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Abstract

Although real estate is believed to be the steady element of a portfolio, volatilities during the global financial crisis has thrown off its "defensive stock" status in terms of optimizing portfolio benefit. Evidence from past research have revealed the same for the Real Estate Investment Trust (REIT) in Malaysia. This paper examines the volatility and stability of the REITs in Malaysia (MREITs), particularly analyzing the correlations between the islamic REITs and their conventional counterparts. We further observe the existence of contagion effects between these assets to ascertain whether the islamic REITs are led by the more established conventional REITs. The DCC-MGARCH model is applied to study the volatilities and correlations within this asset class. We also use the wavelet coherence methodology to see the contagion effects between the REITs, within a time frequency domain. Our contribution to the scarce literature on Islamic REITs is the analysis of time varying correlations from a sector-related perspective, and explaining interdependencies in the time domain as well as the frequency domain. Our findings show that the Malaysian REITs have a long run fundamental relationship with each other, but are independently moving within their respective sectors in the shorter term. The results imply that diversification benefits are not hindered as long as the MREITs held in the portfolio belong to different sectors. Most importantly, although the Shariah (Islamic law) investor may be limited in the selection of investment assets, investing in all three islamic MREITs concurrently will not increase the riskiness of the portfolio.

Keywords: REITs, MGARCH, Dynamic Correlation Coefficient (DCC), wavelet coherency, frequency domain.

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1. INTRODUCTION

To the Shariah compliant investor, there is little doubt as to the permissibility of investing in real estate. The islamic Real Estate Investment Trusts (islamic REIT) provides a relatively new class of asset, as an effective means of getting exposure to large Shariah compliant commercial properties. The source of income for REITs come from the rental of commercial real-estate, typically cyclical in nature, hence REITs are equipped with inflation-hedging attributes. REITs, in general, combine the best features of real estate and trust funds, somewhere between bonds and equities.

In Malaysia investing in REITs (conventional or islamic) is more advantageous than direct commercial property in terms of financial incentives offered by the government. There is tax transparency, whereby Malaysian REITs (MREITs) do not have to pay corporate tax if they distribute more than 90% of their distributable income. Acquisitions of real property by MREIT are exempt from stamp duty, and disposals are exempt from any real property gains tax.[3] Hence, there is huge savings to the MREIT and the seller, leaving much room for price negotiation. In fact, Malaysia was the first country to provide zero tax moving costs to REITs and property sellers.[4] Furthermore, Malaysia's withholding tax rate on REIT distributions is lower than most countries, except Japan and Singapore.

When it comes to investment assets, many have researched about portfolio performance and diversification. This is no different for REITs. Although real estate has always been believed to be the "steady" element of any portfolio, yet, the volatility of what is deemed to be a "defensive stock" during the 2albeit008-2009 financial crisis have thrown off optimization of portfolio benefit. Comparisons between normal and crisis period performances of REITs are researched quite extensively, albeit revealing conflicting results. The matter remains unresolved as recent findings on REITs within the Asian region oscillate from overperformance (Hamzah and Rozali, 2010; Kok and Khoo, 1995[5]) to underperformance during crisis (Boon et al, 2012) while others discuss the loss of

[3] Stamp duty is fixed at 3% of the property purchase price; Real property gains tax (RPGT) levy is usually 10% on gains from the disposal of the property sold within two years of purchase and 5% if sold within two to five years.
[4] Source: PwC, article published in the February 2012 issue of iProperty magazine
[5] cited by Boon et al (2012)

diversification benefits (Chiang et al, 2010; Liu et al, 2012).

The Global REIT Report 2012 (Ernst & Young) reported a relatively uniform recovery of global equity REIT, with most posting positive returns. Alas in 2011, differences in the rate of recovery began to unravel, revealing that best performing REITs are better capitalized, have more financing options, own better-quality assets and have less risk exposure. In addition, the success stories do not necessarily relate to large REITs only.

To the author's knowledge, other than a limited few (Boon et al, 2012; Alhenawi and Hassan, 2011; Ibrahim and Ong, 2008; Ting and M.Noor, 2007), there is insufficient research works on islamic REITs. Even though it seems as though islamic MREITs have a very opportunistic future ahead, especially as they are targeting at affluent and savvy Arab investors seeking to channel their petrodollars in the Far East, industry publications also cite some the challenges faced by this new Shariah compliant asset class. One particular issue is that an islamic REIT, specifically catered to Muslim market players with different underlying investment principles, could be viewed as a smaller and constricting market as compared to conventional REIT that can attract a wide spectrum of investors. Furthermore, due to their market limitations, an islamic REIT is presumed to be exposed to extra risks relative to a conventional one.

Empirically, various methodology have been applied in examining REITs, with isolated findings. Boon et al (2012) applied Treynor and Sharpe while Hamzah and Rozali (2010) added the Adjusted Jensen Alpha as a third measure to compare MREITs performance with the market portfolio, the former reporting underperformance whilst the latter revealing poorer performance pre and post crisis period but better performance during the crisis.

Time varing correlation studies related to REITs analysed Asian REITs and their relative stock markets (Chiang et al, 2010) via the multivariate GARCH-vech model, and USA REITs with Asia Pacific markets (Liu et al, 2012) using the DCC-GARCH model. Tsai and Chiang (2012) examined the relationship for real estate investment trusts (REITs) and stock, and their asymmetric adjustment behaviors in six Asian/Pacific financial markets using the threshold error correction model. Yunus (2013) explored the degree of linkages among key property types in North America and Europe, via cointegration techniques. As islamic REITs are fairly new market players, these studies have not included them.

This paper attempts to study the behaviour of the relatively small REITs industry in Malaysia (MREITs), an under-explored market to date, from the perspective of their riskiness, i.e. analyzing their volatility and stability. Three issues analysed are whether there are interdependencies between the MREITs, whether the different sectors are correlated, and finally, whether the islamic MREITs are led by their conventional counterparts.

The primary source of income of a REIT is rental cash flows from its asset portfolio. As the transparency incentive for MREITs is to pay out at least 90% of its taxable profit as distribution to unit holders, a fairly consistent income stream is assured to the investor. Thus, the key factor that dictates ability of the REIT to pay dividends to its unit holders is the *type* of properties included in the portfolio (Ooi and Neo, 2009). Hence, by looking at only specific MREITs, we aspire to observe the relationship of the islamic MREITs with their conventional counterparts and ascertain whether the behaviorial attributes are sector-related.

The islamic MREITs under study are Al'Aqar Healthcare REIT (Al'Aqar) and Al Hadharah Boustead REIT (Al Hadharah) from the healthcare and plantation sectors, respectively; on the other hand the conventional MREITs in this research are retail-based Hektar REIT (Hektar), the hospitality-based Starhill REIT (Starhill), and office-based AmFirst REIT (AmFirst). Further description of each of these MREITs is available in Appendix 2. As the third islamic MREIT, office-based Axis REIT, has data limitations, AmFirst also plays the role of its proxy.

To meet our first objective, the Dynamic Correlation Coefficient (DCC) MGARCH is used to show us the overall dependencies between the Malaysian REITs over the period of study. To further explore the relationships among the MREITs, we look at the conditional correlations between them. With this method, we may understand sector-related behaviour among these REITs. Thirdly, to ascertain whether there are contagion effects between the MREITs and specifically whether the Islamic MREITs are led by the more established conventional MREITs in the time frequency space, we use wavelet coherence between two time series.

Our contribution to research is to study Islamic REITs' time-varying volatility and stability from the sector-specific perspective, an area scarcely explored to date. In

addition, we also analyze the interdependencies between these REITs with their conventional counterparts in time domain as well as frequency domain.

Our findings tell us that there is significant time-varying volatility within the five MREITs in the study, where plantation-based Al Hadharah is most volatile and retail-based Hektar is most stable. Results suggest that Al Hadharah's high volatility is attributable to its dependency on the global price movements of the palm oil commodity. Correlations observed among these MREITs is explained by the long run theoretical relationships between some of them, as evidently found as we enhance our analysis from time domain to frequency domain. In the short run, these REITs are independently moving within their respective sectors. Some of the long term link ceased to continue or became weaker between many of the paired relationships, commencing from 2009, in the aftermath of the global debt crisis.

The results indicate that having MREITs of different sectors within a portfolio does not hamper diversification benefits for the investors. Furthermore, the Shariah compliant investor would not be disadvantaged if all three islamic REITs in Malaysia are held concurrently, as they all belong to different sectors.

We have organized the rest of this paper as follows: Section 2 gives the literature review of studies related to REITs, particularly in the Asia Pacific region and some relevant features in the Islamic markets. Section 3 explains the data and various wavelet techniques applied to achieve the three objectives above. Section 4 then follows on to discuss the empirical results before conclusions are made in Section 5.

2. LITERATURE REVIEW

As islamic REITs made its debut into the capital market radar only in August 2006 with the listing of Al'Aqar, there is limited literature focusing on this new asset class.

The differences between islamic and conventional REITs are explained by Ting and Md. Noor (2007). The two main differences are that firstly, the islamic REIT must appoint a Shariah Committee or Shariah Adviser; secondly, all activities must comply with Shariah principles, hence the non-permissible activities include financial services based on *riba* (interest), gambling, manufacture or sale of non-halal products, conventional insurance, non-permissible entertainment activities, manufacture or sale of tobacco-based products, non-Shariah-approved stockbroking or share trading, hotels and resorts, and others deemed non-permissible by Shariah. The tax treatment and/or incentives are similar between islamic and conventional REITs. Other similarities include the structure of REITs requiring a trustee, management company, property manager, valuation etc.

The Islamic REITS Guidelines released by Securities Commission of Malaysia in November 2005 lists out the criteria to be followed by the investment managers of islamic REITs:

- Rental incomes are derived from permissible business activities in accordance with Shariah. Non-permissible portion of the rental shall not exceed 20% of total turnover;
- Islamic MREITs are prohibited from owning properties where all the tenants operate non-permissible activities;
- Islamic MREITs must not accept new tenants whose activities are fully non-permissible;
- For mixed-activities tenants, only 20% of the floor area can be occupied for non-permissible activities;
- For activities not involving the usage of space, the Shariah Adviser/ Committee will have the discretion to decide via the process of *ijtihad*;
- All forms of investment, deposit and financing instruments to comply with Shariah principles;
- Property insurance schemes must be based on Takaful; conventional insurance is only permitted if takaful schemes are not able to provide the coverage needed.

Boon et al (2012) studied the investment performance of conventional and islamic REITs listed in Malaysia over the period 2005-2010 and found that the average return for all islamic REITs under-performed the market portfolio. This was explained by the fact that islamic REITs in Malaysia were not yet well recognized by investors, insufficient to create a noticeable buzz and interest in the market. Another suggestion was that the Shariah principles required by Shariah REITs might have misled investors to presume that they are meant for Muslim investors (Boon et al, 2012). Further comparisons between the performances of islamic and conventional REITs revealed inconsistent results. Ibrahim and Ong (2008) found that non-compliant REITs outperformed their Shariah compliant counterparts for equally weighted portfolio, but Alhenawi and Hassan (2011) showed that compliant REITs outperformed non-compliant REITs and also provided less volatility as investment vehicles.[6]

In seeking the difference in 'faith based' investments, Hassan et al (2010) had found no convincing performance differences between islamic and non-islamic Malaysian unit trust funds' performances using Sharpe, Treynor, Jensen and Fama's selectivity, net selectivity and diversification. While controlling performance for style differences they concluded that non-islamic unit trust funds in Malaysia are value-focused while Islamic unit trust funds are small cap oriented.

High dividend yields in REITs are commonly associated to REITs in the USA and listed property trusts (LPT) in Australia, much of which are seen replicated in the REITs in Asia. Ooi and Neo (2009) revealed that as at December 2005, 41% of the REITs in Asia held diversified property portfolios, not merely to diversify risk but also to average up rental yields on prime properties. Typically, the high rental yields are benefited from retail and industrial properties whereas prime grade office buildings, though popular with institutional investors, yield lower rentals. Another diversification strategy within Asian REITs is to acquire foreign properties, China in particular, that are producing high rental yields relative to local ones (Ooi and Neo, 2009).

Yunus (2013) utilized cointegration techniques to analyze the degree of linkages among four key property types (retail, office, industrial and residential) of eight major countries in North America and Europe. The results show that property types are fully converged

[6] cited by Boon et al (2012).

in the markets of USA, Canada, Netherlands and UK, while industrial properties give the greatest long run diversification benefits in Finland, France, Germany and Sweden. Overall, residential leads the rest of the property types.

In terms of the empirical methodology applied in related studies, research on REITs within the Asian region was referred. While Boon et al (2012) used performance measurements namely Sharpe, Treynor and Jensen, the study by Hassan et al (2010) extended further by using Fama's selectivity, net selectivity and diversification and further the Carhart's four-factor pricing models to examine the persistence of performance. Finally, they employed an analysis of cointegration to examine how the Islamic unit trust funds are related in long term with their non-Islamic counterparts, as well as their respective market portfolios (Hassan et al, 2010).

To capture time-varying correlation between Asian REITs and their relative stock markets during the financial market turbulence, Chiang et al (2010) employed the multivariate GARCH-vech model. They concluded that REITs in Asia are no longer “defensive” stocks during a financial crisis based on the extreme value theory (EVT), after employing the Generalized Extreme Value (GEV) distribution, where it was discovered that increases of correlation coefficients after crisis were more than double those before crisis in Taiwan, Hong Kong, Singapore and Japan. The loss of diversification benefits during crisis where REITs are included in a portfolio is also consistent with the findings of Liu et al (2012).

Liu et al (2012) used the DCC-GARCH model, allowing for asymmetries in both the correlation and volatilities, and found significant correlations between REIT markets in the USA with four Asia Pacific countries. These correlations were then regressed on possible factors affecting REIT performance, where they found that the significant factors include financial factors such as credit spread and global volatility, as well as macro economic factors such as unemployment and inflation rates. This method concurs with Chevallier (2011) who found the DCC-MGARCH model provided the best results to examine time-varying correlations between energy and emissions market, after attempting all three MGARCH models: Baba-Engle-Kraft-Kroner (BEKK), Constant Conditional Correlation (CCC) and the DCC discussed above.

The use of wavelet coherence methodology deepens our study, helping us to understand the MREITs' relationships in different frequencies. Prior to financial data, wavelet technology had been widely used in the sciences. Grinsted et al (2004) applied cross wavelet transform and wavelet coherence to geophysical time series. Using wavelet coherence, Baruník, Vácha and Krištoufek (2010) found very interesting dynamics of cross-correlations between Central European and Western European stock markets and saw the potential for a new approach to financial risk modelling. Vácha and Baruník (2012) applied the wavelet coherence to commodity market data and showed dynamic diversification is required in order to preserve a higher profit.

3. EMPIRICAL METHODOLOGY

We employ the Dynamic Correlation Coefficient - Multivariate Generalized Auto Regressive Conditional Heteroskedasiticy (DCC-MGARCH) methodology by Engle (2002) to examine the relationship of the REITs in Malaysia (MREITs) where the volatilities would reveal the stability of each asset relative to the others and the correlations would show us the relationship between them. The unconditional correlations are different from the conditional ones, as the former calculates the total market values whereas the latter calculates correlation based on the market values adjusted for the conditional mean (Heaney et al, 2012). The correlations would indicate to us the relationship of the islamic MREITs with their conventional counterparts and shed some light as to whether the behaviorial attributes are sector-related.

Next, we analyze further to see whether the dependencies vary across different frequencies. The wavelet coherence approached is used as a tool allowing us to study the correlations in time as well as frequency domains. With this method, we are able to ascertain whether there are contagion effects between the MREITs and specifically whether the Islamic MREITs are led by the more established conventional MREITs in the time frequency space.

3.1 Data

Daily data on the prices as well as market values of five selected Malaysian REITs are used, two islamic MREITs (Al'Aqar and Al Hadharah) and three well-established

conventional MREITs (Hektar, Starhill and AmFirst). The latest list of MREITs is available in Appendix 1.

Although the data retreived from Datastream covered at least from 2 Feb 2007, the latest listing date of these five MREITs, Microfit only accepted data covering the period 31 Dec 2010 to 31 Dec 2012, hence, only 522 observations are used for estimation.

3.2 Dynamic Conditional Correlation Multivariate Generalized Autoregressive Conditional Heteroscedastic (DCC-MGARCH) models

This empirical investigation models the volatility of the market values of selected five MREITs based on the Multivariate Generalized Autoregressive Conditional Heteroscedastic (MGARCH) model in Pesaran and Pesaran (2009). We initially tested both normal and t distributions, to determine the more suitable model for our further analysis.

Studies typically employ constant correlation in their efforts to examine diversification benefits, however, this approach ignores the fact that correlation is often time-varying and and hence deviates from constant correlation. In this paper, we examine the Dynamic Correlation (DCC) model introduced by Engle (2002).

To see how close the market values of the Malaysian REITs are associated to each other, we require the computation of conditional cross-asset correlations, computed by Microfit as

$$\tilde{\rho}_{ij,t-1}(\phi) = \frac{q_{ij,t-1}}{\sqrt{q_{ii,t-1}q_{jj,t-1}}}$$

where $q_{ij,t-1}$ are given by

$$q_{ij,t-1} = \bar{\rho}_{ij}(1 - \phi_1 - \phi_2) + \phi_1 q_{ij,t-2} + \phi_2 \tilde{r}_{i,t-1}\tilde{r}_{j,t-1}$$

In the above, $\bar{\rho}_{ij}$ is the (i, j)th unconditional correlation, ϕ_1 and ϕ_2 are parameters such that $\phi_1 + \phi_2 < 1$, and $\tilde{r}_{j,t-1}$ are standardised asset returns.

We also tested whether the computed volatility is mean-reverting by estimating $(1-\lambda_{i1}-\lambda_{i2})$. Some diagnostic test were conducted to substantiate the validity of our models. For brevity, we omit further details of this model, which can be found in Pesaran and Pesaran (2009).

3.3 Continuous Wavelet Transform (CWT) and Wavelet Coherency (WTC)[7]

Having looked at the unconditional and conditional volatilities and correlations between the MREITs, we extend the study to analyse the relationships further at different frequencies i.e. time scales. Investment assets, including REITs may be highly volatile at high or medium frequencies, whereas in the long run (i.e. lower frequencies), it is the market that drives asset movements.

The continuous wavelet transform (CWT), with respect to the 'mother wavelet' Φ (i.e. at high frequencies), is a function $W_x(s,\tau)$ that provides wavelet coefficients, defined as

$$W_x(s,\tau) = \int_{-\infty}^{+\infty} x(t) \frac{1}{\sqrt{s}} \phi^* \left(\frac{t-\tau}{s}\right) \mathrm{d}t$$

where * denotes the complex conjugate form. The mother wavelet $\Phi(\,.\,)$as a prototype for generating other window functions. The term translation, τ, refers to the location of the window (indicating where it is centered). As the window shifts through the signal, the time information in the transform domain is obtained. The term scaling, *s*, refers to dilating (if $|s| > 1$) or compressing (if $|s| < 1$) the wavelet (controls the length of the wavelet by extracting frequency information from the time series). The mother wavelet is dilated or compressed to correspond to cycles of different frequencies. In this way an entire set of wavelets can be venerated from a single mother wavelet function and this set can then be used to analyze the time series.

Wavelet transforms perform what is called time-frequency analysis of signals, being able to estimate the spectral characteristics of signals as a function of time. Therefore, it can provide not only the time-varying power spectrum but also the phase spectrum needed for computation of coherence. The proviso is that this correlation may not be contemporaneous, but may involve a lead or a lag, being the magnitude measured by the phase lead.

Coherence is very important when dealing with fluctuating quantities, indicating how closely *X* and *Y* are related by a linear transformation. Coherence is like a correlation

[7] The description of CWT and WTC are largely drawn from Tiwari et al (2013) and Madaleno et al (2012).

measure that indicates how strongly the two variables are related at business cycle frequencies. It ranges from 0 (no correlation; completely incoherent) to 1 (perfect correlation; completely coherent).

Wavelet Coherency (WTC) can be defined as the ratio of the cross-spectrum to the product of the spectrum of each series, and can be thought of as the local correlation, both in time and frequency, between two time series. Thus, WTC near one shows a high similarity between the time series, while coherency near zero shows no relationship.

In our paper, we use the wavelet coherence which measures local correlation of two time series in time-frequency domain. First, we briefly define the continuous wavelet transform, followed by the wavelet coherence. The continuous wavelet transform (CWT) $W_x(u,s)$ is obtained by projecting a mother wavelet $\Psi(.)$ onto the examined time series

$$x(t) \in L^2(\mathbb{R}): W_x(u,s) = \int_{-\infty}^{\infty} x(t) \frac{1}{\sqrt{s}} \psi\left(\frac{t-u}{s}\right) dt, \text{ where } 1/\sqrt{s}$$

denotes a normalization, u is a location parameter and s is a scale parameter.

Wavelet coherence could be defined the as the squared absolute value of the smoothed cross wavelet spectra, $W_{xy}(u,s)$, normalized by the product of the smoothed individual wavelet power spectra of each series i.e.,

$$R^2(u,s) = \frac{|S(s^{-1}W_{xy}(u,s))|^2}{S(s^{-1}|W_x(u,s)|^2)S(s^{-1}|W_y(u,s)|^2)},$$

where S is a smoothing operator. The squared wavelet coherency coefficient is in the range $0 \leq R^2(u, s) \leq 1$, values close to zero indicates weak correlation, while values close to one are evidence of strong correlation. A high wavelet coherence between two assets at the lower time scales tends to indicate contagion, whilst a high wavelet coherence at higher time scales tends to indicate a fundamental theoretical relationship between assets. Thus it provides a useful tool for analysis of comovement across the financial markets. The phase difference, indicated by arrows, gives us details about delays of oscillation of the two examined time series. Arrows pointing to the right (left) when the time series are in-phase (anti-phase) or are positively (negatively) correlated. Arrow pointing up means

that the first time series leads the second one, arrow pointing down indicates that the second time series leads the first one.

4. RESULTS AND POLICY IMPLICATIONS

4.1 Unconditional and Conditional Volatilities and Correlations

Using Microfit, the multivariate GARCH option was used to estimate DCC models for a portfolio composed of returns on 5 MREITS: Al'Aqar (ALQRM), Al Hadharah (AHBRM), Hektar (HKTRM), Starhill (STHLM) and AmFirst (AFRTM). After many attempts of failed convergence, we switched to the MGARCH option applied to the OLS residuals of a set of regressions. As convergence was still not achieved, the data series of MREITs market values were used instead. Therefore, the following results are based on the market values of the MREITs and not returns.

Table 1 and Table 2 present the maximum likelihood estimates of λ_{i1} and λ_{i2} for the five MREITs market values, and the mean reverting parameters δ_1 and δ_2, under the normal distribution and 't'-distribution, respectively. A new parameter, the degrees of freedom (df) of the 't' distribution is revealed in Table 2.

In both Tables 1 and 2 we find that the time varying volatility parameters of all these MREITs highly significant, implying that gradual volatility decay i.e. high riskiness of the MREITs gradually decays following a shock in the market, which attributes to high volatility. This is confirmed by the sum of the volatility parameters ($\lambda_{i1} + \lambda_{i2}$) of each MREIT being less than unity (i.e. $\lambda_1 + \lambda_2 < 1$). The implication of this is that their market values do not follow IGARCH; in simpler words, the shock to volatility is not permanent and that there is a gradual decay.

Comparing the two maximum log-likelihood values of each table, the t-DCC model with a value of -11058 is significantly larger compared to normal-DCC model's value of -11303. The estimated degrees of freedom is 6.56, well below the value of 30, suggesting that the t-distribution is more appropriate in catching the fat-tailed nature of the

distribution of MREIT market values.[8] These conclusions are robust to the way market values are standardized for the computation of cross-MREIT market value correlations. Therefore, our further analysis will work with the t-distribution estimates.

Table 1. DCC Estimation results using normal distribution.

Parameter	Estimate	Standard Error	T-Ratio [Prob]
lambda1_ALQRM	0.43047	0.0393	10.9533[.000]
lambda1_HKRTM	0.53303	0.03468	15.3699[.000]
lambda1_AHBRM	0.41346	0.038363	10.7777[.000]
lambda1_STHLM	0.41923	0.042721	9.8132[.000]
lambda1_AFRTM	0.51802	0.037454	13.8309[.000]
lambda2_ALQRM	0.49822	0.032635	15.2663[.000]
lambda2_HKRTM	0.42886	0.030857	13.8983[.000]
lambda2_AHBRM	0.55269	0.034659	15.9468[.000]
lambda2_STHLM	0.51936	0.036997	14.0378[.000]
lambda2_AFRTM	0.43045	0.031067	13.8557[.000]
delta1	0.54566	0.024192	22.5556[.000]
delta2	0.3701	0.017606	21.0215[.000]
Maximized Log-Likelihood =	-11303.6		

Table 2. DCC Estimation results using 't' Distribution

Parameter	Estimate	Standard Error	T-Ratio [Prob]
lambda1_ALQRM	0.32634	0.043543	7.4946[.000]
lambda1_HKRTM	0.4453	0.036683	12.1394[.000]
lambda1_AHBRM	0.29654	0.040069	7.4007[.000]
lambda1_STHLM	0.26388	0.043668	6.0429[.000]
lambda1_AFRTM	0.42155	0.040492	10.4106[.000]
lambda2_ALQRM	0.6191	0.038798	15.9571[.000]
lambda2_HKRTM	0.52261	0.033291	15.6983[.000]
lambda2_AHBRM	0.67118	0.037365	17.9624[.000]
lambda2_STHLM	0.68535	0.03974	17.2459[.000]
lambda2_AFRTM	0.53771	0.036079	14.9035[.000]
delta1	0.46957	0.026019	18.0467[.000]
delta2	0.47342	0.021563	21.9552[.000]
df	6.5624	0.45974	14.2741[.000]
Maximized Log-Likelihood =	-11058.0		

Note: Table 1 and Table 2 present the maximum likelihood estimates of λ_{i1} and λ_{i2} for the five MREITs market values, and the mean reverting parameters δ_1 and δ_2. The sum of the volatility parameters ($\lambda_{i1} + \lambda_{i2}$) of each MREIT is less than unity, implying that the volatility of their market values do not follow IGARCH.

[8] Pesaran and Pesaran (2009).

Table 3 reports the estimated unconditional volatilities (diagonal elements, shaded) and unconditional correlations (off diagonal elements) of the vector of MREITs market values. The unconditional volatility is highest for Al Hadharah (AHBRM) and the lowest for Hektar (HKTRM), which shows that market value of Hektar REIT is more stable than that of the Islamic plantation-based REIT, Al Hadharah. Detailed ranking of highest to lowest is shown in parentheses of the diagonal elements. Al'Aqar, the healthcare-based REIT takes fourth place after Starhill but is quite a distance away from the stability level of Hektar REIT. This result sheds light on the sector differences of the REITs under this study. Hektar REIT is retail based i.e. shopping malls, where dividends are stable as they directly come from the rental cash stream. Al Hadharah, the plantation-based REIT is highly dependant on the pricing of palm oil internationally.

With respect to cross correlation, we observe that the market values of Al Hadharah and Starhill are highly positively correlated (0.79361), ranking first; hence the possible direction of movement and the degree of association between the market values of these two MREITs is substantial. The unconditional correlation is ranked 10th (least) between Hektar and Al Hadharah. This would be in line with the unconditional volatility results above as Al Hadharah is the most volatile and Hektar is the most stable. In fact Hektar seems to have the lowest ranking when it is compared to the other MREITs, except for its correlation with AmFirst (2nd place).

Table 3. Unconditional Volatilities and Unconditional Correlations
(Normal and t-Distribution)

	ALQRM	HKRTM	AHBRM	STHLM	AFRTM
ALQRM	61.5459 *(4)*	0.57493	0.76997	0.75269	0.71567
HKRTM	0.57493 *(9)*	40.1437 *(5)*	0.55121	0.63632	0.78725
AHBRM	0.76997 *(3)*	0.55121 *(10)*	81.5229 *(1)*	0.79361	0.62854
STHLM	0.75269 *(4)*	0.63632 *(6)*	0.79361 *(1)*	72.6137 *(2)*	0.60149
AFRTM	0.71567 *(5)*	0.78725 *(2)*	0.62854 *(7)*	0.60149 *(8)*	70.3534 *(3)*

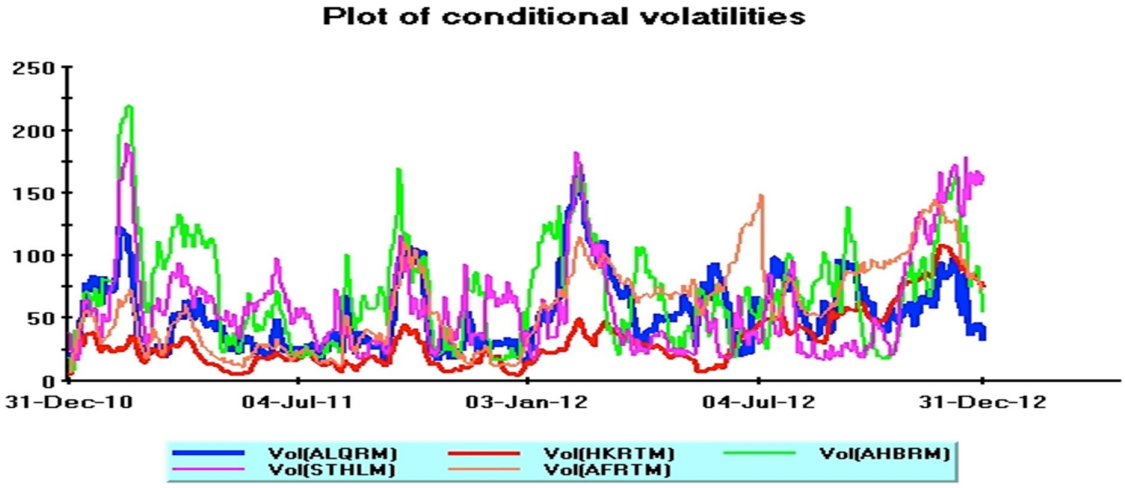
Note: Table 3 reports the estimated unconditional volatilities and unconditional correlation between the MREITs market values. The off diagonal elements represent unconditional correlation and the diagonal elements (shaded blue) represent unconditional volatilities of the MREITs market values. The ranking from highest to lowest are shown in red parentheses unconditional volatilities (1 to 5); and the ranking of unconditional correlation between MREIT pairs are in blue parentheses (1st to10th).

So far, the analyses and conclusions of volatilities and correlations above have been made on an unconditional basis. To inspect the temporal dynamics of conditional volatilities

and correlations of MREITs market values, the graph in Figure 1 is plotted. Heaney et al (2012) explains how they are different: the calculation of unconditional correlations uses the total market values whereas conditional correlations are based on the market values adjustment for conditional mean.

From the graph in Figure 1, we can clearly observe that the highest conditional volatility is in Al Hadharah as it reaches the highest peaks in the year 2011. The plantation sector is not only affected by weather conditions, but also palm oil prices according to global demand. In fact, 2012 proved to be a challenging year for Al Hadharah as palm oil stocks were at record high, excess supply from stronger production was unmet due to sluggish export demand from debt crisis countries in US and Europe.[9] From Jan 2012, the highest volatilities are seen with market value of Starhill. This is most likely due to the new acquisitions made by Starhill REIT in November and December 2011.[10] Al'Aqar and AmFirst are more volatile than Hektar but the competition between these two REITs varies according to time. Al'Aqar was generally more volatile than AmFirst over the year 2011, but AmFirst exceeded Al'Aqar's volatility peak levels in 2012. These REIT market values are not really moving closely together. The rankings of the conditional volatilities in Figure 1 appear to be consistent with the unconditional correlation in Table 3 above.

Figure 1: Conditional Volatilities of MREITs market values



[9] Al Hadharah Boustead REIT - Manager's Report for the year ended 31 Dec 2012

[10] In November 2011 Starhill REIT acquires Pangkor Laut Resort, Tanjong Jara Resort, Cameron Highlands Resort, The Ritz-Carlton Kuala Lumpur, Vistana Kuala Lumpur, Vistana Kuantan and Vistana Penang, as well as the remainder of The Residences at The Ritz-Carlton, Kuala Lumpur, not already owned by the Trust and by the end of Dec 2011 Starhill REIT completed its acquisition of Hilton Niseko in Japan (www.starhillreit.com).

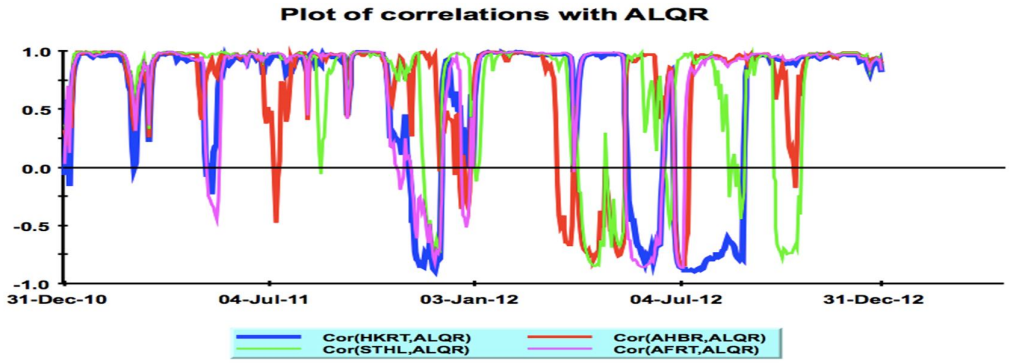
When the conditional correlations are plotted, as in Figure 2, it is very hard to fathom the degree of correlation between the MREITs. Generally, within the 24 month span, all the MREITs under study oscillate unevenly between the perfect correlation of -1 and 1. A perfect positive correlation (i.e. +1) indicates in-phase movement and diversification benefits would not be felt, this is seen consistently over the 2 years other than the two periods of negative correlation. This is not unexpected as these REITs fundamentally move within the same property cycle.

A perfect negative correlation (i.e. -1) correlation would imply that the pair of MREITs are totally out-of-phase, and hence having both in a portfolio would be most beneficial for diversification. This is seen commonly during the periods Nov-Dec 2011 and Mar-Oct 2012. These periods explain the different property cycles between types of properties. As we are interested in the islamic MREITs, we shall focus on the two REITs. During Nov-Dec 2011, both Al Hadharah (Fig. 2.3) and Al'Aqar (Fig. 2.1) were highly uncorrelated with the conventional REITs. Ernst and Young's research claim that the islamic fund industry benefited while global uncertainties loomed ahead.[11] When the two islamic REITs were compared against one another during 2011, there is evidence of some positive correlation. During Mar-Oct 2012, the negative correlations were apparent with all the MREITs under study. From this graphs alone, we may deduce that the market rates of these MREIT were independently changing, as each of them had unsystemic factors affecting them.

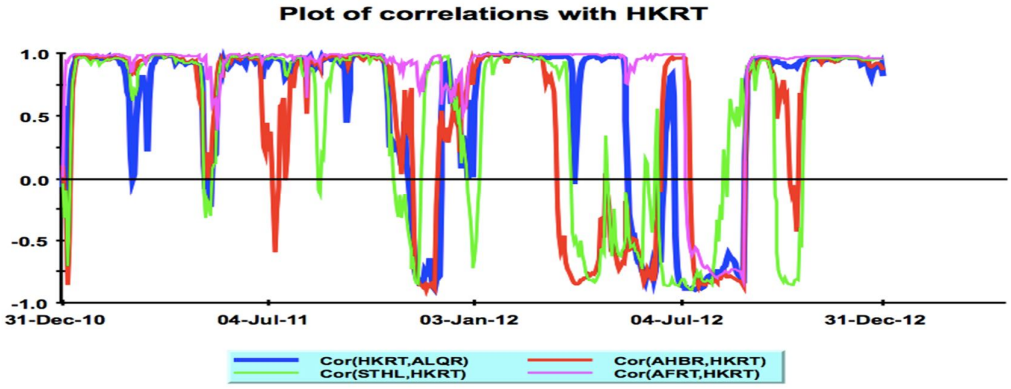
Figure 2. Plot of Conditional Correlations

[11] Ernst & Young Islamic Funds and Investment Report 2011.

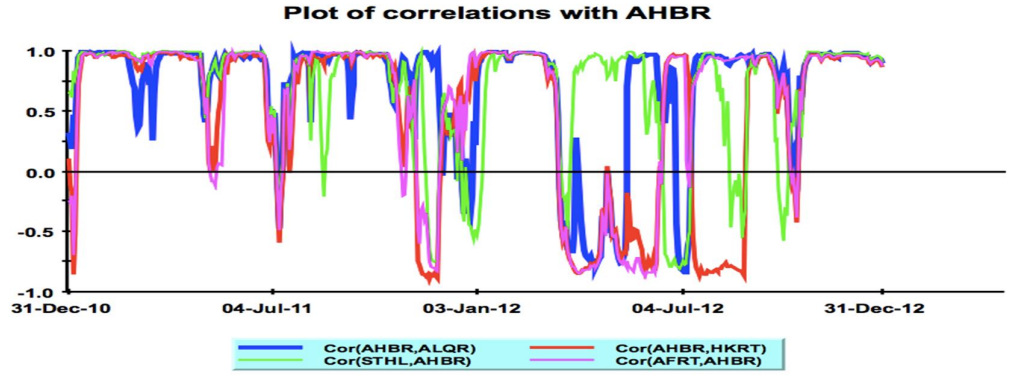
2.1


Plot of correlations with ALQR
1.0
0.5
0.0
-0.5
-1.0
31-Dec-10
04-Jul-11
03-Jan-12
04-Jul-12
31-Dec-12
Cor(HKRT,ALQR)
Cor(STHL,ALQR)
Cor(AHBR,ALQR)
Cor(AFRT,ALQR)

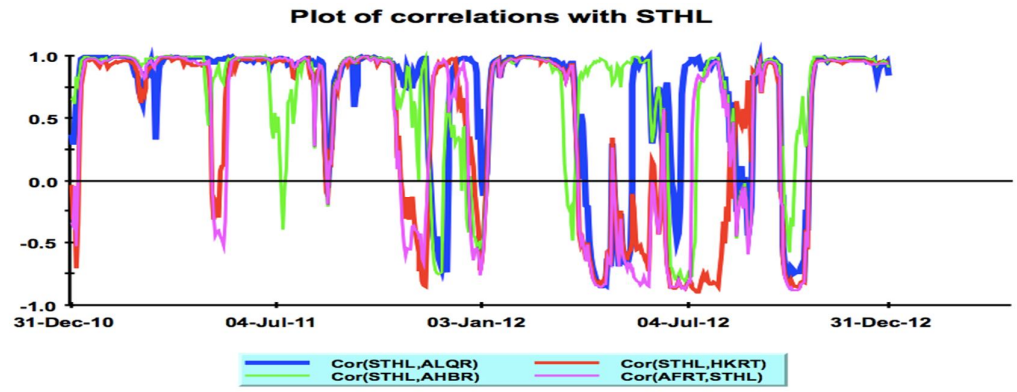
2.2


Plot of correlations with HKRT
1.0
0.5
0.0
-0.5
-1.0
31-Dec-10
04-Jul-11
03-Jan-12
04-Jul-12
31-Dec-12
Cor(HKRT,ALQR)
Cor(STHL,HKRT)
Cor(AHBR,HKRT)
Cor(AFRT,HKRT)

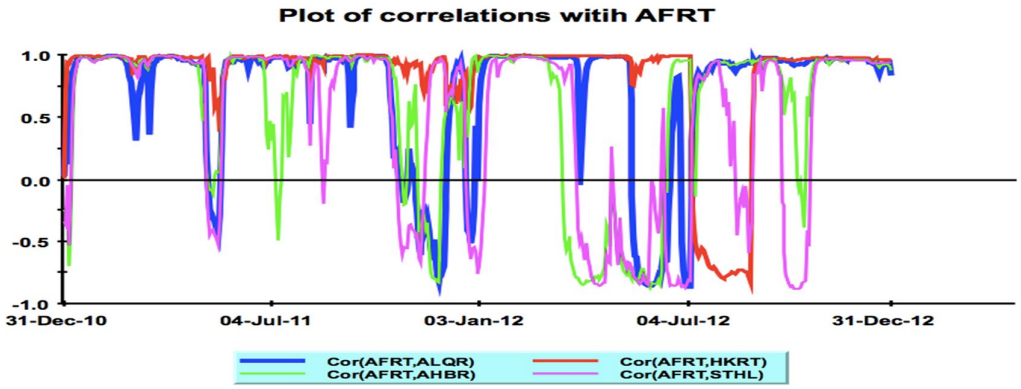
2.3


Plot of correlations with AHBR
1.0
0.5
0.0
-0.5
-1.0
31-Dec-10
04-Jul-11
03-Jan-12
04-Jul-12
31-Dec-12
Cor(AHBR,ALQR)
Cor(STHL,AHBR)
Cor(AHBR,HKRT)
Cor(AFRT,AHBR)

2.4



2.5



Considering the t-DCC model of MREIT market values estimated in Table 2, we now focus on the problem of testing the hypothesis that one of the MREIT market values has non-mean reverting volatility.

The null hypothesis for this test is:

Ho: $\lambda_{i1} + \lambda_{i2} = 1$ (the process is non-mean reverting)

where λ_{i1} and λ_{i2} are the parameters for the conditional volatility equation for the *i*th REIT.

From the results shown in Table 4, we find that in all of the MREITs tested, volatility is mean-reverting as the null is rejected in all cases. This implies that, despite the volatilities and correlations as discussed above, in the long run, volatility assumes an average value. The mean reverting process appears to be not too slow as estimates of $1-\lambda_1-\lambda_2$ range from 0.055, being the fastest (Al'Aqar) to 0.032, the slowest (Hektar). A plausible explanation for this is one that is in line with the results discovered above. Hektar REIT is thus far the

least volatile and most stable amongst the five studied in this paper and hence is already reasonably even out in the long run and is close to its long term average. Even so, evidence tells us that the time for Hektar REIT to revert to its mean is merely 31 days compared to 18 days for Al'Aqar.

Table 4. Testing for mean reversion of volatility of returns

REIT	$1-\lambda_1-\lambda_2$	Standard Errors	t-ratio (Prob.)
ALQRM	0.054564	0.0087736	6.2191[.000]
HKRTM	0.032081	0.0084696	3.7878[.000]
AHBRM	0.032286	0.005582	5.7840[.000]
STHLM	0.050763	0.0075116	6.7579[.000]
AFRTM	0.040741	0.0078388	5.1973[.000]

Note: The null hypothesis is the non-reversion process of each asset.

4.2 Co-movements in the frequency domain

To accommodate for the multihorizon nature of REITs and assess the statistical significance of the correlations in the time-frequency space, we use the assistance of wavelet analysis. Diagrams depicted in Figure 3 present the wavelet coherency and phase difference of the five MREITs against each other, using Monte Carlo simulations. They give a clearer picture of the co-movement between them, to give us a more detail picture relative to the unconditional and conditional correlations (Table 2 and Figure 4) given by the DCC-MGARCH above, as the diagrams 3.1 to 3.10 tell us the level of co-movement at different frequencies, from scale 1 (one day) to scale 8 (512 days, approximately 2 market years). In addition, the period covered in these diagrams go back from February 2007 to December 2012 (almost a six-year stretch).[12] A high wavelet coherence at the lower time scales tends to indicate 'contagion', whereas a high wavelet coherence at the higher time scales tends to indicate a fundamental theoretical relationship between them. Coherency ranges from blue (low coherency) to red (high coherency). Information on the phases shows us that the relationship between the MREITs is not homogenous across scales, since arrows point right and left, down and up, constantly.

[12] Software to produce WTC is based on Matlab, hence we did not face the same convergence limitations as we did with Microsoft.

As our main objective is to see the relationships between the islamic REITs with the others, we focus on the wavelet coherence of Al Hadharah and Al'Aqar and how they fair with the other MREITs. Generally, there is evidence of a fundamental theoretical (long term) relationship amongst the MREITs, but specifically this does not seem to last through-out the six year period with all pairs. Al Hadharah clearly has fundamental long term dependencies with Starhill and Hektar (figures 3.6 and 3.1). Al'Aqar has strong theoretical relationships with AmFirst and Hektar, but there is a reduced dependency with Starhill after mid-2009 (figures 3.5, 3.9 and 3.4). Between the two islamic MREITs, the strength in the fundamental long term red bond wanes after mid-2009 by turning yellow but picks up intensity again in the middle of 2010 (figure 3.3).

The reduced intensity of coherence from 2009 is common for pairs with AmFirst. Fig. 3.2 illustrates the reduced long term relationship between AmFirst with Hektar after 2010, at which point stronger coherence is seen in the monthly to quarterly time scale, implying contagion (with Hektar leading AmFirst). Fig. 3.8 presents AmFirst's strong long term bond with Starhill only up to 2011. This phenomena, where there is actually a cease or dilution in the fundamental theorical ties between assets of the same class, is strongly linked the global debt crisis from 2008 which left a gloomy global market afterwards, the effects of which are still present in 2013.

Evidence of any lead-lag relationship is scarce and seem to move in reverse directions over time. For example, during 2010 and 2011, Hektar seems to lead Starhill within 16 day scales but the reverse can be said in the 32 day timing scales (fig.3.6). What appears to be clear contagion is when Hektar leads AmFirst (fig. 3.2) over the 64-128 day frequencies from 2010 onwards.

To explain the findings above, we analyze the property sectors of each MREIT. Al Hadharah is economically driven because fluctuations in crude palm oil and palm kernel prices are dependant on export demand as well as the volatility of foreign currency rates.

Retail based Hektar has a strong link with macroeconomic factors as economic confidence would increase disposable income and discretionary spending, in line with the Malaysian government's Economic Transformation Program (ETP). This can be seen

from the recent successful REIT listings of well managed malls in prime areas, such as SunREIT's Sunway Pyramid Shopping Mall, CapitaMall Malaysia Trust's Gurney Plaza, IGB REIT's Mid Valley Megamall and Pavilion REIT's Pavilion KL Mall.[13] Therefore, the fundamental relationship between Hektar and Al Hadharah is tied to the economic climate. AmFirst is an office-based REIT whereby rentals may fall when there is an oversupply of office buildings. Once the debt-crisis hit the global market, the fierce competition between the unoccupied office buildings led to slower growth and rental yields dropped. Hence, AmFirst (our proxy for Axis, the third islamic REIT) is seen to be led by Hektar in quarterly to annual frequencies. The plausible explanation for this is that malls are built in commercial development projects which typically include office blocks and some even with residential units. Increased expenditure patterns among the public and private sector may boost mall returns, but office tenancies may not have the same growth as there is an oversupply already.

The market value of Al'Aqar is wholly dependent on the performance of the KPJ Group, a healthcare focused group portfolio. It is unaffected by the debt crisis as its rental rates are increasing with the demand in the health travel industry. It is striving to catch up with the health tourism sectors of Hong Kong and Singapore.[14]

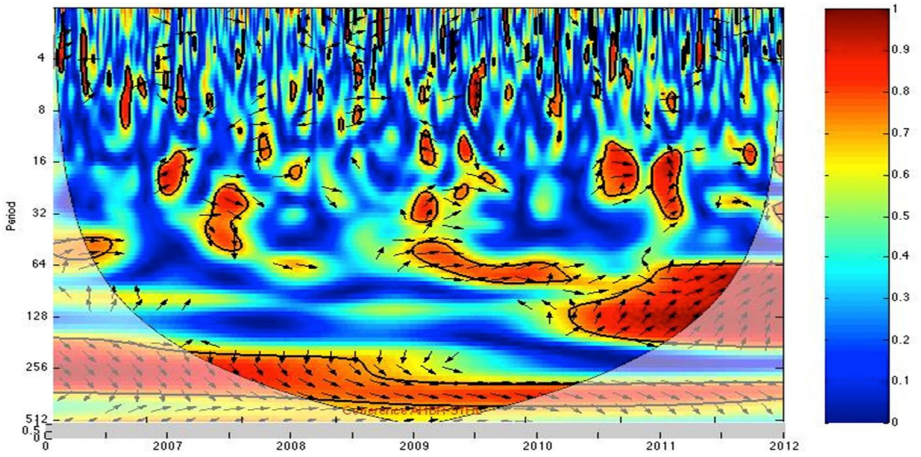
Starhill, on the other hand, went through a rationalization exercise to position itself as a fully fledged global hospitality REIT in November 2009. It would appear that this REIT does not halt even during the debt crisis. By the end of 2011, this REIT had acquired the star cladded hotels in various locations in Malaysia plus one in Japan. Continuing with the acquisition drive, Starhill REIT acquired three Marriott Hotels in Australia (i.e. Sydney Harbour, Brisbane and Melbourne) for AUD415 million in June 2012.[15]
The wavelet coherence shown would also reflect much of the unexplained difference among them - the management of the properties, mergers and acquisition of value assets, recapitalizing the balance sheet and disposing of underperforming assets.

Figure 3. Wavelet Coherence and Phase Difference plots between MREITs

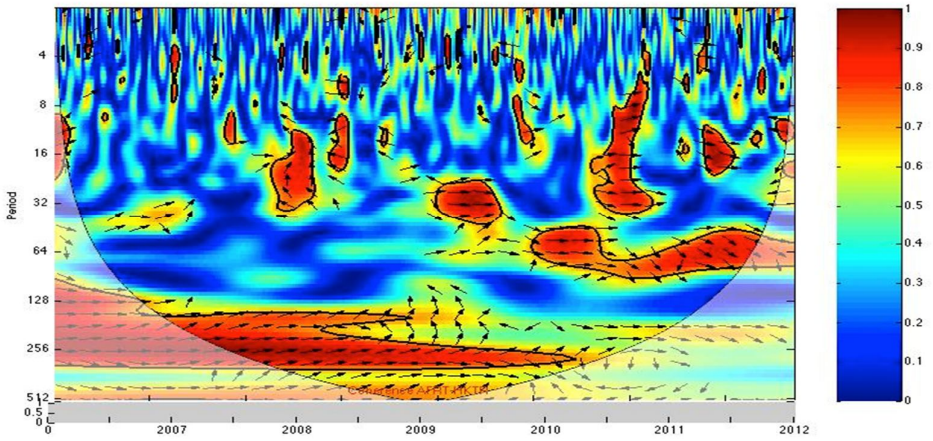
[13] Outlook from various analyst reports Dec 2012.
[14] Al'Aqar Healthcare REIT Annual Report 2012.
[15] Press release dated 13 June 2012 *(http://www.starhillreit.com/press-releases)*

These diagrams show the estimated wavelet coherence and the phase difference for all examined pairs of market values from scale 1 (one day) up to a scale of 256 (approximately one market year). Time is shown on the horizontal axis, while the vertical axis refers to frequency; the lower the frequency, the higher the scale. The wavelet coherence finds the regions in time-frequency space where the two time series co-vary.

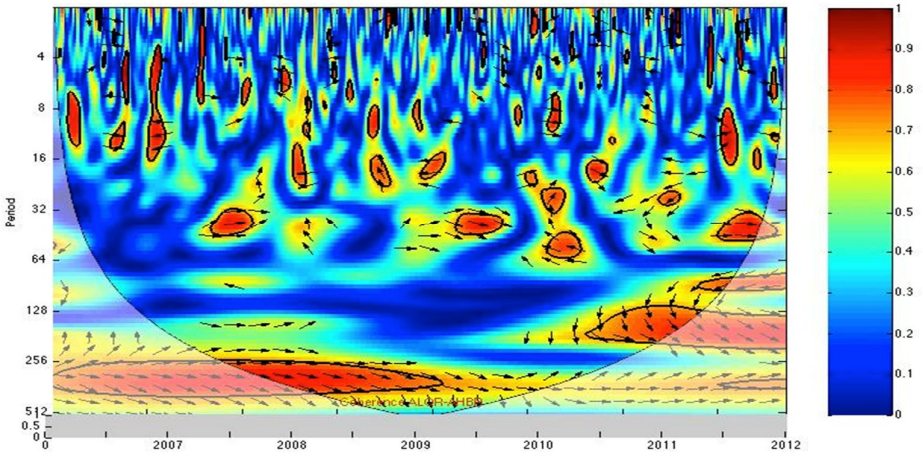
3.1 AHBR-STHL



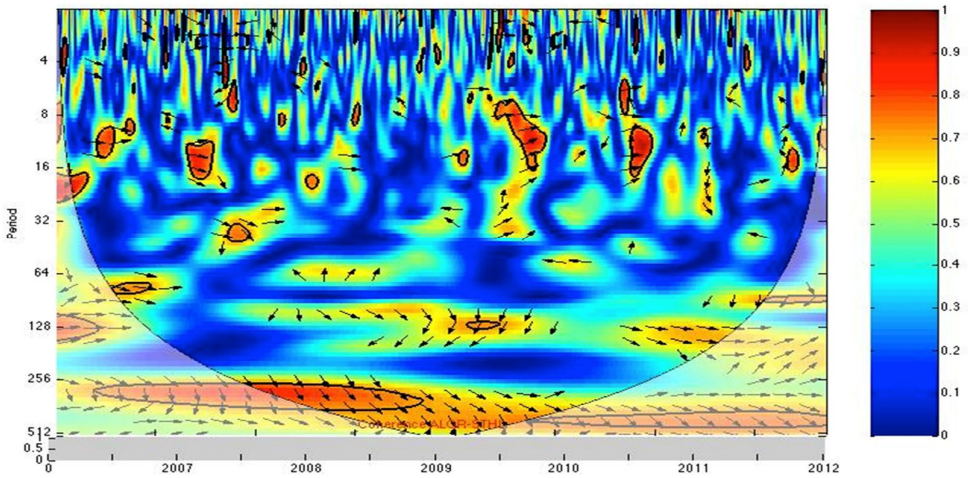
3.2 AFRT-HKTR



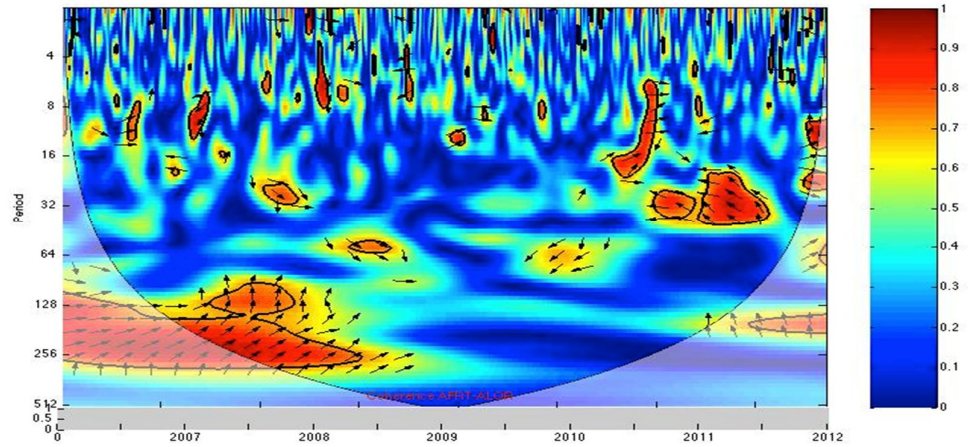
3.3 AHBR-ALQR



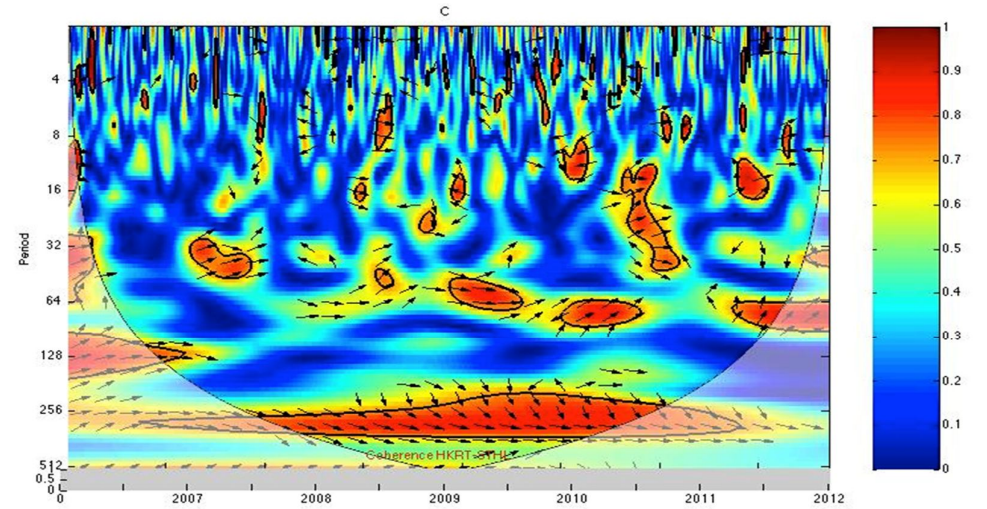
3.4
ALQR-
STHL

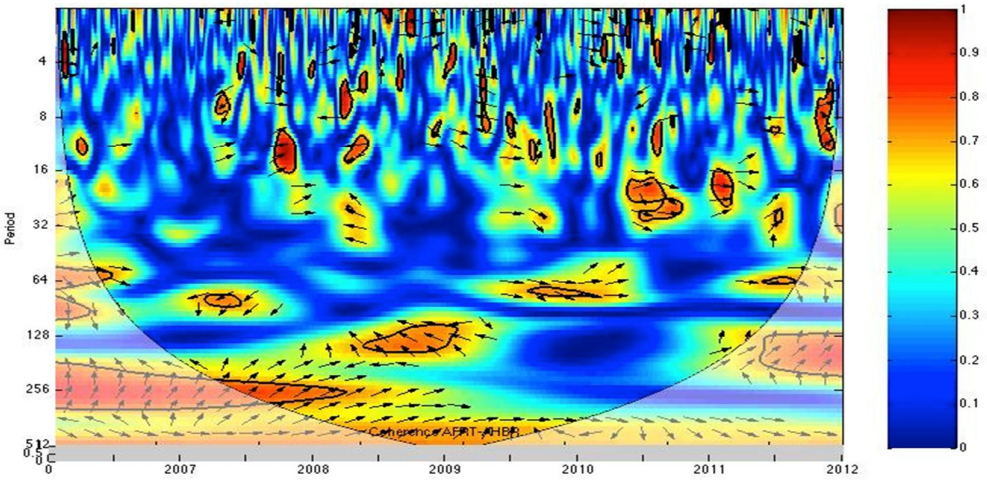


3.5
AFRT-
ALQR

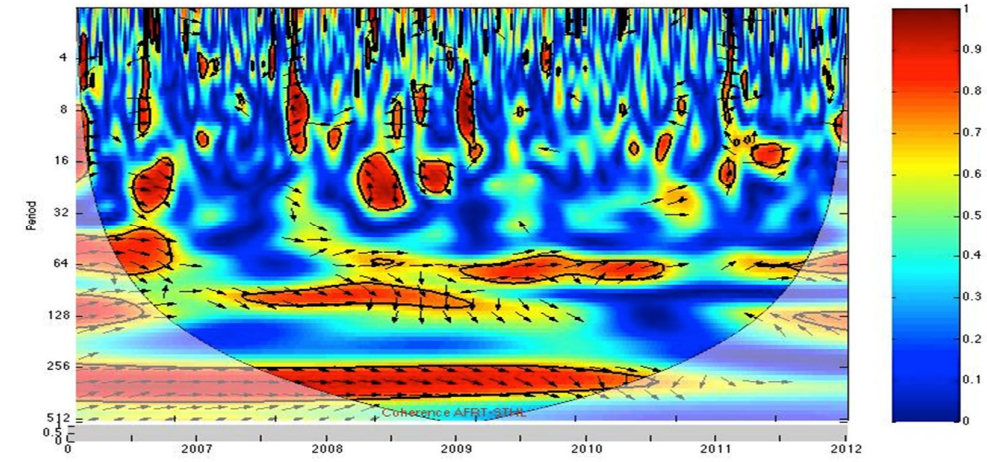


3.6
HKTR-
STHL



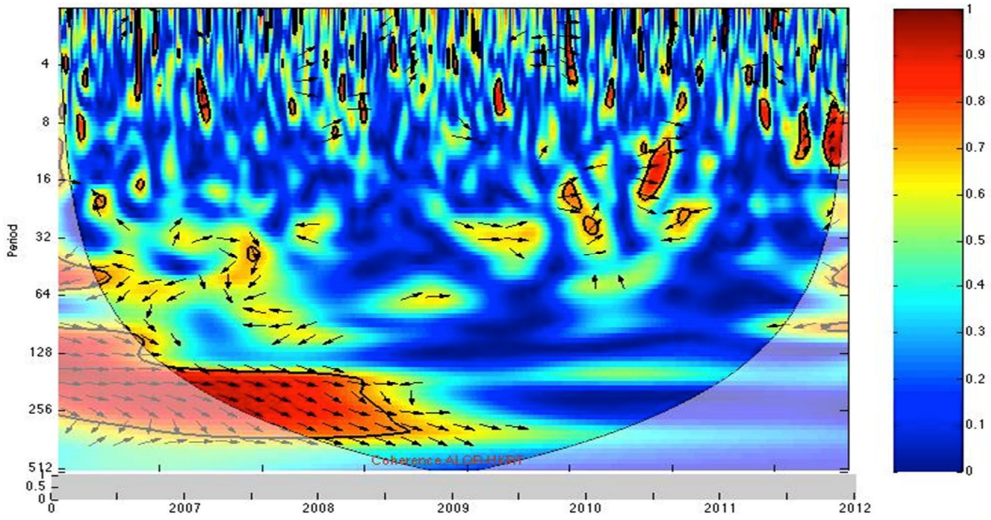


3.7 AFRT-AHBR

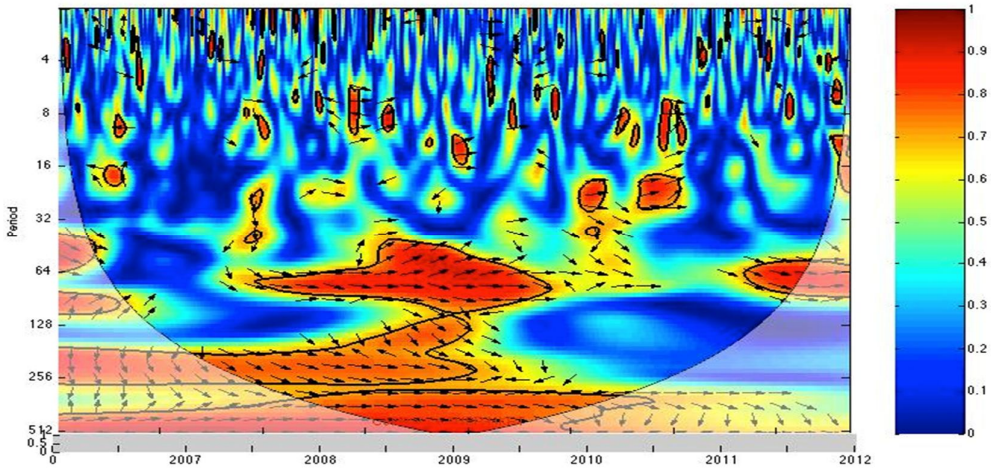


3.8 AFRT-STHL

3.9
ALQR-
HKTR



3.10
AHBR-
HKTR



5. CONCLUSION

The key objective of our study is to examine the volatility and stability of a fairly new asset class in Malaysia, the islamic REITs. The MREITs under study are sector specific: plantation-based Al Hadharah Bousted REIT, healthcare-based Al'Aqar REIT, and office-based Axis REIT (using AmFirst REIT as proxy) and the established conventional counterparts (retail-based Hektar REIT and hospitality-based Starhill REIT).

The DCC-MGARCH method illustrated varying volatility levels, where plantation-based Al Hadharah is significantly most volatile and retail-based Hektar significantly most stable. Correlations between these Malaysian REITs suggest some dependencies between them, but when the analysis is switched from time domain to frequency domain, we find that other than the long term fundamental relationship between some of them, which may have been disrupted or diluted by the 2008 debt crisis, these Malaysian REITs move within their sectors independently. Although this result may be conflicting with earlier research that showed the loss of diversification benefits in times of crisis (Chiang et al, 2010; Liu et al, 2012) , the perspective of our study is different as we focus on sector-related behaviours.

On whether the islamic REITs are led by their conventional, more established counterparts, the results are negative, as their success stories are separately relating to their respective sectors. The three islamic REITs in Malaysia represent three diverse sectors and thus have their own strategies for growth. For Al Hadharah, the global market demand for palm oil and currency fluctuation dictate its performance and yield; a drop in palm prices attributable to oversupply and poor global demand would increase its volatility. As for Al'Aqar, there is continuing growth and stability as Malaysia is striving to market an attractive health travel sector to match regional hubs of Hong Kong and Singapore. The glut of office buildings in the cities lowers rental yields for office REITs, applicable to Axis REIT, based on results shown by AmFirst, its proxy.

The conventional MREITs also vary in their direction and movements independently, as results show for Hektar REIT and Starhill REIT. As for Hektar REIT, the domestic demand based on private and public sector spending play a pivotal role in sustaining the retail sector. A portfolio with recognizable and well managed malls which investors and shoppers are familiar with, would give income instability. Hence retail would be a

favourable sector as compared to office, in the near future, consistent to the analysis by Ooi and Neo (2009). The hospitality focus of Starhill's properties is unaffected by debt crisis as Starhill pursues the strategy of building its asset size via acquisition and mergers.

These result may be compared to Yunus' (2013) where the linkages between property types were found to vary from country to country. Limited diversification benefits can be made from properties in USA, UK, Canada and Netherlands, but industrial properties are able to provide long term diversification benefits in Finland, France, Germany and Sweden (Yunus, 2013).

Based on the Global REIT Report 2012 by Ernst & Young, many REITs focus on internal growth rather than external growth. Internal growth, which is not studied in this paper, is nurtured via efficient property management, cost reduction measures to improve portfolio occupancy as well as increase rental yields. External growth refers to selective property acquisitions or investments in and/or mergers with other REITs, which appears to be Starhill's strategy.

With our findings above, portfolio diversification is possible for investors holding the same asset class of Malaysian REITs. More importantly, Shariah compliant investors will not be disadvantaged should they have all three islamic MREITs within their portfolio. However, it still remains advisable for all investors to carefully study sector related market movements as well as internal property management strategies to enable troubleshooting measures in mitigating the risks of uncertainties ahead.

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Ernst & Young, 2012 REIT Report.

Starhill REIT Annual Report 2012.

APPENDICES

Appendix 1.

Listed real estate investment trust in Malaysia (As at 28 February 2013)

No.	Funds Under Management	Trustee	Management Company
1	AmFirst Real Estate Investment Trust	Maybank Trustees Berhad	AmARA REIT Managers Sdn Bhd
2	Axis Real Estate Investment Trust *	OSK Trustees Berhad	Axis-REIT Managers Berhad
3	AmanahRaya Real Estate Investment Trust	CIMB Islamic Trustee Berhad	AmanahRaya-REIT Managers Sdn Bhd
4	Atrium Real Estate Investment Trust	CIMB Commerce Trustee Berhad	Atrium REIT Managers Sdn Bhd
5	Al-Hadharah Boustead REIT *	CIMB Islamic Trustee Berhad	Boustead REIT Managers Sdn Bhd
6	Al-`Aqar Healthcare REIT *	AmanahRaya Trustees Berhad	Damansara REIT Managers Sdn Bhd
7	CapitaMalls Malaysia Trust	AmTrustee Berhad	CapitaMalls Malaysia REIT Management Sdn Bhd
8	Tower Real Estate Investment Trust	AmTrustee Berhad	GLM REIT Management Sdn Bhd
9	Hektar Real Estate Investment Trust	AmTrustee Berhad	Hektar Asset Management Sdn Bhd
10	IGB Real Estate Investment Trust	AmTrustee Berhad	IGB REIT Management Sdn Bhd
11	Starhill Real Estate Investment Trust	Maybank Trustees Berhad	Pintar Projek Sdn Bhd
12	Pavilion Real Estate Investment Trust	AmTrustee Berhad	Pavilion REIT Management Sdn Bhd
13	Amanah Harta Tanah PNB	AmanahRaya Trustees Berhad	Pelaburan Hartanah Nasional Berhad
14	Quill Capita Trust	Maybank Trustees Berhad	Quill Capita Management Sdn Bhd
15	Sunway Real Estate Investment Trust	OSK Trustees Berhad	Sunway REIT Management Sdn Bhd
16	UOA Real Estate Investment Trust	OSK Trustees Berhad	UOA Asset Management Sdn Bhd

* Islamic Fund

Source: Securities Commission Malaysia

Appendix 2.

Information about the Malaysian REITs under study

Name	Listing date	General information	Average yield*
Al Hadharah Bousted REIT (AHBR)	7 Feb 2007	PALM OIL PLANTATION • Value of properties RM1.3 billion (FY2012) • Consists of 12 oil palm plantations and 3 palm oil mills in Malaysia of 20,000 hectares (ha)	5.263%
AL'Aqar Healthcare REIT (ALQR)	9 Aug 2006	HEALTHCARE *The Al-Aqar REIT set many milestones: the world's first listed Islamic REIT, Asia's first healthcare REIT, the first listed Islamic REIT under the new SC "Guidelines for Islamic REITs," and a benchmark for the development of Islamic REITs in Malaysia, as well as in the region.* • Value of properties RM1.36 billion • Comprises of 23 healthcare centres including those in Indonesia and Australia.	5.778%
Hektar REIT (HKTR)	4 Dec 2006	RETAIL (MALL) • Invests in income-production real estate primarily used for retail purposes. • Currently consists of quality shopping centres situated in Subang Jaya, Melaka, Muar, Sungai Petani and Kulim. • Value of properties RM1.03 billion (FY2012) • Strategy: acquisition of retail properties throughout Malaysia and optimising property yields • Focus: Neighbourhood and regional shopping centres throughout Malaysia with the objective of providing Malaysian consumers with conducive retail environments based on international best practices • Hektar REIT's motto is about "Creating The Places Where People Love to Shop" and the business model employs international standard best practices.	6.797%
Starhill REIT (STHL)	16 Dec 2005	HOSPITALITY (HOTEL, RESORT, APARTMENT) • Market capitalization of approximately RM1.43 billion (as at 31 March 2013) • Comprises of prime hotel and hospitality-related properties: JW Marriott Hotel KL, The Ritz-Carlton, KL, The Residences at The Ritz-Carlton KL, Pangkor Laut, Tanjong Jara, Cameron Highlands resorts, the Vistana chain of hotels in KL, Penang and Kuantan, and Hilton Niseko in Japan.	6.522%

AmFirst (AFRT)	20 Dec 2006	OFFICE, RETAIL AND HOTEL • 8 properties in Klang Valley and Cyberjaya; > 2.5 million sq ft of real estate space. • Average occupancy as at 31 March 2012 has risen to 89% from 83% as at 31 March 2011. • Total trust value at 31 March 2012 is RM1.18 billion • Strategy for improved occupancy: proactive in asset enhancements, effective leasing and marketing	7.33%

Sources:

* as at 26 April 2013 (*mreit.reitdata.com)*

Individual REIT's Annual Reports (FY2012)