The co-movement and contagion effect on real estate investment trusts prices in Asia

Paper to be presented in Ronald Coase Centre for Property Rights Research Brownbag Workshop on 10 March 2016

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Abstract
Previous studies show that there is a strong correlation between Real Estate Investment Trusts (REITs) in different parts of the world because of the contagion effect. Unanticipated shock of one REITs market might transmit to the other REITs market around the world. It is important for us to know how the shocks are transmitted and its impact on the other REITs market. This paper tries to fill the gap of the previous research to examine the transmission of unanticipated shock among REITs in different Aisan countries under the lens of Johansen cointegration test with break test. It is also the first of its kind that considers the possible structural break in a time series data that may affect the REITs prices in Asia.

1. Introduction

REITs was firstly launched in the United States. It provided investors valuable opportunity to invest in large-scale, diversified portfolios of income-producing real estate. After that, many countries around the world listed REITs. As an investment tool, heaps of the previous studies investigated the factors that might affect REITs' return. Some of them studied the relationship between REITs returns, housing prices or other variables. McCue and Kling (1994) used prices, nominal short-term interest rates, output, investment and REIT return to form an unrestricted vector autoregressive (VAR) model. He (2000) found a very strong positive correlation between apartment REITs' returns and new housing prices. Glascock et al. (2000) provided the evidence of cointegration relationship between REITs and the direct real estate. In addition, Ewing and Payne (2005) investigated the relationship between macroeconomic shock and REIT returns.

Another strand of literatures shed light on discovering the contagion effect in international securitized real estate markets. Ghosh, Guttery and Sirmans (1998) studied the contagion effect of REITs in response to news. Since the underlying assets of securitized real estates in different countries are not directly related., there should be segmentation to a certain extent between international securitized real estate markets as well. As a result, international securitized real estate markets are highly connected. Guttery and Sirmans (1998) suggested that as real estate assets are not traded in a frequent manner, the market has incomplete information about their true value, leading to the so-called contagion effect in REITs market. Thus, REITs prices react negatively to the announcements of poor perform real estate portfolios, and contagious movement exists in REITs markets. In addition, Wilson and Zurbruegg (2004) used conditional and unconditional correlation analyses to test whether there is contagion effect from Thailand securitized real estate market to four other Asia-Pacific real estate markets. Results evidence contagion effect from Thailand to Hong Kong and Singapore between early July and late October 1997.

To take one step further, unlike the previous studies mainly focus on study the correlation between REITs to give out evidence for contagion effect in REIT market. Bond et al. (2006) used a multivariate latent factor model to evidence the existence of contagion effect and shows how unanticipated shocks are influenced through real estate securities and stock markets of the major developed economies of the Asia-Pacific region over the period of the Asian financial crisis. Bond et al. (2006) suggested that their studies had broader implications for asset market diversification; on top of the evidence that diversification across asset classes, as well as geographical borders, assists in risk management. Loo et. al. (2016)'s research showed that certain emerging Asia REITs markets experienced higher degree of integration with macroeconomic variables in long run. This implies that emerging REITs markets are more sensitive to the change in macroeconomy as compared to the developed ones. Hui et. al. (2016) found that Asian, European and North American REITs markets followed a similar co-integration trend: the co-integration relationship raised prior the global financial crisis, reached the peak during the crisis and died down after the crisis. Nevertheless, co-integration among Asian and European countries occurred later than co-integration among North American countries did. Hence, North America was the source of co-integration whilst Asia and Europe were the recipients.

Even though knowing how the shocks are transmitted from one REITs market to another from time to time, the above research studies have not considered the possibility of structural break. Moreover, As heaps of the previous research shed light on REITs returns instead of prices, this paper fills the gap of research by using co-integration test with structural break and an impulse response function to examine the transmission of unanticipated shock and their influence tough time across REIT prices in different countries.

2. Methodology

In this paper, we throw light on the transmission of unanticipated shock due to the changes in REITs prices in different countries. Since we are dealing with time series data, we perform unit root and cointegration tests on the existence of non-stationary characteristics. To ensure the robustness of testing results, we employ different unit root tests and cointegration tests with different approach. The unit root tests include the Augmented Dickey-Fuller Tests, The Phillips-Perron Test and Zivot and Andrews test. The cointegration tests include the Johansen cointegration test and the Johansen cointegration with break test. We will discuss them in more details as follows:

2.1 Johansen cointegration test with break

Johansen et al. (2000) proposed a cointegration approach that allows for structural breaks in a series as a generalization of cointegration analysis in Johansen (1988).

This approach has been used in many different areas. For example, Johansen et al. (2000) employed it to test the uncovered interest parity hypothesis under the impact of change in the European Monetary System. Zurbruegg and Allsopp (2004) used it to test the purchasing power parity hypothesis under the impact of the East Asian currency crisis. Gerlach, Wilson and Zurbruegg (2006) used it to examine the impact of 1997 Asian financial crisis on the integration of Asia-Pacific real estate markets. The model that allows for any pre-specified number of sample periods q is constructed as follow.

Let $D_{v,t-i}$ as an indicator function for the ith observation in the vth period; where $D_{v,t-i} = 1$ if $t = T_{v-1} + i$. Also,

$$E_{v,t} = \sum_{i=k+1}^{T_v - T_v - 1} D_{v,t-i} = \begin{cases} 1 & for\ T_{v-1} + k + 1 \le t \le T_v, \\ 0 & otherwise \end{cases}$$

Is the effective sample of the v th period where $v = 2, \dots, q$ .Let $E_t(E_{1,t}, \dots, E_{q,t})', \mu(\mu_1, \dots, \mu_q), \gamma = (\gamma_1', \dots, \gamma_q')'$ represent the vectors of sample dummies and the drift parameters for the different periods. According to Johansen et al. (2000), the model is then defined as:

$$\Delta Z_t = \alpha \binom{\beta}{\gamma}' \binom{Z_{t-1}}{tE_t} + \mu E_t + \sum_{i=1}^{m-1} \Gamma_i \Delta Z_{t-i} + \sum_{i=1}^{m} \sum_{v=2}^{s} \kappa_{v,i} D_{v,t-i} + \varepsilon_t$$

Where $\kappa_{v,i}$ are p -vectors and the observations $Z_1, \dots, Z_k$ are fixed as the initial observations. With this equation, similar rank hypothesis trace tests can then be conducted as those presented in Inoue (1999) approach. The χ^2 test statistic is a likelihood ratio given by:

$LR = \tau \sum_{j=1}^{r} \{ln[1 - \hat{\rho}_j(\tau)] - ln[1 - \hat{\lambda}_j(\tau)]\}, \ \ \tau = T_0, \dots, T$

Where T_0 is the sample size of the subsample, T is the sample size of the full sample, r is the hypothesized number of cointegrating vectors, and $\hat{\rho}_j(\tau)$ and $\hat{\lambda}_j(\tau)$ are the restricted and unrestricted solutions to the eigenvalue problems.

2.2 Granger Causality test

If the REIT indices are cointegrated, an error-correction mechanism then should be used to examine whether REIT index changes in one market. The Granger representation theorem states that if variables Y and X, are cointegrated, an error-correction term, e_{t-1} can be included in the following equations to test for Granger causality:

$$\Delta Y_t = \alpha_0 + \alpha e_{t-1} + \sum_{i=1}^{k} \alpha_{1i} \Delta Y_{t-i} + \sum_{i=1}^{k} \alpha_{2i} \Delta X_{t-i} + \varepsilon_{1t}$$

$$\Delta X_t = \beta_0 + \beta e_{t-1} + \sum_{i=1}^{k} \beta_{1i} \Delta Y_{t-i} + \sum_{i=1}^{k} \beta_{2i} \Delta X_{t-i} + \varepsilon_{2t}$$

Where $\Delta Y_t = Y_t - Y_{t-1}$, $\Delta X_t = X_t - X_{t-1}$, k are the number of lags, and ε_{1t} and ε_{2t} are random-error terms.

If we reject the hypothesis that $\alpha_{21} = \cdots = \alpha_{2k} = 0$, then X_t is say to Granger-cause Y_t. Similarly, the rejection of $\beta_{11} = \cdots = \beta_{1k} = 0$ suggests that Y_t does Granger-cause X_t.

3. Data and Results

3.1 Data and descriptive statistics

This paper use daily REITs indices data from China, Hong Kong, Indonesia, Japan Malaysia and Singapore. The corresponding REIT indices of this market are Shanghai Stock Exchange Property Index (*SHPROP*), Hong Kong Hang Seng Properties Index (*HSP*), Jakarta Stock Exchange Construction Property and Real Estate Index (*JAKPROP*), Tokyo Stock Exchange TOPIX Real Estate Index (*TPREAL*), Bursa Malaysia Property Index (*KLPRP*) and FTSE ST Real Estate Index (*FSTRE*). We collect all the daily data from 31 August 1999 to 19 February 2016 of these indices. All of them are composite index for most REITs listed in their corresponding market. These countries were chosen because all of them have a well-developed stock market. All the data in this paper are taken form Bloomberg database. The descriptive statistics of their return rates are computed for three periods which is Entire period (from 31 August 1999 to 19 February 2016), Sub-period 1 (from 31 August 1999 to 28 November 2008) and Sub-period 2 (from 1 December 2008 to 19 February 2016) and will be first presented in Table 1.

Table 1 shows that the mean of the REIT indices for entire period fall within the range [0.000006, 0.000567]. For the sub-period 1, they fall in a relatively large range [-0.000318, 0.000385] while the sub-period 2 they fall in a relatively small range [0.000318, 0.000800]. The skewness estimates reveal more than half of the REIT indices skewed to the right for the entire period and sub-period 1, but only half of the REIT indices skewed to the right. Table 1 also all of the REIT indices have a smaller variances than a standard normal distribution and the normality hypothesises are rejected for all REIT indices for all periods.

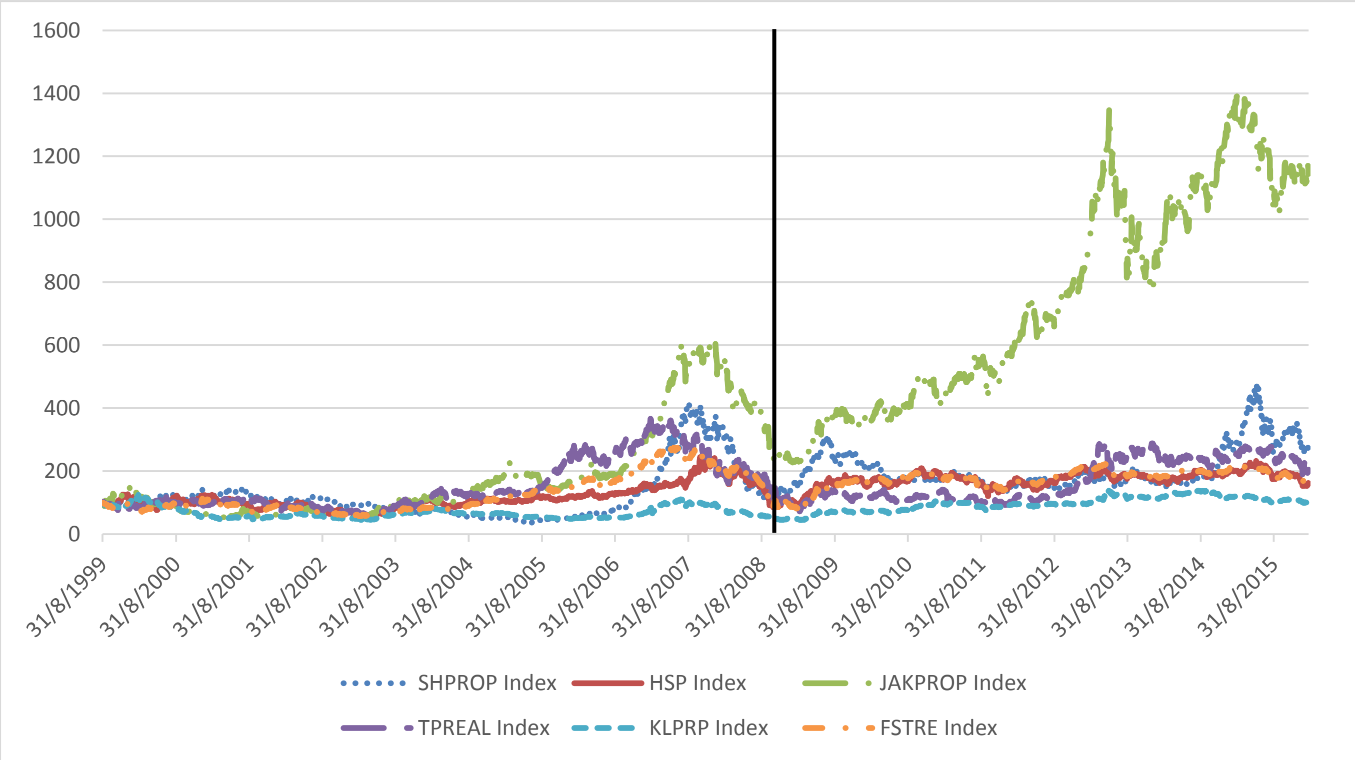
Table 1: Descriptive statistics

	Entire period				
	Mean	Std Dev	Skewness	Kurtosis	J-B
FSTRE	0.000128	0.012832	-0.01079	7.9893	4458.052***
HSP	0.000113	0.018022	0.155151	7.1615	3118.693***
JAKPROP	0.000567	0.016311	-0.142496	9.3630	7265.287***
KLPRP	0.000006	0.010899	-0.488321	11.0912	11894.87***
SHPROP	0.000236	0.021852	-0.264905	5.9972	1659.051***
TPREAL	0.000167	0.021485	0.105959	7.0822	2992.304***
	Sub-period 1				
	Mean	Std Dev	Skewness	Kurtosis	J-B
FSTRE	-0.000035	0.01395	-0.223862	6.4211	1196.917***
HSP	0.000001	0.019318	0.043378	7.1163	1704.312***
JAKPROP	0.000385	0.017639	-0.078654	9.8864	4770.412***
KLPRP	-0.000318	0.011998	-0.618182	11.0836	6723.481***
SHPROP	0.000104	0.022397	-0.146183	5.8992	853.7015***
TPREAL	0.000050	0.022218	0.168481	6.9553	1584.327***
	Sub-period 2				
	Mean	Std Dev	Skewness	Kurtosis	J-B
FSTRE	0.000338	0.011239	0.541717	11.3795	5607.096***
HSP	0.000257	0.016216	0.403081	6.5610	1047.036***
JAKPROP	0.000800	0.014435	-0.261286	6.6047	1042.029***
KLPRP	0.000420	0.009292	-0.004597	8.1898	2115.419***
SHPROP	0.000406	0.021138	-0.442007	6.1139	822.968***
TPREAL	0.000318	0.020515	0.007463	7.1936	1381.252***

Notes: The *, **, and *** denote the significance at 10%, 5% and 1% levels, respectively.

Figure 1 shows the REIT indices used in this paper. In Figure 1, there is a big drop around between 2008 and 2009 which support that 1 December 2008 could be used as a break point. From the figure, we could also see that besides the Indonesia REIT index (JAKPROP) in Sub-period 2, all REIT indices move together.

Figure 1: REITs of five countries from Jan-2006 to Dec-2014



Note: For an easier comparison, we set all the variables at the same basis of 100 on the start.

The correlation coefficients and its' corresponding tests (testing whether the correlation is zero) are showing almost the same thing, that is the REIT index generally move together. These results are presented in Table 2 and 3.

Table 2 Correlation coefficient of Entire period

Entire period	RFSTRE	RHSP	RJAKPROP	RKLPRP	RSHPROP
RHSP	0.58 (46.27***)				
RJAKPROP	0.30 (20.78***)	0.31 (21.33***)			

RKLPRP	0.40 (28.28***)	0.36 (25.36***)	0.30 (20.71***)		
RSHPROP	0.18 (11.80***)	0.25 (16.89***)	0.13 (8.48***)	0.14 (9.15***)	
RTPREAL	0.36 (25.39***)	0.35 (24.56***)	0.21 (14.13***)	0.25 (16.68***)	0.12 (8.04***)

Notes: The *, **, and *** denote the significance at 10%, 5% and 1% levels, respectively.

Table 3 Correlation coefficient of Sub-periods

Sub-period 1	RFSTRE	RHSP	RJAKPROP	RKLPRP	RSHPROP
RHSP	0.56 (32.92***)				
RJAKPROP	0.27 (13.61***)	0.27 (13.93***)			
RKLPRP	0.37 (19.68***)	0.33 (17.35***)	0.25 (12.85***)		
RSHPROP	0.13 (6.67***)	0.17 (8.38***)	0.09 (4.45***)	0.10 (4.69***)	
RTPREAL	0.34 (17.67***)	0.32 (16.83***)	0.19 (9.43***)	0.21 (10.30***)	0.08 (4.12***)
Sub-period 2	**RFSTRE**	**RHSP**	**RJAKPROP**	**RKLPRP**	**RSHPROP**
RHSP	0.61 (33.81***)				
RJAKPROP	0.37 (17.29***)	0.38 (17.70***)			
RKLPRP	0.45 (21.58***)	0.42 (19.85***)	0.40 (18.83***)		
RSHPROP	0.25 (11.20***)	0.38 (17.94***)	0.19 (8.48***)	0.22 (9.57***)	

RTPREAL	0.40 (19.06***)	0.40 (18.71***)	0.25 (11.17***)	0.32 (14.81***)	0.18 (7.84***)

Notes: The *, **, and *** denote the significance at 10%, 5% and 1% levels, respectively.

3.2 Unit root test

Table 4 shows the results of widely used Augmented Dickey-Fuller unit root test to test whether the time series used in this paper content a unit root. The stationary properties of the time series for different periods and all their corresponding first differenced series are examined. Our results of the ADF test, show that all of our time series are I(1) at 1% significant level. That is, hypothesises of unit root are all accepted using the original series (Level) but all rejected when the first difference of the series are used.

Table 4: Unit root tests

	Entire period		Sub-period 1		Sub-period 2	
	Level	Difference	Level	Difference	Level	Difference
FSTRE	-1.5365	-13.5664***	-1.1596	-8.0397***	-2.37427	-9.0701***
HSP	-1.9892	-11.1639***	-1.8820	-8.4760***	-2.994577	-23.1114***
JAKPROP	0.0023	-11.9134***	-0.9001	-13.8314***	-2.553989	-15.9334***
KLPRP	-1.4325	-13.1405***	-1.9769	-8.3810***	-1.729951	-10.8943***
SHPROP	-2.0576	-10.6183***	-1.5555	-7.6300***	-2.363926	-7.6642***
TPREAL	-1.6489	-12.0457***	-1.0529	-14.6727***	-2.156381	-9.6007***

Notes: The *, **, and *** denote the significance at 10%, 5% and 1% levels, respectively.

3.3 Johansen cointegration test with structural break

When we adopt Dec-2008 as a break point, the results of Johansen tests with structural break are presented in Table 5. In the Johansen cointegration test, the number of lags to introduce is a key decision, various informational criteria could lead to different lag lengths of the explanatory variable. Thus, different criteria may lead to conflicting results. To avoid these complications, we apply the null hypothesis of no cointegration between the REIT indices from lag one to lag four. Table 5 shows that the hypothesis that the REIT indices is not cointegrated is rejected in all three assumptions for all lag (k) specification. This result implies that the REIT indices in Asia markets like China, Hong Kong, Indonesia, Japan Malaysia and Singapore are in fact moving together. This results also implies that we should adopt the VECM specification when we try to test the causality between the REIT indices.

Table 5 Johansen cointegration test

Assumption	LR statistic			
	k=1	k=2	k=3	k=4
Constant	141.64***	140.71***	134.41***	137.54***
Constant and trend	151.99***	149.5***	143.11***	144.98***
Orthogonal trend	105.02***	102.8**	98.42**	100.46**

Notes: The *, **, and *** denote the significance at 10%, 5% and 1% levels, respectively.

3.4 Granger Causality test

Given the cointegration test results, the VECM based Granger Causality test are conducted for the corresponding REIT index data. The Granger Causality test is applied to test the hypothesis that a REIT index doesn't granger cause another REIT index. The results are showed in Table 6 and 7.

Because of the reason that the number of lags to introduce is an important decision, and various informational criteria could lead to conflicting results, the null hypothesis of no Granger Causal relationship between the REIT indices is examined in all periods from lag one to lag four.

For the entire period, the results shows that the hypothesis that FSTRE does not cause HSP or TPREAL is rejected for all four specifications. HSP does not cause FSTRE or SHPROP is rejected. JAKPROP does not cause FSTRE, HSP, KLPRP or SHPROP is rejected. KLPRP not cause FSTRE, HSP or TPREAL is rejected. SHPROP not cause FSTRE or HSP is rejected. TPREAL not cause HSP or JAKPROP is rejected.

Table 6 Granger Causality test for entire period

	Entire period			
	k=1	k=2	k=3	k=4
FSTRE does not Granger cause HSP	12.8062***	12.2860***	16.7379***	17.0580***
FSTRE does not Granger cause	2.3657	5.3714*	5.1216	5.2371

JAKPROP				
FSTRE does not Granger cause KLPRP	0.8426	1.2015	1.9070	2.8465
FSTRE does not Granger cause SHPROP	0.0781	0.1597	3.1476	5.0985
FSTRE does not Granger cause TPREAL	30.0815***	29.6186***	30.8243***	32.1990***
HSP does not Granger cause FSTRE	6.2700**	17.5588***	21.4980***	29.7421***
HSP does not Granger cause JAKPROP	1.2852	1.3514	6.6754*	6.3003
HSP does not Granger cause KLPRP	0.1004	0.2002	0.2192	4.74363
HSP does not Granger cause SHPROP	3.8901**	3.7443	17.9055***	23.4048***
HSP does not Granger cause TPREAL	1.1055	0.8786	1.5025	1.1773
JAKPROP does not Granger cause FSTRE	4.0025**	6.3862**	8.5464**	8.3946*
JAKPROP does not Granger cause HSP	3.4131*	4.7109*	10.1957**	10.7101**
JAKPROP does not Granger cause KLPRP	4.7405**	7.2074**	7.6436*	7.569164
JAKPROP does not Granger cause SHPROP	0.4797	0.6120	13.0793***	25.5669***
JAKPROP does not Granger cause TPREAL	0.0091	1.6761	6.164	8.1285*
KLPRP not cause does not Granger cause FSTRE	0.1036	4.9233*	5.3515	10.4005**
KLPRP does not Granger cause HSP	0.423	5.8672*	6.7697*	8.7844*
KLPRP does not Granger cause JAKPROP	0.6598	1.7491	2.0391	5.381
KLPRP does not Granger cause SHPROP	0.5483	0.9242	0.8658	9.8012**
KLPRP does not Granger cause TPREAL	0.0148	4.6327*	9.3500**	8.6249*
SHPROP does not Granger cause	10.7428***	11.9034***	12.1427***	14.7135***

FSTRE				
SHPROP does not Granger cause HSP	37.2677***	36.5714***	36.7760***	36.0785***
SHPROP does not Granger cause JAKPROP	0.2364	0.405	2.306	2.1268
SHPROP does not Granger cause KLPRP	1.3631	2.9278	2.8191	0.9574
SHPROP does not Granger cause TPREAL	2.6646	2.688	2.86	2.7963
TPREAL does not Granger cause FSTRE	1.3562	4.7759*	3.9407	4.6500
TPREAL does not Granger cause HSP	13.0150***	12.2807***	12.7706***	14.0544***
TPREAL does not Granger cause JAKPROP	8.8133***	10.8300***	15.4979***	16.9453***
TPREAL does not Granger cause KLPRP	1.0794	2.9884	2.253	2.9371
TPREAL does not Granger cause SHPROP	0.9234	1.2006	2.7668	2.7757

Notes: The *, **, and *** denote the significance at 10%, 5% and 1% levels, respectively.

For the Sub-period 1, the results in table 7 show that FSTRE not cause HSP or TPREAL is rejected. HSP not cause FSTRE or SHPROP is rejected. JAKPROP not cause HSP, KLPRP or SHPROP is rejected. KLPRP not cause HSP is rejected. SHPROP not cause FSTRE, HSP, JAKPROP, KLPRP or TPREAL is rejected. TREAL not cause HSP is rejected.

For the Sub-period 2, the results in show that FSTRE not cause HSP or TPREAL is rejected which is same to Sub-period 1. HSP not cause FSTRE or TPREAL is rejected. JAKPROP not cause SHPROP is rejected. KLPRP not cause JAKPROP or TPREAL is rejected. SHPROP not cause TPREAL is rejected. TPREAL not cause JAKPROP is rejected.

Table 7 Granger Causality test Sub- periods

	Sub-period 1				Sub-period 2			
	k=1	k=2	k=3	k=4	k=1	k=2	k=3	k=4
FSTRE does not Granger cause HSP	7.2984***	7.6850**	11.7217***	13.7829***	4.7417**	4.8820*	4.6302	8.7869*
FSTRE does not Granger cause JAKPROP	0.1999	0.4500	0.9831	1.8159	0.8775	3.7405	3.1406	3.5162
FSTRE does not Granger cause KLPRP	0.1416	1.1211	1.0877	3.9458	0.1123	2.8869	2.4457	2.8791
FSTRE does not Granger cause SHPROP	0.8303	2.1018	5.8212	11.6402**	0.1023	0.2670	1.2506	1.3267
FSTRE does not Granger cause TPREAL	14.8964***	15.1104***	21.8036***	22.1007***	10.6078***	10.6267***	10.1723**	12.5551**
HSP does not Granger cause FSTRE	0.7409	7.0893**	7.4702*	28.4714***	7.4742***	15.0038***	29.4650***	30.5075***
HSP does not Granger cause JAKPROP	1.0557	3.0819	5.9150	8.4847*	0.6275	1.2827	6.2254	6.2936
HSP does not Granger cause KLPRP	0.0616	0.479066	5.8760	12.7795**	1.4922	2.6708	6.2539*	6.7463
HSP does not Granger cause SHPROP	5.9317**	6.5995**	18.8733***	46.0971***	0.0163	0.0298	6.1790	10.2582**
HSP does not Granger cause TPREAL	0.6248	0.7147	1.9949	6.0548	0.0012	0.0320	7.1541*	12.6852**

JAKPROP does not Granger cause FSTRE	3.0474*	3.5783	3.8394	2.9677	1.7121	4.5493	7.5066*	7.7641
JAKPROP does not Granger cause HSP	3.2696*	9.0937**	13.4168***	12.0545**	1.7304	1.8478	3.4952	4.7056
JAKPROP does not Granger cause KLPRP	7.7759***	7.5556**	12.7614***	11.4254**	0.6749	2.6519	3.2218	2.8821
JAKPROP does not Granger cause SHPROP	11.1367***	12.9783***	16.8366***	15.5956***	0.0003	0.0019	6.2889*	16.9877***
JAKPROP does not Granger cause TPREAL	4.1625	3.9334	8.4142**	7.3290	0.4373	1.6089	3.5076	5.8860
KLPRP does not Granger cause FSTRE	0.0398	4.1368	6.7657*	12.4940**	0.5746	1.0681	6.6739*	7.1216
KLPRP does not Granger cause HSP	0.02153	13.1215***	12.7711***	13.5834***	1.7844	2.2416	6.2643*	7.0884
KLPRP does not Granger cause JAKPROP	0.0574	5.0160*	5.8184	8.7219*	1.0762	4.6815*	6.3866*	8.5720*
KLPRP does not Granger cause SHPROP	1.8174	2.1746	1.8727	2.3888	0.6015	1.2322	0.9433	1.1168
KLPRP does not Granger cause TPREAL	0.0152	2.1663	2.5770	2.7378	0.0875	3.0064	9.0195**	8.0935*
SHPROP does not Granger cause FSTRE	21.2988***	21.1477***	21.0361***	26.4728***	0.2948	1.7883	2.4699	2.9319
SHPROP does not Granger cause HSP	55.6391***	55.3040***	55.1027***	58.0131***	3.5911*	3.5706	3.6491	2.9725

SHPROP does not Granger cause JAKPROP	4.1672**	12.8070***	18.6437***	20.1390***	0.0214	0.2312	5.3646	5.2304
SHPROP does not Granger cause KLPRP	3.7046*	6.4109**	9.3884**	14.3416***	0.0046	0.0146	3.7795	7.6492
SHPROP does not Granger cause TPREAL	18.9040***	18.9766***	19.8683***	2.7378***	2.9361*	6.8312**	6.8716*	7.1618
TPREAL does not Granger cause FSTRE	0.8690	5.6217*	5.6048	6.4810	0.7955	0.7358	1.5336	2.6861
TPREAL does not Granger cause HSP	16.4068***	15.1785***	17.3721***	19.3155***	1.291	1.6327	4.3918	4.2357
TPREAL does not Granger cause JAKPROP	2.1910	3.4974	4.2571	3.9463	7.1567***	8.0017**	12.9514***	14.6404***
TPREAL does not Granger cause KLPRP	2.1095	6.2350**	4.9519	4.9105	0.1280	0.5753	1.3035	3.2900
TPREAL does not Granger cause SHPROP	3.1694*	2.8669	3.9942	3.3289	0.0020	0.6087	1.2253	1.5680

Notes: The *, **, and *** denote the significance at 10%, 5% and 1% levels, respectively.

4. Conclusion

Whether there is contagion effect in REIT markets or not is important for asset market diversification across different markets, as well as geographical borders, assists in risk management. This paper examined and documented the response of REIT returns to shocks from other REIT market using the technique of granger causality. The results add to the literature on the dynamic interaction between REIT prices.

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