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Faith based vs Value based finance: Is there a portfolio diversification benefit between Responsible and Islamic finance?

Md Hakim Ali¹ | Md Akther Uddin² | Md. Atiqur Rahman Khan³ | Blake Goud⁴

The aim of the study is to explore whether responsible investment and Islamic (Shari'ah compliant) investment, which have many similarities in objectives but some differences in how they are implemented, hold any diversification benefits for investors across a variety of investment horizons. We adopt an advanced econometric estimation using MGARCH-DCC and Wavelet using daily returns data between 01-January-1997 and 22-May-2017. We find indications that responsible investment strategies can offer some hedging benefit to Islamic investors and vice versa. Moreover, the returns from this hedging strategy are higher for those addressing a shorter-term rather than long term investment horizon. One exception was that we found diversification benefits for both short- and long-term focused investors during the financial crisis, when the time varying correlation were near their lowest point.

Keywords: MGARCH-DCC, portfolio diversification, responsible investment, Shariah-compliant investment, wavelet

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1. Introduction

Sustainable and responsible investment (SRI) has received much attention in the recent past. Investors, especially Millennials, are interested to invest in a responsible manner. A recent YouGov poll⁵ reported that Millennial savers are twice as likely as older generations to want their pension to be invested responsibly (Williams, 2018). The world is facing major environmental challenges including climate change caused by human-generated greenhouse gases and deforestation. Additionally, rapid industrialization and urbanization is taking place without considering its environmental consequences. The consequence of historical industrialization of Western countries and the future trajectory of greenhouse gas emissions in emerging markets has caused climate change, requiring mitigation to avoid the most adverse impacts on the environment and humanity.

As in previous generations, dramatic social, economic and environmental changes are driving behavior. The origins of the first generation of SRI investments can be traced back to the 1960s immediately after movements led by young people focused on addressing social, environmental, human rights and ethical issues in the United States (Lydenberg, 2000; Schueth, 2003).

The Millennial generation increasingly approaches these issues in the investment context through an environmental, social and governance (ESG) approach to limit negative impacts and generate a positive impact on the world and for their investments. Moreover, the social norms, belief, religious faiths, ethics, and environmental consciousness affect the individual behavior as well as investing behavior (Baker and Nofsinger, 2012; Al-Awadhi & Dempsey, 2017; AlAwadhi, 2019). Although many SRI investors care about environmental issues, other SRI investors focus their efforts on eliminating poverty, avoiding social inequality, reducing gender discrimination and preventing child labor. Still other investors are focused on good governance. These investors see governance improvements as a catalyst for more financially sustainable investment returns, which may also help put the underlying companies in a better position to withstand future environmental and social crises. Within the financial sector in particular, the Great

⁵The YouGov poll reported that 13% out of 2100 people within the ages between 18 to 34, wished their pension money to be invested by maintaining the principles of ethics. Moreover, 44% respondents strongly believe that supporting ethical investment and ethical firms would bring about positive social change. The further details about the poll can be accessed in the name of “UK ethical funds surge in popularity” through this link <https://www.ft.com/content/a1e55502-c25b-11e8-8d55-54197280d3f7>

Financial Crisis of 2007-2008 showed the breadth of possible consequence that comes from catastrophic governance failures.

Investors are beginning to understand that – contrary to the age-old myth – you don't have to sacrifice profit for your principles. The key for matching values and value comes when the implementation is approached in a systematic way that integrates the financial consequences of ESG impacts into investment decisions rather than excluding investments solely because they are unethical. The growth of responsible finance is remarkable across the world and brings together SRI, ESG and Islamic finance united by a focus on aligning principles and profits. According to Global Sustainable Investment Review 2018, sustainable investing assets in the five major markets reached at \$30.7 trillion at the beginning of 2018, a 34percent increase in two years. In all the regions except Europe where it accounts for a large proportion of the market, sustainable investing's market share has grown. Responsible investment now commands a sizable share of professionally managed assets in each region, ranging from 18 percent in Japan to 63 percent in Australia and New Zealand as per Global Sustainable Investment Review 2018⁶.

Likewise, the Islamic finance is experiencing a high growth rate and also taps into the growing trend for ethical products and services. Islamic finance firstly focuses on screening out companies to ensure that the investable universe includes only those companies whose business activities avoid non-Shari'ah compliant activities such as interest-based contracts, transactions where gharar (excessive contractual uncertainty) is found, and transactions that involve gambling (maysir). This exclusionary screen also excludes companies dealing with pork, alcohol, and tobacco, and pornography (Wilson, 1997; Benson et al., 2006). After the sector screening, Islamic investment adds an accounting-based screen focused on the capital structure. Although the specific ratios are not fully harmonized industry-wide, a common type of screen would limit debt to total assets or market capitalization ratio to less than 33%. Cash and interest-bearing securities to total assets or market capitalization ratio is also limited to less than 33%, and a maximum of 5% non-Shari'ah compliant income to revenue is allowed (Elgari, 2000; Derigs & Marzban, 2008; Masood, Rehman, & Bellalah, 2012 & Ho et al., 2014).

⁶Global Sustainable Investment Alliance released a report in 2019 titled "Global Sustainable Investment Review 2018" showing the increasing trend of Sustainable Investing across the Europe, the U.S.A, Canada, Japan, Australia, and New Zealand. The report illustrates the new initiatives and effective management taken by the country specific authority to enhance the sustainable investment. The report is available at http://www.gsi-alliance.org/wp-content/uploads/2019/03/GSIR_Review2018.3.28.pdf

Although the growth of Islamic finance has slowed to the high single digit level in recent years it remains more rapidly growing than conventional finance and it has spread widely even across many non-Muslim majority countries. A recent report on State of the Global Islamic Economy estimates that total assets of the Islamic finance industry reached US\$2.5trillion in 2018 and is forecast to grow to \$3.5 trillion by 2024 (Dinar Standard, 2019). There is significant scope for growth and maturity in the Islamic economy, with a mere US\$745 million in disclosed private equity investments over three years, far less than the almost US\$595 billion in private equity and venture capital investments that occurred globally in 2017. Islamic equity investments have also risen, and the momentum can be reinforced by adding to our understanding of the performance impact of Islamic investment screens (Hassan and Girard, 2010).

The growth of Islamic finance and responsible finance have accelerated in the aftermath of the Great Financial Crisis which exposed a financial system that did not focus enough on the real economy focus and lacked an ethnically based approach which philosophically complements ESG alignment (Zeti et al, 2019). The confluence of these approaches has drawn the attention of individual as well as institutional investors. The two different ethically based strategies (Islamic and responsible investment) share many similarities that are more significant than their differences (Wilson, 1997; Schwartz, 2003; Benson et al., 2006). For instance, responsible finance focuses on sustainability by ensuring environmental, social and ethical investments while Islamic finance deals with avoiding businesses with significant involvement with *riba* (interest) and requires a link between financial transactions and an underlying real economy activity.

Based upon similarities, we conjecture that the performance of Islamic and responsible equity would be similar both before and after risk adjustment. Consequently, we also believe that the volatility of these two industries would be similar. The rest of the paper is organized as follows. Section 2 discusses the theoretical foundation and literature review. The model specification, data, and the econometric methods are explained in section 3. The empirical results and discussions are presented in section 4. The last section ends with concluding remarks and policy implications.

2. Theoretical framework & literature review

As mentioned above, the growth of Islamic finance and responsible finance is on the rise immediately after global financial crisis. One reason which can explain the success of both are a shared ethical foundation and the real economy link of the former, and ESG framework for the latter (Wilson, 1997; Hassan and Girard, 2010). The benefit of the two fields in the wake of the Great Financial Crisis has drawn the attention of individual as well as institutional investors. Previous studies concentrate more on the diversification benefits of Islamic versus conventional or of unscreened versus responsible finance although theoretically Islamic finance and responsible investments share many similarities. Therefore, we believe that investors should not restrict themselves to using only one or the other approach and can benefit from combining the two together. This conjecture is corroborated by several recent studies (Stanley and Jaffery, 2009; Mensi et al., 2017; Umar, 2017). Some studies find more commonalities between ESG and Shari'ah than differences (Charfeddine et al., 2016) while others find the variation regarding asset allocation, sector exposure, and econometric profile (Forte and Miglietta, 2007).

However, Erragraguy and Revelli (2015) approach the comparison in a different way explaining that the performance of Islamic investment, in the long run, may be affected by concentration in investment in tangible assets, with more limited exposure to companies with substantial intangible assets such as reputation, R&D, Corporate Social Responsibility (CSR). On the other hand, responsible finance may deliver better performance in the long run because it embraces companies that are committed to a stakeholder model and a focus on innovation efforts that will drive long-term benefit (Edmans, 2012; Rodgers et al., 2008; Park et al., 2017). Interestingly, Islamic indices outperform during financial distress (Hoepner et al., 2011; Walkshaeusl and Lobe, 2012), which is often attributed to the exclusion of financial equities from the Shari'ah screened portfolio. Although the experience of 2008-09 has led some of the outperformance of Islamic equities to be attributed only to this exclusion, other research that includes longer-periods of time does not find the performance benefit to be entirely related to the impact of the Great Financial Crisis (Gueckel, 2017).

So far, previous studies concentrate more on the diversification benefits of Islamic versus conventional and conventional versus responsible finance. The empirical studies regarding the return volatility as well as the linkage between these two approaches to values-based and

responsible finance are still in the infancy stage and lacking the conclusive evidence. This is important because the investors owning these industry investments are dependent upon empirical evidence to decide whether there is any portfolio diversification benefits between the two and relative to unscreened investments. We hypothesize that investors from Islamic finance and SRI could use complementary investment classes and the differences between these two could offer diversification opportunities for both sorts of investors by reducing the unsystematic risk arising from the differences.

Therefore, the purpose of the study is to investigate whether there is any diversification opportunity exists between Islamic and SRI and if so, does that approach maintain time-varying profile moreover sorting the portfolio diversification benefits at multiple investment horizons using MGARCH-DCC and wavelet method since the econometric methodology used in the prior studies were cointegration tests, generalized VAR, BEKK-GARCH, ARMA, VEC, Copula, and EGARCH models. Daily return series of 8 stock indices (4 Dow Jones Islamic and 4 FTSE4Good), are used for the period from 01-January-1997 to 22-May-2017. Therefore, this study contributes to examining whether there are time-varying diversification opportunities as well as analyzing the returns features in multiple investment horizons which has not been studied elsewhere.

In terms of performance, we conjecture that the performance of Islamic and responsible equity before and after risk adjustment and thereupon the volatility of these two industries would be alike. This conjecture is corroborated by Stanley and Jaffery (2009) who use top ten constituents of Domini 400 Social Index and S&P 500 Shari'ah index and find more commonalities than differences. On the contrary, Mensiet al., (2017) finds that Dow Jones Sustainability Index is less persistent and more volatile than Dow Jones Islamic Market Index. However, Umar (2017) find that Islamic equity outperforms in the short run- particularly in emerging markets as a result of finding higher Sharpe ratios than for an unscreened alternative.

Islamic finance and responsible finance focus similarly on the strong alignment of investment with social welfare, making the linkage between the financial sector and the real sector. It encourages a more resilient and sustainable financial system with reduced levels of unsustainable systemic risk. Islamic finance is subset within responsible finance that is a value-based system. Responsible investment is a financial returns-oriented approach focusing on the integration of

ESG data within financial analysis to improve investment results while also supporting the greater welfare to the society and environment.

One of the key differences in responsible finance is a focus on more active engagement with companies about their ESG qualities, which is not something in common practice for Islamic investments. For Islamic investment, excessive leverage in the capital structure of investee companies is restricted, originating from a need to reduce exposure to companies that pay or receive more than a *de minimis* levels of interest in relation to their business activities. Responsible investment does not apply the same principles, but it strives to positively change the environmental and social impact of the investment considering the contribution towards SDGs. In contrast, although Islamic values prioritizes these same SDG-relevant issues, Islamic finance is more narrowly focused on the Shari'ah compliance and legal perspectives in practice in comparison to the wider ethical proposition.

Due to the ever-changing nature of global markets, investors are always on the search for strategies that can improve risk-adjusted returns including new ways to benefit from diversification. Investors from Islamic and responsible finance angles want to know whether other strategies can be complementary in terms of the hedging properties they deliver. The overlaps between SRI and Islamic finance both being ethically screened could lead to wider uptake if they can generate superior investment performance which would benefit the shared objectives of both (Charfeddine et al., 2016).

Empirical studies regarding the return volatility as well as the linkage between these two approaches to responsible finance are still in the infancy stage, but it is important because opportunities for portfolio diversification between the two investment strategies could attract new investors to each. For example, one of the reasons for the positive abnormal return over the bull period could be Islamic index's dominant focus on the defensive sector such as basic materials, industrial sector and consumer cyclical (Hussein and Omran, 2005). Bin Mahfouz and Hassan (2013) document similar performance between Islamic and SRI and conclude that Islamic investment philosophy is integral and complementary to the wider sustainable and socially responsible investment market.

Theoretically, Markowitz (1952) concludes that the adoption of an ethical filter should lead to the suboptimal and lower performing portfolio because of the reduction in the efficient frontier. Within Islamic finance, Bauer et al., (2005) find support for this theoretical result and find that higher transaction costs, excess liquidity constraints, and lower Shari'ah-compliant diversification potential leads to higher risk and lower performance. In contrast, Gueckel (2017) finds that the Shari'ah compliant portfolio outperforms both an exclusions-based socially responsible and unscreened portfolio while validating the theoretical proposition from Markowitz that exclusions-focused SRI investments underperformed their unscreened universe.

Barnett and Salomon (2006) find that the performance of SRI funds increases with the intensified screening system focused on finding financially material rationale during implementation. Capelle-Blancard and Monjon (2014) explain that greater strategy and positive screening motivate the best ESG practices and thus lead to better financial performance. Hayat and Kraeussl (2011) find no significant differences in the risk-adjusted return between Islamic and conventional mutual funds or indices. Hussein and Omran (2005) and others including Hoepner et al., (2011), & Walkshaeusl and Lobe (2012) concur and find that Islamic indices at least narrowly are able to return superior performance than its conventional counterpart during the financial crisis. Merdad et al., (2010) show the underperformance of Islamic fund during buoyant periods. Each of these findings is narrower than the finding in Gueckel (2017) which studies broad investment universes rather than funds to avoid differences in transaction costs or internal expenses between Islamic and conventional funds. The latter study finds clear performance benefit from Shari'ah compliant screening as a result of the accounting ratio screens which provide a bias to quality in the investment universe compared to both SRI and unscreened universes.

Although many similarities exist between Islamic finance and SRI particularly in promoting social welfare by incorporating ethics in investing (Williams and Zinkin, 2010; Erragraguy and Revelli, 2015), there are many differences due to concentration on different market capitalization companies, restrictions on excessive leverage, and sector concentrations that affect performance differently for Islamic investment strategies at different points in the economic cycle (Bauer et al., 2005; Forte and Miglietta, 2007; Walkshaeusl and Lobe, 2012). Consequently, we expect investors from Islamic finance and SRI could pair together complementary investment classes

and more intuitively the differences between these two could offer diversification opportunities for both sorts of investors. This would allow them to reduce the unsystematic risk arising from the differences between the two. Islamic investors who have not included consideration of any environmental or ecological risks can derive similar outcomes that mitigate negative impacts by incorporating the ESG screening in their investments.

We aim to estimate whether there are any diversification opportunities between Islamic and SRI investments. If so, we investigate whether a combined approach maintain time-varying profile and sorting the portfolio diversification benefits at multiple investment horizons using MGARCH-DCC and wavelet methods which we think will be the most effective econometric method to use. In the past, other studies have used cointegration test, generalized VAR, BEKK-GARCH, ARMA, VEC, Copula, and EGARCH models, which are less applicable for testing diversification benefits because of the poor fitness of the model (see Sadorsky, P. 2012). Therefore, this study contributes to time-varying diversification opportunities as well as analyzing the returns features in multiple investment horizons that has not been reflected in the previous research that we have reviewed.

2.1 Modern Portfolio Theory

Generating positive equity returns is the greatest wealth building tool for the equity investors, who seek to maximize returns for a given level of risk. Hence, the investment strategy that a given investor employs will be critical to delivering the desired outcome. This paper adopts Markowitz’s modern portfolio theory of 1952 that assumes the expected portfolio returns tends to be maximized for a given portfolio risk level, or that the risk of a portfolio is minimized for a given portfolio return with a diversified portfolio compared to an investment in an individual security (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. The model describes the risk as:

$$\sigma_p^2 = (\sum W_i^2 \sigma_i^2 + \sum W_i W_j Cov_{ij}) \dots \dots \dots (i)$$

Here, W_i indicates proportion of the portfolio in asset i , σ_i implies the standard deviation of expected returns of asset i , and Cov_{ij} means the covariance of expected return of assets of i and j . Because the covariance maintains less than one (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 individual portfolio holdings, so diversification contributes to reducing risk.

In line with Bouri et al., (2017) and Guesmi et al. (2019), our study would address the portfolio diversification benefits of using a different form of responsible investment for investors who have already invested or interested in Shari'ah compliant securities. Unlike previous studies, we use both time invariant and time variant correlations in order to see relationships in different investment time horizons.

3. Data & Methodology

The daily stock indices return of Dow Jones Islamic Global Market – Price index, Dow Jones Islamic Europe - Price index, Dow Jones Islamic US-Price index, Dow Jones Islamic UK-price index and FTSE4GOOD Global (US\$) – Price Index, FTSE4GOOD Europe-price index, FTSE4GOOD US-price index, FTSE4GOOD UK-price index, are used for the period from 01-January-1997 to 22-May-2017. The time period of this study is restricted due to non-availability of a longer period of time. However, we have 5,320 observations which would well capture the time-varying volatilities and correlation dynamics of market returns. The full data set has been collected from Thomson Reuters DataStream. The stock indices are calculated as difference of the logarithmic daily closing prices of indices $[\ln(p_t) - (\ln p_{t-1})]$ where p is an index value. The conversion is necessary to get stationarity in variance (Engle, 2002).

This research applied two methodologies such as Multivariate Generalized Autoregressive Conditional Heteroscedastic-Dynamic Conditional Correlation (MGARCH-DCC) and Continuous Wavelet Transforms (CWT) wavelet respectively to investigate how volatility and correlation change over time and how outcomes vary at different stock holding periods.

3.1.1 Multivariate GARCH-DCC

This study uses the Multivariate Generalized Auto-regressive Conditional Heteroscedastic-Dynamic Conditional Correlation (MGARCH-DCC) model suggested by Engle (2002) and Pesaran and Pesaran (2010) to find out how variance and correlations between the assets change over time including the directions (positive or negative) as well as the magnitude (strong or weak). There are a few advantages that motivate us to use it in our study: firstly, DCC enables the analysis of time variation in both mean and variance equation; secondly, DCC helps investors to

find out how correlations between assets change over time; thirdly, DCC approach is reasonably flexible in modeling individual volatility and can be applied to portfolios with large assets (Pesaran and Pesaran 2010).

Therefore, the MGARCH-DCC model has been widely used to detect portfolio diversification benefits. Hence, we make a humble attempt to use this model to meet our research target. The equation formulation similarly applied by the previous studies (see, Hsu Ku & Wang, 2008; Najeeb, Bacha, & Masih, 2015; Saiti, Bacha, & Masih, 2014) can be laid down as follows;

$$\begin{aligned}
 r_t &= \beta_0 + \sum_{i=1}^k \beta_i r_{t-1} + u_t = \mu_t + u_t \\
 \mu_t &= E[r_t | \Omega_{t-1}] \\
 u_t | \Omega_{t-1} &\sim N(0, H_t) \\
 H_t &= G_t R_t G_t \\
 G_t &= \text{diag}\{\sqrt{h_{ii,t}}\} \\
 Z_t &= G_t^{-1} u_t
 \end{aligned}$$

Hence, $h_{ii,t}$ 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-zero and variance-one. With the accomplishment of this basic construction, the dynamic correlation coefficient matrix of the DCC model can be specified further following Hsu Ku & Wang (2008):

$$\begin{aligned}
 R_t &= (\text{diag}(Q_t))^{-1/2} Q_t (\text{diag}(Q_t))^{-1/2} \\
 Q_t &= (q_{ij,t}) \\
 (\text{diag}(Q_t))^{-1/2} &= \text{diag}\left(\frac{1}{\sqrt{q_{11,t}}}, \dots, \frac{1}{\sqrt{q_{nn,t}}}\right) \\
 q_{ij,t} &= \bar{p}_{ij} + \alpha(Z_{i,t-1} Z_{j,t-1} - \bar{p}_{ij}) + \beta(q_{ij,t-1} - \bar{p}_{ij})
 \end{aligned}$$

Where \bar{p}_{ij} is the unconditional correlation coefficient and the time-varying conditional correlation coefficient is $p_{i,j,t} = q_{i,j,t} / \sqrt{q_{ii,t} q_{jj,t}}$. Meanwhile, the returns of financial assets often appear to be fat-tailed where the assumption of normal distribution is invalid. To that end, one plausible treatment might be the usage of the Student's T-distribution. That means the conditional distribution $u_t | \Omega_{t-1} \sim N(0, H_t)$ takes the place of $u_t | \Omega_{t-1} \sim \int \text{student-t}(u_t; v), (0, H_t)$ hence v constitutes the parameter for the degree of freedom.

3.1.2 Continuous Wavelet Transformation (CWT)

Investors have different preferences regarding time scales or investment horizons or holding periods of stocks. While, the detection of true dynamics and relationship of co-movement between different markets would be possible if the financial markets were decomposed into different time scales or holding periods (In & Kin 2013). This has been possible because of Wavelet, since it takes care of the heterogeneity in investment horizons considering the time and frequency domain feature of the data. Several studies by applied CWT approach to figure out the heterogeneity in investment horizons (Saiti, 2012; Madaleno & Pinho,2012; Vacha & Barunik, 2012; Aloui & Hkiri, 2014; Najeeb et al., 2015; Rahim & Masih, 2016; Buriev et al., 2018). Therefore, we adopt the Continuous Wavelet Transformation (CWT) to examine how the international portfolio diversification benefits changes over time provided the appearance of the heterogenous equity-holding periods.

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

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

Hence, u refers to the time domain and s refers to its location in the Frequency domain. Thus, the wavelet transforms, by mapping the original series into a function of u and s , give us information simultaneously with respect to time and frequency. This study applied a bivariate framework called wavelet coherence to find out the interaction between two-time series (e.g., how closely X and Y are interrelated by liner transformation). Similar with Torrence and Webster (1999), the wavelet coherence of two-time series can be explained as follows:

$$R_n^2(s) = \frac{IS(s^{-1}W_n^{xy}(s))I^2}{S(s^{-1}IW_n^x(s))I^2 \cdot S(s^{-1}IW_n^y(s))I^2}$$

While S is a smoothing operator, s is a wavelet scale, $W_n^x(S)$ is the continuous 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 (see details: Madaleno and Pinho, 2012; Gencay et al. 2002; and In and Kim 2013).

4. Empirical Results and discussion

Table A1 & A2 (see the Appendix) presents variables of the study and the descriptive statistics of the entire studied variables from January 1, 1997 and May 22, 2017. The mean of all eight variables namely DKT, DEU, DUS, DUK, FGL, FEU, FUS, and FUK hold 2003.04, 2,420.69, 2,297.90, 1,950.66, 5,445.51, 4,077.43, 5,207.43, 4,905.46 with SD of 542.40, 596.13, 756.83, 375.27, 1,104.32, 832.46, 1,419.74, 787.49 respectively which implies a particular deviation from the mean. Hence, dispersion ranges from 375.27(DUK) to 1,419.74 (FUS). This means that the magnitude of the variation of the Dow Jones Islamic UK-price index return for the period of January 1, 1997 and May 22, 2017 is relatively low whereas, the variation of the FTSE4GOOD U.S.-price index return is high over the period of January 1, 1997 and May 22, 2017. However, the skewness and Kurtosis indicates the normality of the distributions for all the studied variables.

4.1 Results of MGARCH-DCC

The results in Table 1 implies that the volatility parameters are highly significant which means the gradual volatility decay over the time. This indicates that the availability of riskiness in the returns gradually cancels out after a shock in the market. This could be explained by the fact that that the stock return volatility changes with the time-varying volatility of various macro-economic variables (Schwert, 1989). The sum up of λ_{DKT1} and λ_{DKT2} ($0.93183+0.060253=0.992083$) is less than 1, this means that the volatility of Dow Jones Islamic Market Index returns together with other returns are not following the Integrated Generalized Auto Regressive Conditional Heteroskedasticity (IGARCH), or alternatively, the shocks to the volatilities are not permanent, but mean reverting. This also means that the index return might go ups and downs considerably, but it tends to converge to the mean value in the long run and it does not completely crush to zero even in the face of significant shocks. Although the diffusion and noise makes the deviation, a strong elastic force make the volatility back to the long term value (Merville&Piepeta, 1989). If shocks are permanent, investors and portfolio managers would have high possibility to lose their investment. While the shocks are transitory, speculators welcome such conditions because this is favorable to their interests (Najeeb et al., 2015; Ali et al., 2018).

Table 1: Multivariate GARCH with underlying multivariate t-distribution

Volatility decay factors unrestricted, different for each variable.

Correlation decay factors unrestricted, same for all variables.

Parameter	Estimate	Standard Error	T-Ratio[Prob]
<i>lambda1_DEU</i>	.94038	.0043774	214.8274[.000]
<i>lambda1_DKT</i>	.93183	.0037894	245.9071[.000]
<i>lambda1_DUK</i>	.94595	.0039525	239.3303[.000]
<i>lambda1_DUS</i>	.89848	.0078868	113.9231[.000]
<i>lambda1_FEU</i>	.93941	.0034555	271.8568[.000]
<i>lambda1_FGL</i>	.93637	.0031815	294.3122[.000]
<i>lambda1_FUK</i>	.94301	.0033633	280.3853[.000]
<i>lambda1_FUS</i>	.92696	.0045767	202.5373[.000]
<i>lambda2_DEU</i>	.053519	.0036546	14.6443[.000]
<i>lambda2_DKT</i>	.060253	.0031267	19.2701[.000]
<i>lambda2_DUK</i>	.047733	.0031968	14.9314[.000]
<i>lambda2_DUS</i>	.091593	.0067193	13.6314[.000]
<i>lambda2_FEU</i>	.055133	.0029572	18.6437[.000]
<i>lambda2_FGL</i>	.056852	.0026360	21.5675[.000]
<i>lambda2_FUK</i>	.051388	.0028341	18.1322[.000]
<i>lambda2_FUS</i>	.065456	.0038819	16.8618[.000]
<i>delta1</i>	.97587	.0011043	883.7045[.000]
<i>delta2</i>	.017128	.6299E-3	27.1892[.000]
<i>Df</i>			
Maximized Log-Likelihood = 228405.7			

df is the degrees of freedom of the multivariate t distribution

Next, this MGARCH-DCC approach is conducted to detect the portfolio diversification benefits for Islamic equity investors as well as responsible investors. Hence, we look at the unconditional volatilities and correlations (Table 2) below after MGARCH-DCC analysis on all indices returns.

Table 2: Unconditional volatility and correlation

	DEU	DKT	DUK	DUS	FEU	FGL	FUK	FUS
<i>DEU</i>	.0017641	-.029408	.93799	.46954	-.058936	-.042224	-.065538	-.006790
<i>DKT</i>	-.029408	.0014113	-.027116	-.010380	.72828	.95093	.69989	.87101
<i>DUK</i>	.93799	-.027116	.0018623	.44521	-.058634	-.039097	-.069504	-.004116
<i>DUS</i>	.46954	-.010380	.44521	.0016862	-.017947	-.023157	-.019886	-.005687
<i>FEU</i>	-.058936	.72828	-.058634	-.017947	.0015869	.80980	.92611	.53471
<i>FGL</i>	-.042224	.95093	-.039097	-.023157	.80980	.0012862	.77938	.85024
<i>FUK</i>	-.065538	.69989	-.069504	-.019886	.92611	.77938	.0013967	.49284
<i>FUS</i>	-.0067905	.87101	-.004116	-.005687	.53471	.85024	.49284	.0015491

The On-diagonal element of table 2 indicates the unconditional volatilities of the assets, while off-diagonal elements represent the unconditional correlation between assets. The coefficient of any unconditional volatility near to zero means the particular asset has the least volatility whereas the coefficient of any unconditional volatility near to 1 indicates that it has higher volatility levels. thus, the magnitude of the volatility changes with the increase from 0 to 1. Hence, the results show that Dow Jones UK Islamic Index return has the highest volatility, where as the FTSE4Good Global Index has the lowest volatility.

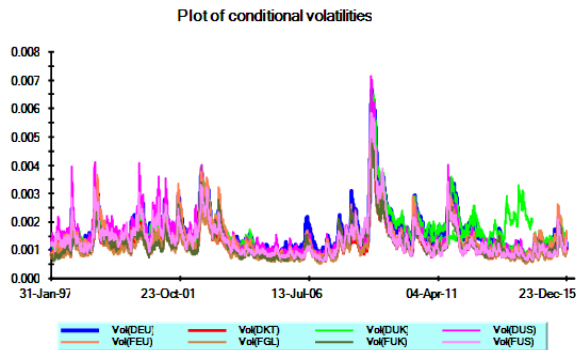


Figure 1 Conditional Volatility based on Gaussian Distribution

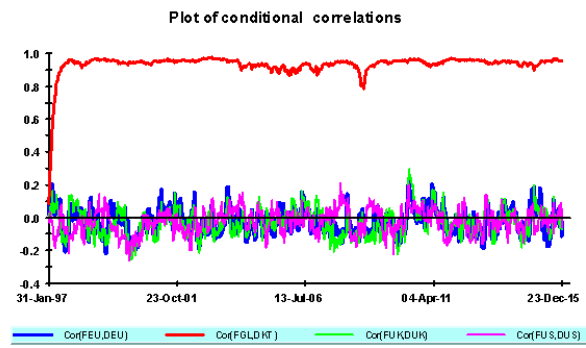


Figure 2: Conditional Correlation based on Gaussian Distribution

Figures 1 and 2 show the time-varying volatilities and correlations among Shari'ah equity indices and socially responsible equity indices ranging from January 1, 1997, to May 22, 2017. The conditional volatilities of all stock indices both Shari'ah and responsible returns move together closely during the observation period with sometimes the leads of U.S. and UK Shari'ah equity return which is observable and consistent with our earlier results driven by unconditional volatility and correlation matrix illustrated in Table 2. Figures 3 and 4 show the correlation of all equity indices correspondingly varies overtime. The Dow Jones Global Islamic and FTSE4GoodGlobal Market Index have the highest positive correlation, whereas all other corresponding equity indices move between positive and negative correlation over the sample time frame. This implies the existence of portfolio diversification benefits over the time for the investors and fund managers maintaining Shari'ah and responsible principles.

Moreover, the breakdown during the time period between 2007 and 2009, which is marked as the Great Financial Crisis, shows that there was a great volatility at the end of 2008 and beginning of 2009. However, during the time of 2008, dynamic conditional correlations were negative among all Shari'ah and responsible investment indices correspondingly except the global series of each.

This supports the higher volatility during global financial crisis and the prevalence of portfolio diversification between Shari'ah and responsible investment, since the correlations of all indices maintain lower than 0.30 and even negative which support the prevalence of portfolio diversification benefits. The diversification might appear because of Islamic indexes are less affected by the systematic risk than responsible indexes, again because of the immunity of Islamic stock to the interest rate risk, market, liquidity and unsystematic risk (Erragragui, Hassan, Peillex, & Khan, 2018; Shamsuddin, 2014). While, the study by Jawadi, Jawadi, and Cheffou (2019) document that responsible and conventional stock have high level of uncertainty varying with time due to business cycles and other noises.

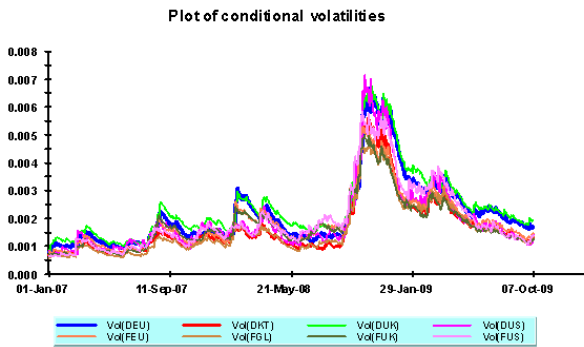


Figure: 3 Conditional Volatility based on Student T distribution

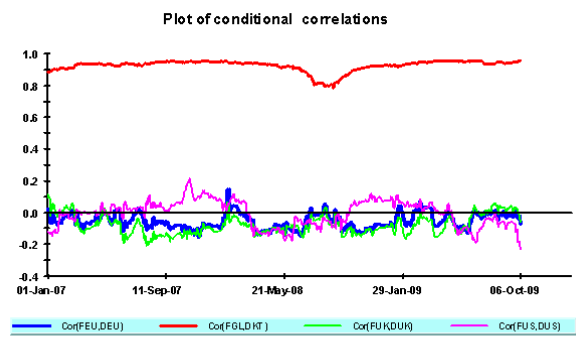


Figure: 4 Conditional Correlation based on Student T distribution

4.1.1 Results of CWT

As we know that CWT can capture the existence of portfolio diversification opportunities at different investment horizons, we apply it for the portfolio diversification between Shari'ah-compliant and responsible investment presented in the figure 5a-d. Here, the horizontal axis represents time (number of trading days) and the vertical axis indicates investment horizons. The thick black line in the coherency plots indicates the statistical significance level at 5% estimated by using Monte Carlo method. The color code for power ranges from blue (low coherence) to red (high coherence). The right-pointing vector indicates the indexes are in the phase while left-pointing vector indicates just the opposite. To understand more about the lead/lag relationship, right (left) arrow means that the two variables are in phase (anti-phase). The arrows point to the right and up, suggesting the first series is leading. When they point to the right and down, suggesting the first series is lagging. While the arrows are to the left and up, indicating second

series is leading and if they are to the left and down second series is lagging (Saiti, 2012; Madaleno & Pinho, 2012; Gallegati et. al, 2014; Abdullah, 2016).

Hence, we sorted the series into various holding periods from short to long time length such as 4-16 and 16-32, 32 to 64 and 64 to 256 trading days particularly to capture the existence of portfolio diversification. We find that the correlation between the series of Shari'ah compliant and responsible investment equity indices are quite high as shown in Figure 5abcd. The result also shows that the correlation between Shari'ah compliant and responsible equity indices is largely independent of the investment horizon, although in some index pairs, the longer time horizons (c. 256 days) show the greatest benefit from Shari'ah compliant investment as a leading indicator for responsible investment. This suggests that the benefits from Shari'ah compliant investments is not something that speculators can take advantage of but that patience among investors is rewarded, which is in line with our expectation.

The comparison between the global and U.S. indices with the UK and European indices shows that the former tends to have higher correlation than the latter. The UK and European indices diverged more significantly before the crisis but joined the U.S. and global indices in driving similar portfolios for both Shari'ah compliant and responsible investment. They have also returned to being less correlated after the European debt crisis and only experienced a high degree of correlation when central bank action was most critical for equity performance.

The figure 5a-d shows that the Islamic equity of UK and Europe have lower correlation with responsible investments of the UK and Europe respectively for very short holding periods (such as 4-16 and 16-32 and 32 to 64 days). However, the correlation of the above stock indices of UK and Europe grows up in the longer investment horizons. Whereas the correlation between US Shari'ah-compliant equity and US responsible investments maintains relatively lower correlation only 4- and 8-days investment horizons but there is a high correlation of Shari'ah and responsible of global market for almost all investment horizons for. However, the correlation of all the equity indices is always lower during the global financial crisis, implying the crisis reduces the integration process.

In summary, CWT result reveals that the diversification opportunity between Shari'ah compliant and responsible investment exists for short run holding period (anomaly happens only for the global equity market index). This result suggests that diversification benefits of using the

screening methods are greater over short run holding periods, but there are exceptions in several market areas to this conclusion. Whereas, we can see the relative higher correlation for longer investment horizons across all market of Shari’ah and responsible stocks. Moreover, the lower correlation among the Shari’ah and responsible equity investments prevails during the Great Financial Crisis of 2007 to 2008. This result is also consistent with our earlier findings in time varying conditional correlation analysis.

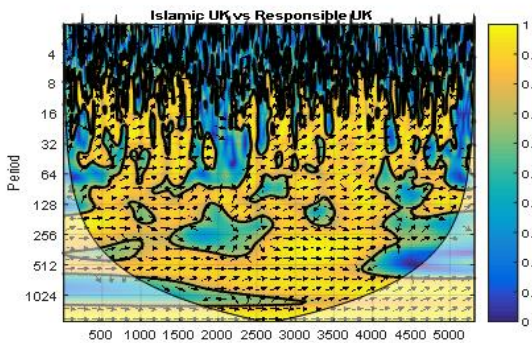


Figure: 5.a Continuous Wavelet Transform-UK *Shariah* and Responsible Stocks

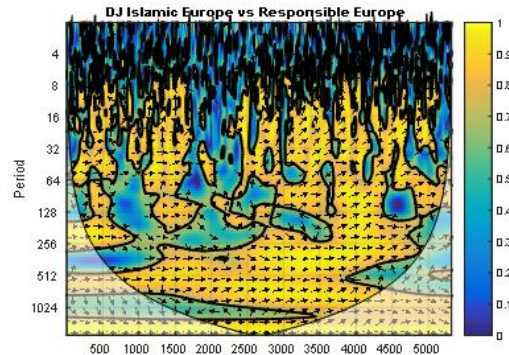


Figure: 5.b Continuous Wavelet Transform-Europe *Shariah* and Responsible stock

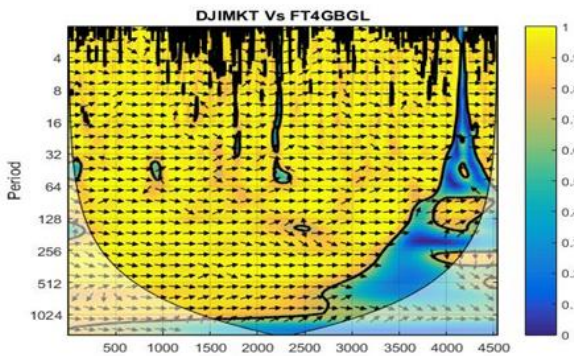


Figure: 5.c Continuous Wavelet Transform-Global *Shariah* and Responsible Stocks

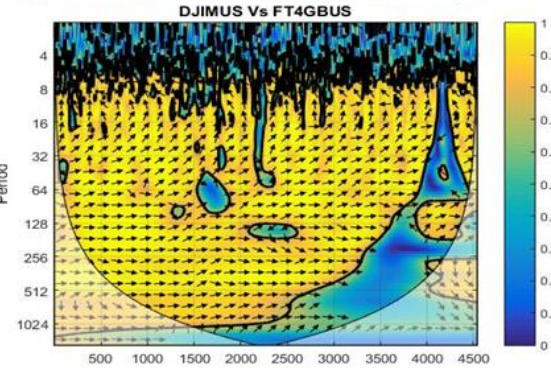


Figure: 5.d Continuous Wavelet Transform-US *Shariah* and Responsible stocks

5. Discussions and Analysis

The results across the model show the diversification which persists along all the indices except the global Shari’ah-compliant and responsible investment index returns. This suggests that Shari’ah-compliant and responsible investment can be useful for hedging the risk to both sides. This hedging purpose may be easier for conventional SRI investors to implement because they have fewer types of investments that are permitted by Islamic screens that SRI investors would avoid. For example, most SRI investors exclude GMO and nuclear power, which remain viable for Islamic investors. Companies with very poor ESG scores or those involved in serious

controversies may be included in Islamic investment universes that focus on a more legalistic approach to screening and don't consider wider ethical issues. Excluding these particular sectors or companies, or investing in them and undertaking more aggressive engagement, may be an option for the conventional investors wishing to use Islamic portfolios for diversification.

Islamic investors would have more of an objection to using traditional responsible investment portfolios that include non-Shari'ah compliant investments, even for hedging purposes. These portfolios would include several prohibited sectors including financial institutions that operate with interest. It would be much harder to implement, and there would be loss of diversification benefits if these investors took an SRI strategy and then overlaid an Islamic sector screen to remove poor performers. An alternative strategy that may be more effective would be to overlay a higher-frequency ESG tilt (adjusting the weightings of the Shari'ah compliant portfolio on the basis of their ESG scores) to pick up the short-term diversification benefits without restricting investment options too significantly.

This would align with another solution that has come into focus recently, but which does not have the available empirical evidence yet to understand the financial implications. This would be an investment approach combining responsible investment principles in the context of a Shari'ah screened portfolio. Islamic finance has started to focus more than ever to enhance the projects tied up more positive environmental impact as well as to train employees and managements on sustainable business practices (RFI Foundation, 2018). As a result, if the evidence confirms performance benefits from combining responsible investment and Islamic screens offers better risk-adjusted returns than either deliver on their own, it could create a better outcome for all responsible investors.

6. Conclusions

Despite the many similarities between responsible finance and Islamic finance, the proponents of both want to see the convergence rather than divergence, Investors from both sides in OIC countries as well as countries with sizeable responsible investment participation in Europe and North America are showing interest to have cross-access to responsible and Islamic investment because of the benefits of integration of ESG factors in their investment process. However, little is known about the performance of both when paired together to promote portfolio

diversification. Therefore, this study makes the first empirical attempt to explore this possibility with daily data frequency.

Our findings intuitively indicate that responsible investment practices can contribute as a hedging tool compared with traditional Islamic screening or vice versa. The impact of combining the two together is higher across shorter time frames rather than long term investment horizons. The diversification impact may be significant during financial crisis when time varying correlation is low. The result could be beneficial for individual and institutional investors and could also be a relevant item for awareness when making capital market policy to encourage different forms of responsible.

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Appendix

Table A1: Selected stock indices applied for the study

Symbol	Stock indices
<i>DJIMKT</i>	Dow Jones Islamic Global Market – Price index
<i>DJIMEU</i>	Dow Jones Islamic Europe - Price index
<i>DJIMUS</i>	Dow Jones Islamic US-Price index
<i>DJIMUK</i>	Dow Jones Islamic UK-price index
<i>FT4GBGL</i>	FTSE4GOOD Global (US\$) – Price Index
<i>FT4GBEU</i>	FTSE4GOOD Europe-price index
<i>FT4GBUS</i>	FTSE4GOOD US-price index
<i>FT4GBUK</i>	FTSE4GOOD UK-price index

Table A2: Descriptive statistics

	Mean	SD	Min	Max	Skewness	Kurtosis
<i>DKT</i>	2003.048	542.4053	1038.47	3259.01	.2599918	2.062691
<i>DEU</i>	2420.691	596.1332	1246.24	3538.56	-.0398424	1.870172
<i>DUS</i>	2297.905	756.8355	1086.73	4281.88	.8299045	2.732355
<i>DUK</i>	1950.661	375.2725	1054.32	2840.83	-.266207	2.327919
<i>FGL</i>	5445.511	1104.32	0	7768.75	-.0202354	2.138249
<i>FEU</i>	4077.43	832.4685	2118.1	6167.57	.1983535	2.342132
<i>FUS</i>	5207.437	1419.742	0	9297.3	.857306	3.124615
<i>FUK</i>	4905.466	787.4915	2887.54	6681.07	-.1978942	2.221802
<i>N</i>	5319					