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Should the Malaysian Islamic stock market investors invest in regional and international equity market to gain portfolio diversification benefits ?

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Abstract: This paper is aimed at determining the dynamic links of conventional and Islamic, regional and international equity markets with Shariah compliant equity (FTSE Hijrah Shariah Index) investing in Malaysia using MGARCH-DCC and Wavelet Coherence, given different holding periods. The data for this study is taken for the year 2007-2017. Overall, the results show there is a dynamic link between six sample stocks and this indicates that the Malaysian Shariah Compliant investors can invest in international or regional markets with different investment horizons bearing important implications for portfolio diversification strategies. In particular, the results tend to show that the FTSE Bursa Malaysia Hijrah Shariah Index has the low correlation with global stock market indexes, regardless of conventional or Islamic. However, the correlation between Islamic stocks are quite high. These results have implications for the portfolio diversification by the Malaysian Shariah investors.

Keywords: Stock market, Dynamic link, MGARCH, Wavelet Coherence, Malaysia, FTSE Hijrah Shariah Stock Index

1. Introduction

Malaysia is one of the open and fast-growing economies in the region. The development of its stock market is also exceptional. The Malaysian stock market, known today as Bursa Malaysia (it was previously known as the Kuala Lumpur Stock Exchange, or KLSE), has gained the fast momentum of globalization due to Malaysia's small but open economy. The Malaysian stock market is one of the biggest markets in Southeast Asia, with a history stretching back about 50 years. Malaysia also has launched two Shariah Indices, FTSE Bursa Malaysia EMAS Shariah Index and FTSE Bursa Malaysia Hijrah Shariah Index on 2007 and the indices have been designed to be used as a basis of Shariah-compliant investment products that meet the screening requirements of international Islamic investors. Companies in the index are screened by the Malaysian Securities Commission's Shariah Advisory Council (SAC) and the leading global Shariah consultancy, Yasaar Ltd, against a clear set of guiding principles. Since then, the Malaysian stock market has grown tremendously, thanks to many financial policies aimed to attract foreign capital with the favor of Islamic and conventional stocks that promote further growth.

Both FTSE Bursa Malaysia EMAS (conventional) and FTSE Bursa Malaysia Hijrah Shariah Index (Islamic) show an upward trend within the last five years excepting the year 2009 it went down just because of economic recession, otherwise the stock market of Malaysia performed very well in last few years and after the recession this market improved a lot. In year 2005, the stock price was near about 900 and this price jumps to above 1000 in year 2007 and the highest stock price goes till now is in year 2008 which is 1500 or more but after this the market goes down very badly and it comes to near about 850 but after this the stock market goes up and it reached to 1350 in till now.

The dynamic linkages or integration among the stock market provides crucial implications for potential benefits of the international portfolio diversification and financial stability for a country (Ibrahim, 2005). It is important to know how the local investor will benefit from investing in other stock as well. The essence of lower risks from international diversification is crucially dependent upon low correlations across cross-border markets (Grubel and Fadner, 1971). Hence, an increase

in co-movements between asset returns of international stock markets can therefore diminish the advantage of internationally diversified investment portfolios (Ling and Dhesi, 2010). The issue of dynamic linkages among stock markets has been extensively researched in the literature of financial economics.

Existing literatures such as Goldstein and Michael (1993) mentioned that that international links have been increasing over the past decade, especially for stocks that are mainly traded in major financial centers. An increasing integration among the national stock markets further implies that international financial instabilities are easily transmitted to domestic financial markets, which is known as financial contagion (Ibrahim, 2005). This has been proven during the event of financial crisis, such as the 1997 Asian Financial Crisis and Global Financial Crisis in 2008. The 1997 Financial Crisis is believed to be triggered by the distorted policies and market overreaction which led the exchange rates, asset prices and economic activities in Asian countries to plunge (Corsetti et al, 1998). In addition, Global Financial Crisis that occurred in 2008 had indicated that the global financial systems were far more interconnected than was previously recognized (Mishkin, 2011).

A big chunk of the empirical literature concerning stock market dynamics which employs times series techniques can be broadly classified into two groups and mostly the previous studies are only study on the conventional stocks. One group follows the work initiated by Kasa (1992) which uses multivariate cointegration techniques to examine the number of common stochastic trends in a system of national stock market prices. This method provides insights into how integrated markets have become and the popular intuitive notion of whether or not stock markets share long run relationships over time. Relevant studies include Chung and Liu (1994) and Corhay et al. (1995) on Pacific-Rim country stock markets, Blackman et al. (1994) on 17 OECD markets, Jeon and von Furstenberg (1990) and Kwan et al. (1995) on major world equity markets. The second group has attempted to investigate lead–lag relationships among prices of national stock markets (Eun and Shim, 1989; Arshanapalli and Doukas, 1993; Smithi et al., 1993; Brocato, 1994; Cheung and Mak, 1992; Malliaris and Urrutia, 1992).

However, despite the contributions they have made in demonstrating the interdependencies and lead–lag relationships among the stock markets,they suffer from the following limitations. They employed simple bivariate lead–lag relationships between two markets, or standard Granger F-tests in a VAR framework which are useful only in capturing short run temporal causality. Even

those studies that employed a multivariate framework (for example, Mathur and Subrahmanyam, 1990, on linkages between Nordic and US stock markets) have done so using ordinary first-difference VARs, which not taking into account any presence of long run relationships inherent in the multivariate system.

Basically, the purpose of this paper is to determine the dynamic link of conventional and Islamic, regional and international equity markets on Shariah compliant equity investing in Malaysia using MGARCH-DCC and Wavelet Coherence. MGARCH-DCC will show us the conditional correlations and volatilities among the return of stock indices and Wavelet Coherence will show the correlation and the lead-lag relation between Shariah compliant equity investing in Malaysia with other Islamic stock indices. We focus on FTSE Bursa Malaysia Hijrah Shariah Index as a benchmark of Malaysia's Islamic equity investments which is the second Shariah indices that launched by Bursa Malaysia. This paper also investigates whether the Malaysian Islamic stock market investors should invest in other regional or international market to gain international portfolio diversification benefits given different investor stock holding periods (e.g. 2-4 days, 4-8 days, 8-16 days, etc.).

In particular, we have three research questions:

> RQ1: How vast the dynamic link between conventional and Islamic stock to the Malaysian Islamic stock market?
>
> RQ2: Should the Malaysian Islamic stock market investors invest in (regional and international) conventional or Islamic equity market to gain international portfolio diversification benefits?
>
> RQ3: How would the portfolio diversification benefits to the Islamic investor change given different investor stock holding periods (e.g. 2-4 days, 4-8 days, 8-16 days, etc.)?

The unique contributions of the paper which enhance existing literature is in empirically testing for the 'time-varying' and 'scale dependent' volatilities and correlations of the sample markets. Particularly, by incorporating scale dependence, the paper is able to identify unique portfolio diversification opportunities for different set of investors bearing different investment horizons or holding periods of stocks (for e.g. weekly, monthly, quarterly, etc.). The ability to do this is

achieved by applying 'three' modern empirical research techniques: Multivariate Generalized Autoregressive Conditional Heteroscedastic – Dynamic Conditional Correlations (M-GARCH-DCC) model of Engle (2002), and Continuous Wavelet Transform (CWT) analysis of volatility and correlations.

The results show FTSE Bursa Malaysia Hijrah Shariah Index have the low correlation with global stock market index, regardless conventional or Islamic. However, the correlation between Islamic stocks are quite high. Malaysian Islamic stock market investors who have allocated their investment globally markets may enjoy portfolio diversification benefits. However, Malaysian Islamic stock market investors may not enjoy the really benefit if they allocate their fund in Dow Jones Islamic Asia Pacific Market but interestingly it for the medium-term investor, they may benefitted from the investment. Besides that, Malaysian Islamic stock market investors may lose if they invest in conventional Malaysia Stocks Market (EMAS) as they may consist the same stocks. Overall, the results indicate invest in international or regional market with different investment horizons bear important implications for portfolio diversification strategies.

The findings of this paper would help fund manager or investor to play their role in diversify their portfolio in Malaysia. It also would help the potential investor to make decision making through the economic outlook and anticipating changes in investment returns. The findings of this research would be of particular interest to an investor limited to Shariah compliant equity investment in the Malaysian market. It would help the investor to determine which is the appropriate reference point in terms of conventional versus Islamic, local versus regional/international.

The rest of this paper is organized as follows. The issues that encourage this study and objectives of the study will be shown in Section 1. Section 2 provides a briefly review theoretical perspectives while Section 3 shows past studies on the dynamic links among the stock markets in the economics literature. Section 4 discusses the data and methodology used. The empirical results from the analysis are presented in Section 5 and a conclusion of the major findings and policy implications are presented in Section 6.

1. THEORETICAL PERSPECTIVE AND REVIEW OF LITERATURE

There have been numerous studies that have focused on the issue of market integration and interdependencies. Click and Plummer (2005) shows interest in stock market integration arises primarily because financial theory suggests that an integrated regional stock market is more efficient than segmented national capital markets. It is believed that investors from all members of the countries would be able to allocate capital to the locations in the region where it is the most productive in an integrated regional stock market. The degree of linkages or integration among the stock market provides important implications for potential benefits of the international portfolio diversification and financial stability for a country (Ibrahim, 2005). Stock market integrations is also believed to create long run equilibrium relationship, which ties price movements in national stock indices and could considerably reduce benefits from international portfolio diversification.

One important implication of integrated markets is that assets associated with similar levels of risk in different countries should also lead to a similar level of return. This issue has been empirically addressed in several studies (Errunza and Losq, 1985; Hietala, 1989) as well as placed under critical scrutiny due to inconsistent results. For example, Wheatly (1988) who argues that even without market integration, assets that are diversified internationally could be "mean-variance efficient". The integration and interdependence of stock markets underlies a major cornerstone of modern portfolio theory that addresses the issue of diversifying assets. In essence, this theme advocates investors diversify their assets across national borders, provided returns to stock in these other markets are less than perfectly correlated with the domestic market.

Solnik (1991) stated that the advantages of asset diversification have already been widely discussed in the literature in which much effort was devoted to quantify risk-reduction and its associated benefits available to the internationally diversified portfolio. Closely tied with this issue is the observation that stock prices tend to move closely together and trend upward over time. Taleb (2007) argued that the behavior of investor is related to some extent of their psychology factors, thus, the Black Swan theory is found to be relevant in this case. The Black Swan theory argues that human beings are tend to dwell and reflect towards the past event so that they can predict the future, which will limit one's understanding of the world. This, would increases the vulnerability which later on result in extreme and unexpected events.

2. LITERATURE REVIEW

2.1 International Portfolio Diversifications

Numerous studies had empirically evaluated the connection between the stock market linkages with the globalization to test the validity of the international portfolio diversification. Jorion (1985) and Grubel (1968) suggest the possibility of portfolio diversification, whereby they argue that international portfolio diversification will reduce the risk for the investors, as they tend to have lower correlation in the stock market returns. Levy and Sarnat (1970) found there was a significant diversification benefits for US investors by investigating twenty-eight markets, which include both developed and emerging market. In line with the past studies, Eun and Resnick (1994) examined international diversification from the point of view of Japanese investors and US during the period 1979 to 1989. They found diversification benefits for both investors, although US investors enjoy greater benefits. However, it should be noted that other research suggests that the portfolio diversification is not necessary to bring benefits for investors. For instance, King and Wadhwani (1990) argue a significant increase in the correlation markets following a period of turbulence and labeled this as "contagion".

Karim et al (2009) and Ibrahim (2005) investigate on the international linkages of Indonesia's stock market. By implementing Auto Regressive Distributive Lead Lag (ARDL) in his studies, Karim et al (2009) found that Indonesians stock market is cointegrated with its major trading partners, which in this case are United States, Japan, Singapore and China from July 1998 to December 2007. This implies that the opportunities for international investors to gain benefit from international portfolio diversification in those markets are limited. However, Ibrahim (2005) stated that it does not reflect the recent research techniques and does not shed light on the Shariah stock market indices which can potentially raise interest to invest in Shariah compliant stock.

Dacjmant et al (2012) have studied on the co-movement dynamics between the developed European markets and they suggest that the co-movements of the stocks are not constant, and returns are time-varying. Thus, it suggested for researchers too use time varying conditional correlation models when modeling volatilities and correlations. Besides that, Further studies suggest that there is high possibility that investment holding periods also have impacts to the volatilities and the correlations dynamics of stock market returns for example Gencay et al (2001)

and In and Kim (2013). Gencay et al (2001) was one of the earliest studies that used time scaled dependence of returns in financial markets. In addition, In and Kim (2013) published a book that focused on wavelet theory, which were written based on their papers that used wavelet time scaling in finance.

2.2 Dynamic link between Islamic and Conventional Stocks

The performance of one stock market is well influenced by the other stock markets as they are connected theoretically (Kamil, 2010), and it is proven by Masih and Masih (2001). In study conducted by Kamil (2010) about influence of conventional and Islamic regional and international equity markets on Shariah compliant equity investments in Malaysia, he employed time series technique to elucidate the nature of relations between equity markets. He found out that there is correlation between Islamic and Conventional Stocks in Malaysia, as one of the variables, FTSE Bursa Malaysia Shariah index (FBMSHA) performance variation was explained by two Conventional Stocks, which are EMAS index and KLCI (Kuala Lumpur Composite Index). Besides that, Islamic indices showed more influence on the returns of Shariah compliant equity in Malaysia than the conventional indices. Girard and Hassan (2008) find similar reward-to-risk ratios and diversification benefits for both the FTSE Islamic indices and their conventional counterparts from 1999 to 2006 after controlling for market risk, size, book-to-market, momentum, local and various global factors.

Ajmi et al., (2014) also found out there are significant linear and nonlinear causality between the Islamic and conventional stock markets, but the evidence more strongly from the Islamic stock market to the global conventional equity markets. They performed causality tests by using heteroscedasticity-consistent covariance matrix estimator (MacKinnon & White, 1985), fixed design wild bootstrap (Hafner & Herwartz, 2009), and nonparametric nonlinear Granger causality test (Hiemstra & Jones, 1994). The results showed that there are rich interactions between variables and prove that the Islamic equity market is not partitioned from external shocks of different types, regions, and sources. This showed that Sharia-stock-based may make some difference in the causal relationships and links for the DJIM index, which may encourage the Islamic market to outperform the conventional counterparts during bull markets but underperform in bear markets because of lack of hedging.

2.3 Dynamic link between Different Regional Islamic Stock Market

There are also study on the dynamic link between different regional Islamic stock market. Saiti (2013) found that correlations among the five Islamic indices five Shariah-compliant stock indices (such as, FTSE Shariah China Index, FTSE Shariah India Index, FTSE Sharia USA index, FTSE Malaysia, EMAS Shariah Index and Dow Jones Shariah Index) covering the period from 26 October 2007 to 9 March 2011. are not constant but are dynamic and time-varying. Hence the investors should monitor these correlations and manage their investment portfolios accordingly. He stated that different financial markets offer different opportunities for portfolio diversification. The results also show the timing of investment is also important. There are times when the Chinese and the US indices are negatively correlated and hence the investors may also gain by timing their portfolio diversification properly.

3. DATA AND METHODOLOGY

3.1 Data

In this study, we are using secondary data. Daily stock price indices data from 1st March 2007 – 12th May 2017 has been collected from the Datastream of Thompson Reuters for our study. The variable that is used to represent local, regional and international equity markets addressed in this study is the prevailing or commonly cited by financial reporting indices, namely the FTSE Bursa Malaysia EMAS (EMAS), the Dow Jones Islamic Market index (DJIM), the Dow Jones Islamic Asia Pacific index (DJIAP), the Dow Jones Industrial Average index (DJIA), the Hang Seng (Hong Kong) and the Financial Times Stock Exchange index (FTSE 100). The FTSE Bursa Malaysia Hijrah Shariah Index (FTHISHA) is used as the proxy variable to represent the Shariah compliant Malaysian equity market. The indices are denominated in US Dollar currency units. Prior to the analysis, the stock indices returns were calculated as differences of the logarithmic daily closing prices of indices $\{ln(p_t) - ln(p_{t-1})\}$ where p is an index value.

Symbol	Definition
FTHISHA	FTSE Bursa Malaysia Hijrah Shariah
DJIM	Dow Jones Islamic Markets
DJIAP	Dow Jones Islamic Asia-Pacific
EMAS	FTSE Bursa Malaysia EMAS
HSENG	Hang Seng (Hong Kong)
FTSE 100	Financial Times Stock Exchange 100

Table 1: Selected Indexes for Research

The table below illustrates the indices and which dimension of equity investment is represents.

INDEX	Conventional	Islamic	Local	Regional	International
FTHISHA		X	X		
DJIM		X			X
DJIAP		X		X	
EMAS	X		X		
HSENG	X			X	
FTSE 100	X				X

Table 2: Dimension of equity investment

3.2 Multivariate GARCH model and Dynamic Conditional Correlations (DCC)

The aims of the study are to study the dynamic link between conventional and Islamic stock to the Malaysian Islamic stock market and to investigate whether the Malaysian Islamic stock market investors should invest in other (regional or international) conventional or Islamic equity market to gain portfolio diversification benefits. In a multivariate GARCH (p,q) model, conditional variance and covariance of each asset depend upon not only on its own past conditional variance and past squared innovations but also on the past squared innovations and past conditional variances of the other assets (Bollerslev et al. 1994). The multivariate GARCH model is used in this paper to estimate the Dynamic Conditional Correlations (DCC) for a portfolio composed of returns on six return of stock indices as mentioned above. The estimation of the Dynamic Conditional Correlations (DCC) has a lot of potentials.

An understanding of how volatilities of and correlations between asset returns change over time including their directions (positive or negative) and size (stronger or weaker) is of crucial importance for both the domestic and international investors with a view to diversifying their portfolios for hedging against unforeseen risk. The dynamic conditional correlations (DCC) enable a determination of whether the shocks to the volatilities in asset returns are substitutes or complements in terms of taking risks. This model allows us to pinpoint changes (both when they occur and how) in the interdependence between financial variables.

One of the earliest volatility models, autoregressive conditional heteroscedastic (ARCH), was proposed by Engle (1982) which captured the time-varying conditional variances of time series based on past information. This model was then enhanced by Bollerslev (1986) who proposed a generalized ARCH (GARCH) which took into account both past error terms and conditional variances into its variance equation simultaneously to avoid the problem that the number of parameters to be estimated becomes too large as the number of lagging periods to be considered increases in the ARCH model. Bollerslev (1990) further extended the GARCH model in a multivariate sense to propose a Multivariate GARCH – Constant Conditional Correlation (M-GARCH-CCC) model where the conditional correlations amongst different variables were assumed to be constant. The MGARCH-CCC model only allows the variances of each variable to be time varying while keeping the correlation coefficient among them constant. However, while

the CCC assumption makes estimation simple, it may be inconsistent with reality (Longin and Solnik, 1995, 2001). Therefore, Engle (2002) finally proposed an M-GARCH-DCC model where the conditional correlations amongst variables were allowed to be dynamic and this paper makes use of this model in answering parts of the research questions. It can be stated as follows:

$$\mathbf{r}_t = \boldsymbol{\beta}_0 + \sum_{i=1}^{k} \boldsymbol{\beta}_i \mathbf{r}_{t-i} + \mathbf{u}_t = \boldsymbol{\mu}_t + \mathbf{u}_t$$
$$\boldsymbol{\mu}_t = E[\mathbf{r}_t | \Omega_{t-1}]$$
$$\mathbf{u}_t | \Omega_{t-1} \sim N(0, \mathbf{H}_t)$$
$$\mathbf{H}_t = \mathbf{G}_t \mathbf{R}_t \mathbf{G}_t$$
$$\mathbf{G}_t = \operatorname{diag}\left\{\sqrt{h_{ii,t}}\right\}$$
$$\mathbf{z}_t = \mathbf{G}_t^{-1} \mathbf{u}_t$$

Source: Ku (2008)

Where $h_{ii,t}$ is the estimated conditional variance from the individual univariate GARCH models, $\mathbf{G_t}$ is the diagonal matrix of conditional standard deviations, $\mathbf{R_t}$ is the time-varying conditional correlation coefficient matrix of returns, and $\mathbf{z_t}$ is the standardized residuals vector with mean zero and variance one. After the above basic construction, the dynamic correlation coefficient matrix of the DCC model can be specified further:

$$\mathbf{R}_t = (\operatorname{diag}(\mathbf{Q}_t))^{-1/2} \mathbf{Q}_t (\operatorname{diag}(\mathbf{Q}_t))^{-1/2}$$
$$\mathbf{Q}_t = (q_{ij,t})$$
$$(\operatorname{diag}(\mathbf{Q}_t))^{-1/2} = \operatorname{diag}\left(\frac{1}{\sqrt{q_{11,t}}}, \ldots, \frac{1}{\sqrt{q_{nn,t}}}\right)$$
$$q_{ij,t} = \overline{\rho}_{ij} + \alpha\left(z_{i,t-1} z_{j,t-1} - \overline{\rho}_{ij}\right) + \beta\left(q_{ij,t-1} - \overline{\rho}_{ij}\right)$$

Source: Ku (2008)

Where $\overline{\rho}_{ij}$ is the unconditional correlation coefficient and the new time-varying conditional correlation coefficient is $\rho_{i,j,t} = q_{i,j,t} / \sqrt{q_{ii,t}\, q_{jj,t}}$. Meanwhile, the returns on financial assets have often been documented to be fat tailed or leptokurtic where a normal distribution assumption is not appropriate. One possible remedy for such is to use a Student-*t* distribution setting. That is,

the conditional distribution $\mathbf{u}_t|\Omega_{t-1} \sim N(0, \mathbf{H}_t)$ is replaced by $\mathbf{u}_t|\Omega_{t-1} \sim f_{\text{Student}-t}(\mathbf{u}_t; v)$, where v is the degree of freedom parameter.

3.3 Continuous Wavelet Transformation (CWT)

Numerous authors have recently begun to use the continuous wavelet transform (CWT) in economics and finance research (for e.g. see Vacha and Barunik (2012), Madaleno and Pinho (2012), Saiti (2012), among others). The CWT maps the original time series, which is a function of just one variable time-separate into function of two different variables such as time and frequency. The CWT maps the series correlations in a two-dimensional figure that allows the researcher to easily identify and interpret patterns or hidden information. The analysis of correlation between two CWT is generally known as the wavelet coherence. These figures would indicate the extent of correlation between two variables with both time and time scale/frequency changing.

We use the Daubechies (1992) least asymmetric wavelet filter of length L=8 denoted by LA (8) based on eight non-zero coefficients. In choosing the wavelet filter, we have applied the principal of maintaining a 'balance' between the sample size and the length of the wavelet filter (In and Kim, 2013). Previous studies on high-frequency data have shown that a moderate-length filter such as L = 8 is adequate to deal with the characteristic features of time-series data (see Gencay et al., 2001, 2002, In and Kim 2013). In the literature, it is argued that an LA (8) filter generates more smooth wavelet coefficients than other filters such as, Haar wavelet filter. The continuous wavelet transform (CWT) $W_X(u,s)$ is obtained by projecting a mother wavelet ψ onto the examined time series $x(t) \in L^2(\mathbb{R})$, that is:

$$W_X(u,s) = \int_{-\infty}^{\infty} x(t) \frac{1}{\sqrt{s}} \psi\left(\frac{t-u}{s}\right) dt$$

The position of the wavelet in the time domain is given by u, while its position in the frequency domain is given by s. Therefore, the wavelet transform, by mapping the original series into a function of u and s, gives us information simultaneously on time and frequency. To be able to study the interaction between two time series, how closely X and Y are related by a linear

transformation, we need to apply a bivariate framework which is called wavelet coherence. The wavelet coherence of two time series is defined as:

$$R_n^2(s) = \frac{\left|S(s^{-1}W_n^{xy}(s))\right|^2}{S(s^{-1}|W_n^x(s)|^2 . S(s^{-1}\left|W_n^y(s)\right|^2}$$

Where *S* is a smoothing operator, *s* is a wavelet scale, $W_n^x(s)$ is the continuous wavelet transform of the time series X, $W_n^y(s)$ is the continuous wavelet transform of the time series Y, $W_n^{xy}(s)$ is a cross wavelet transform of the two time series X and Y (Madaleno and Pinho, 2012). For brevity, the paper omits the mathematical details of the method {interested readers may refer to Madaleno and Pinho (2012), Gencay et al (2001; 2002) and In and Kim (2013)}.

4. EMPIRICAL RESULTS

In this section, we report the descriptive statistics for the six daily returns of the stock price indices and analyse the results of MGARCH-DCC and Continuous Wavelet Transform to determine the dynamic link of conventional and Islamic, regional and international equity markets on Shariah compliant equity investing in Malaysia and whether the Malaysian Islamic stock market investors should invest in (regional and international) conventional or Islamic equity market to gain international portfolio diversification benefits given different investor stock holding.

4.1 Descriptive Statistics

The descriptive statistics of the six daily returns of the stock price indices are reported below.

	FTHISHA	DJIM	DJIAP	EMAS	HSENG	FTSE_100
Mean	0.00006	0.00007	0.00004	0.00004	0.00006	0.00005
Median	0.00000	0.00026	0.00027	0.00000	0.00016	0.00000
Maximum	0.02334	0.04245	0.04209	0.02363	0.04490	0.05263
Minimum	-0.05252	-0.03555	-0.04207	-0.04758	-0.03407	-0.04569
Std. Dev.	0.00452	0.00466	0.00513	0.00445	0.00475	0.00718
Skewness	-0.55879	-0.46621	-0.52310	-0.50935	-0.33743	-0.04692
Kurtosis	12.76566	12.91093	10.97772	11.06206	12.65932	8.81055
Jarque-Bera	10716.44846	10991.38230	7180.57541	7324.34448	10399.30273	3745.80531
Probability	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Table 3: Descriptive Statistics

Table 3 shows all the six daily returns of the stock price indices means is not differ much from each other. The Dow Jones Islamic Market index seems to be the highest average (0.007%) and followed by FTSE Bursa Malaysia Hijrah Shariah Index (FTHISHA) and Hang Seng Index (HSENG) which at 0.004%. FTSE Bursa Malaysia EMAS (EMAS) and Dow Jones Islamic Asia Pasific (DJIAP) show the lowest mean among those six equity market indices. In term of overall volatility, the most volatile Stock Market Index is Financial Times Stock Exchange index 100 (FTSE 100). The standard deviation (0.007) is much higher than the other stock indices. The fatness of the distribution can be measured by the kurtosis which describe how concentrated the fatness around the mean of the distribution. Kurtosis values for all stock indices are more than 3, which indicates are not normally distributed, and all variables have high variability risk.

For the Jarque-Bera test results, all returns are significant, which means that the non-normality, variability and risk of the returns of the stock market indices are further strengthen.

4.2 Estimation using M-GARCH DCC

We ran an MGARCH-DCC analysis on the six stock indices daily returns. Under this section, we did the comparison of Gaussian DCC Model and the t-DCC model is done together with plotting the estimated conditional correlations. The comparison between the Gaussian DCC Model and the t-DCC model serves as a preliminary step to determine which model is relatively more significant. Since we are interested in volatility modelling and the correlation between the selected indices, therefore we estimate the DCC models on the six stock indices daily returns and the Maximum Likelihood estimates of the Gaussian DCC and t-DCC models on stock indices daily return.

Parameter	Estimate	Standard Error	T-ratio
Lambda1_FTHISHA	0.1837604***	0.0228399	8.05
Lambda1_DJIM	0.1794194***	0.0199516	8.99
Lambda1_DJIAP	0.1781423***	0.020991	8.49
Lambda1_EMAS	0.1843074***	0.0863169	8.76
Lambda1_HSENG	0.1402502***	0.0238525	5.88
Lambda1_FTSE100	0.1658451***	0.0209831	7.90
Lambda2_FTHISHA	0.5232074***	0.0825711	6.34
Lambda2_DJIM	0.8189416***	0.0776141	10.55
Lambda2_DJIAP	1.032004***	0.0926473	11.14
Lambda2_EMAS	0.5237538***	0.0863169	6.07
Lambda2_HSENG	0.9480627***	0.101827	9.31
Lambda2_FTSE100	0.8623577***	0.0889613	9.69
Delta 1, δ_1	0.0056352***	0.0003429	16.44
Delta 2, δ_2	0.9903415***	0.14740	2924.16
Maximum log likelihood	72885.31		

Table 4:Maximum Likelihood estimates of the Gaussian DCC model on the stock

	FTHISHA	DJIM	DJIAP	EMAS	HSENG	FTSE100
FTHISHA	0.2495	0.3509	0.6037	0.955	0.4792	0.308
DJIM	0.3509	0.4167	0.5109	0.3735	0.404	0.9779
DJIAP	0.6037	0.5109	0.3745	0.6328	0.7002	0.4469
EMAS	0.955	0.3735	0.6328	0.2897	0.5143	0.3286
HSENG	0.4792	0.404	0.7002	0.5143	0.1953	0.3488
FTSE100	0.308	0.9779	0.4469	0.3286	0.3488	0.4427

Table 5:Unconditional Correlation and Volatilities

Table 4 shows the result of the Gaussian DCC model, whereby it shows that the maximum likelihood estimates for the returns on the six stock indices returns, Lambda1 and Lambda2 and δ_1, δ_2. The table shows that all volatilities decay parameters are significant, which imply that gradual volatility decay for all indices.

The volatility parameters observed for FTHISHA, DJIM, EMAS is highly significant together with the estimates are very close to unity implying volatility of the stock market return is not following I-GARCH which the shock to volatility is not permanent, while the other three indices DJIAP, HSENG, FTSE100 estimates are more than 1 which means they are following I-GARCH which the shock to volatility is permanent. The estimated unconditional volatilities and correlations are reported within the lower panel of the results in table 5.

Following the estimations, we obtained the maximized log likelihood of the t-DCC model as a preliminary step to determine which model is more significant for this study, which are shown in table 6.

Parameter	Estimate	Standard Error	T-ratio
Lambda1_FTHISHA	0.1208767***	0.0198578	6.09
Lambda1_DJIM	0.0864448***	.0137263	6.30
Lambda1_DJIAP	0.0911177***	.0177345	5.14
Lambda1_EMAS	0.1190492***	.0181866	6.55
Lambda1_HSENG	0. 0730691***	.0164008	4.46
Lambda1_FTSE100	0.0760005***	.0147436	5.15
Lambda2_FTHISHA	0.7963682***	.0988724	8.05

Parameter	Estimate	Standard Error	T-ratio
Lambda2_DJIM	1.15477***	0.1116899	10.34
Lambda2_DJIAP	1.247492***	.1467215	8.50
Lambda2_EMAS	0.8472058***	0. 1044666	8.11
Lambda2_HSENG	1.185715***	0.1305195	9.08
Lambda2_FTSE100	1.213099***	0.1406156	8.63
Delta 1, δ_1	0.005077***	0.0005334	9.52
Delta 2, δ_2	0.9916194***	0.0006754	1468.13
Maximum log likelihood	73868.35		
Degree of freedom	4.817938		

Table 6:Maximum Likelihood estimates of the t-DCC model on the stock

The maximized log likelihood value of 73868.35 in t-DCC model is higher than the maximized log likelihood value of 72885.31 in Gaussian model. In addition, the estimated of degree of freedom for the t-normal distribution are below 30 (4.8179), which suggest that the t-distribution is more appropriate for capturing the fat-tailed nature of the distribution of stocks returns. By also looking at the summation of lambda 1 and lambda two, some of them have the summation which are less than one; this indicates that these indices does not follow I-GARCH; which means shocks to volatility is not permanent. As for implications form the shocks to volatilities that are permanent, it indicates that there is high possibility that investors and portfolio managers to make loses if they are investing in short run. On the contrary, speculators will make benefits as they tend to invest in short duration than long duration.

	FTHISHA	DJIM	DJIAP	EMAS	HSENG	FTSE100
FTHISHA	0.2782	0.3509	0.6037	0.9550	0.4792	0.3080
DJIM	0.3509	0.3367	0.5109	0.3735	0.404	0.9779
DJIAP	0.6037	0.5109	0.3126	0.6328	0.7002	0.4469
EMAS	0.955	0.3735	0.6328	0.3490	0.5143	0.3286
HSENG	0.4792	0.404	0.7002	0.5143	0.2755	0.3488
FTSE100	0.308	0.9779	0.4469	0.3286	0.3488	0.3170

Table 7:Unconditional Correlation and Volatilities

The on diagonals in table 7 explains the unconditional correlation and volatilities of the indices. If the unconditional volatility is near to zero, thus, it can be concluded that the particular index has the least volatility, whereby if the volatility is near to one would mean that the index has high volatility levels. Based on the result in table 7, we found out that all indices have very low unconditional volatilities ranging. The highest unconditional volatility is EMAS compared to other five indices.

Figure 1: Conditional Correlation of Malaysia's Shariah Compliance stock return to the other stocks return.

Figures 1 confirm the time-varying properties of correlations. **Figure 1** indicates that consistently, the Malaysian returns are less correlated with global conventional stocks (FTSE 100) markets returns as compared to conventional regional (Hong Kong) stock markets returns (HSENG) and hence it suggests Malaysian investors are better off by investing in FTSE 100 to gain portfolio diversification benefits. We suspected that the EMAS which is Malaysia mainstream index returns may be highly correlated with FTSE Hijrah Shariah which is also Malaysia stocks since there are mostly likely have the same stocks in the index.

In terms of the low correlations with Dow Jones Islamic Markets index (DJIM) on average shows Malaysian's Islamic investor may consider investing in Dow Jones Islamic Markets to gain portfolio diversification benefits. Hence, we can conclude that the Malaysian returns are less correlated with globally Islamic index return as compared to other markets returns and hence Malaysian investors are possibly better off to gain portfolio diversification benefits.

4.3 Estimation using Continuous Wavelet Transform Analysis

Earlier using M-GARCH-DCC analysis, we observed how Malaysian investors can gain portfolio diversification benefits by investing in (regional and international) conventional or Islamic equity markets. However, the previous analysis ignored investor stock holding periods and the results were based on daily volatilities in indices. In this section, we use modern wavelet transformations to analyze the impact on portfolio diversification benefits given different investment horizons and focus on the benefit to the Islamic Malaysian investor that only want to invest in Shariah Compliance Stocks.

Figures 2 and **Figures 3** present the estimated wavelet coherence and phase difference of Malaysian Islamic returns with Dow Jones Islamic Asia-Pacific as a representative of regional Islamic Stocks return from scale 1 (one day) up to scale of 8 (approximately one market years, 256 days) using continuous wavelet transformations (CWT). In these figures, time is shown on the horizontal axis in terms of number of trading days during the sample years 2007-2017, while the vertical axis refers to the investment horizon in terms of investors' stock holding periods (e.g. 2-4 days, 4-8 days, 8-16 days, etc.). The curved line below shows the 5% significance level which is estimated using Monte Carlo simulations and the region beyond this boundary is not statistically significant for interpretations at the 95% confidence level. The figure follows a colour code as illustrated on the right with power ranges from blue (low correlations which indicate weak relationship between the two time series) to red (high correlations which indicate strong relationship between the two time series).

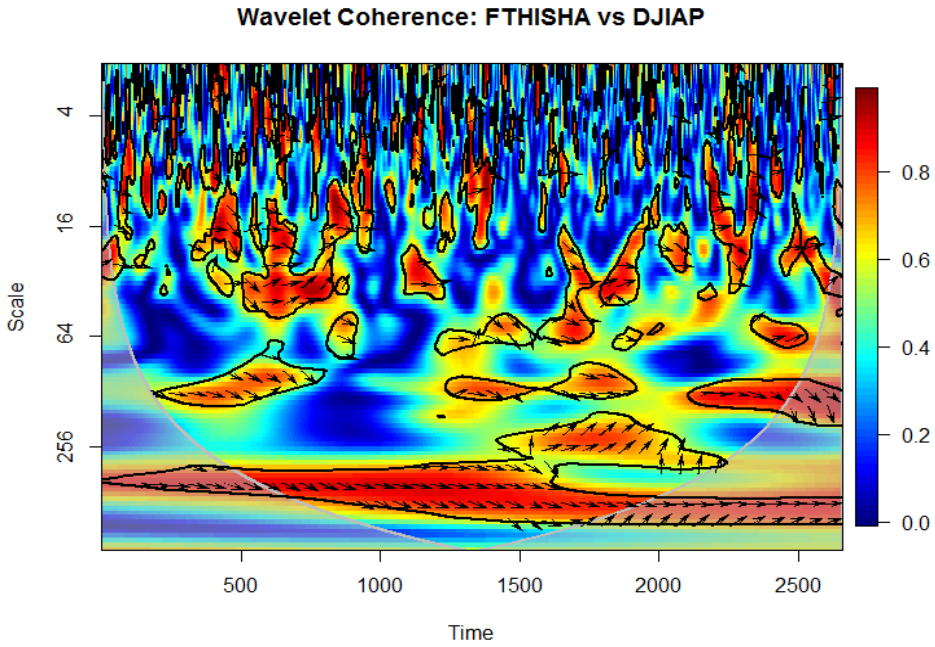

Figure 2:Wavelet Coherence: FTHISHA vs DJIAP

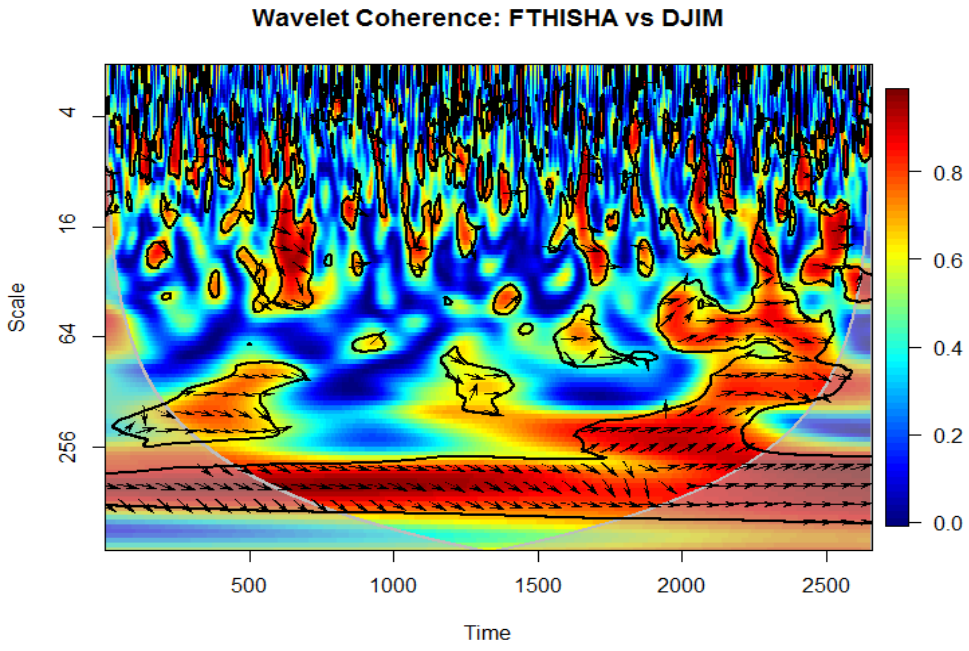

Figure 3:Wavelet Coherence: FTHISHA vs DJIM

A first bird-eye view instantly confirms the higher correlations of the Dow Jones Islamic Market (DJIM) returns to the Malaysian returns as evident by the greater number of red spots on the coherence diagram compared to Dow Jones Islamic Asia-Pacific (DJIAP). More specifically, we find that for very short holding periods consisting of 2-4 days and 4-8 days, Dow Jones Islamic Asia-Pacific returns are consistently weakly correlated to Malaysian returns over the past 7 years thus offering effective portfolio diversification opportunities. The same is not true for emerging markets where particularly during Global Financial Crisis 2008/2009, the correlations become very high thus effectively eliminating any diversification opportunities. For the short investment horizon consisting of 8-16, 16-32 and 32-64 days holding periods, the result was vice versa, we find Dow Jones Islamic Market (DJIM) returns correlations to be lower correlated as compared to Dow Jones Islamic Asia-Pacific (DJIAP) which exhibit very strong levels of interdependence in returns except during Financial crisis 2014. However, we may say investors have international portfolio diversification opportunities in Dow Jones Islamic Market. However, moving towards medium investment horizons consisting of 64-128 and 128-256 days, interestingly we observe that there are very strong correlations in returns for both global and Asia Pacific markets that eliminate potential international portfolio diversification opportunities. The arrow shows FTSE Hijrah is leading stocks that will affected both Dow Jones Islamic and Asia Pacific Market. We can clearly see the contributions of the wavelet transformations in helping us understand international portfolio diversification opportunities for investors with different investment horizons.

5. CONCLUSIONS AND POLICY IMPLICATIONS

The paper examines the dynamic link between conventional and Islamic stock with the Malaysian Islamic stock market and determine whether the Malaysian Islamic stock market investors should invest in (regional and international) conventional or Islamic equity market to gain international portfolio diversification benefits or not. The paper has the research question as to how would the portfolio diversification benefits to the Islamic investor change given different investor stock holding periods (e.g. 2-4 days, 4-8 days, 8-16 days, etc.)

The stock markets that we focus on in this study is FTSE Bursa Malaysia EMAS (EMAS), the Dow Jones Islamic Market index (DJIM), the Dow Jones Islamic Asia Pacific index (DJIAP), the Dow Jones Industrial Average index (DJIA), the Hang Seng (Hong Kong) and the Financial Times Stock Exchange index (FTSE 100). The FTSE Bursa Malaysia Hijrah Shariah Index (FTHISHA) is used as the proxy variable to represent the Shariah compliant Malaysian equity market. The study uses the MGARCH-DCC and Wavelet Coherence (Continuous Wavelet Transform) approach to investigate dynamic relationship among the variables. The results show FTSE Bursa Malaysia Hijrah Shariah Index has the low correlation with global stock market index, regardless conventional or Islamic. However, the correlation between Islamic stocks are quite high.

This result has an important implication for the potential investor. Since there FTSE Bursa Malaysia Hijrah Shariah Index has the low correlation with global stock market index, regardless conventional or Islamic, Malaysian Islamic stock market investors who have allocated their investment globally markets may enjoy portfolio diversification benefits. However, Malaysian Islamic stock market investors may not enjoy the really benefit if they allocate their fund in Dow Jones Islamic Asia Pacific Market, and may lose if they invest in conventional Malaysia Stocks Market (EMAS) as they may consist of the same stocks. In general, the results of this study supports the previous empirical literature whereby stock market tends to have strong cointegration during crisis period, which will decrease the portfolio diversification benefit (Karim and Majid, 2010). It is suggested for policy makers to keep alert on any event of shocks, natural disasters and also political conflicts as those issues may affect the dynamic link between stock markets.

This study has a few limitations to be highlighted. One of the critical limitations of this study is that it has lack of sufficient time to examine the dynamic link with other major regional stock market. Besides that, the data period of this study is only from 2007 to 2017 as Malaysia only started the Islamic Stock Indices from 2007. By taking a longer period of data and taking consideration of other updated econometric methods might help future researchers obtain the results that are more comprehensive.

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