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Cross-country evidence of Islamic portfolio diversification: are there opportunities in Saudi Arabia?

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Cross-country evidence of Islamic portfolio diversification: are there opportunities in Saudi Arabia?

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Abstract

Purpose – On the backdrop of growing importance of *Shariah* compliant equity markets, the purpose of this paper is to study cross-country portfolio diversification benefits for investors with major trading partners of Saudi Arabia, namely, USA, China, Japan, Germany and India, who have already invested or tend to invest in Saudi Arabian stock market.

Design/methodology/approach – The authors have investigated time invariant, dynamic correlations at different investments horizons of the investors among Islamic asset classes by applying relevant econometric techniques like multivariate generalized autoregressive conditional heteroscedastic –DCC and continuous wavelet transforms. For robustness, this study also applied maximal overlap discrete wavelet transform.

Findings – The findings tend to indicate that the Saudi Arabian investors have portfolio diversification benefits with all major trading partners in the short-term investment horizon. Interestingly, Saudi Arabian market has the least portfolio diversification benefits with the Chinese market. However, in the long run, all markets are correlated, yielding minimum portfolio diversification benefits and most importantly Saudi Arabian investors have portfolio diversification benefits with the Indian Islamic equity market in almost all investment horizons. The findings are highly consistent across different econometric technique estimations.

Research limitations/implications – The authors are only considering five major trading partners of Saudi Arabia. Also, the authors are using S&P and FTSE shari'ah index. Moreover, the time period of the study is constrained by the availability of shari'ah indices. Econometric limitations are also well documented in the literature.

Practical implications – The results could be beneficial for the investors, portfolio managers, hedge fund managers and institutional investors and also could be useful for the policy makers in their policy-making decisions.

Originality/value – Only very few studies have looked into the benefits of international portfolio diversification from the perspective of local investors as well as the portfolio diversification benefits with the major trading partners of Saudi Arabia. One of the novelties of the method is to make the stock investors, practitioners and policy makers aware of the portfolio diversification benefits available at different time scales such as 4, 8, 16, 32, 64 and 256 trading days as investment holding periods to unveil the true dynamics of co-movement between those different assets.

Keywords Saudi Arabia, Emerging markets, MGARCH–DCC, Wavelet, International portfolio diversification

Paper type Research paper

1. Introduction

The global equity market has been highly volatile since the global financial crisis of 2008/2009. The situation has even further exacerbated in the recent past due to high volatility in oil price, slowdown of China's economic growth, extraordinary monetary policy,

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Euro debt crisis, intense political instability in the Middle East, Brexit[1], and most recently intense trade war between the USA and its major trading partners. In the meantime, Islamic banking and finance have shown tremendous potential and become a viable alternative to conventional finance. Islamic finance assets have enjoyed exceptional growth during the last decade, from about $200bn in 2003 to an estimated $1.8 trillion at the end of 2013 (IMF, 2015) and are expected to reach $3 trillion in total assets with 1bn users by 2020. Moody's rating agency is predicting that Islamic finance will continue to outgrow conventional assets in core Islamic markets as the appetite for *Shariah* compliant financial services increases. *Shariah* compliant assets follow specific *Shariah* screening criteria to include asset classes. Asset-backed financing and exclusion of sin stock[2] have given a competitive advantage to *Shariah* compliant equities (Ho *et al.*, 2014; Ashraf and Mohammad, 2014).

Saudi Arabia remains one of the largest markets for Islamic finance with $292bn of assets as of September 2017[3]. Tadawul, Saudi Stock Exchange, is one of the largest stock markets in GCC and is among the top 26 largest capitalized bourses globally which is largely dominated by commodity-based equities and government-owned enterprises. Recent economic reforms are being taken seriously by local and international investors, and plans from major index providers to add Saudi stocks to emerging market benchmarks are providing support for stock growth. As a result, the kingdom will have a 2.7 percent weighting in its main emerging stock benchmarks. If the 5 percent sale of $2 trillion oil giant Aramco shares happens, then the projected weight for the kingdom would increase to 4.5 percent. According to HSBC estimates, an upgrade by MSCI could trigger flows of more than $17bn into Saudi Arabia. The Tadawul index has already advanced 15 percent this year, compared with a drop of 0.2 percent for the MSCI Emerging Market Index[4].

Markowitz's modern portfolio theory assumes that the expected portfolio returns in a given portfolio risk tend to be maximized or the risk of a portfolio in a given portfolio return tend to be minimized compared to the investment into the security individually (Lintner, 1965; Miller, 1977). In their recent study, Bergin and Pyun (2016) find that contemporary investors seek destination economy which is less correlated to home economy in order to increase diversification benefits. Additionally, other recent studies also document the availability of the existence of international portfolio diversification across countries (Teti *et al.*, 2017; Fletcher *et al.*, 2018; Viceira and Wang, 2018). However, very few studies have been carried out on Islamic stock market integration as the Islamic stock markets are at infantile stage. More recent studies find that the international Islamic equity-based portfolio diversification opportunity prevails (Najeeb *et al.*, 2015; Sakti *et al.*, 2018). Najeeb *et al.* (2015) also explore that diversification benefit is time-variant which is interesting to explore for other countries. However, existing results from current literature are conflicting and not irrefutable (Saiti *et al.*, 2014; Najeeb *et al.*, 2015). There have been few studies executed on the *Shariah* equity indices, but to the best of our knowledge no study is yet done particularly on the portfolio diversification opportunities among the trading partners of an important country like Saudi Arabia, which is a major oil exporter in the global market and a major Islamic equity market in the Middle East. Many international investors have already shown great enthusiasm as the Kingdom has already started tremendous economic reforms. Therefore, it is high time to study the Saudi stock market return and their short- and long-term dynamic correlations with their major trading partners by using appropriate recent econometric techniques.

We have applied relatively advanced methods such as multivariate generalized autoregressive conditional heteroscedastic–dynamic conditional correlation (MGARCH–DCC) and continuous wavelet transforms (CWT). One of the novelties of our method is to take more heterogeneous time scale such as 4, 8, 16 and 32 days as investment holding periods to unveil the true dynamics of co-movement relationship between its trading partners by taking

six *Shariah* indices for the period from September 6, 2008 to November 3, 2016. Time period of this study is restricted due to the non-availability of *Shariah* indices for a longer period of time. Therefore, the time-varying volatilities and correlation dynamics of market returns are well captured. Moreover, for the sake of robustness tests, we have also checked the consistency of our MGARCH–DCC and CWT results with another recent time series method, maximal overlap discrete wavelet transform (MODWT).

Our econometric estimations tend to indicate that portfolio diversification opportunities exist for almost all trading partners of Saudi Arabia but more specifically, the Indian Islamic equity markets offer portfolio diversification benefits across all our observation periods from July 7, 2008 to March 11, 2016. Time invariant analysis shows that India and USA Islamic equity markets offer more portfolio diversification benefits than the other Islamic equity markets. The Saudi Arabian market has the least portfolio diversification benefits with the Chinese market. It is also found that all *Shariah* indices experienced higher volatility during the peak of global financial crisis. The results obtained from the CWT suggest that the Indian Islamic equity markets offer portfolio diversification benefits both in the short-run (16–32) days and long-run (64–256 days) investment holding periods, apart from this the other Islamic equity markets offer portfolio diversification benefits up to two months' investment holding periods. We have found highly consistent results in our MODWT robustness check. It is clear that out of five markets, the Indian Islamic equity markets offer portfolio diversification frequently. However, the Chinese, Japanese, US and German Islamic equity markets do not pose portfolio diversification benefits from 64 to 512 days' holding periods, suggesting that the Islamic equity market investors of Saudi need to invest in the other global Islamic equity markets in order to get effective portfolio diversification benefits in those investment horizons. So, the result could be beneficial for the investors, portfolio managers, hedge fund managers, institutional investors and also could be useful for the capital market policy makers for policy-making decisions on portfolio diversification.

The rest of the paper is organized as follows. Section 2 reviews the relevant theoretical and empirical literature. The theoretical model specification, data and the econometric methodology are explained in Section 3. The empirical results and discussions are presented in Section 4 followed by robustness check in Section 5. The last section ends with the concluding remarks and policy recommendations.

2. Theoretical framework and literature review

2.1 Modern portfolio theory

Positive equity return is the greatest wealth building tool for the equity investors; thus, maximizing return by reducing risk is appealing to the investors. Hence, investment strategy plays an important role to make that happen. As a result, this paper adopts Markowitz's modern portfolio theory of 1959 assumes that the expected portfolio returns with a given portfolio risk tends to be maximized or the risk of a portfolio with a given portfolio return tends to be minimized compared to the investment into the securities individually (Lintner, 1965; Miller, 1977). In addition, the theory implies that every single security has its idiosyncratic risk whereby a portfolio of various equities could result in lower risk than a single security investment. Thus, the model explains:

$$\sigma_p^2 = \left(\sum W_i^2 \sigma_i^2 + \sum W_i W_j Cov_{ij}\right), \tag{1}$$

where W_i indicates proportion of the portfolio in equity i; σi implies the standard deviation of expected returns of stock i; and Cov_{ij} means the covariance of expected return of stocks of i and j. Rationally, conjecturing that the covariance maintains less than 1 (which is always true), and thus, this will not be more than the weighted average of the standard

deviation of the expected return of the stocks. As a result, diversification contributes to reducing risk.

However, Grubel (1968) employs modern portfolio theory to explore the potential advantage in cross-country investment, and he surprisingly finds that international portfolio diversification benefits exist in cross-country investment, for instance, countries A and B as follows:

$$E(r_{a,b}) = W_a R_a + W_b R_b, \tag{2}$$

$$V(r_{a,b}) = W_a^2 \sigma_a^2 + W_b^2 \sigma_b^2 + 2 W_a W_b Cov_{ab}, \tag{3}$$

where $E(r_{a,b})$ indicates the expected return of portfolio consisted of countries A and B with investment weights of w_a and w_b, respectively, and $V(r_{a,b})$ weighs the variance of the portfolio. Importantly, the lower the covariance (Cov_{ab}) between countries A and B, the greater is the diversification benefits. Therefore, investors can either increase return or decrease risk or even a combination of both while maintaining cross-border equity markets. At this phase of globalization, the portfolio diversification benefits prevail in cross-border level proposed by the portfolio theory of scholars, namely Markowitz (1952), Sharpe (1964), Lintner (1965), Ross (1976), Fama and French (1996).

2.2 Relevant literature

There have been voluminous studies focusing on the existence of international portfolio diversification across the globe. One strand of scholars supports diversification benefit (Agmon, 1972; Lessard, 1973; Solnik, 1974; Jorion 1985), although some of them find the benefits vary country to country. Interestingly, Bergin and Pyun (2016) find that investors of these days seek destination economy which is less correlated to home economy in order to increase diversification benefits. In addition, the recent studies also document the availability of the existence of international portfolio diversification across countries (Gregg, 2012; Teti *et al.*, 2017; Liu, 2016; Jamaledin Mohseni Zonouzi *et al.*, 2014; Fletcher *et al.*, 2018; Viceira and Wang, 2018). On the other hand, empirical studies illustrate that national portfolio diversification exceeds international portfolio diversification in terms of return and that reflects "home bias" as investors prefer to hold home country securities due to investment complexities (French and Poterba, 1991; Karolyi and Stulz, 2003; Chan *et al.*, 2005; Choi *et al.*, 2017). However, investors rationally hold foreign equities for heterogeneous investing periods due to information advantage derived from specialization and economies of scale.

Over the last few years, Islamic finance market has gained significant momentum in tempting capital inflow from both Muslim and non-Muslim investors across cross-borders. Therefore, the growth of Islamic finance leads Islamic capital market to a strong standing with diverse products. However, considering the portfolio diversification in the light of the Islamic finance, the risk return behavior of Islamic equity does not posit all-similar characteristics as its conventional counterpart. Although Islamic equity market is also exposed to global financial downturn, it still performs better than conventional equity, as shown by Ho *et al.* (2014) and Ashraf and Mohammad (2014). However, regarding diversification, the Islamic index offers diversification opportunities (Hakim and Rashidian, 2004; Hussein, 2007); the reason could be short selling is not allowed in Islam (Dusuki, 2008; although there is a debate on it) and real Islamic model of doing business is far more different from interest-based business model which is likely to be volatile.

Some countries practice Islamic finance and banking as a backdrop, for instances, Saudi Arabia, Bahrain, Qatar, Kuwait, United Arab Emirates, Oman, Iran, Malaysia, Pakistan, Iran, Sudan, Yemen, Indonesia and Bangladesh (Khatat, 2016). Some country-specific studies regarding Islamic equity diversification show (Achsani *et al.*, 2007)

evidence that Islamic stock market is asymmetric across a wide geographical area and surprisingly find the existence of strong correlation between the Islamic equity indices of Indonesia and Malaysia, USA and Canada, Japan and Asia pacific. Further, they add documents that the USA has a strong impact on other Islamic stock markets perhaps because of better trading relation with them. Keeping in line, Aziz and Kurniawan (2007) explore the availability of portfolio diversification benefit between Indonesia and Malaysia while considering Islamic equity indices. More recent studies find that the international Islamic equity-based portfolio diversification opportunity prevails (Majid and Kassim, 2010; Bahlous and Mohd. Yusof, 2014; Najeeb *et al.*, 2015; Sakti *et al.*, 2018). Najeeb *et al.* (2015) also explore that diversification benefit is time-variant which is interesting to explore for further countries. However, on the flip side Kamil *et al.* (2012) find mixed evidence in their studies perhaps because some markets may be highly cointegrated regionally because of their monetary and fiscal policy, while others are not.

Unfortunately, not all capital market is well developed and, for instance, Saudi Arabia is at the forefront in practicing Islamic finance and furthermore its oil-dependent economy despite underdeveloped capital market with new monetary and fiscal policy announcements makes us think further about its capital market volatility and cointegration with other cross-border trading partners. At this phase, it is time to check how far Saudi capital market is integrated with that of its major cross-border markets and explore any international portfolio-investment opportunities for both individual and institutional investors across the globe.

As for the empirical literature discussed in this section, there have been studies executed on the *Shariah* equity indices, but no study is yet done particularly on the trading partners of a country like Saudi Arabia because investors are more interested in the countries where they have frequent dealings. Hence, a relatively advanced method such as multivariate GARCH is applied to explore the portfolio diversification among its business partners, as multivariate GRACH model can be well applied in portfolio theory and diversification (Bauwens *et al.*, 2006). Moreover, in this study, we add more heterogeneous time scales such as 4, 8, 16, 32, 64 and 256 days as investment holding periods to unveil the true dynamics of co-movement relationship between its trading partners. Therefore, the time-varying volatilities and correlation dynamics of market returns are well captured.

3. Data and methodology

3.1 Data

The daily stock indices return of S&P Saudi Arabia *Shariah* – price index, FTSE *Shariah* India – price index, FTSE *Shariah* China – price index, FTSE Shariah Japan 100 – price index, FTSE *Shariah* USA – price index, S&P EUR 350 *Shariah* Germany – price index are used for the period from September 6, 2008 to November 3, 2016. The full data set has been collected from Thomson Reuters DataStream. The total of 2,027 observations were used, and the stock indices returns were calculated as difference of the logarithmic daily closing prices of indices $[\ln(p_t)-\ln(p_{t-1})]$, where p is an index value. In order to get stationarity in variance, the conversion is necessary (Engle, 2002) (Table I).

Symbol	Stock indices
SAUD	S&P Saudi Arabia *Shariah* – price index
IND	FTSE *Shariah* India – price index
CHIN	FTSE *Shariah* China – price index
JAPN	FTSE *Shariah* Japan 100 – price index
USA	FTSE *Shariah* USA – price index
GERM	S&P EUR 350 *Shariah* Germany – price index

Table I.
Selected Islamic stock indices for the study

3.2 Methodology

For examining how the volatility and correlation changes over time and how the outcome differs at different stock holding periods, this study employed two methodologies: MGARCH-DCC and CWT wavelet, respectively. This study also applied MODWT as a robustness test of this study as it answers some additional research questions. The details of all the above-mentioned methodologies are explained below.

3.2.1 Multivariate GARCH-DCC. For finding how volatilities of and correlations between the assets change over time while including the directions (positive or negative) as well as the size (strong or weak), this study employs MGARCH–DCC model suggested by Engle (2002) and Pesaran and Pesaran (2010). There are a few advantages which motivate us to use it in our study: first, DCC allows for the analysis of the time variation in both mean and variance equation, second, DCC allows investors to find how correlations among the assets change over time; third, DCC approach is reasonably flexible in modeling individual volatilities and can be applied to portfolios with large number of assets (Pesaran and Pesaran, 2010).

Since then MGARCH–DCC model has been extensively used to identify portfolio diversification benefits, in this paper we make a humble effort to use this recent model in addressing our research objective. This model can be stated as follows (see, Hsu Ku and Wang, 2008; Najeeb *et al.*, 2015):

$$r_t = \beta_0 + \sum_{i=1}^{k} \beta_i r_{t-1} + u_t = \mu_t + u_t,$$

$$\mu_t = E\left[r_{t|\Omega_{t-1}|}\right],$$

$$u_t I\Omega_{t-1} \sim N(0, H_t),$$

$$H_t = G_t R_t G_t,$$

$$G_t = \text{diag}\left\{\sqrt{h_{ii,t}}\right\},$$

$$Z_t = G_t^{-1} u_t,$$

where $h_{ii,t}$ represents the estimated conditional variance of the single univariate GARCH model; G_t refers to the diagonal matrix of contingent standard deviations; R_t implies the time-varying conditional correlation coefficient matrix of stock returns; and finally, z_t indicates the standardized residual vector along with mean 0 and variance 1. With the accomplishment of this basic construction, the dynamic correlation coefficient matrix of the DCC model can be specified further following Hsu Ku and Wang (2008):

$$R_t = (\text{diag}(Q_T))^{-1/2} Q_t \left(\text{diag}(Q_t)^{-1/2}\right),$$

$$Q_t = (q_{ij,t}),$$

$$(\mathrm{diag}(Q_t))^{-1/2} = \mathrm{diag}\left(\frac{1}{\sqrt{q_{11,t}}}, \frac{1}{\sqrt{q_{nn,t}}}\right),$$

$$q_{ij,t} = \overline{p}_{ij} = \alpha\left(Z_{i,t-1}Z_{j,t-1} - \overline{p}_{ij}\right) + \beta\left(q_{ij,t-1} - \overline{p}_{ij}\right),$$

where $\overline{p}_{ij}$ is the unconditional correlation coefficient and the time-varying conditional correlation coefficient is $p_{i,j,t} = q_{i,j,t}\mathrm{I}\sqrt{q_{ii,t}q_{jj,t}}$. Moreover, it is evident that financial assets tend to be fat-tailed where normal distribution assumption is invalid. In this situation, a reasonable solution would be to apply the Student's *t*-distribution. That means the conditional distribution $u_t|\Omega_{t-1} \sim N(0, H_t)$ takes the place of $u_t\left|\Omega_{t-1} \sim \int \mathrm{student}-t(u_t; v), (0, H_t)\right.$; hence, v constitutes the parameter for the degree of freedom.

3.2.2 Continuous wavelet transformation (CWT). In financial markets, investors have different preference of time scales or investment horizons or stock holding periods. In and Kim (2013) emphasized that the true dynamics and co-movement relationship between different markets would be possible when financial markets are decomposed into different time scales or different holding periods. Wavelet takes care of the heterogeneity in investment horizons considering the time and frequency domain feature of the data. A number of studies, namely Haque *et al.* (2018), Saiti (2012), Madaleno and Pinho (2012), Vacha and Barunik (2012), Aloui and Hkiri (2014), Rahim and Masih (2016), Najeeb *et al.* (2015), and Buriev *et al.* (2018), applied CWT for finding the heterogeneity in investment horizons. In our study, CWT has been used to examine how the international portfolio diversification benefits would change over time given different investor equity holding periods.

The CWT $w_{x(u,s)}$ is obtained by projecting a mother wavelet Ψ onto the examined time series $x(t) \in l^2(R)$ (see Najeeb *et al.*, 2015), that is:

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

where u refers to the time domain and s refers to its position in the frequency domain. Therefore, the wavelet transforms, by mapping the original series into a function of u and s, give us information simultaneously on time and frequency. For finding the interaction between two time series (e.g. how closely X and Y are interrelated by liner transformation), this study applied a bivariate framework called wavelet coherence. Like Torrence and Webster (1999), the wavelet coherence of two time series can be defined as follows:

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

where S is a smoothing operator; s a wavelet scale; $WWn^x(S)$ the continuous transform of the time series X; $Wn^y(S)$ the continuous wavelet transform of the time series Y; Yn^{xy} (s) a cross-wavelet transform of the two time series X and Y (see details Madaleno and Pinho, 2012; Gençay *et al.*, 2001, 2002; In and Kim, 2013).

3.3.3 Robustness test – MODWT. Like Zhou (2012), this study uses the MODWT as robustness test to address three questions: Does the portfolio return as measured by wavelet correlation differ across the scales? If so, then how? Does the wavelet correlation change over time on a scale by scale basis? In terms of volatility, does it differ across scale? If yes, then how? Unlike the classic discrete wavelet transform, MODWT is able to handle any sample size and not just those that are multiples of 2. The MODWT is highly redundant,

non-orthogonal transform that enables alignment of the decomposed wavelet and scaling coefficient at each level with original time series and thus allowing a ready comparison between the series and its decomposition (Najeeb *et al.*, 2015). Using MODWT, the wavelet covariance and wavelet-based correlation coefficient between X and Y at scale j can be obtained using the following two formulas (see Fernandez, 2008):

$$\widehat{v}^2_{XY}(\tau_j) \equiv \frac{1}{M_j}\sum_{t=L_j}^{n-1} \tilde{d}^{(X)}_{j,t}\tilde{d}^{(Y)}_{j,t}, \tag{4}$$

$$\hat{\rho}X, Y(\tau_j) = \frac{\hat{V}X, Y(^{\tau_j})}{\hat{V}X, (\tau_j)\hat{V}, Y(\tau_j)}, \tag{5}$$

where $\left|\hat{\rho}X.Y(\tau_j)\right| \leqslant 1$ shows that the wavelet correlation is analogous to its Fourier equivalent, indicating the complex coherency (see Gençay *et al.*, 2002, p. 25).

4. Empirical results and discussion

4.1 Results of MGARCH–DCC

For finding the international portfolio diversification benefits for Saudi Arabian investors, this study applied the MGARCH–DCC approach. Initially, we conducted MGARCH–DCC analysis on all indices returns (S&P Saudi Arabia *Shariah* – price index, FTSE *Shariah* India – price index, FTSE *Shariah* China – price index, FTSE *Shariah* Japan 100 – price index, FTSE *Shariah* USA $ – price index, S&P Eur 350 *Shariah* Germany – price index). Thereupon, we first look at the unconditional volatilities and correlations shown in Table II.

On-diagonal element in Table II indicates the volatilities of the return, while off-diagonal elements represent the unconditional correlation between returns. The result shows that US *Shariah* index return has the lowest volatility (0.013159) and China *Shariah* index return has the highest volatility (0.023381). Thereafter, regarding the correlation, Saudi Arabic market has the least correlations with the Indian and US's market; on the other hand, highest positive correlation is obvious with China's market. Thus, this result is time invariant which means the above-stated correlations are constant or static; unfortunately, that is not the fact in financial markets of the present world economy (Schwert, 1989; Whitelaw, 1994). This intuition particularly motivates us to explore the dynamic conditional correlation which captures the time-varying correlation and volatilities.

Figures 1 and 2 show the time-varying volatilities and correlations among the sample countries ranging from July 7, 2008 to March 11, 2016, respectively. The conditional volatilities of all shari'ah indices returns move together closely during the observation period besides shari'ah index return of China, which supports our earlier result driven by unconditional volatility and correlation matrix table. The correlation among all the *Shariah* indices here varies overtime which is relevant with Schwert (1989) and Whitelaw (1994).

	SAUD	IND	CHIN	JAPN	USA	GERM
SAUD	0.01457	0.19209	0.23461	0.21436	0.17846	0.20309
IND	0.19209	0.017265	0.42211	0.29406	0.33228	0.38409
CHIN	0.23461	0.42211	0.023381	0.47325	0.23244	0.32461
JAPN	0.21436	0.29406	0.47325	0.01557	0.14425	0.28035
USA	0.17846	0.33228	0.23244	0.14425	0.013159	0.56920
GERM	0.20309	0.38409	0.32461	0.28035	0.56920	0.018997

Table II. Unconditional volatilities and correlations

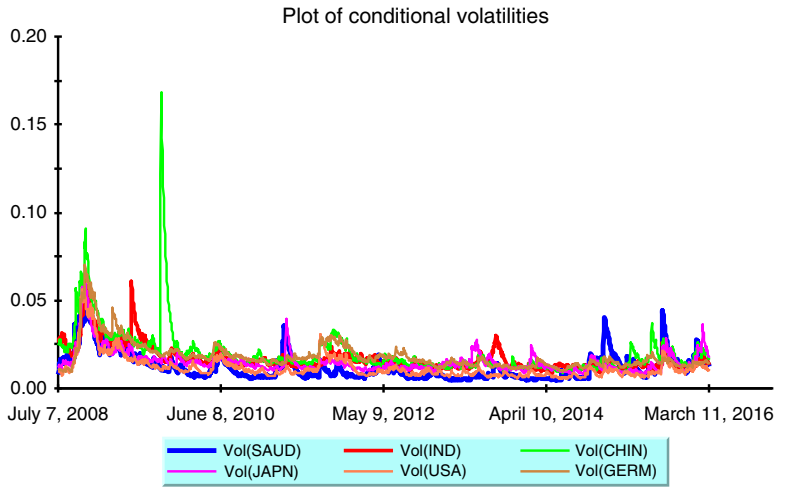

Figure 1.
Volatility from July 8 to March 16

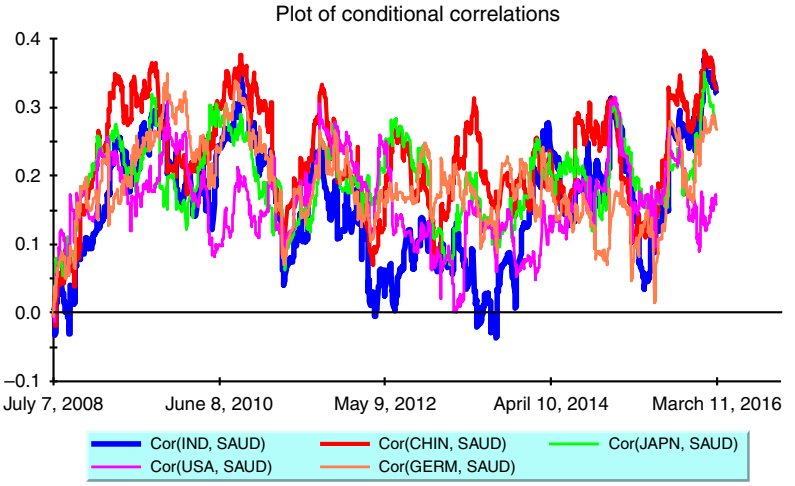

Figure 2.
Correlation from July 8 to March 16

The Indian and the US *Shariah* equity indices have the lowest positive correlation, sometime even negative correlation with Saudi *Shariah* equity index. This implies the existence of portfolio diversification benefits for the investors and fund managers. Moreover, the deeper sight at the US market shows that there was a bit of volatility during the 9/11 attack in 2001 which is consistent with Chesney *et al.* (2011) but more positive correlation prevails with Saudi *Shariah* equity market. Interestingly, the correlations of all *Shariah* indices maintain lower than 0.60, which support the prevalence of portfolio diversification benefits (Figure 3).

However, we find volatilities among all the *Shariah* indices during the global financial crisis. The result mirrors that all sample markets are volatile, but the China maintains the highest volatility. Volatilities are highly obvious during the peak period of financial crisis. On the other hand, Saudi market return has the negative correlation with Indian market return, indicating there is a portfolio diversification benefit during the global financial crisis. Figure 4 shows that the correlations among all *Shariah* equity indices tend to move upward

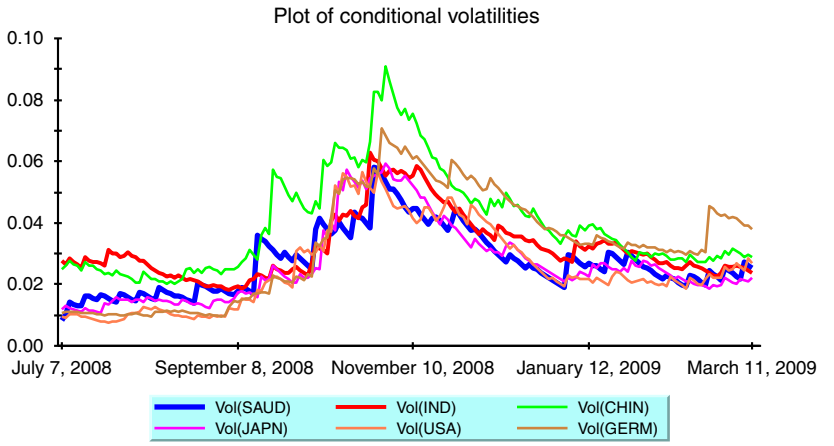

Figure 3.
Volatilities during financial crisis

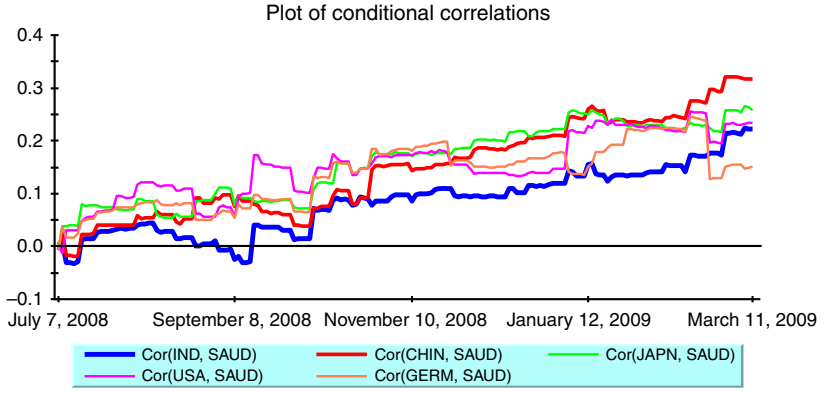

Figure 4.
Correlations during global financial crisis

after September of 2008. Hence, the World Bank states that cross-country correlations increase during "crisis times" relative to correlations during "tranquil times." Furthermore, Kim and Kim (2013) explain that the important judgments about the contagion effect depend heavily on the time length and the extent of increased correlations.

4.2 Result of CWT

As mentioned earlier in the methodology part that CWT can explain the impact of portfolio diversification at different investment horizons, this study applied it for the portfolio diversification for the Saudi Arabia market as shown in Figures 5–8. Here, time (number of trading days) is depicted in the horizontal axis and investment horizon is on the vertical axis. The 5 percent statistical significance level of the wavelet coherence is estimated using Monte Carlo methods. The color code for power ranges from blue (low coherence) to red (high coherence). The vector pointing to the right indicates that the indexes are in phase, whereas left indicates just the opposite. For the interpretation of lead/lag relationship, we can bear in mind that: right (left) arrow means that the two variables are in phase (anti-phase). If the arrows point to the right and up, it means the first series is leading. If they point to the right and down, the first series is lagging. If the arrows are to the left and up,

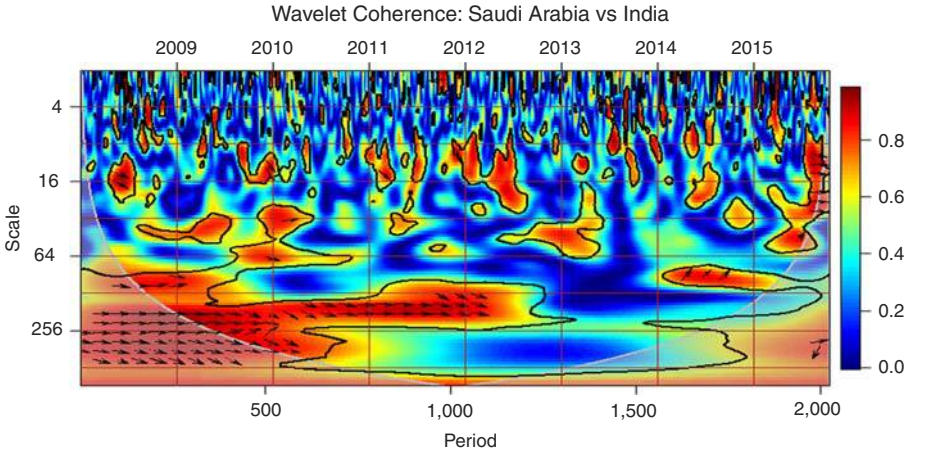

Figure 5.
Continuous wavelet transform – Saudi and India

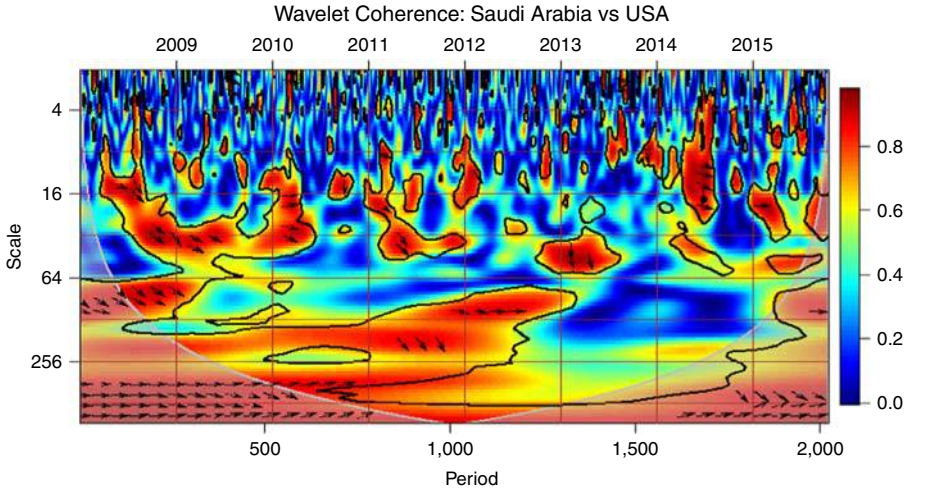

Figure 6.
Continuous wavelet transform – Saudi and USA

it means second series is leading and if they are to the left and down, second series is lagging (Gallegati *et al.*, 2014).

For finding the portfolio diversification, this study divided the series into different holding periods from short to long time length such as 4–16 and 16–32, 32–64 and 64–256 trading days. As shown in Figures 5–9, it is found that the correlation between Saudi Arabian *Shariah* stock and its major trading partner is quiet low. If we compare it relatively, the returns of China *Shariah* stock indices tend to have stronger correlation relative to the correlation of the *Shariah* stock indices of other trading partners. The correlations of India's stock indices are also relatively low during the global financial crisis, which occurs on the observation points of 16–32 days. This would mean that speculators, who tend to invest in this holding period (very short period), would benefit from the investment, which is in line with our expectation. There is high correlation with the China equity market during the global financial crisis at 16–32 days holding period compared to other equity markets. In the case of investment horizons of 64–256 days, comparatively higher correlation are

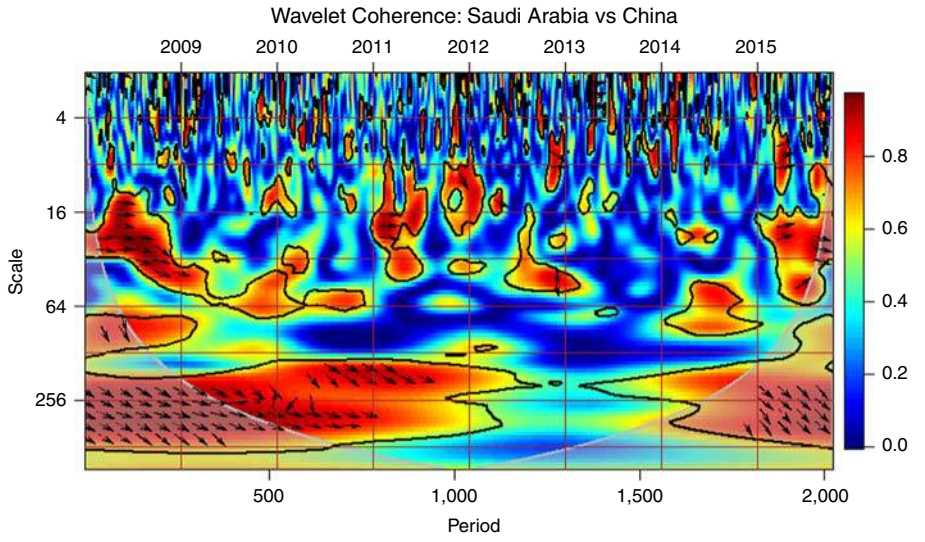

Figure 7.
Continuous wavelet transform – Saudi and China

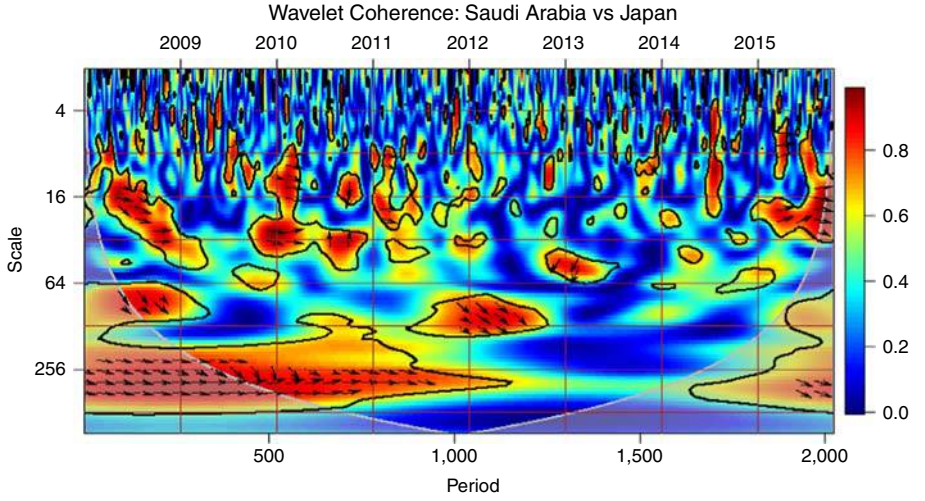

Figure 8.
Continuous wavelet transform – Saudi and Japan

observed between all the *Shariah* stock index returns of Saudi Arab's major trading partners except less with India's Islamic equity index return. This will reduce or eliminate the potential portfolio diversification benefits.

In summary, CWT result reveals that the short-run holding period of investment portfolio is more beneficial than long-run holding period. Broadly, in the short-run holding period (16–32 days), the CWT result found low correlation between the Saudi Arabia and other markets, whereas the long-run holding period (64–256 days) found high correlation between Saudi Arabia and other markets excepting the Indian Islamic stock index. This result can finally bring us to a conclusion that the return of the short-run holding period is greater than the long-run holding period for the Saudi investors. This result is consistent

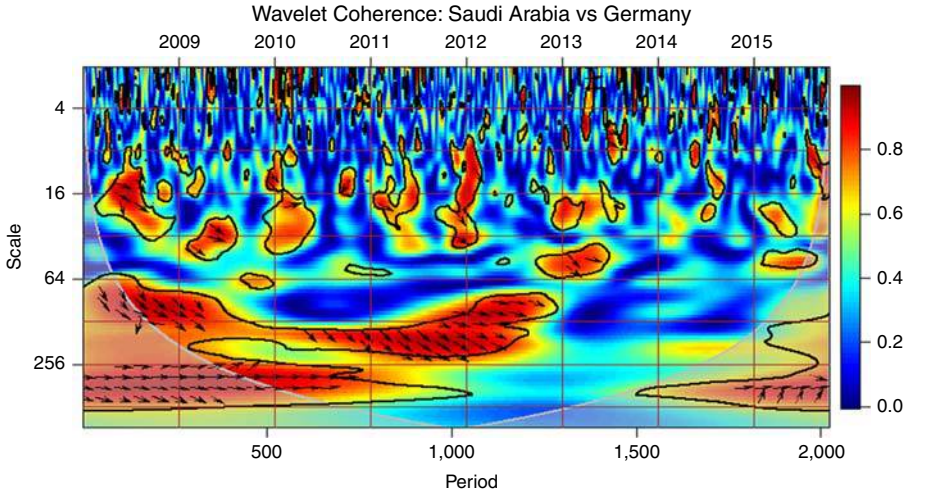

Figure 9.
Continuous wavelet transform – Saudi and Germany

with Rahim and Masih (2016), who found that the stock holding periods exceeding 32–64 days contain minimal benefit of portfolio diversification in comparison with the stock holding period of 32–64 days for Islamic investors with their major trading partners.

4.3 Robustness test: MODWT

In order to test the robustness of the results that is obtained in CWT analysis, an MODWT was applied to our original data set consisting of return of series for all six *Shariah* indices. In MODWT, researcher is required to specify the time scales for the returns whereby the present paper uses eight scales (1–2 days, 2–4 days, 4–8 days, 8–16 days, 16–32 days, 32–64 days, 64–128 days, 128–256 days and 256–512 days). The correlations between Saudi Arabia *Shariah* index returns with the index returns of its major trading partners were examined using the generated MODWT returns series using "R" studio software and the result is shown in Table III.

Table III.
Correlation of Saudi Arabia Islamic equity market returns *vis-à-vis* India, China, Japan, USA, German Islamic equity market returns

MODWT Transformations					
MODWT Scaling	India	China	Japan	USA	Germany
1–2 Days	0.1006657	0.15905072	0.1292999	0.10118996	0.1428343
2–4 Days	0.1558715	0.18155541	0.1474289	0.09644206	0.1291893
4–8 Days	0.3209354	0.36634673	0.4244505	0.35840675	0.3411678
8–16 Days	0.4060826	0.56486091	0.4424534	0.47376667	0.4372629
16–32 Days	0.3798621	0.45606845	0.3931458	0.5150828	0.4066196
32–64 Days	0.4078311	0.31146629	0.2274593	0.45078754	0.3806015
64–128 Days	0.6811541	0.58965165	0.5756927	0.67348701	0.6769713
128–256 Days	–0.1951082	0.3516383	0.7880871	0.96495913	0.3297222
256–512 Days	–0.2410731	0.04511409	0.8983471	0.88622056	0.8289613

The results are remarkably consistent with the results obtained from the earlier CWT analysis. Out of five markets, Indian Islamic equity markets offer portfolio diversification frequently. However, in the short investment holding periods, almost all Islamic equity markets offer portfolio diversification benefits, but in the long investment holding period, Japan, USA, German Islamic equity markets do not offer portfolio diversification benefits, thus eliminating portfolio diversification benefits for the Saudi Islamic investors (Table IV).

5. Conclusion and policy implications

Islamic finance assets have enjoyed exponential growth during the last decade or so. Saudi Arabia, one of the largest markets, has recently shown exceptional results in international market. Saudi Arabia has become No. 2 among all global country stock market ETFs in 2018. Although recent crude oil's rally is a big reason for the Saudi stock market boom, it is definitely not the only reason. Saudi regulators have recently changed rules for the qualified foreign institutions to allow them to own up to 49 percent of listed securities. Also, a bankruptcy law was enacted to make the Saudi market more attractive to entrepreneurs and investors. Moreover, the trading of local currency government bonds on the Saudi exchange will further deepen the kingdom's capital markets. On top of that, Saudi's non-hydrocarbon real GDP expects to grow at 2.7 percent in 2018 and 2019. The development of the non-oil private sector gets priority and the authority envisages increasing the private sector's contribution to GDP from 40 to 65 percent. For example, a broader blueprint for life after oil calls for selling shares in the state oil giant Saudi Aramco and creating the world's largest sovereign wealth fund. With economic reform "Vision 2030," Tadawul expects market capitalization to reach $1 trillion by 2022.

On this backdrop, we have made a humble attempt to study the international portfolio diversification benefits of *Shariah* investors who are interested in or already invested in Saudi stock market and want to maximize their portfolio return by international diversification. To address the issue, we have applied relatively advanced methodological strategies, MGARCH–DCC and CWTs, which give us consistent results. Our findings tend to suggest that the portfolio diversification exists for almost all trading partners of Saudi Arabia but more specifically the Indian Islamic equity markets offer portfolio diversification benefits across our observation period from July 7, 2008 to March 11, 2016. Furthermore, the results obtained from CWT suggest that the Indian Islamic equity markets offer portfolio diversification benefits both in short-run and long-run investment holding periods. Speculators who tend to invest in very short holding period would benefit from the investment, which is in line with our expectation. There is high correlation with China equity market during the global financial crisis at 16–32 days holding period compared to other equity markets. In the case of investment horizons of 64–512 days, comparatively higher correlations are observed, which indicates lower diversification benefits of Islamic equities in the long run. The result during the global financial crisis is intuitive. The robustness tests stemming from the MODWT results have shown remarkably consistent results. It is clear that out of five markets, Indian Islamic equity markets offer portfolio diversification more frequently. However, Chinese, Japanese, US and German Islamic equity

Analysis	India	China	Japan	USA	Germany
MGARCH	Possible	Possible	Possible	Possible	Possible
CWT	Possible	Possible up to 2 months	Possible up to 2 months	Possible up to 2 months	Possible up to 2 months
MODWT	Possible all time	Possible all times horizons	Possible up to 2 months	Possible up to 2 months	Possible up to 2 months

Table IV. The summary of all results obtained from the three analyses

markets do not pose portfolio diversification benefits from 64 to 512 days holding periods, suggesting that Islamic equity market investors of Saudi need to invest in the other global Islamic equity markets in order to get effective portfolio diversification benefits in those investment horizons.

Investors, portfolio managers, hedge fund managers and institutional investors could apply our findings in designing their international portfolios. As *Shariah* compliant investment funds have been growing in popularity, further research is needed to investigate this issue by using recent appropriate techniques to see the asymmetric relationship. Nonlinear techniques like Markov switching can be applied to study the structural breaks which would provide more insightful and more robust results. Finally, future studies can consider investigating the volatilities of and correlations between the Saudi Arabian market and its major trading partners at the sectoral level.

Notes

1. Brexit is a contraction for Britain's exit from European Union.
2. Stocks of companies dealing with businesses such as gambling, pork, wine, weapon manufacturing and conventional banking.
3. Moody's recent report "Cross-Sector Islamic Finance: Strong longer-term growth prospects despite relatively flat 2018."
4. Rosenbaum, Eric. "It's not only oil: Saudi Arabia a top stock market in 2018 as reforms rally investors." CNBC, www.cnbc.com/2018/04/30/saudi-arabia-a-top-stock-market-as-reforms-and-oil-rally-investors.html (accessed August 6, 2018).

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