INTERNATIONAL REAL ESTATE REVIEW

Interdependence of Securitized Real Estate in Frontier Markets

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Regional interdependence among the real estate markets in the Gulf Cooperation Council (GCC) is tested by using a variety of techniques. Econometric tests that involve error correction, symmetric/asymmetric autoregressive distributed lag (ARDL) and structural time series models are utilized. The results reveal the absence of long-run relationships, thus indicating cross-sectional efficiency. However, strong evidence is found for both short and long-run dynamic interdependence when the model allows for asymmetric responses. Finally, the results from the structural time series modeling show that a weak form of interdependence is present, which partly shows that other factors of significant impact explain for the real estate fluctuation other than the corresponding prices of the neighboring countries. Plausible fiscal and monetary policy recommendations are presented.

Keywords

Interdependence; Real Estate; Emerging Markets; GCC; Asymmetric Responses

1.   Introduction

Regional interdependence in real estate markets became evident in the midst of the global financial crisis in 2008. With increased integration of the economies, market liberalization and technological advances, markets in general became more interdependent than previously confirmed as witnessed in various studies such as Saunders and Walter (2002), Shen et al. (2012) and Oyedele et al. (2014). However, the author is not aware of an empirical investigation that examines the Middle Eastern real estate markets especially the period following the global financial crisis even though many studies have investigated the developed and emerging markets. This study intends to partially address the research gap and shed light to fellow economists on the interdependence of three key real estate markets in the Gulf Cooperation Council (GCC)[1] through a series of empirical tests. Furthermore, it is of particular interest in this study to analyze the interdependence of the regional real estate markets and test its significance in both bull and bear markets. As such, an asymmetric model is specified and tested for presence or absence of asymmetry. Lastly, the observed time series are divided into trend, cyclical, seasonal and irregular components, and then the relationship between the three real estate markets is investigated by using structural time series modeling.

2.   Literature Review
2.1   Asymmetry in Market Interdependence

It is well documented in the literature that with the globalization and financial integration of markets, empirical evidence has proven that markets influence one another. King and Wadhwani (1990) is the first study to record market interdependence after observing the spillover effect of the October 19, 1987 market crash, or what is commonly known as 'Black Monday'. It is said that Black Monday provided the first global spillover effect which confirms that there is international market interdependence after the crash started in Hong Kong and spread to Europe and the U.S. within the day. Subsequently, Koch and Koch (1991) test both contemporaneous and dynamic relations among eight stock markets and suggest that independence grows over time. Moreover, Longin and Solnik (1995) and Ramchand and Susmel (1998) assert that previous findings use correlations and conditional correlation coefficients to examine the degree of dependence across markets. Nonetheless, it is hypothesized that the degree and direction of market interdependence vary across market cycles and conditions. Koutmos (1996) addresses the phenomenon by modelling the dynamic interdependence of the major European markets to capture the presence of asymmetry.

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[1] GCC denotes the Gulf Cooperating Council/Countries which consist of six Middle Eastern countries, namely; Kuwait, Saudi Arabia, United Arab Emirates, Qatar, Oman and Bahrain.

2.2   Evidence from Developed Markets

In general, market interdependence has been confirmed by the empirical testing results in Taylor and Tonks (1989), Malliaris and Urrutia (1992), Ghallager (1995). A study by Hashmi and Liu (2001) states that the influence of the U.S. markets on other markets is strong, however, the inter-regional dependence is even stronger. The study, which was conducted seven years prior to the global crisis, seems to prove the first part of the statement and invite interest in testing the second. In real estate, market integration studies are provided, *inter alia*, by Liu and Mei (1998), Eichholtz et al. (1999), and Lee and Stevenson (2005) by testing for the presence of diversification benefits in various developed markets. For instance, Liu and Mei (1998) find some diversification benefits by analyzing the possible integration of real estate markets across the U.S, U.K, France, Japan and Australia. The results, however, are partially driven by changes in exchange risk. Similar results are obtained by Eichholtz (1996) and Stevenson (2000). More recently, Nikbakht et al. (2016) test the spillover effect between the U.S. and European real estate markets. The paper divides the samples into pre and post crisis and confirms a spillover effect from the U.S. to the European markets.

2.3   Evidence from Emerging Markets

The general consensus on emerging markets is that they generally have higher average returns, less correlation with developed markets, and greater serial correlation and volatility (see Errunza (1994) and Eaker et al. (2000)). Many studies have investigated the benefits of emerging markets in a global portfolio. Bekaert and Urias (1999) examine twenty emerging markets while Lu and Mei (1998) examine ten emerging markets across South America and Asia. Both studies take the perspective of U.S. investors. The results show mixed results depending on the markets, benchmarks and asset classes. The results are further confirmed by Sarkar and Li (2002), Mo and Chang (2005) and Tanura et al. (2006). It is worth noting that when considering regional emerging markets, the degree of financial liberalization should be assessed prior to investigating interdependence in the GCC. The effects of market liberalization have been tested on emerging markets by Henry (2000) who finds abnormal returns of market price indices of 3.3 per cent per month in real dollar terms during roughly the first eighteen months of liberalizing the market. Oztay and Sak (2002) confirm an enhanced financial system in Turkey after the 1980 financial reform. The Turkish market is further investigated by Alper and Onis (2003). If market liberalization causes integration and, hence, interdependence, then benefits are expected to arise in the form of lower market risk premiums. Bakaert and Harvey (2000) confirm that market liberalization reduces the cost of capital between 5 and 75 basis points. Furthermore, Rakhmayil (2006) confirms that higher degrees of financial integration reduce country risks.

Nonetheless, Moosa and Al-Abduljader (2005) point out the importance of a competent derivative market to allow for effective currency hedging.

Studies on regional market interdependence in emerging markets are done by Moosa and Al-Deehani (2006), Padhan (2007), Arouri and Nguyen (2010) and Neaime (2012). The aforementioned studies investigate Middle Eastern equity markets and produce mixed results. For instance, Moosa and Al-Deehani (2006) test three GCC equity markets and show strong evidence for short-term dynamic interdependence. Padhan (2007) finds that the Egyptian market has a price discovery role amongst the Middle Eastern markets. In Asia, market interdependence between the Indian stock market and developed markets is investigated by Menon et al. (2009). Gupta and Agarwal (2011) extend the dataset to include Hong Kong, Indonesia, Malaysia and South Korea. Particular focus on regional interdependence in South East Asia is also found in the literature. Sharma and Bodla (2011) examine Pakistan, Sri Lanka and India where the latter market is found to affect the two other markets. Other studies have analyzed the interdependence between regional and developed markets. Lamba (2005), Ibrahim (2005), Hoque et al. (2007), Batareddy et al. (2012) and Dhanaraj et al. (2013) proxy the U.S. market for the developed markets and find the U.S. to impact Asian emerging equity markets. In Africa, Agyei-Ampomah (2011) examine: (i) the interdependence among African markets and (ii) the linkages between African and developed markets. The study finds that African markets are segmented from developed global markets and calls for a regional structural adjustment and relevant policy making.

2.4   The Asymmetry Hypothesis: Empirical Evidence

Cooper et al. (2000) applied the model in Wang (1994) on the U.S. real estate market and find strong evidence of asymmetry in the price volume relation. In terms of real estate market interdependence, Michayluk et al. (2006) analyze the asymmetric volatility between the U.S. and U.K. securitized real estate markets. The results show significant asymmetric effects on the volatility and correlations between markets. Liow (2012) investigate the correlations across Asian securitized real estate and stock markets prior and post financial crisis with a data set that spans from 1995. The study identifies asymmetric interdependence pre and post crisis which take the form of increased correlation over time. Interestingly, Oikarinen (2010) examine the interdependence between national housing and the stock market in Finland and find long-term interdependence. The intention of the study is to test the market dynamics especially after the financial liberalization of Finland and foreign ownership permission in its local housing market. The work by Oikarinen (2010) has particular relevance to this study as it reflects a similar interest to investigate interdependence on small open economies before and after financial liberalization. In addition to financial liberalization and technological advances in the GCC region, the very formation of the GCC in 1981 was intended to enhance integration, both politically and economically, between six countries

to form a global trading bloc (Al-Abduljader, 2008). Consequently, it is expected that a high degree of interdependence is present. Nonetheless, the asymmetric relation between the markets has yet to be explored.

3.   Significance and Contribution

The GCC is an intergovernmental union of six Arab states in the Middle East. The member states are Kuwait, Saudi Arabia, the United Arab Emirates (UAE), Qatar, Bahrain and Oman. An idea originally proposed by the Emir of Kuwait to create an economic and political bloc after gaining independence from British influence, the intended union is anticipated to fill the apparent void and represent a plausible counter-balance to regional threats on the small oil-rich states. In May 25, 1981, the heads of the six member states met in the UAE and the GCC was formed. Today, the GCC population exceeds 50 million, with an aggregate GDP in excess of USD 1 trillion and among the highest GDP per capita, standing at an average of USD 30,000. Table 1 is a brief summary on the main economic indicators of the GCC countries.

Table 1   Economic Indicators of GCC

| | GCC | | | | | |
	Saudi Arabia	UAE	Kuwait	Bahrain	Qatar	Oman
GDP (bn USD)	646	349	124	32	152	66
GDP Growth (%)	22	20	17	24	22	13
GDP/Capita (USD)	20029	37622	30010	22354	59331	14982
GDP/Capita Growth (%)	4	7	-22	8	-16	-22
Inflation (%)	2	2	3	2	2	0
Population (mn)	32	9	4	1	3	4
Market Cap. (bn USD)	449	213	99	19	155	23
Export (% of GDP)	31	104	54	85	47	56
FDI (% of GDP)	1	3	0	NA	1	NA
Time to Start a Business (days)	16	8	43	9	9	6

Notes: GDP is gross domestic product, Market Cap denotes market capitalization, and FDI is foreign direct investment. GDP figures are presented in USD billions and population is presented in millions. GDP, GDP/Capita, Export and Population figures presented are for 2016. Inflation and FDI are 2015. GDP Growth and Market Cap. Growth are measured as the percentage change of the period (2010-2016). NA=Not Available

Source: World Bank (2017)

After the formation of the GCC, the member states began a series of initiatives to integrate their markets, unify their policies and move towards a single currency. GCC nationals are partially granted citizen privileges on ownership of real and financial assets. Consequently, property markets have witnessed increased activity in trade amongst the GCC countries. Freehold properties, with the exception of residential properties, have been changing hands among investors in all of the member states. The GCC states, by all of the economic indicators, have become more integrated since the formation of the GCC, but the degree of integration has and does vary in the markets. Our interest in this study lies specifically in real estate.

The significance of the region under investigation in this paper should be of particular interest to fellow economists, investors and regulators for multiple reasons. To fellow economists, it is apparent that the literature on the GCC has been negligible. Data are scarce, fragmented, expensive and unreliable. It is only recently, during the past decade, that market operators have began to comply with international best practices and follow globally recognized industry classifications such as the Industry Classification Benchmark (ICB) after Dow Jones and the Financial Times Stock Exchange (FTSE) collaborated to develop a rigorous set of standards. The data are now made public and integrated with major terminals such as Reuters and Bloomberg. To investors, especially institutional investors, evidence has demonstrated interest in the GCC markets by adding them to their emerging market allocation of their portfolio after permission of restricted foreign investments. Given the distinct risk/return profiles of the region along with low and negative correlations with the major global markets (Al-Abduljader, 2008), many have begun to seek further insights into ways to maximize global and emerging market portfolios through diversification. To regulators and policy makers, investigating interdependence is an urgent matter given the latest developments. The very destiny of the GCC that was established to create a political and an economic bloc thirty-eight years ago is now under severe scrutiny with the possibility of a cessation. On June 5, 2017, three of the GCC countries, Saudi Arabia, the UAE and Bahrain, cut ties with Qatar due to political differences and multiple claims of supporting terrorism while Kuwait and Oman remained neutral with the former, endeavoring to mediate between Qatar and the three GCC countries. At the time of writing this article, the political unrest in the region remains unresolved while major intermediation is taking place by the U.S, U.K, European Union, Russia and Turkey in hopes to restore relations among the GCC countries. Nonetheless, after four decades of economic ties, it is evidently crucial to governments and policy makers to assess the degree of the significance and repercussions of the (dis)integration of the region.

The contribution of this study is threefold. While most studies model specifications based on correlation coefficients that are conditional on market volatility (see Forbes and Rigobon 2002), this study considers asymmetry by analyzing positive and negative market directions to examine the bull and bear

market effects amongst interdependence[2]. Secondly, this paper divides the observed time series into trend, cyclical, seasonal and irregular components and then tests are conducted to reveal the relationship between these various components of the real estate market with the corresponding components of other real estate markets. Thirdly, the paper contributes to the literature by investigating a region that is currently limited in the emerging markets literature and virtually absent in the real estate literature. The remainder of the paper is organized as follows. There is data description, followed by a discussion on the model estimation and then presentation of the empirical results. Finally, interpretations, recommendations and concluding remarks are presented.

4.   Data Description

The results in this study is based on monthly observations of real estate indices in three markets in the GCC: Saudi Arabia, Kuwait, and the United Arab Emirates[3], with a total of 10, 34 and 9 underlying companies respectively.   The indices represent listed real estate operating companies (REOCs) with a diverse set of specializations mainly in mix-use development. The sample covers the period between January 2007 and October 2016. Figure 1 shows the performance of all three markets rebased to the first observation which takes the value of 100. The descriptive statistics are reported after an initial examination of the data and the correlation matrix of the rates of return in the three markets are reported in Tables 2 and 3, respectively.

Figure 1   Real Estate Index Prices (re-based at 100)

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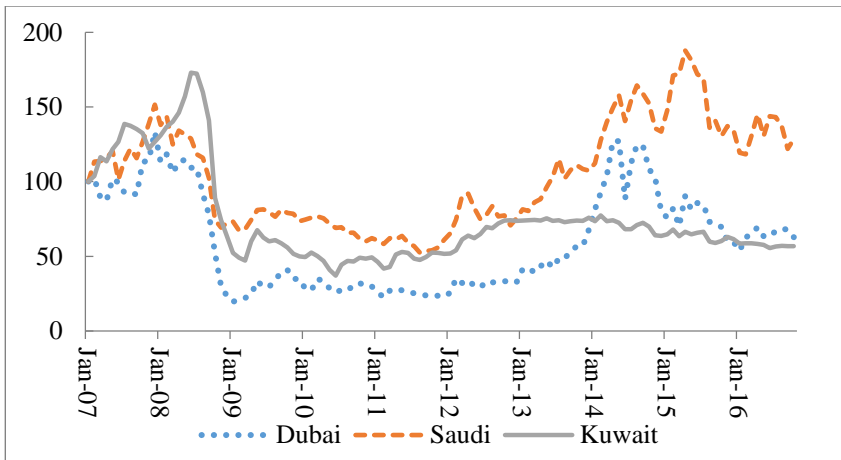
[2] Forbes and Rigobon (2002) adjust the bias of the conditional correlation coefficient and reject contagion which occurs in the past main financial crises by using rather 'high level' market co-movement and interdependence.

[3] The three countries represent approximately 80% of the GCC market capitalization.

In this study, the empirical work shall apply the following notation: p_d, p_k and p_s which are the log real estate index prices of Dubai, Kuwait and Saudi Arabia, respectively. Hence, the first log differences (Δp_d, Δp_k and Δp_s) are the corresponding real estate index returns.

Table 2   Basic Statistics of Monthly Real Estate Index Returns (n=117)

	Dubai	Kuwait	Saudi Arabia
Maximum	0.315	0.242	0.195
Minimum	-0.554	-0.459	-0.319
Mean	-0.039	-0.005	0.002
Standard Deviation	0.135	0.077	0.081
Skewness	-0.582	-1.541	-0.659
Kurtosis	5.054	13.165	4.253

Table 3   Correlation Matrix of Real Estate Index Returns

	Dubai	Kuwait	Saudi Arabia
Dubai	1.000	0.505	0.495
Kuwait		1.000	0.434
Saudi Arabia			1.000

5.   Model Estimation and Empirical Results
5.1   Testing for Unit Root and Cointegration

The augmented Dickey-Fuller (DF) test, which is a unit root test, was used for the level and first differences of the logarithm of prices. The lagged length of the DF regression is based on the Akaike information criterion (AIC). Clearly, the results show that $p_d \sim I(1)$, $p_k \sim I(1)$ and $p_s \sim I(1)$[4]. As for the cointegration, the cointegrating regression was initially carried out by using the residual-based approach, which is written as:

$$p_{i,t} = \alpha_0 + \alpha_1 p_{j,t} + \alpha_2 p_{k,t} + \varepsilon_t \tag{1}$$

where p_i is the variable (log price) on which the cointegrating regression is normalized. Hence, this can be in any of the three markets. For instance, if $p_i \equiv p_d$, then $p_j \equiv p_k$ and $p_k \equiv p_S$. The results show that $\varepsilon \sim I(1)$; therefore,

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[4] The ADF statistics for the levels of the variables (p_d, p_k and p_s) are -1.75, -2.26, and -1.33 respectively. For the first differences (returns), they are-10.16, -6.06, and -10.23, respectively. With a critical value of -2.89, all three variables are integrated of the order of 1.

the results are not cointegrated in any of the three cases. Moreover, two further tests are conducted for cointegration based on the autoregressive distributed lag (ARDL) specification. The first is based on the Granger representation theorem (Engle and Granger, 1987) which states that cointegration denotes the presence of a valid error correction representation. Consequently, the error correction model is estimated by the following representation of the cointegrating relationship:

$$\Delta p_{i,t} = \alpha + \sum_{m=1} \beta_{im} \Delta p_{i,t-m} + \sum_{m=0} \gamma_{im} \Delta p_{j,t-m} + \sum_{m=0} \delta_{im} \Delta p_{k,t-m} + \phi \varepsilon_{t-1} + \xi_t \quad (2)$$

where ε is the empirical residual of the cointegrating regression. The significance of the coefficient ϕ can be used as a test for cointegration if the coefficient is significantly negative. The coefficient of the t statistic is used to test for cointegration as suggested by Kremers et al. (1992). The lag length of the error correction model is initially specified to be 4. All combinations are estimated and the best model is determined on the basis of the Schwarz Bayesian criterion (SBC). Consequently, the t statistic of the coefficient on the error correction term, and the results of the cointegration are confirmed. [5]

Proceeding to the ARDL approach suggested by Pesaran and Shin (1995,1996) to confirm the robustness of the cointegration results, a dynamic model can be specified as follows:

$$\Delta p_{i,t} = \alpha + \sum_{m=1} \beta_{im} \Delta p_{i,t-m} + \sum_{m=0} \gamma_{im} \Delta p_{j,t-m} + \sum_{m=0} \delta_{im} \Delta p_{k,t-m} +$$
$$+ \phi_1 p_{i,t-1} + \phi_2 p_{j,t-1} + \phi_3 p_{k,t-1} + \xi_t \quad (3)$$

whereby the null hypothesis of no cointegration is represented by

$$H_0 : \phi_1 = \phi_2 = \phi_3 = 0 \quad (4)$$

The appropriate lag length is determined by the model estimation with a maximum of 4 for all variables. The best model is selected on the basis of the SBC. Both the F and the W tests are utilized which have non-standard distributions. The results show no cointegration as reported in Table 4 and are numerically smaller than the respective critical values. [6]

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[5] The t statistics for the error correction terms are -11.96, -9.75, and -11.85 for all three equations.
[6] The critical values are reported by Pesaran et al. (1996) and reproduced in Pesaran and Pesaran (1997), pp 478-479. The critical values of the F and W test statistics are 4.86 and 14.56, respectively.

Table 4   Results of ARDL Test for Cointegration (Equation 3)

	F	W
Δp_d	2.77	2.08
Δp_K	5.07	1.97
Δp_S	1.11	1.98

5.2   Dynamic Interdependence

Interdependence can be modeled by using the first difference ARDL model and specified as follows:

$$\Delta p_{i,t} = \alpha + \sum_{m=1} \beta_{im} \Delta p_{i,t-m} + \sum_{m=0} \gamma_{im} \Delta p_{j,t-m} + \sum_{m=0} \delta_{im} \Delta p_{k,t-m} + \xi_t \qquad (5)$$

where γ_{i0} and δ_{i0}, measure the impact that markets j and k have on market I, respectively. Eq. 5 can be utilized to assess the cumulative effect from the impact coefficients γ_{im} and δ_{im}. Assuming θ_i is the measure of the cumulative effect of market j on market i, it can be calculated as:

$$\theta_i = \frac{\sum_{m=0} \gamma_{im}}{1 - \sum_{m=1} \beta_i} \qquad (6)$$

Similarly, assuming ϕ_i is a measure of the cumulative effect of market k on market i, it can be calculated as:

$$\phi_i = \frac{\sum_{m=0} \delta_{im}}{1 - \sum_{m=1} \beta_i} \qquad (7)$$

The results of estimating Equations (5), (6) and (7) are presented in Table 5. The results are interpreted as follows:

a)   The Kuwait real estate market has a positive impact and a negative cumulative impact on the Dubai real estate market. The Saudi real estate market has a negative impact and a positive cumulative impact on the Dubai real estate market.

b)   The Dubai real estate market has a positive impact and a negative cumulative impact on the Kuwait real estate market. The Saudi real estate market has no significant effects on the Kuwait real estate market.

c)   The Dubai real estate market has a positive impact and a negative cumulative impact on the Saudi real estate market. The Kuwait real estate market has a positive impact on the Saudi real estate market, but the cumulative effect is insignificant.

Table 5   Estimated Symmetric ARDL Model (Equation 5)

	Δp_d	Δp_K	Δp_S
γ_0	3.88 (3.4)	2.10 (2.9)	1.72 (3.0)
θ	-3.30 (-2.8)	-1.95 (-2.7)	-1.42 (-2.6)
δ_0	-4.93 (-4.2)	0.09 (0.1)	0.11 (0.8)
ϕ	5.49 (4.8)	0.04 (0.1)	-0.03 (-0.3)

5.3   Asymmetric Interdependence

The abovementioned results, so far, demonstrate a symmetric response from one market to the other two. This assumption might not stand when accounting for responses from bull and bear markets. Hence, the response of the markets might change when analyzing the responses in both positive and negative markets and therefore, the asymmetric hypothesis is tested. Allowing for asymmetry, let $\Delta p_j^+ = \Delta p_j$ if $\Delta p_j > 0$ and $\Delta p_j^+ = 0$ and $\Delta p_j^- = \Delta p_j$ if $\Delta p_j < 0$ and $\Delta p_j^- = 0$ otherwise. Therefore, the asymmetric model is written as:

$$\Delta p_{i,t} = \alpha + \sum_{m=1} \beta_{im} \Delta p_{i,t-m} + \sum_{m=0} \gamma_{im}^+ \Delta p_{j,t-m}^+ + \sum_{m=0} \gamma_{im}^- \Delta p_{j,t-m}^-$$
$$+ \sum_{m=0} \delta_{im}^+ \Delta p_{k,t-m}^+ + \sum_{m=0} \delta_{im}^- \Delta p_{k,t-m}^- + \xi_t \tag{8}$$

Whereas the coefficients are γ_{i0}^+, γ_{i0}^-, δ_{i0}^+ and δ_{i0}^- and the cumulative effects are measured as:

$$\theta_i^+ = \frac{\sum_{m=0} \gamma_{im}^+}{1 - \sum_{m=1} \beta_{im}} \tag{9}$$

$$\theta_i^- = \frac{\sum_{m=0} \gamma_{im}^-}{1 - \sum_{m=1} \beta_{im}} \tag{10}$$

$$\phi_i^+ = \frac{\sum_{m=0} \delta_{im}^+}{1 - \sum_{m=1} \beta_{im}} \tag{11}$$

$$\phi_i^- = \frac{\sum_{m=0} \delta_{im}^-}{1 - \sum_{m=1} \beta_{im}} \tag{12}$$

Testing for asymmetry is based on the following hypotheses:

$$\gamma_{im}^{+} = \gamma_{im}^{-} \qquad \forall m \tag{13}$$

$$\delta_{im}^{+} = \delta_{im}^{-} \qquad \forall m \tag{14}$$

$$\theta_{i}^{+} = \theta_{i}^{-} \tag{15}$$

$$\phi_{i}^{+} = \phi_{i}^{-} \tag{16}$$

The Wald test with χ^2 distribution is used to restrict Equations (13) and (14) whereas the t statistic is used for Equations (15) and (16) to test for the linear and nonlinear functions of the estimated coefficients. In principle, if, for instance, $\gamma_{j}^{+} \neq \gamma_{j}^{-}$ then asymmetry is said to be present. The results obtained from estimating the asymmetric model are reported in Table 6. It is clear that the results show strong evidence of asymmetry. For instance, positive returns on the Kuwait market are stronger than negative returns on returns in the Saudi market. Furthermore, it is clear that positive returns in one market triggers negative returns in the other markets and vice versa. The results are consistent with those in Al-Abduljader (2008) and Moosa (2010). One plausible explanation is the interconnected investor base among the GCC markets. Investment funds rebalance between the markets of this region and, as a result of supply and demand, returns are affected accordingly. Interdependence, therefore, may also be found in the common factors that affect investor sentiment in the GCC markets.

External factors such as geopolitical events, oil price fluctuations and macroeconomic changes, all determine the direction of the flow of funds within a region (Al-Abduljader, 2008). This would cast serious concerns among the GCC economies as investors may potentially revert back to home bias allocations, even though the magnitude of the effects would vary among the countries. Dubai, for instance, hosts a higher proportion of foreign investors than Kuwait and Saudi Arabia. This could partially explain for the high degree of volatility, as measured by its standard deviation, and the negative cumulative effect on its neighboring markets. Nonetheless, almost all of the GCC countries report that GCC investors are the largest real estate owners, beyond the locals, than any other nationality. The same goes for capital markets and foreign direct investments in infrastructure. As such, it is clear that market independence has been a result of years of pro-regional policies and incentives to grant local privileges and incentives to the investor base in the region and, therefore, it comes with no surprise that the interconnectedness amongst regional markets is well rooted. More so, government revenues from oil proceeds would affect capital expenditure and, ultimately, corporate earnings. The magnitude of the effect, both positively and negatively, would entail investors to engage in a dynamic asset allocation between the GCC markets in order to capture potential increases in markets and avoid possible declines.

Table 6: Estimated Asymmetric ARDL Model (Equation 8)

	Δp_d	Δp_K	Δp_S
γ_0^+	0.0001	-4.12*	-3.69*
	(0.0)	(-4.5)	(-3.0)
γ_0^-	1.17	1.38*	5.02*
	(1.4)	(2.6)	(4.7)
δ_0^+	-10.58*	-6.75*	-5.64*
	(-9.5)	(-5.4)	(-3.7)
δ_0^-	8.09*	6.72*	-0.51
	(9.1)	(4.6)	(-0.4)
θ^+	0.188	5.42*	3.73*
	(0.1)	(4.6)	(3.3)
θ^-	-0.19	-1.33*	-4.98*
	(0.2)	(-2.4)	(-4.5)
ϕ^+	10.41*	6.75*	5.41*
	(9.8)	(5.5)	(3.8)
ϕ^-	-7.99*	-6.92*	0.31
	(-9.1)	(-4.7)	(0.3)
$\gamma_m^+ = \gamma_m^-$ ($\chi^2(m+1)$)	13.40*	21.87*	27.26*
$\delta_m^+ = \delta_m^-$ ($\chi^2(m+1)$)	0.011	38.43*	6.03*
$\theta^+ = \theta^-$ (t)	4.13*	4.25*	5.39*
$\phi^+ = \phi^-$ (t)	9.58*	6.32*	2.49*

Note: * Significant at the 5% level.

5.4   Structural Time Series Analysis

One of the criticisms of error correction models is based on the autoregressive representation of the models so that they lack the ability to address seasonal and cyclical patterns (Harvey and Scott, 1994). Instead, Harvey and Scott (1994) recommend a procedure whereby trends, seasonality, and cyclicality are explicitly modeled as unobserved components, thereby removing the risk of misspecification. This section divides the observed time series into trend, cyclical, seasonal and irregular components, and then tests the relationship between the three real estate markets by using structural time series modeling which is proposed by Harvey (1989, 1997). The univariate model would, therefore, be written as:

$$z_t = \mu_t + \phi_t + \gamma_t + \varepsilon_t \qquad (17)$$

where z_t is the logarithm of the observed value of the series, μ_t is the trend component, ϕ_t is the (additive) cyclical component, γ_t is the seasonal

component and ε_t is the irregular component. The trend, cyclical and seasonal components are assumed to be uncorrelated while ε_t is assumed to be white noise.

The trend component, which represents the long-term movement in a time series, is assumed to be stochastic and linear. This component is represented by:

$$\mu_t = \mu_{t-1} + \beta_{t-1} + \eta_t \qquad (18)$$
$$\beta_t = \beta_{t-1} + \zeta_t \qquad (19)$$

where $\eta_t \sim NID(0, \sigma_\eta^2)$, and $\zeta_t \sim NID(0, \sigma_\zeta^2)$. μ_t is a random walk with a drift factor, β_t, which follows a first order autoregressive process as shown by Equation (19). This process breaks down to a simple random walk with drift if $\sigma_\zeta^2 = 0$, in addition to a deterministic linear trend if $\sigma_\eta^2 = 0$. Moreover, if $\sigma_\eta^2 = 0$ while $\sigma_\zeta^2 \neq 0$, the process will have a trend with relatively smooth changes.

The cyclical component, which is assumed to be a stationary linear process, is represented by:

$$\phi_t = a \cos \theta t + b \sin \theta t \qquad (20)$$

where t is time and the amplitude of the cycle is given by $(a^2 + b^2)^{\frac{1}{2}}$. To make the cycle stochastic, ϕ is constructed to allow the parameters a and b to evolve over time while maintaining their continuity. Hence

$$\phi_t = \rho(\phi_{t-1} \cos \theta + \phi_{t-1}^* \sin \theta) + \omega_t \qquad (21)$$
$$\phi_t^* = \rho(-\phi_{t-1} \sin \theta + \phi_{t-1}^* \cos \theta) + \omega_t^* \qquad (22)$$

where ϕ_t^* is obtained by construction and ω_t and ω_t^* are uncorrelated white noise disturbances with variances σ_ω^2 and $\sigma_{\omega^*}^2$ respectively. The parameter $0 \leq \theta \leq \pi$ is the frequency of the cycle and $0 \leq \rho \leq 1$ is the damping factor on the amplitude. Harvey (1989) states that one complete cycle can be expressed as $2\pi / \theta$.

The seasonal component, γ_t, is stationary when multiplied by the seasonal summation operator, $S(L)$, which is given by:

$$S(L) = \sum_{j=0}^{s-1} L^j \qquad (23)$$

where s is the number of seasons each year and L is the lag operator such that $L^j \gamma_t = \gamma_{t-j}$.

The seasonal component mainly follows a trigonometric specification. If we take s to be the number of seasons each year in which there are twelve seasons each year (for monthly data), then the seasonal component can be expressed as:

$$\gamma_t = \sum_{j=1}^{s/2} \gamma_{j,t} \tag{24}$$

in which $\gamma_{j,t}$ is given by:

$$\gamma_{j,t} = \gamma_{j,t-1} \cos \lambda_j + \gamma_{j,t-1}^* \sin \lambda_j + \kappa_{j,t} \tag{25}$$

$$\gamma_{j,t}^* = -\gamma_{j,t-1} \sin \lambda_j + \gamma_{j,t-1}^* \cos \lambda_j + \kappa_{j,t}^* \tag{26}$$

where $j = 1,...,s/2-1$, $\lambda_j = 2\pi j / s$ and

$$\gamma_{j,t} = -\gamma_{j,t-1} + \kappa_{j,t}, \quad j = s/2 \tag{27}$$

where $\kappa_{j,t} \sim NID(0,\sigma_\kappa^2)$ and $\kappa_{j,t}^* \sim NID(0,\sigma_{\kappa*}^2)$. It is also worth noting that $\sigma_\kappa^2 = \sigma_{\kappa*}^2$ is enforced.

Moosa (2005) put forward the argument that the model represents the main feature of a time series by considering its various components. Hence, for the multivariate analysis, the structural time series model can be written as:

$$y_{i,t} = \mu_{i,t} + \phi_{i,t} + \gamma_{i,t} + \sum_{n=1}^{2} \lambda_n x_t + \varepsilon_{i,t} \tag{28}$$

where y_t is the logarithm of the real estate price index in market i, such that $i=$ 1, 2, and 3, and x_t is the logarithm of the real estate price index of market n. Equation (28) is estimated by using the maximum likelihood (ML) method. The hypothesis of interdependence is validated if the coefficient on x_t is positive and statistically significant. The key advantage of this model is that the independent variables can be examined without explicit identification (Moosa, 2010). The effects of these factors are represented in the behavior of the components μ_t, γ_t and ϕ_t. If these components are significant while λ is also significant, this would mean that other factors affect the real estate price index as opposed to the regional markets. On the contrary, if the components are insignificant and λ is statistically significant, then strong interdependence between the markets is established. However, if λ is insignificant and the components are statistically significant, then the interdependence hypothesis is rejected as factors other than the respective regional markets affect the real estate index.

Table 7 reports the results of estimating Equation (28). The results of the components μ_t, γ_t and ϕ_t indicate the final state vector of their values. The coefficient of determination, and the modified coefficient of R_d^2 determination is reported. Furthermore, three diagnostic test statistics are presented: (i) the Durbin Watson (DW) statistic, the Ljung-Box (1978) test statistic for serial correlation (Q) and the test for heteroscedasticity (H)[7]. It can be seen that the model is reasonably well-determined in goodness of fit and diagnostic tests. One case (Kuwait) shows the level of the trend to be statistically significant and in two cases (Kuwait and Saudi Arabia), the slope is shown to be statistically significant but in opposite directions. The results are not unexpected since the time series investigated occurred before and after the global financial crisis which caused an apparent fluctuation in market trends. The cyclical component is significant in all three cases and the coefficient on the explanatory variables are significantly positive on all three cases as well. Consequently, there is evidence the markets are dependent on other factors than the corresponding GCC real estate markets which only provide weak forms of market interdependence.

Figures 2 to 4 graphically present the components for each case. A visual examination of the components shows that Figure 2 illustrates the transformation of the Dubai trend component from positive to negative during November 2013. In Kuwait and Saudi Arabia, we see an inverse direction of trends before leveling off during the same time period, July 2008, which coincided with the arrival of the initial shock of the global financial crisis to the regional market. This further solidifies how the dependence of the two markets is concurrent. Figure 4 presents the cyclical component. While it is difficult to draw many inferences about the cyclical behavior of the variables, it is worth noting (i) the amplitude of cycles in Kuwait is higher towards the early part of the sample (beginning of financial crisis) than the latter, and (ii) a complete cycle in Saudi Arabia takes approximately 24 months. The implications of the graphical representation suggest other factors have greater significance than the performance of the respective neighboring markets.

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[7] The Q statistic is calculated as $Q(n,q) = T(T+2)\sum_{t=j}^{n} \frac{r_j^2}{T-n}$ where n is the number of autocorrelation coefficients and q is the number of estimated parameters with a $\chi^2(k)$) distribution. $H(h) = \sum_{t=T-h+1}^{T} v_t^2 \Big/ \sum_{t=d+1}^{d+1+h} v_t^2$ is the test for heteroscedasticity and the ratio of the squares of the last h residuals to the squares of the first h residuals, where h is the closest integer to one third of the sample size distributed as $F(h,h)$.

Figure 2   Trend Components
Panel A   Dubai
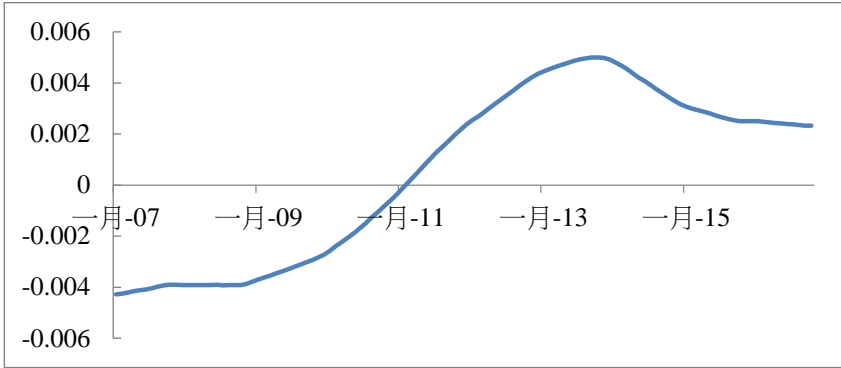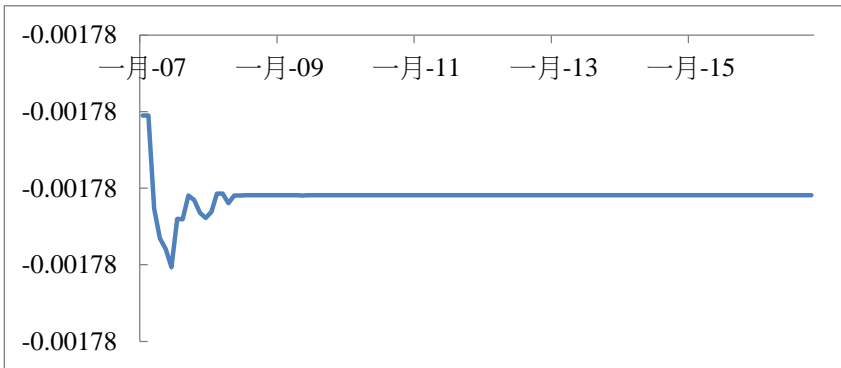
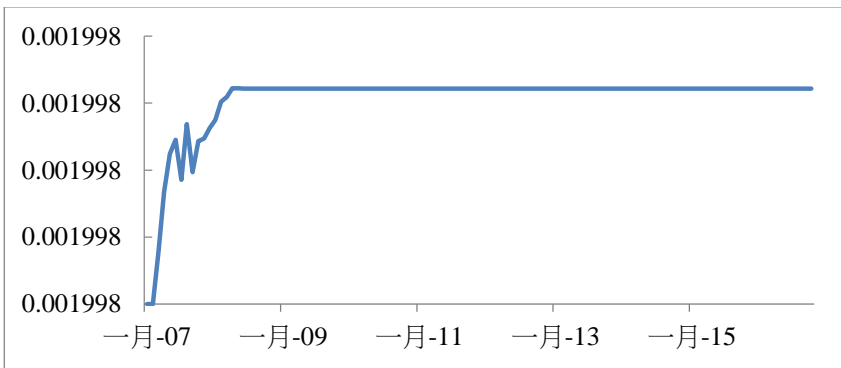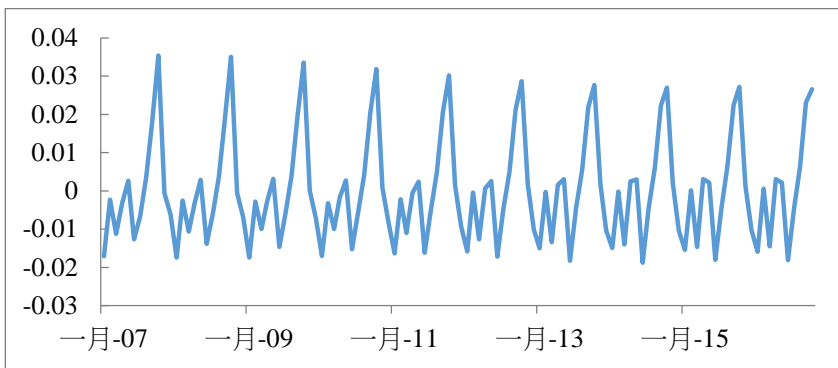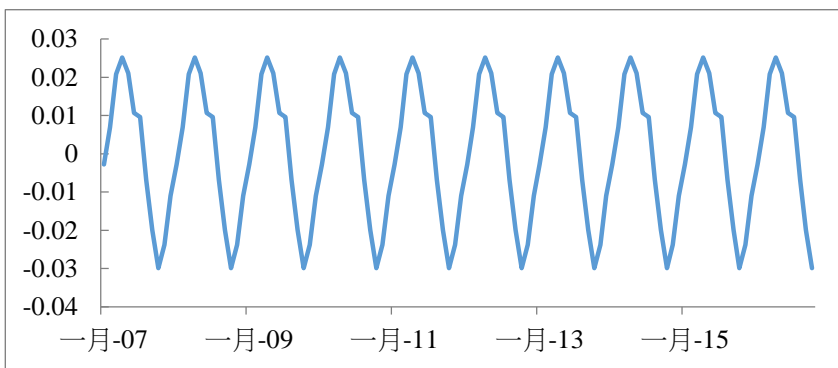**Panel B   Kuwait**

Panel C   Saudi Arabia

Figure 3   Seasonal Components
Panel A   Dubai

Panel B   Kuwait

Panel C   Saudi Aribia

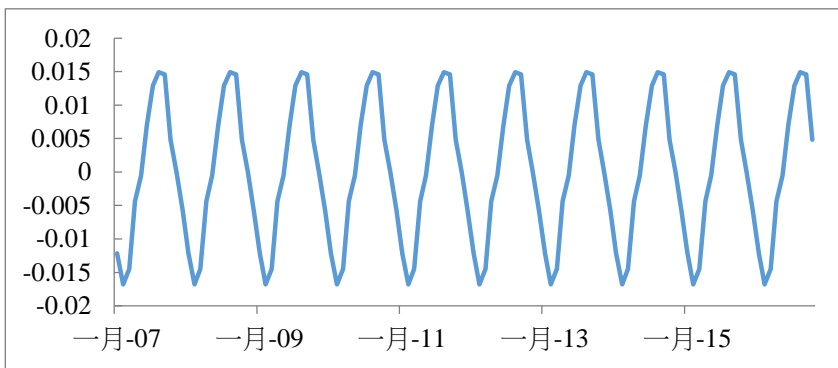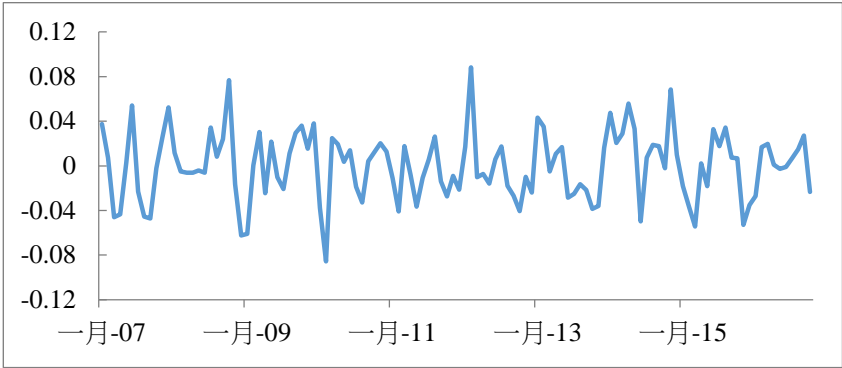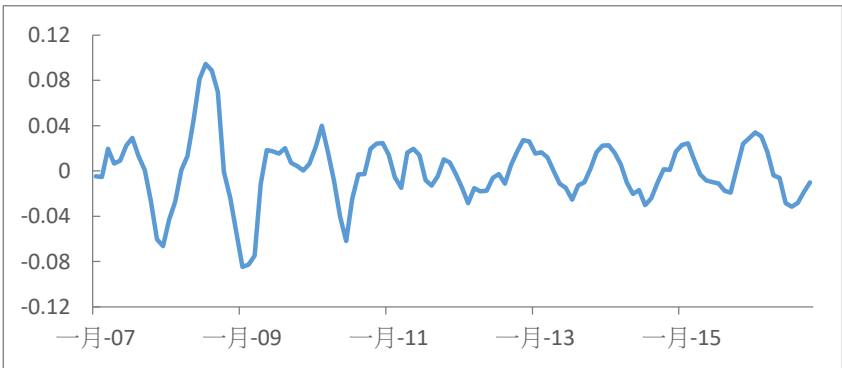**Figure 4   Cyclical Components**
Panel A   Dubai

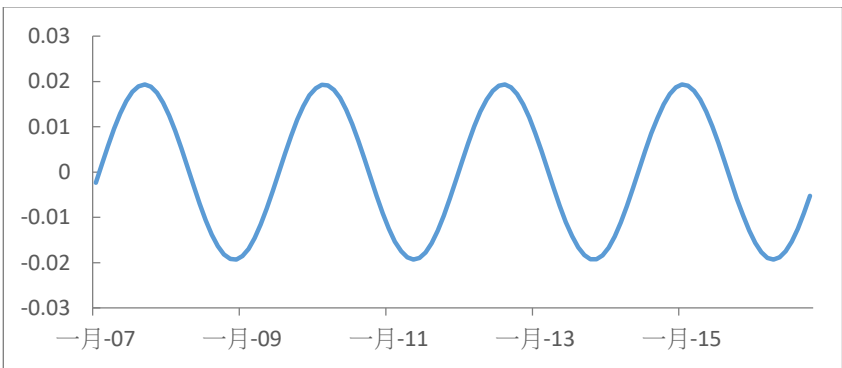**Panel B   Kuwait**

Panel C   Saudi Arabia

Table 7   **Estimation Results of Structural Time Series Model Equation (28)**

State Variable/ Test Statistic	Dubai	Kuwait	Saudi Arabia
μ_t	0.24 (0.2)	5.72* (14.1)	0.03 (0.0)
β_t	0.01 (0.7)	0.00* (5.6)	-0.01* -(3.1)
ϕ_t	-0.14* -(4.8)	0.07* (2.3)	0.12* (2.4)
ϕ_t^*	0.14* (4.9)	-0.15* -(3.5)	0.09 (0.0)
γ_{1t}	0.03 (1.4)	-0.05* -(3.4)	-0.11* -(2.4)
γ_{2t}	-0.01 -(0.4)	-0.01 -(0.6)	-0.03 -(0.6)
λ_1	0.68* (5.1)	0.16* (3.2)	0.23* (4.4)
λ_2	0.63* (5.3)	0.27* (3.4)	0.23* (2.4)
R_d^2	0.97	0.98	0.96
R^2	0.50	0.54	0.48
DW	1.93	1.94	2.02
Q	13.26	34.29	12.53
H	0.85	0.20	0.96

Note: * Significant at the 5% level

6.   Limitations and Further Research

One clear limitation in this study is found in the relatively short duration of the time series applied (10 years). Prior to 2007, the markets in the region underwent the process of index standardization and compliance with the international standards such as the Dow Jones and FTSE Industry Classification Benchmark. Hence, it would not have been appropriate to utilize the data prior to standardization due to the weighting and index calculation variations between the markets. Another key limitation that requires further investigation is the impact of the global financial crisis. Although the study intends to cover pre and post crises to examine the asymmetric effects in both bull and bear markets, further research is certainly recommended to address the shock effects of the global financial crisis.

7.   Concluding Remarks

In this paper, a series of econometric procedures is done to comprehend the level and degree of market interdependence among the GCC real estate markets. First, the cointegration tests reveal the absence of a long-run relationship between the real estate indexes in the three markets investigated, thus implying cross-sectional efficiency. The interpretation is that one market cannot be utilized to forecast the returns of another.   Second, by estimating the first-difference ARDL model, significant impacts and cumulative effects are found in one of the market returns (Kuwait, Saudi or Dubai) on the other two markets, thus indicating the presence of interdependence. Moreover, strong evidence is found for asymmetric interdependence in addition to the cumulative effect. The results reveal differentiating directions of interdependence between these markets which reinforces the prominence of an asymmetric analysis. The implicit disregard of asymmetry may have resulted in a perilous inclination towards similar directional effects. Lastly, a structural time series model has been utilized to provide an original perspective for market interdependence. The results show that a weak form of interdependence is present, which partly shows other factors of significant impact that explain for real estate fluctuations other than the corresponding prices of the neighboring countries. It is possible that further studies on the macroeconomic determinants of real estate and oil prices might result in a better understanding of the mechanisms behind GCC real estate. This study, however, has been able to capture the dynamic properties of the observed time series of the real estate indices in order to provide better insights into the real estate industry in this region.

Evidently, one cannot ignore the political, social and economic implications of the possible disentanglement of a cooperating council established four decades ago as this study produces evidence that such incidents may have a rippling effect on the respective markets. The findings of this study is anticipated to direct decision makers in the GCC governments towards policy implications in favor of a more effective and stabilized region. Likewise, it is anticipated that this study would enlighten fellow economists as well as regional and international institutional investors in the real estate markets specifically and capital markets generally in the GCC region.

Acknowledgment

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