. W., Li, X. & Tao, R. (2019). How does economic policy uncertainty affect prices of housing?: Evidence from Germany. Argumenta Oeconomica, 42(1), 1-23. DOI:10.15611/aoe.2019.1.06.