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Contagion between Stock and Real Estate Markets: International Evidence from a Local Gaussian Correlation Approach

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Abstract

In this paper, we analyze contagion over the daily period of January 1, 1998 to September 13, 2018 between Real Estate Investments Trusts (REITs) and the equity markets of nineteen countries, which are at their different stages of development in terms of the REITs market. For our purpose, we use the local Gaussian correlation approach during the dot-com, global financial, European sovereign debt crises, and the more recent period involving the Brexit in the UK. In general, we find strong evidence of contagion between equities and REITs of not only matured and established markets, but also in economies with an emerging REITs sector, especially during the global financial and sovereign debt crises. Further, when we considered contagion across REITs of the US and the other countries, and between US REITs and equities of the remaining eighteen countries, a similar pattern emerges. Our results have important implications for investors and policymakers alike.

Keywords: REITs; Equities; Financial crises; Contagion; Local Gaussian correlation

JEL Codes: C22; G10; G15; R31

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1. Introduction

In the wake of extreme events that unfolded in the worldwide financial markets during the recent global financial and the European sovereign debt crises, there has been a renewed interest among researchers to better understand contagion, whereby, loosely speaking, contagion can be defined as a rapid shock spillover that increases cross-market linkages.[1] There exists large number of (earlier and recent) studies on contagion (surrounding older and newer crises episodes) involving bonds, stocks, currencies, commodities and more recently, hedge funds (see for example, Pericoli and Sbracia (2003), Tai (2004), Dungey et al. (2005), Pesaran and Pick (2007), Forbes (2012), Mollah et al. (2016), Bampinas and Panagiotidis (2017), Chuliá et al., (2017), Samarakoon (2017), and Caporin et al. (2018) for detailed reviews). However, the literature on contagion concerning real estate markets is limited (see for example, Kallberg et al., (2002), Gerlach et al., (2006), Fry et al., (2010), Guo et al., (2011), Hoesli and Reka (2013, 2015)). In general, these studies confirm the existence of contagion in the United States (US) with the domestic financial market, and across international real estate markets (like Australia and the United Kingdom (UK)), during the Asian crisis of 1997 and the financial crisis of 2007-2008.

The benefits of including real estate in mixed-asset portfolios are now well-recognized (Hoesli et al., 2004; MacKinnon and Al Zaman, 2009; Bouri et al., 2018). However, investing in real estate can be problematic due to the high unit value and illiquidity of properties. Thus, it is not surprising that the importance of the securitized real estate market, i.e., Real Estate Investment Trusts (REITs), has grown substantially during the past decades, with a total market capitalization of US $ 1.7 trillion (Global REITs Market, EY Global Real Estate Report, 2016). Though the US continues to remain the leader in REITs, the number of countries now offering REITs as an investment vehicle has almost doubled in the last 10 years to 37. Given the well-accepted importance of REITs in investment portfolios now, we aim to extend the limited literature on contagion involving the real estate sector of primarily the US, by studying contagion between REITs and the equity

[1] The existing literature has recognized at least three possible `theories' of contagion, i.e., through financial linkages (which in turn has three channels, i.e., information correlation, liquidity correlation, and portfolio rebalancing), trade links, and herding behaviour (Hoesli and Reka, 2015).

markets of nineteen countries. The included countries, based on data availability, are at their different stages of development in terms of the REITs market, and correspond to mature (US), established (Australia, Belgium, Canada, France, Germany, Hong Kong, Japan, The Netherlands, New Zealand, Singapore and the UK) and emerging (Ireland, Italy, Malaysia, Mexico, South Africa, Spain and Turkey) categories. In addition, we also conduct contagion analyses between US REITs and the other international REITs, as well as between US REITs and equity markets of the eighteen remaining countries in our sample. In sum, unlike the existing studies, we provide a more comprehensive analysis with a wider international dimension, which in turn, would allow us to draw better inferences about contagion involving REITs market.

In terms of the econometric methodology, we study contagion by using the local Gaussian correlation approach introduced by Tjøstheim and Hufthammer (2013) during the dot-com, global financial, European sovereign debt crises, and the more recent period involving the Brexit in the UK, spanning the daily period of January 1, 1998 to September 13, 2018. Though this framework is conceptually close to the traditional correlation analysis, it differs being a dependence measure that is localized and nonlinear. Unlike linear dependence measures, local Gaussian correlation not only avoids the bias of the conditional correlation, but also describes any non-linear structure in dependence and the deviation from global normality. In addition, our approach does not suffer from additional bias that might result from the increased volatility observed during periods of turmoil. Further, the method can also capture the asymmetric response associated with shocks of different magnitudes, as it measures lower, median and upper tail dependencies. Finally, within the context of the local Gaussian correlation, we can also test for contagion by comparing the local correlation of the stable and the crisis periods based on a bootstrap procedure of Stove et al., (2014).

To the best of our knowledge, this is the first paper to study contagion involving REITs and equity markets of nineteen countries surrounding the extreme events of last two decades, based on a local Gaussian correlation approach. This method controls for various types of biases observed in the contagion literature due to studies ignoring heteroscedasticity (Forbes and Rigobon, 2002), nonlinearity (Bae et al., 2003; Baur, 2013) and asymmetry (Bodart and Candelon, 2009). The remainder of the paper is organized as follows: Section 2 outlines the basics of the methodology of local Gaussian correlation, while Section 3 presents the data and results, and Section 4 concludes.

2. Methodology

2.1. Local Gaussian Correlation

The objective of this paper is to investigate the dependence structure in the pairs involving REITs and equity returns, and whether a contagion existed in those two markets during four different periods. It is not legitimate to the use the standard correlation approach because: 1) the correlation is primarily meaningful under the Gaussian assumption; and 2) the correlation can only capture the linear dependence. There are many empirical evidence against the Gaussianity of the financial returns and indeed non-Gaussianity is one of the stylized fact of the daily financial returns (Rydén et al., 1998; Bulla and Bulla, 2006; Liu and Wang, 2017). Additionally, the dependence between REIT and equity returns have also been found to be non-linear (Hoesli and Reka, 2013; 2015; Li et al., 2015).

In this regard, Tjøstheim and Hufthammer (2013) proposed a new approach called local Gaussian correlation to measure the local dependence and reveal the full dependence structure. The central idea of the new approach is to approximate an arbitrary bivariate return distribution with a family of Gaussian bivariate distributions. At each point of return distribution, there is a Gaussian distribution that approximates that point (approximating the density locally rather than the correlation). The correlation of the approximating Gaussian distribution is taken as the local correlation in that neighborhood.

Given two *i.i.d.* random variables, u and v, the bivariate density $f(x, y)$ at the location point (x, y) can be approximated by a bivariate Gaussian density

$$\Phi_{x,y} = \Phi\{u, v, \mu_1(x,y), \mu_2(x,y), \sigma_1(x,y), \sigma_2(x,y), \rho(x,y)\}$$

$$= \frac{1}{2\pi\sigma_1(x,y)\sigma_2(x,y)\sqrt{1-\rho(x,y)^2}} \exp\left\{-\frac{1}{2(1-\rho(x,y)^2)}\left[\left(\frac{u-\mu_1(x,y)}{\sigma_1(x,y)}\right)^2 + \left(\frac{v-\mu_2(x,y)}{\sigma_2(x,y)}\right)^2 - 2\rho\left(\frac{u-\mu_1(x,y)}{\sigma_1(x,y)}\right)\left(\frac{v-\mu_2(x,y)}{\sigma_2(x,y)}\right)\right]\right\} \quad (1)$$

where $\mu_1(x,y), \mu_2(x,y)$ are the local means of u and v, $\sigma_1(x,y), \sigma_2(x,y)$ are the local standard deviation, and $\rho(x,y)$ is the local Gaussian correlation.

The five parameters $\mu_1(x,y), \mu_2(x,y), \sigma_1(x,y), \sigma_2(x,y), \rho(x,y)$ are the functions depending on the location point (x,y), and thus $\Phi_{x,y}$ is able to approximate the density function $f(x,y)$ only in a neighbourhood of (x,y). Given another location point (x',y'), it is thus necessary to find another Gaussian $\Phi_{x\prime,y\prime}$ to get close to the density function $f(x',y')$ in a neighbourhood of (x',y'). Moving the location point to all possible regimes of u and v, we can complete the full approximation for the bivariate density by a family of bivariate Gaussian densities. Since the local Gaussian correlation $\rho(x,y)$ captures the dependence in a neighbourhood of (x,y), the collection of all local Gaussian correlations can fully reveal the dependence structure between the underlying two random variables. Such a way of studying dependence structure is flexible in that it can capture the nonlinear dependence and it is free of the Gaussian assumption on the underlying variables. Additionally, it is robust than the conditional correlation approach.

To implement the Local Gaussian approach, it is necessary to employ an appropriate method to fit a Gaussian density in a neighbourhood of (x,y). In the literature, Tjøstheim and Hufthammer (2013) and Støve et al., (2014) suggested that the local likelihood method developed by Hjort and Jones (1996) is adequate in fulfilling this task. One essentially issue is that the local Gaussian correlation estimator $\hat{\rho}(x,y)$ is based on the two kernel smoothing devices with the arbitrary choice of bandwidth $h = (h_1, h_2)$, which needs to be specified by the user. Interested readers can refer to the cited publication for technical details.

2.2. Marginal Model

It is crucial to ensure that the assumption of *i.i.d.* is satisfied in order to use the Local Gaussian approach (Støve et al., 2014). As a matter of fact, financial returns have heteroskedasticity, and the typical way is to apply Generalized Autoregressive Conditional Heteroskedastic (GARCH)-family models to capture the dynamics in the volatility (Bollerslev et al., 1992; Nyakabawo et al., 2018). Additionally, there could be weak dependence in the mean of financial returns via an ARMA structure (Wei, 2006). Overall, the marginal model of returns is specified as an $ARMA(p_1, q_1) - GARCH(p_2, q_2)$ model:

$$R_{k,t} = \mu + \Sigma_{i=1}^{p_1}\phi_{k,i}R_{k,t-i} + \Sigma_{j=1}^{q_1}\theta_{k,j}\varepsilon_{k,t-1} + \varepsilon_{k,t}, \quad k = 1,2 \quad (2)$$

$$\sigma_{k,t}^2 = \omega_{k,0} + \Sigma_{i=1}^{p_2}\alpha_{k,i}\varepsilon_{k,t-1}^2 + \Sigma_{j=1}^{q_2}\beta_{k,j}\sigma_{k,t-1}^2 \quad (3)$$

$$\eta_{k,t} = \frac{\varepsilon_{k,t}}{\sigma_{k,t}}, \eta_{k,t}|\Omega_{t-1} \sim t(\upsilon_k) \quad (4)$$

where $R_{k,t} = 100 \times \{log(P_{k,t}) - log(P_{k,t-1})\}$, $P_{k,t}$ is the price of REIT or equity at time t . $\eta_{k,t}$ is the standardized residuals, which follows the Student-t distribution with υ_k degrees of freedom. The computed standardized residuals from the selected model are consequently used in the following analysis.

The maximum of ARMA lags p_1 and q_1 are capped at 5, i.e. $\mathrm{p}_1 \leq 5, \mathrm{q}_1 \leq 5$. The maximum of GARCH lags p_2 and q_2 are capped at 2, i.e. $\mathrm{p}_2 \leq 2, \mathrm{q}_2 \leq 2$. In order to find the most appropriate lag lengths for p_1, q_1, p_2, q_2, we employ the following procedure:

1. Run all models in the setting of $ARMA(p_1, q_1) - GARCH(1,1)$ and select the best model by the Bayesian information criterion (BIC), within the adequate models that can pass various diagnosis tests.
2. If there is no adequate model in the setting of $ARMA(p_1, q_1) - GARCH(1,1)$, then proceed to try $ARMA(p_1, q_1) - GARCH(2,1)$. The best model is selected by the BIC, within the adequate models that can pass various diagnosis tests.

3. If there is no adequate model in the setting of $ARMA(p_1, q_1) - GARCH(2,1)$, then proceed to try $ARMA(p_1, q_1) - GARCH(1,2)$. The best model is selected by the BIC, within the adequate models that can pass various diagnosis tests.
4. If there is no adequate model in the setting of $ARMA(p_1, q_1) - GARCH(1,2)$, then proceed to try $ARMA(p_1, q_1) - GARCH(2,2)$. The best model is selected by the BIC, within the adequate models that can pass various diagnosis tests.
5. If there is still no adequate model in the setting of $ARMA(p_1, q_1) - GARCH(2,2)$, then we skip the analysis for this country in this period.

The motivation for the above procedure is that the model with a smaller number of parameters are preferred and typically $ARMA(p_1, q_1) - GARCH(1,1)$ is adequate to produce a satisfactory model. In rare cases, we will have higher orders in the GARCH part.

To empirically check the *i.i.d.* assumption, we consider three diagnosis tests[2] developed by Fisher and Gallagher (2012) on the standardized residuals:

- Weighted Ljung-Box Test on Standardized Residuals (to ensure no autocorrelation)
- Weighted Ljung-Box Test on Standardized Squared Residuals (to ensure no heteroskedasticity)
- Weighted ARCH-LM Tests (to ensure no heteroskedasticity)

If the standardized residuals from the $ARMA(p_1, q_1) - GARCH(2,2)$ fails to pass any one of the tests at the significance level (5%), then no model is deemed to be adequate.

2.3. Bootstrap Test for Contagion

Stove et al., (2014) developed a bootstrap test for contagion based on the local Gaussian approach. We briefly summarized this method here. Denote that $\{R_{1,t}, R_{2,t}\}, t = 1, \ldots, T$ as the pair of the log returns of REITs and equity indices. To ensure the *i.i.d.* assumption of the Local Gaussian approach, we apply the ARMA-GARCH model to filter the log returns, and extract the standardized residuals $\{\eta_{1,t}, \eta_{2,t}\}, t = 1, \ldots, T$. Then, the standardized

[2] In our case, all our chosen models for the various cases considered satisfied the *i.i.d.* assumption. The results of all these tests are available upon request from the authors and have been suppressed to save space.

residuals are split into two subperiods, the period before the crisis (denoted as BP) and the period after it (denoted as AP).

According to Forbes and Rigobon (2002), a contagion can be defined as a significant increase in cross-market linkages after a shock to one market (or a group of markets). Following the logic, a contagion is believed to occur if the local correlation function in the BP is significantly above the local correlation function in the AP. Hence, the contagion test is formulated as follows:

$$H_0: \rho_{AP}(x_i, y_i) = \rho_{BP}(x_i, y_i) \quad \text{for} \quad i = 1, \dots, n, \text{ i.e., no contagion} \tag{5}$$

$$H_A: \sum_{i=1}^{n} \rho_{AP}(x_i, y_i) - \rho_{BP}(x_i, y_i), \quad \text{i.e., contagion} \tag{6}$$

where (x_i, y_i) are the selected location points where the local correlations are estimated. For the choice of the location points, we follow Stove et al., (2014) and use a diagonal grid, i.e. $x_i = y_i$ in order to reduce the computational time. It is natural to have the test statistic:

$$D = \frac{1}{n} \sum_{i=1}^{n} \{\hat{\rho}_{BP}(x_i, x_i) - \hat{\rho}_{AP}(x_i, x_i)\} w(x_i, x_i) \tag{7}$$

where $w(x_i, x_i)$ is a weight function such that the distance between the grid points and the observations is not too large.

However, the proposed test statistic has a non-analytical asymptotic distribution. In order to obtain the p-value of the test, Stove et al., (2014) suggested to use the following bootstrap procedure:

Step 1. Randomly draw samples from the standardized residuals $\{\eta_{1,t}, \eta_{2,t}\}$ with replacement

Step 2. Split the resampled data into BP and AP and compute $\hat{\rho}^*_{AP}(x_i, x_i)$ and $\rho^*_{BP}(x_i, y_i)$

Step 3. Calculate the bootstrapped the test statistic

$$D^* = \frac{1}{n} \sum_{i=1}^{n} \{\hat{\rho}^*_{BP}(x_i, x_i) - \hat{\rho}^*_{AP}(x_i, x_i)\} w(x_i, x_i) \tag{8}$$

Repeat Step 1 to Step 3 for a large number of times, B, and collect all bootstrapped statistics D^*. Finally, the p-value of the test can be found by comparing D in terms of the distribution of bootstrapped statistics D^*, and a decision of rejecting H_0 can be made if it is below a given significant level α.

In this regard, the following practical settings were used: (i) For the bandwidth, we follow Stove et al., (2014) to choose the bandwidth using a simple rule of thumb – the global standard deviation times a constant close to one; (ii) The number of repetition times in the bootstrap test is set to be B = 1000; (iii) The diagonal grid is set to be between -2.5 and 2.5 with step-size 0.05, and; (iv) Our implementation[3] is based on the R package "localgauss" (Berentsen et al., 2014).

3. Data and Empirical Results

3.1. Data

Our analysis involves two variables namely, the REITs and stock indices of nineteen economies (Australia, Belgium, Canada, France, Germany, Hong Kong, Ireland, Italy, Japan, Malaysia, Mexico, The Netherlands, New Zealand, Singapore, South Africa, Spain, Turkey, UK, and US) covering the daily period of January 1, 1998 to September 13, 2018. The data is sourced from the DataStream database of Thomson Reuters, with the real estate data corresponding to the S&P REITs indices for each country, while the stock market data are the MSCI indices. To avoid the impact of exchange rate movements, both the REITs and stock indices for each country are in US dollar terms. As pointed out earlier, we work with log-returns of these two series. However, not all countries have REITs data available for this period, unlike the equity market data. Table A1 in the Appendix of the paper provides the individual sample period of each country (for REITs and stock returns) and also summarizes the basic statistical properties of the data. As can be seen, what stands out is the non-normality of the all the raw log-returns series based on the strong rejection of the null of normality under the Jarque-Bera test. Figure A1 in the Appendix of the paper provides the plot of the data.

[3] The authors would like to thank Bård Støve and Dag Tjøstheim for providing the R codes of the contagion bootstrap test.

3.2. Results

Next, we turn our attention to the local Gaussian approach for the investigation of the dependence structure and the existence of contagion between the REIT return and equity returns among different countries during four different periods: Period 1 (dot-com crisis), Period 2 (global financial crisis), Period 3 (European sovereign debt crisis), and Period 4 (Recent, or Brexit in the UK). The contagion is analysed in the context of cross-markets within a country, cross-country relative to the US within the REITs sector, and cross-market-cross-country, whereby we look at US equities and REITs of the remaining eighteen countries.

We identify the chronology of the different crisis periods from the literature. The timeline of the dot-com crisis and global financial crisis follows Philips et al., (2011). The period surrounding the dot-com crisis covers January 1, 1998 to December 31, 2002, with the before-crisis sub-period spanning January 1, 1998 to March 10, 2000 and the after-crisis subperiod running from March 11, 2000 until December 31, 2002. As also suggested by Stove et al., (2014), in terms of the global financial crisis due to the subprime mortgage turmoil, we define the before-crisis subperiod to be from January 1, 2005 to August 8, 2007 and the after-crisis subperiod ranging between August 9, 2007 and August 7, 2009. Following Bampinas and Panagiotidis (2015), the European sovereign debt crisis starts from October 24, 2007 and ends at July 31, 2012, and the cutting date for before-crisis and after-crisis subperiods is October 4, 2009 (i.e., elections in Greece). Finally, we also include a recent period from Jan 1, 2014 to September 13, 2018 (corresponding to the last day of our data sample). Within this period, one of the major events is the Brexit, i.e., the voting result of the British Referendum on withdrawing its membership from the European Union, as announced on June 23, 2016. Thus, we use this date as the cutting line to distinguish the before-crisis and after-crisis subperiods in Period 4. This also allows us to have more than two years of data in the sub-period after the announcement of the Brexit vote result. In summary, the chronology of the four periods are listed below:

- Period 1 (dot-com crisis):
    - before: Jan 1, 1998 – Mar 10, 2000
    - after: Mar 11, 2000 – Dec 31, 2002

- Period 2 (global financial crisis):
  - before: Jan 1, 2005 – Aug 8, 2007
  - after: Aug 9, 2007 – Aug 7, 2009
- Period 3 (European sovereign debt crisis):
  - before: Oct 24, 2007 – Oct 4, 2009
  - after: Oct 5, 2009 – Jul 31, 2012
- Period 4 (Recent, or Brexit in the UK):
  - before: Jan 1, 2014 – Jun 23, 2016
  - after: Jun 24, 2016 – Sep 13, 2018

3.2.1. (Cross-Market) Contagion between REITs and Equity

We start our analysis by investigating the cross-market local Gaussian correlation between returns of the REITs and equity markets for each country. As demonstration, Figure 1 shows the local Gaussian correlation curves between REITs and equity returns of the US in each of the four sub-periods. In Period 1 (dot-com crisis), there is a substantial increase of the local Gaussian correlation from -0.03 to 0.34 in the right tail after the crisis, while there is only a slight increment in the left tail and the middle regime of the distribution. The global financial crisis is also observed to have significantly increased the linkage between the US REITs and US equity in Period 2. The European sovereign debt crisis and Brexit occurred in Europe and have small impact on the US market, and we observe that the local Gaussian correlation curve decreased after the crisis in Periods 3 and 4. Barring the initial pre-dot-com crisis period, with the correlation between REITs and stock returns always being positive, tends to suggest that there are no diversification opportunities across securitized real estate and equity markets in the US during periods of turmoil, irrespective of whether these markets are in bearish (lower tail), normal (median), or bullish (upper tail) phases.[4]

[INSERT FIGURE 1]

[4] The figures for the local Gaussian curves of all countries for the various sub-periods can be obtained upon request from the authors. In general, as in the case of the US, with the correlation being positive between REITs and stock returns, any possibility of diversification is nullified.

For the sake of brevity, we concentrate on Table 1, which presents the bootstrap test of contagion for the nineteen counties in the four periods. It must be noted that results are available for all or certain sub-periods depending on data availability of the REITs. For the US, the bootstrap test indeed shows that there is significant evidence of contagion that occurred between REITs and equity in Period 1 and 2, while there is no evidence of contagion in Periods 3 and 4, as depicted in Figure 1. As for other counties, i.e., the established markets of Australia, Canada, France, Hong Kong, Japan, The Netherlands, New Zealand and Singapore, for which REITs data is available, there is strong evidence of contagion for almost all countries during the global financial crisis. For Belgium, weak evidence is observed at the 10% level of significance. In terms of the European sovereign debt crisis (Period 3), not surprisingly all the European countries for which REITs data is available, i.e., Belgium, France, Germany, The Netherlands, and the UK, we observe strong evidence of contagion. In addition, contagion across real estate and equity markets are also observed in Australia, Canada and the emerging market of South Africa, which could be a result of the equity and REITs markets in these economies being affected by a common factor, i.e., global slowdown ("double-dip" following the "Great Recession") due to this shock in the sovereign bonds market. Given that South Africa has a relatively well-functioning REITs sector among the emerging markets (Akinsomi et al., 2017), in Figure 2, we plot the local Gaussian correlation curve for South Africa, as a representative of emerging REITs markets. As can be seen there is strong evidence of contagion in the post European sovereign debt crisis episode, and with the Gaussian correlation being positive, there is no possibility of diversification opportunities between equities and the securitized real estate market.[5] The lack of contagion in the US is most likely because the US real estate market was still recovering when the European sovereign debt crisis hit the world economy. Interestingly, there is no evidence of contagion in the UK after the Brexit vote, which in turn, can possibly be explained by the fact that the negotiations for the process is still in process, and is yet to take effect. Surprisingly, contagion is observed in the two emerging markets of Mexico and Spain, likely due to the fact that REITs as an alternative

[5] Note that, as no adequate ARMA-GARCH framework could be obtained for the marginal model in the last sub-period, and no data on REITs is available for the first and the second crises, we are only restricted to the third sub-period of the bonds market crisis in Europe.

and new investment instrument in these two economies got introduced during this period, and was relatively more susceptible to negative news shocks.

[INSERT TABLE 1 AND FIGURE 2]

3.2.2. (Cross-Country) Contagion between US REITs and REITs of other Countries

We proceed with our analysis by studying the cross-country linkage in the REITs markets, i.e., the US with other countries, given the dominance of the former in the REITs sector (as indicated by the Nareit: the worldwide representative voice for REITs)[6] and the global economy in general. Table 2 presents the bootstrap test of contagion between US REITs and the REITs in the other eighteen countries in the four sub-periods. In the dot-com crisis, the contagion only took place between US and Belgium. In terms of the global financial crisis, we find strong evidence of contagion between US and Canada, and also between US and most established European markets except for Germany and the UK. While there is weak evidence between US and Australia, the effect is strong for New Zealand and Singapore. Contagion during the European sovereign debt crisis is observed between the US with Australia, France, the Netherlands, New Zealand, South Africa and the UK, with weak effects on Germany and Singapore. Interestingly, the contagion between US and Japan is found to be significant in sub-period 4.

[INSERT TABLE 2]

To analyse contagion between the mature US REITs market with the established Canadian securitized real estate sector, we present in Figure 3 the local Gaussian correlation curves between US and Canada during the four different sub-periods. In Period 1, the local Gaussian correlation curve drops after the burst of the dot-com bubble, but there is a rise in the local Gaussian correlation curve after the subprime mortgage crisis, especially in the middle regime of the distribution, but the increment in the right tail is marginal. Conversely and interestingly, there is a surge in the right tail of the local Gaussian correlation curve in the third period, while the curve keeps the similar level in the middle regime and left tail. Subsequently, the high local Gaussian correlation in the right tail dropped in sub-period 4.

[6] See: https://www.reit.com/investing/global-real-estate-investment.

But more importantly, with the correlation being positive in all sub-periods between REITs returns across the North American borders, imply that there is no inter-country diversification benefits.

In order to demonstrate the linkage in the REITs markets of the US and Europe, Figure 4 presents the local Gaussian correlation curves with the Netherlands, as an example. We choose the Netherlands, as the bootstrap test had provided strong evidence of significance during the periods spanning the global financial and sovereign debt crises. For sub-periods 1, 2, and 3, we observe higher local Gaussian correlation estimates for the majority of the distribution, although in sub-periods 1 and 2 the curves cross each other at the upper tail, which in turn could have made the contagion insignificant during the dot-com crisis. There is an obvious shrinkage of local Gaussian correlation in sub-period 4. Barring the lower-tail, i.e., bearish state of the REITs markets during the dot-com crisis, any possibility of diversification benefit seems to have frittered away during the recent episodes of financial market crises. The consistent evidence of lack of diversification benefits relative to the US REITs market,[7] especially during recent periods, is an indication of the integration in the REITs market across the world, i.e., they are driven by common shocks (Bardhan et al., 2008; Ji et al., 2018).

[INSERT FIGURES 3 AND 4]

3.2.3. (Cross-Market-Cross-Country) Contagion between US REITs and Equity Markets of other Countries

Again given the dominance of the US real estate sector, malfunctioning of which basically led to the global financial crisis, there could be contagion between US REITs and equity markets in other countries, i.e., cross-market-cross-country contagion. Hence, we now study the local Gaussian correlation between US REITs and equity markets in the other eighteen countries during the four sub-periods. Table 3 exhibits the bootstrap test of contagion between US REIT and the equity in the other eighteen countries in the four periods. During the dot-com crisis, strong evidence of contagion for equity markets is

[7] The figures for the local Gaussian curves of the remaining sixteen countries for the various sub-periods, showing similar positive correlation patterns in general, are available upon request from the authors.

observed in the three European countries of France, Germany, and Italy, with weak evidence for Canada and Mexico. In terms of the global finance crisis, the bootstrap test suggests that contagion from US REITs is significant for the equity markets in the majority of countries (with weak effects in France, Germany, Italy and Singapore), except for New Zealand and the three Asian countries of Hong Kong, Japan, and Malaysia. All the mainland European countries (with weak effect on the Netherlands), Ireland and the UK, other than Italy, shows evidence of contagion in their equity market with the US REITs market during the sovereign debt crisis. Additionally, we also observe strong evidence of contagion in Australia, Canada, Singapore and South Africa in sub-period 3, with weak affects also observed for New Zealand. Lastly, there is no strong evidence of contagion in the equity markets of any other eighteen countries in the recent period (sub-period 4), barring a weak impact on Australia.

[INSERT TABLE 3]

To reflect the cross-market-cross-country linkages, we display the local Gaussian correlation curves between US REITs and equity market of the UK in Figure 5. Sub-period 1 is shown to exhibit an interesting pattern, in the sense that there is a rise in the right tail and a drop in the left tail, making possibly the overall impact insignificant, as found in Table 3. We can clearly observe the upward movement in the local Gaussian correlation curves in both sub-periods 2 and 3, while there is a reduction in the local Gaussian curve in the recent period (Period 4). In Figure 6, we select the pair of US REITs and equity market of Singapore and present their local Gaussian correlation curves for the four sub-periods. In sub-period 1, there is a fall of local Gaussian correlation in the right tail of the distribution. It is intriguing to observe that sub-period 2 experiences a rise in the middle of the distribution and a reduction in both tails, resulting in a weak overall effect as observed in Table 3. There is a universal increase in the whole distribution in Period 3, especially for the right tail and the regime between -2 and -1 in the distribution. In sub-period 4, the two local Gaussian correlation curves cross each other. In general again, due to the correlation being positive across US REITs return and equity return of the other countries,[8]

[8] The figures for the local Gaussian curves of the remaining sixteen countries for the various sub-periods, depicting positive correlation in general, are available upon request from the authors.

cross-market-cross-country diversification, will not help in improving the profitability of the portfolio during these periods of global crises. This is possibly due to the fact that though REITs market is indeed associated with the real estate market, characteristically it is much similar to standard equity markets (Ghysels et al., 2013).

[INSERT FIGURES 5 AND 6]

4. Concluding Remarks

In this paper, we study contagion between REITs and the equity markets of nineteen countries, which are at their different stages of development in terms of the REITs market. In addition, we also conduct contagion analyses between US REITs and the other international REITs, as well as between US REITs and equity markets of the eighteen remaining countries in our sample. We analyze contagion by using the local Gaussian correlation approach during the dot-com, global financial, European sovereign debt crises, and the more recent period involving the Brexit in the UK, spanning the daily period of January 1, 1998 to September 13, 2018. In general, we find strong evidence of contagion between equities and REITs of not only matured and established markets, but also in economies with an emerging REITs sector, especially during the global financial and sovereign debt crises. Further, when we considered contagion across REITs of the US and the other countries, and between US REITs and equities of the remaining eighteen countries, a similar pattern emerges. These results tend to suggest that REITs and equity markets within and across economies have become more integrated post the dot-com crises, to the extent that the local Gaussian correlations are positive, implying no diversification opportunities for investors. With asset prices being leading indicators for economic activity (Plakandaras et al., 2017), policymakers must closely monitor contagion of especially negative shocks emanating from not only domestic, but also foreign REITs (and equity) markets, as this is likely to deepen recessions or slowdown the recovery process. Naturally, policy authorities might need to be proactive with expansionary (monetary) policies to revive the economy.

Given that REITs markets around the world seems to have become integrated in recent years, as part of future research, it would be interesting to obtain common time-varying components of returns and volatilities following the procedure of Bhatt et al., (2017), and then analyze the factors that drive these comovements. Further, one could do a similar analysis for equity markets, and then compare whether the driving factors across REITs and equity markets are common or not. These would serve as important information for investors and policymakers alike.

References

Akinsomi, O., Balcilar, M., Demirer, R., and Gupta, R. (2017). The Effect of Gold Market Speculation on REIT Returns in South Africa: A Behavioral Perspective. Journal of Economics and Finance, 41(4), 774–793.

Bae, K., Karolyi, G., and Stulz, R. (2003). A new approach to measuring financial contagion. Review of Financial Studies, 16, 717–763.

Bampinas, G., and Panagiotidis, T. (2015). On the relationship between oil and gold before and after financial crisis: linear, nonlinear and time-varying causality testing. Studies in Nonlinear Dynamics and Econometrics, 19(5), 657-668.

Bampinas, G., and Panagiotidis, T. (2017). Oil and stock markets before and after financial crises: A local Gaussian correlation approach. Journal of Futures Markets, 37(12), 1179-1204.

Bardhan, A., Edelstein, R. and Tsang, D. (2008). Global Financial Integration and Real Estate Security Returns. Real Estate Economics, 36(2), 285-311.

Baur, D.G. (2013). The structure and degree of dependence: A quantile regression approach. Journal of Banking & Finance, 37, 786–798.

Berentsen, G. D., Kleppe, T. S., and Tjøstheim, D. (2014). Introducing localgauss, an R package for estimating and visualizing local Gaussian correlation. Journal of Statistical Software, 56(1), 1-18.

Bhatt, V., Kishor, N.K., and Ma, J. (2017). The Impact of EMU on Bond Yield Convergence: Evidence from a Time-Varying Dynamic Factor Model. Journal of Economic Dynamics and Control, 82, 206-222.

Bodart, V. and Candelon, B. (2009). Evidence of interdependence and contagion using a frequency domain framework. Emerging Markets Review, 10, 140–150.

Bollerslev, T., Chou, R. Y., and Kroner, K. F. (1992). ARCH modeling in finance: A review of the theory and empirical evidence. Journal of Econometrics, 52(1-2), 5-59.

Bouri, E. Gupta, R., Wong, W-K., and Zhu, Z., 2018. Is Wine a Good Choice for Investment? Pacific-Basin Finance Journal, 51, 171-183.

Bulla, J., and Bulla, I. (2006). Stylized facts of financial time series and hidden semi-Markov models. Computational Statistics and Data Analysis, 51(4), 2192-2209.

Caporin, M., Pelizzon, L., Ravazzolo, F., and Rigobon, R., 2018. Measuring sovereign contagion in Europe. Journal of Financial Stability, 34, 150–181.

Chuliá, H., Guillén, M., and Uribe, J.M. (2017). Spillovers from the United States to Latin American and G7 stock markets: A VAR quantile analysis. Emerging Markets Review, 31(C), 32-46.

Dungey, M., and Fry, R., Gonzalez-Hermosillo, B., Martin, V.L., 2005. Empirical modelling of contagion: a review of methodologies. Quantitative Finance, 5, 9–24.

EY Global Real Estate Report (2016). Global REIT Markets. Available for download from: https://www.ey.com/Publication/vwLUAssets/ey-global-reit-markets/$FILE/ey-global-reit-markets.pdf.

Fisher, T. J., and Gallagher, C. M. (2012). New weighted portmanteau statistics for time series goodness of fit testing. Journal of the American Statistical Association, 107(498), 777-787.

Forbes, K.J., 2012. The “Big C”: Identifying and mitigating contagion. NBER Working Paper No. 18465.

Forbes, K. J., and Rigobon, R. (2002). No contagion, only interdependence: measuring stock market comovements. The Journal of Finance, 57(5), 2223-2261.

Fry, R., Martin, V.L., and Tang. C., 2010. New Class of Tests of Contagion with Applications. Journal of Business and Economic Statistics, 28(3), 423-437.

Gerlach, R., Wilson, P., and Zurbruegg, R., 2006. Structural Breaks and Diversification: The Impact of the 1997 Asian Financial Crisis on the Integration of Asia-Pacific Real Estate Markets. Journal of International Money and Finance 25(6): 974-991.

Ghysels, E., Plazzi, A., Torous, W.N., and Valkanov, R.I. (2013). Forecasting Real Estate Prices. Handbook of Economic Forecasting: Vol II, G. Elliott and A. Timmermann, eds., Elsevier, 509-580.

Guo, F., Chen, C.R., and Huang, Y-S. (2011). Markets contagion during financial crisis: A regime-switching approach? International Review of Economics & Finance, 20(1), 95-109.

Hjort, N. L., and Jones, M. C. (1996). Locally parametric nonparametric density estimation. The Annals of Statistics, 24(4), 1619-1647.

Hoesli, M., Lekander, J., and Witkiewicz, W., 2004. International evidence on real estate as a portfolio diversifier. Journal of Real Estate Research, 26(2), 161–206.

Hoesli, M. and Reka, K., 2013. Volatility Spillovers, Comovements and Contagion in Securitized Real Estate Markets. Journal of Real Estate Finance and Economics, 47, 1-35.

Hoesli, M., and Reka, K. (2015). Contagion channels between real estate and financial markets. Real Estate Economics, 43(1), 101-138.

Ji, Q., Marfatia, H.A., and Gupta, R. (2018). Information spillover across international real estate investment trusts: Evidence from an entropy-based network analysis. The North American Journal of Economics and Finance, 46, 103-113.

Kallberg, J.G., Liu, C.H. and Pasquariello, P., 2002. Regime Shifts in Asian Equity and Real Estate Markets. Real Estate Economics, 30(2), 263-291.

Li, X-L., Chang, T., & Miller, S.M., Balcilar, M., and Gupta, R. (2015). The co-movement and causality between the U.S. housing and stock markets in the time and frequency domains. International Review of Economics & Finance, 38(C), 220-233.

Liu, Z., and Wang, S. (2017). Decoding Chinese stock market returns: Three-state hidden semi-Markov model. Pacific-Basin Finance Journal, 44, 127-149.

MacKinnon, G. H., and Al Zaman, A., 2009. Real estate for the long term: the effect of return predictability on long-horizon allocations. Real Estate Economics, 37(1), 117–153.

Mollah, S., Quoreshi, A. S., and Zafirov, G. (2016). Equity market contagion during global financial and Eurozone crises: Evidence from a dynamic correlation analysis. Journal of International Financial Markets, Institutions and Money, 41, 151-167.

Nyakabawo, W., Gupta, R., and Marfatia, H.A. (2018). High Frequency Impact of Monetary Policy and Macroeconomic Surprises on US MSAs, Aggregate US Housing Returns and Asymmetric Volatility. Advances in Decision Sciences, 22(1), 1-25.

Pericoli, M., and Sbracia, M., 2003. A primer on financial contagion. Journal of Economic Surveys, 17, 571–608.

Pesaran, H., and Pick, A., 2007. Econometric issues in the analysis of contagion. Journal of Economic Dynamics and Control, 31, 1245–1277.

Phillips, P. C., Wu, Y., and Yu, J. (2011). Explosive behavior in the 1990s NASDAQ: When did exuberance escalate asset values? International Economic Review, 52(1), 201-226.

Plakandaras, V., Cunado, J., Gupta, R., and Wohar, M.E. (2017). Do leading indicators forecast U.S. recessions? A nonlinear re-evaluation using historical data. International Finance, 20(3), 289–316.

Rydén, T., Teräsvirta, T., and Åsbrink, S. (1998). Stylized facts of daily return series and the hidden Markov model. Journal of Applied Econometrics, 13(3), 217-244.

Tjøstheim, D., and Hufthammer, K. O. (2013). Local Gaussian correlation: A new measure of dependence. Journal of Econometrics, 172(1), 33-48.

Samarakoon, L. P. (2017). Contagion of the eurozone debt crisis. Journal of International Financial Markets, Institutions and Money, 49, 115-128.

Støve, B., Tjøstheim, D., and Hufthammer, K. O. (2014). Using local Gaussian correlation in a nonlinear re-examination of financial contagion. Journal of Empirical Finance, 25, 62-82.

Tai, C. S. (2004). Looking for risk premium and contagion in Asia-Pacific foreign exchange markets. International Review of Financial Analysis, 13(4), 381-409.

Wei, W. W. S. (2006). Time Series Analysis Univariate and Multivariate Methods, 2nd ed., Adison Westley.

Table 1. *p*-values of the bootstrap test between REITs and equity returns in the same country

Country	Period 1	Period 2	Period 3	Period 4
UNITED STATES	1,60%	0,10%	94,71%	100,00%
AUSTRALIA	69,03%	0,80%	0,60%	100,00%
BELGIUM	19,48%	9,19%	0,10%	25,47%
CANADA	92,81%	0,10%	0,70%	72,03%
FRANCE	-	0,10%	0,10%	100,00%
GERMANY	-	-	3,50%	93,91%
HONG KONG	-	0,10%	100,00%	55,34%
JAPAN	-	0,30%	97,30%	36,96%
THE NETHERLANDS	37,16%	0,10%	0,10%	96,30%
NEW ZEALAND	~	0,40%	94,71%	97,40%
SINGAPORE	-	0,10%	96,80%	92,31%
UNITED KINGDOM	-	-	0,10%	99,10%
IRELAND	-	-	-	/
ITALY	-	-	-	85,71%
MALAYSIA	-	-	~	100,00%
MEXICO	-	-	-	0,70%
SOUTH AFRICA	-	-	0,30%	/
SPAIN	-	-	-	0,50%
TURKEY	-	-	46,55%	84,72%

Note: This table shows the *p*-values of the bootstrap test between REITs and equity market returns within a specific country, i.e., cross-market contagion in a particular country. Strong evidence, i.e., *p*-values less than 5% is highlighted in red background, and weak evidence implied by *p*-values between 5% and 10% is highlighted in yellow background. The symbol "-" denotes no available data in that period; the symbol "~" denotes the non-convergence of the local Gaussian approach; and the symbol "/" denote that no adequate ARMA-GARCH could be obtained for the marginal model.

Table 2. *p*-values of the bootstrap test between US REITs and REITs of other countries

Country	Period 1	Period 2	Period 3	Period 4
AUSTRALIA	66,13%	8,59%	1,00%	41,36%
BELGIUM	4,00%	0,10%	1,50%	46,65%
CANADA	86,11%	0,10%	12,59%	65,93%
FRANCE	-	0,10%	1,00%	57,64%
GERMANY	-	-	6,69%	64,44%
HONG KONG	-	24,98%	10,99%	69,63%
JAPAN	-	75,32%	56,84%	1,50%
THE NETHERLANDS	15,18%	0,30%	0,30%	97,00%
NEW ZEALAND	~	0,90%	3,50%	22,38%
SINGAPORE	-	3,70%	8,99%	33,07%
UNITED KINGDOM	-	-	2,50%	86,81%
IRELAND	-	-	-	52,35%
ITALY	-	-	-	56,34%
MALAYSIA	-	-	~	78,12%
MEXICO	-	-	-	45,15%
SOUTH AFRICA	-	-	3,30%	/
SPAIN	-	-	-	~
TURKEY	-	-	21,08%	92,01%

Note: This table shows the *p*-values of the bootstrap test between US REITs and REITs in other countries, i.e., cross-country contagion for the REITs sector. Strong evidence, i.e., *p*-values less than 5% is highlighted in red background, and weak evidence implied by *p*-values between 5% and 10% is highlighted in yellow background. The symbol “-” denotes no available data in that period; the symbol “~” denotes the non-convergence of the local Gaussian approach; and the symbol “/” denote that no adequate ARMA-GARCH could be obtained for the marginal model.

Table 3. *p*-values of the bootstrap test between US REITs and equity markets in other countries

Country	Period 1	Period 2	Period 3	Period 4
AUSTRALIA	31,68%	1,98%	1,98%	8,91%
BELGIUM	45,54%	0,99%	3,96%	94,06%
CANADA	5,94%	0,99%	2,97%	44,55%
FRANCE	2,97%	9,90%	4,95%	100,00%
GERMANY	0,99%	7,92%	1,98%	97,03%
HONG KONG	45,54%	23,76%	28,71%	40,59%
JAPAN	56,44%	54,46%	13,86%	13,86%
THE NETHERLANDS	14,85%	1,98%	9,90%	99,01%
NEW ZEALAND	33,66%	11,88%	6,93%	24,75%
SINGAPORE	43,56%	8,91%	2,97%	26,73%
UNITED KINGDOM	37,62%	0,99%	1,98%	98,02%
IRELAND	12,87%	1,98%	1,98%	/
ITALY	4,95%	6,93%	14,85%	98,02%
MALAYSIA	78,22%	49,50%	12,87%	79,21%
MEXICO	5,94%	0,99%	84,16%	77,23%
SOUTH AFRICA	62,38%	4,95%	0,99%	38,61%
SPAIN	32,67%	/	/	98,02%
TURKEY	37,62%	0,99%	51,49%	75,25%

Note: This table shows the *p*-values of the bootstrap test between US REITs and equity markets in other countries, i.e., cross-market-and-cross-country contagion. Strong evidence, i.e., *p*-values less than 5% is highlighted in red background, and weak evidence implied by *p*-values between 5% and 10% is highlighted in yellow background. The symbol "/" denote that no adequate ARMA-GARCH could be obtained for the marginal model.

UNITED STATES

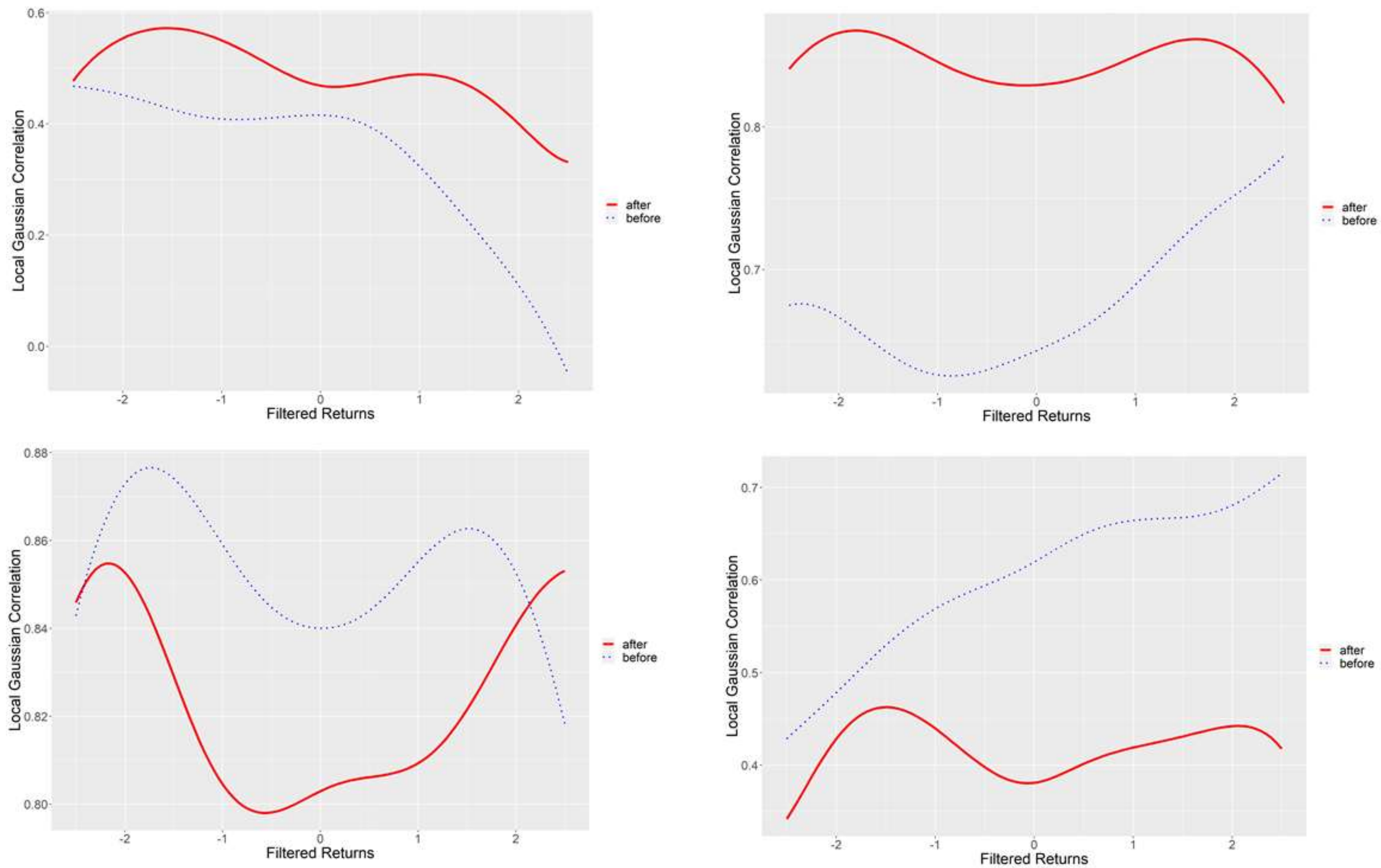

Figure 1. Local Gaussian correlation curves between REITs and equity returns in the US in four sub-periods: Period 1 (upper-left); Period 2 (upper-right); Period 3 (lower-left); and Period 4 (lower-right).

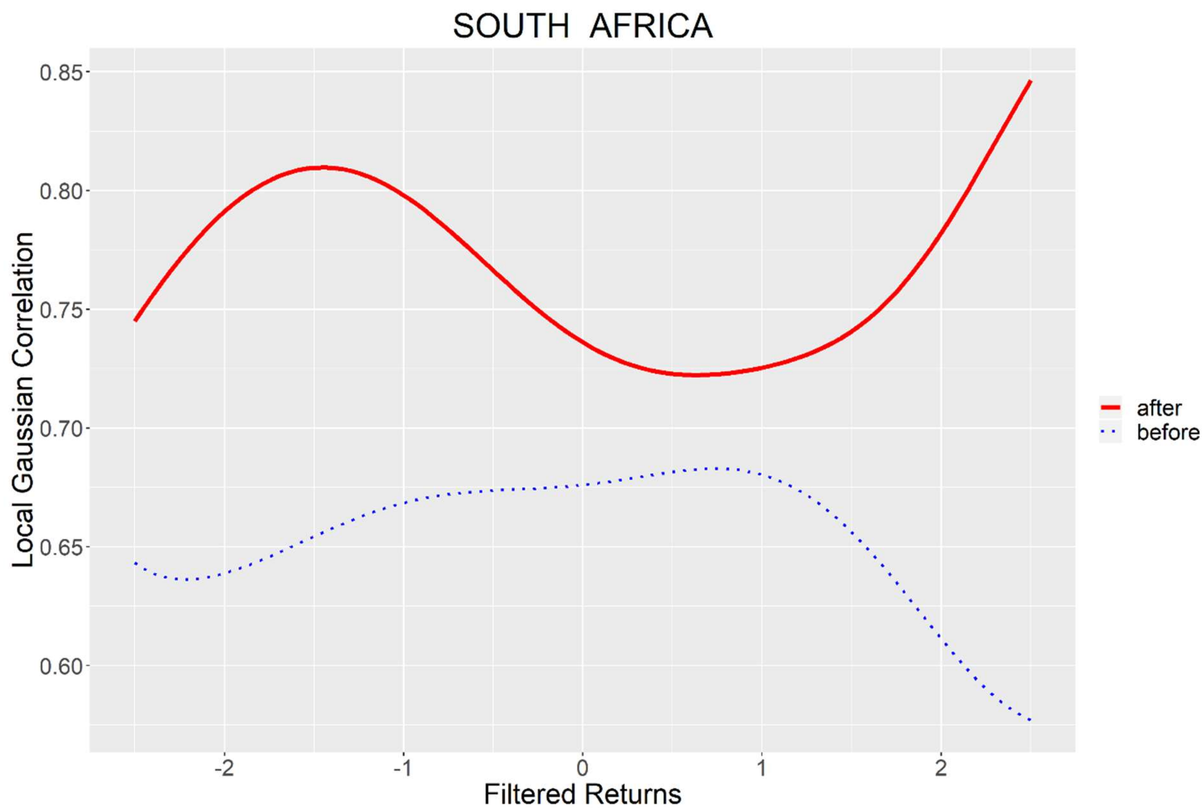

Figure 2. Local Gaussian correlation curves between REITs and equity returns in South Africa for the third sub-period

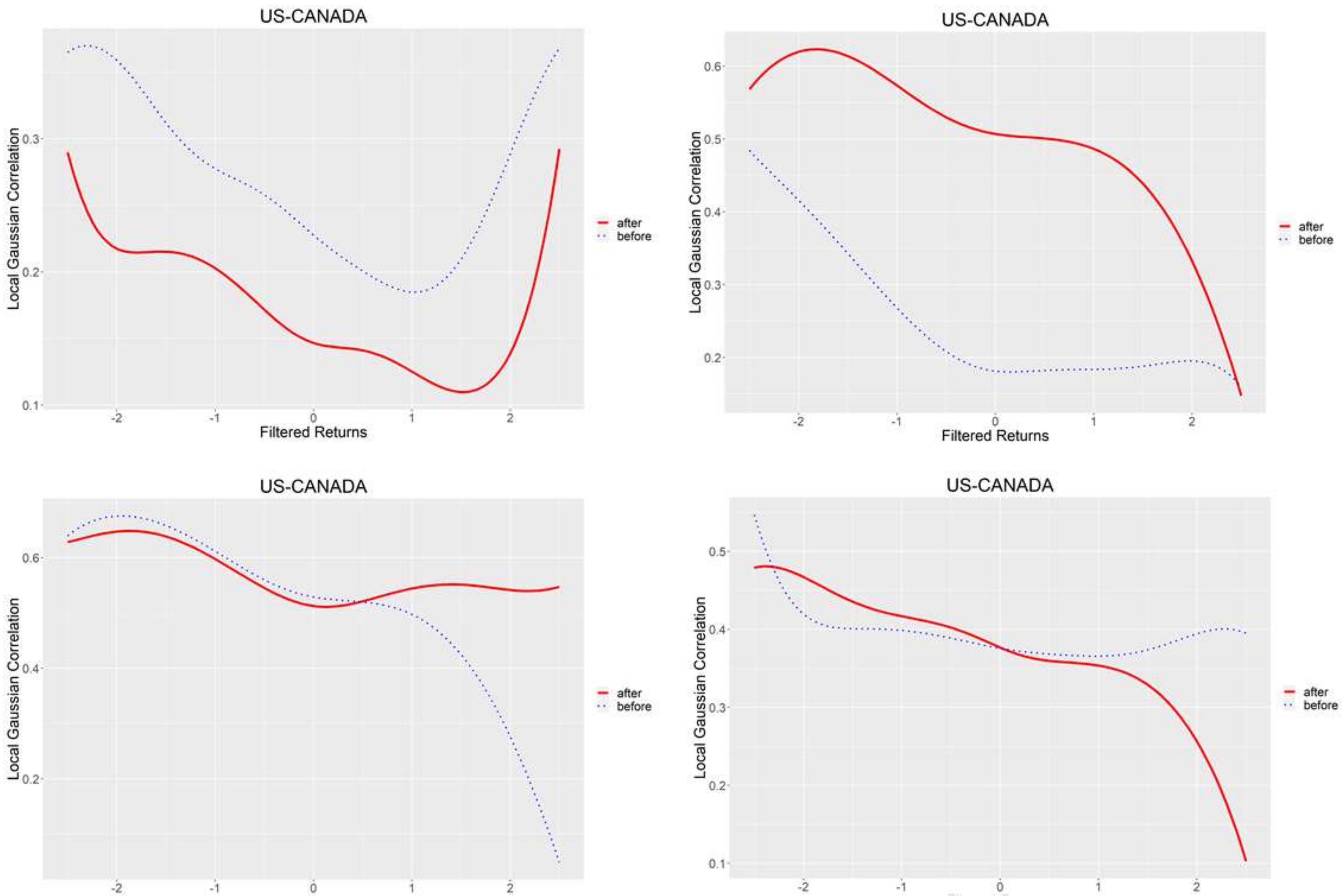

Figure 3. Local Gaussian correlation curves between the US and Canadian REITs in four sub-periods: Period 1 (upper-left); Period 2 (upper-right); Period 3 (lower-left); and Period 4 (lower-right).

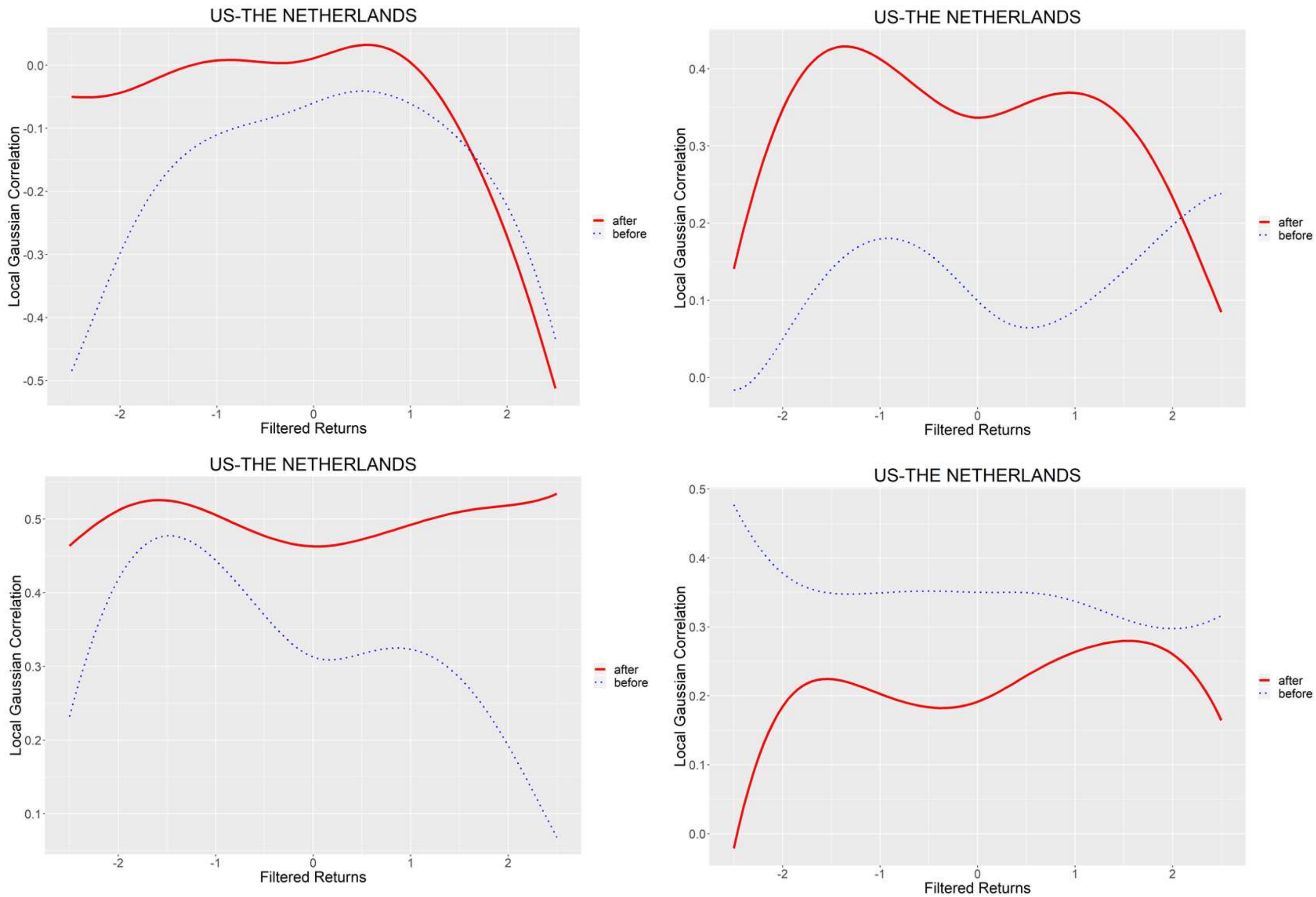

Figure 4. Local Gaussian correlation curves between REITs of the US and the Netherlands in four sub-periods: Period 1 (upper-left); Period 2 (upper-right); Period 3 (lower-left); and Period 4 (lower-right).

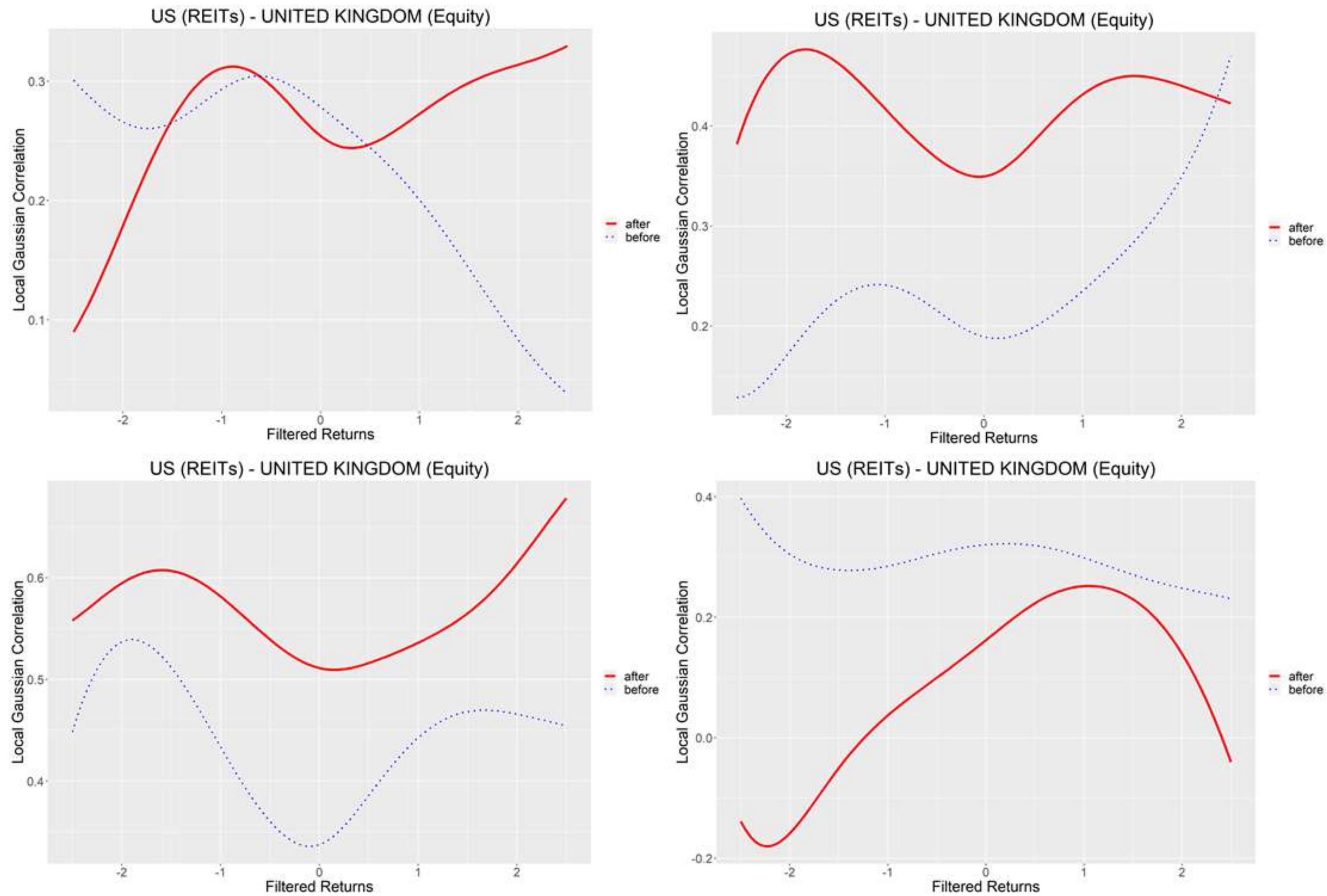

Figure 5. Local correlation curves between REITs of the US and equity of the UK in four sub-periods: Period 1 (upper-left); Period 2 (upper-right); Period 3 (lower-left); and Period 4 (lower-right).

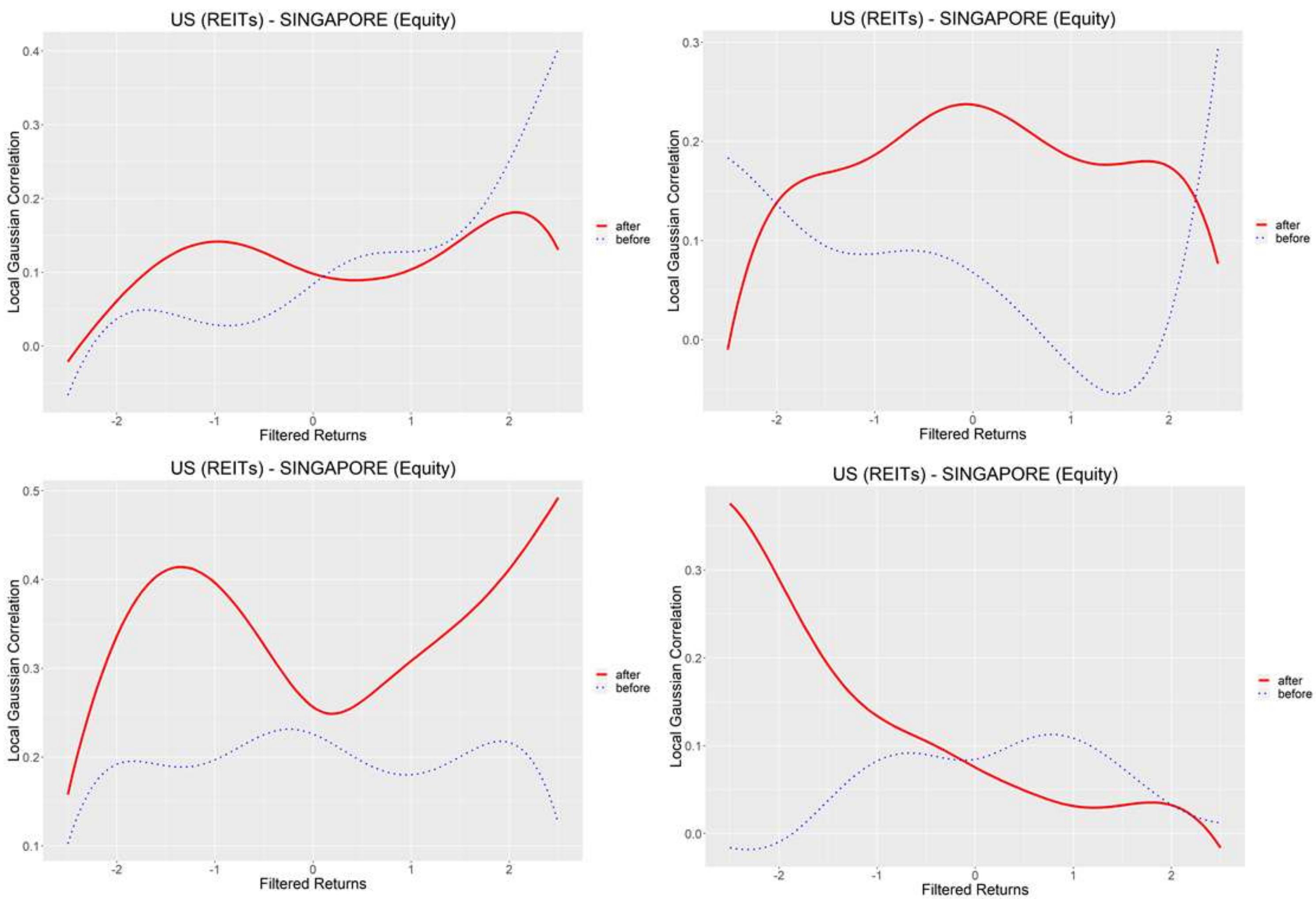

Figure 6. Local correlation curves between REITs of the US and equity of Singapore in four sub-periods: Period 1 (upper-left); Period 2 (upper-right); Period 3 (lower-left); and Period 4 (lower-right).

APPENDIX

Table A1(a): Summary Statistics of Equity Return

Country	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	*p*-value	Obs.
Australia	0.0002	0.0005	0.0881	-0.1598	0.0144	-0.7490	12.6115	20577	0.0000	5219 (14/09/1998-13/09/2018)
Belgium	0.0000	0.0003	0.1066	-0.1546	0.0145	-0.3835	10.8849	13648	0.0000	5219 (14/09/1998-13/09/2018)
Canada	0.0002	0.0007	0.1028	-0.1425	0.0138	-0.6783	12.4423	19788	0.0000	5219 (14/09/1998-13/09/2018)
France	0.0001	0.0005	0.1184	-0.1157	0.0152	-0.0802	9.2711	8558	0.0000	5219 (14/09/1998-13/09/2018)
Germany	0.0001	0.0004	0.1159	-0.0964	0.0157	-0.0907	7.7706	4956	0.0000	5219 (14/09/1998-13/09/2018)
Hong Kong	0.0003	0.0001	0.1045	-0.1257	0.0134	-0.1331	9.6450	9617	0.0000	5219 (14/09/1998-13/09/2018)
Ireland	-0.0001	0.0001	0.1360	-0.1893	0.0172	-0.6845	13.0615	22422	0.0000	5219 (14/09/1998-13/09/2018)
Italy	-0.0001	0.0002	0.1247	-0.1569	0.0164	-0.2109	9.5727	9433	0.0000	5219 (14/09/1998-13/09/2018)
Japan	0.0001	0.0001	0.1227	-0.0951	0.0139	-0.0138	7.9173	5258	0.0000	5219 (14/09/1998-13/09/2018)
Malaysia	0.0003	0.0000	0.1797	-0.3697	0.0125	-4.0721	168.9842	6005566	0.0000	5219 (14/09/1998-13/09/2018)

Mexico	0.0004	0.0006	0.1516	-0.1090	0.0167	0.0836	9.8755	10286	0.0000	5219 (14/09/1998-13/09/2018)
Netherlands	0.0001	0.0003	0.1053	-0.1151	0.0145	-0.1750	9.3865	8896	0.0000	5219 (14/09/1998-13/09/2018)
New Zealand	0.0001	0.0005	0.1020	-0.1007	0.0135	-0.3625	7.1696	3895	0.0000	5219 (14/09/1998-13/09/2018)
Singapore	0.0003	0.0003	0.0856	-0.0981	0.0132	-0.1367	7.7980	5022	0.0000	5219 (14/09/1998-13/09/2018)
South Africa	0.0003	0.0009	0.1235	-0.1357	0.0178	-0.2890	7.1634	3842	0.0000	5219 (14/09/1998-13/09/2018)
Spain	0.0001	0.0001	0.1601	-0.1604	0.0166	-0.0631	10.5854	12516	0.0000	5219 (14/09/1998-13/09/2018)
Turkey	0.0001	0.0003	0.2202	-0.2742	0.0281	-0.1786	11.0058	13965	0.0000	5219 (14/09/1998-13/09/2018)
United Kingdom	0.0000	0.0003	0.1216	-0.1147	0.0133	-0.2358	12.2133	18507	0.0000	5219 (14/09/1998-13/09/2018)
United States	0.0002	0.0003	0.1104	-0.0951	0.0118	-0.2262	11.5557	15962	0.0000	5219 (14/09/1998-13/09/2018)

Table A1(b): Summary Statistics of REITs Return

Country	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	*p*-value	Obs.
Australia	0.0001	0.0004	0.1050	-0.1848	0.0150	-1.1566	17.8391	49048	0.0000	5219 (14/09/1998-13/09/2018)
Belgium	0.0001	0.0003	0.1067	-0.0867	0.0116	-0.0966	8.9083	7599	0.0000	5219 (14/09/1998-13/09/2018)
Canada	0.0002	0.0003	0.0852	-0.1183	0.0115	-0.5916	13.3374	23542	0.0000	5219 (14/09/1998-13/09/2018)
France	0.0003	0.0006	0.0955	-0.1036	0.0158	-0.1452	6.8434	2415	0.0000	3902 (01/10/2003-13/09/2018)
Germany	-0.0001	0.0002	0.2765	-0.2254	0.0246	0.3228	19.2504	31320	0.0000	2842 (24/10/2007-13/09/2018)
Hong Kong	0.0004	0.0000	0.1008	-0.1325	0.0117	-0.4057	14.4024	20178	0.0000	3706 (01/07/2004-13/09/2018)
Ireland	-0.0001	0.0000	0.0564	-0.0764	0.0140	-0.1768	5.4248	308	0.0000	1232 (25/12/2013-13/09/2018)
Italy	-0.0002	0.0000	0.2267	-0.1380	0.0243	0.1446	9.3411	4504	0.0000	2683 (03/06/2008-13/09/2018)
Japan	0.0002	0.0001	0.1060	-0.1181	0.0136	-0.2180	11.3108	12767	0.0000	4424 (01/10/2001-13/09/2018)
Malaysia	0.0001	0.0000	0.0998	-0.0886	0.0104	0.0636	12.9803	12855	0.0000	3097 (01/11/2006-13/09/2018)
Mexico	-0.0002	0.0000	0.0749	-0.1093	0.0141	-0.4056	7.9165	1611	0.0000	1557 (26/09/2012-13/09/2018)

Netherlands	0.0000	0.0004	0.0862	-0.0828	0.0138	-0.2967	8.1037	5741	0.0000	5219 (14/09/1998-13/09/2018)
New Zealand	0.0001	0.0000	0.0797	-0.0939	0.0117	-0.5779	7.7619	5221	0.0000	5219 (14/09/1998-13/09/2018)
Singapore	0.0003	0.0002	0.2042	-0.1774	0.0129	0.2813	34.2087	161085	0.0000	3968 (01/07/2003-13/09/2018)
South Africa	0.0000	0.0004	0.1426	-0.1491	0.0167	-0.5725	10.8111	9045	0.0000	3483 (10/05/2005-13/09/2018)
Spain	0.0001	0.0000	0.0464	-0.1750	0.0087	-5.5489	111.9655	1199163	0.0000	2399 (06/07/2009-13/09/2018)
Turkey	-0.0007	0.0000	0.1715	-0.1846	0.0263	-0.4955	8.9918	5029	0.0000	3272 (01/03/2006-13/09/2018)
United Kingdom	-0.0003	0.0001	0.1171	-0.2428	0.0191	-1.0259	16.8280	24680	0.0000	3031 (01/02/2007-13/09/2018)
United States	0.0002	0.0000	0.1712	-0.2195	0.0173	-0.2222	26.3021	118120	0.0000	5219 (14/09/1998-13/09/2018)

Figure A1 (a). Data Plots of Equity Return

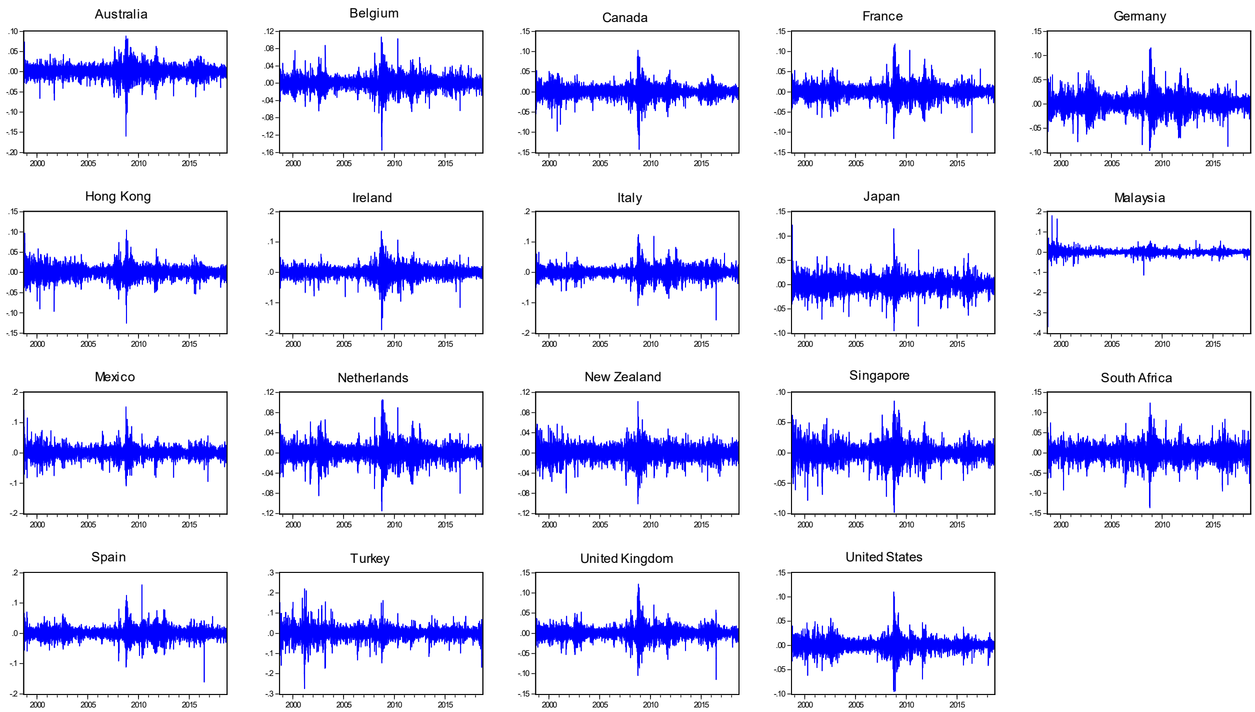

Figure A1 (b). Data Plots of REITs Return