Global Risk Exposures and Industry Diversification with Sharia-Compliant Equity Sectors

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Abstract

This paper examines the risk exposures of ten major Islamic sector indexes with respect to shocks in global conventional markets. Utilizing a dynamic three-regime, three-factor risk spillover model, we generally observe positive risk exposures of Islamic equity sectors with respect to developed market shocks. Consumer Services, Oil & Gas and Technology, however, are found to exhibit negative risk exposures during crash periods, implying possible safe haven benefits for global investors. Both in- and out-of-sample results suggest that the portfolios supplemented with positions in Islamic equity sectors yield much improved risk adjusted returns, implying significant international diversification benefits. Financials, Healthcare, Telecommunication, and Utilities particularly stand out with relatively higher weights allocated in the optimal portfolios, implying the significance of these Islamic sectors in global diversification strategies.

JEL Classification: C32, G11, G15

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1. Introduction

The Islamic financial industry is viewed as an alternative investment to the conventional counterpart in the world of financial intermediation because it may bring diversification and financial stability. This Sharia-compliant industry has experienced significant growth over the past two decades, with an increasing number of equity and debt (sukuk) securities offered in financial markets worldwide including North America, Europe, Asia and the Middle East and North Africa (MENA). The growth has been reinforced in the wake of the 2008-2009 global financial crisis (GFC) which wreaked havoc on conventional markets.

At the end of 2012, the total value of Islamic finance assets under management was estimated at US $1.6 trillion and approximately US $1.8 trillion at the end of 2013. They are estimated to reach the US $2 trillion mark by the end of 2015. These are also predicted to reach US $6.5 trillion by 2020.[1] Similarly, the global emerging sukuk (Islamic bond) market was expected to reach US $131.2 billion. At the end of 2012, the size of the Islamic banking assets that have been the main driving force of the global Islamic finance industry reached US $1.27 trillion. The asset allocations in the Islamic funds are composed of 46.9% equities, 22.2% money markets, 11.8% mixed assets and 9.0% real estate.

Islamic equity securities are viewed to be less risky than their conventional counterparts, largely due to their relatively low leverage ratios, the restrictions on investable industries and on the use of financial derivatives which might be related to speculative transactions. Investments in the Sharia-compliant assets are considered in line with the socially responsible and ethical investments (Saida et al., 2013; Abdelsalam, 2014). Sharia compliance requires that Islamic equity finance follows two sets of screens. The first set eliminates any companies with involvement in activities such as alcohol, tobacco, pork-related products, gambling, entertainment, weapons, and conventional financial services. These activities are prohibited by Sharia rules since they are not considered to be conducive to the society's welfare. Sharia rules also prohibit dealing with activities that involve *Riba* and *Gharar* (Berg and Kim, 2014). Although the term *Riba* has no precise translation in English (El-Gamal, 2006), it can basically be interpreted as the premium (or interest) that should be paid by the borrower to the lender along with the principal. The term *Gharar* on the other hand refers to transactions that involve the sale of risk or trading in risk which may result in the creation of doubt or deception (El-Gamal, 2001). These rules view the creation of wealth for one party at the expense of another as unjustified and against the general

[1] These numbers come from various sources including Bloomberg and Kuwait Finance House Research Ltd.

interest and welfare of the society. Consequently, speculation and short-selling in stocks are also not allowed under Sharia rules (Kamali, 2000). The former is considered to be hazardous that harms more than benefits, while the second is regarded to involve selling what is not in one's possession and involves uncertainty. Finally, risk management or risk reduction techniques such as hedging and insurance are not allowed in Islam.

On the other hand, the economic interpretations of Riba and Gharar have often been open to interpretation and it can be argued that almost all business transactions involve some form of Riba and Gharar. Consequently, if these rules are applied literally to Islamic investments, the number of companies eligible for investment under Sharia rules would virtually be equal to nil. Therefore, Islamic scholars have established a set of financial rules that utilizes financial ratios to screen and filter companies to be included in Islamic equity indices. First, the company's debt ratio must not exceed 33% of total assets. Second, the ratio of accounts receivables to total assets must be below 45%. Third, any income generated from interest must equal to or less than 5% of total revenue. The process of prohibiting interest income does not halt at the enforcement of those rules. Any interest income spawned from interest-based sources is identified and must be given out for charity. This process is known as 'cleansing'. Equally, preferred stocks and the receipt of fixed dividends are also considered unlawful.

In short, the Sharia-based rules lead to the elimination of a number of investments including speculative financial transactions such as those involving financial derivatives that have no underlying real assets, government debt issues with a fixed coupon rate, hedging by forward sale, interest-rate swaps and any other transactions involving items not physically in the ownership of the seller (e.g., short sales). To that end, it can be argued that Islamic equity markets may be largely segmented from their conventional counterparts as they avoid much of the fundamental risk factors, some of which had contributed to the recent global financial

crisis. Thus, a natural research question is whether these unique features of Islamic securities lead to the segmentation of this market segment from conventional markets and whether this segmented nature can offer significant international diversification benefits for investors in global markets.

This paper contributes to the literature in several ways. First, it extends the emerging literature on Islamic equity markets by examining risk exposures of ten major Islamic equity sectors with respect to shocks in global markets and their conventional sector counterparts, which to our knowledge has not been done before. This contribution is important due to the considerable sector rebalances that occurred in response to the losses suffered in the conventional equity sectors during the recent crisis and post crisis periods. The industry focus in the current study is further motivated by Moerman (2008) stating that industry-based diversification yields more efficient portfolios than country-based diversification. Therefore, extending industry diversification to Islamic equities offers a new perspective to the literature.

Second, the paper proposes a generalized three-factor spillover model to explore the Islamic and conventional equity sectors' sensitivity to shocks in global conventional markets. The three-factor spillover model distinguishes between shocks to advanced and emerging markets as well as shocks in the corresponding conventional equity sectors. By doing so, the model provides inferences regarding the possible segmentation (or integration) of Islamic equity sectors from (or with) the conventional equity markets and allows us to make inferences regarding the industry diversification benefits of Islamic versus conventional industries. For this purpose, we cover ten key sectors including Technology, Financials, Industrials, Utilities, Basic Materials, Consumer Goods, Oil & Gas, Healthcare, Consumer Services, and Telecommunications. Third, the paper offers a dynamic analysis of risk transmissions over three market regimes, low, high and extreme volatility, as suggested by

the data. The dynamic spillover model takes the time-varying and regime dependent nature of the interactions across developed and emerging markets as well as global and Islamic sectors in a robust framework with flexible regime-switching structure. Thus, the dynamic approach allows us to examine whether Islamic sectors could serve as a diversifier or a safe haven for global investors during different market regimes. Finally, the study provides evidence on the in- and out-of-sample performance of dynamic portfolio strategies in which the global portfolio is supplemented by positions in the Islamic equity sectors and provides insight to the international diversification benefits of these assets.

Our findings suggest that Islamic sectors generally but with some exceptions exhibit positive risk exposures with respect to developed market shocks, implying that Islamic sectors in general are not isolated from developed equity market fundamentals. The sectors Consumer Services, Oil & Gas and Technology are however found to exhibit negative risk exposures during extreme market volatility periods, suggesting that these three Islamic sectors could serve as a safe haven for investors in developed markets during periods of market crisis. We also observe a significant "industry effect" in Islamic equities, particularly in the case of Consumer Goods and Consumer Services sectors, while Islamic Financials are found to show the lowest level of risk exposure to shocks in the global (conventional) financial sector, suggesting some degree of separation from the conventional financial system. Interestingly, Islamic financials are found to be mostly driven by its own sector specific fundamentals, possibly due to the investment filters in places that affect financial firms the most.

Finally, the analysis of both in- and out-of-sample portfolios from all three alternative spillover models suggests that portfolios augmented with positions in Islamic equities yield much improved risk-adjusted returns compared to the undiversified global portfolio, implying significant international diversification benefits from allocating portfolio positions to Islamic

equities. The Islamic Financials, Healthcare, Telecommunication, and Utilities sectors stand out with relatively higher weights allocated in the optimal portfolios, compared to other sectors. The findings also suggest that the dynamic portfolios constructed using the covariance matrices obtained from the general unsynchronized MS model yield the best risk-adjusted returns, underscoring the importance of the risk spillover model underlying the model parameters.

The remainder of the paper is organized as follows. Section 2 provides the review of the literature. Section 3 presents the details of the three-factor spillover model and the variance ratio analysis. Section 4 discusses the results and Section 5 examines the diversification benefits across the Islamic sectors. Section 6 concludes the paper.

2. Literature review

The early literature on Islamic finance focuses on the characteristics of these markets and the possible links between Islamic banks, equity markets and their conventional counterparts (Bashir, 1983; Robertson; 1990; Usmani, 2002; and Iqbal and Mirakhor, 2007; Obaidullah, 2009; Sefiani, 2009; Abd Rahman, 2010; Adam and Abu Bakar, 2014). The more recent literature has focused mostly on the relative performance of the Islamic finance industry in comparison to the conventional counterpart, particularly during the recent global financial crisis. In this aspect, the focus has been largely on the major or aggregate benchmark indexes (e.g., Annuar et al., 1997; Hussein and Omran, 2005; Abdullah et al., 2007; Hayat and Kraeussl, 2011; Milly and Sultan, 2012; Abdul Karim et al., 2012; Beck et al., 2013; Jawadi et al., 2014). For example, Hayat and Kraeussl (2011) examine the risk and return characteristics of a sample of 145 Islamic equity funds (IEFs) over the period 2000-2009 and find that IEFs are underperformers, compared to the Islamic and conventional equity benchmarks. This underperformance seems to have increased during the recent financial crisis.

Abdul Karim et al. (2012) examine the effect of subprime mortgage crisis on Islamic banking financing and the Islamic stock market in Malaysia over the period 2000-2011. They find that both the Islamic banking financing and stock market variables are cointegrated with several macroeconomic variables (inflation, real exchange rate, interest rate, and economic activity as represented by the industrial production index) both before and during the crisis period. With the onset of the global financial crisis (GFC) and the Eurozone debt crisis, the burgeoning literature has also examined the impact of the crisis on the performance of Islamic finance and the link between Islamic and conventional stock markets as well as other macroeconomic and financial factors. In a related study, Jawadi et al. (2014) underlines the superiority of Islamic stock investing in outperforming conventional investments, particularly during the recent global financial crisis.

A number of studies have examined the risk/return tradeoffs offered by Islamic equity funds, compared to conventional market benchmarks, either globally or within domestic markets. While some of these studies find statistical evidence that the Sharia-compliant equity funds do not outperform conventional market benchmarks (e.g. Hayat and Kraussl, 2011), in the limited instances where outperformance is found, a significant part is documented to be attributable to luck, rather than to the skill of fund managers (see Elfakhani and Hassan, 2005; Girard and Hassan, 2008; Hakim and Rashidian, 2004; Hoepner et al., 2011; Hussein, 2004; Kamil, et al., 2014; and Merdad et al., 2010). In studies that focus more on risk management issues, Elfakhani and Hassan (2005) and Abdullah et al. (2007) argue that Islamic mutual funds can offer hedging benefits during market downturns although these funds do not necessarily outperform their conventional counterparts during bullish market periods. Later, Hoepner et al. (2011) suggest that the hedging benefits offered by Islamic equity funds are largely due to their low debt ratios. Similarly, Merdad et al. (2010) find that Islamic funds underperform conventional funds during bullish periods whereas the opposite

holds for bearish periods, providing further support for the hedging potential of these securities during market downturns. Interestingly, however, these studies have generally focused on aggregate benchmark indexes without providing sector specific perspective despite the evidence of an 'industry effect' in stock returns well documented in the literature (e.g. Chan et al., 2007; Hong et al., 2007 and Chou et al., 2012).

In the next section, we propose a generalized spillover model that takes into account both global aggregate market shocks as well as industry specific shocks on the Islamic equity sector returns.

3. Methodology

3.1. Model specification

The spillover model is based on a three-factor specification describing risk exposures along the lines of Bekaert et al. (2005), Baele and Inghelbrecht (2009, 2010) and Balcilar et al. (2014). Let $R_{l,t}$ be the excess return on market l for day t, where $l=k$ (Islamic sector index), G (global sector index), E (emerging market index), and D (developed market index). Following an asset pricing perspective, we assume that global equity returns in both the conventional and Islamic market segments are primarily driven by a common systematic risk factor. Therefore, we begin by specifying the excess return of the developed market index as

$$R_{D,t} = \mu_{D,S_{D,t},t-1} + \varepsilon_{D,t}\,, \qquad \varepsilon_{D,t} \sim iid\left(0, \sigma^2_{D,S_{D,t}}\right) \qquad \textbf{(1)}$$

with the latent regime variable $S_{D,t}$ taking values in {1,2,3} and following a three-state, first order Markov process.[2] The term $\mu_{D,S_{D,t},t-1}$ represents the regime-dependent expected return for the advanced market index at time *t*-1.

Similarly, the emerging market excess return is modeled in terms of the risk exposure with respect to advanced market shocks as

$$R_{E,t} = \mu_{E,S_{E,t},t-1} + \beta^{D}_{E,S_{E,t}} \varepsilon_{D,t} + \varepsilon_{E,t}, \qquad \varepsilon_{E,t} \sim iid\left(0, \sigma^2_{E,S_{E,t}}\right) \qquad \textbf{(2)}$$

where $\mu_{E,S_{E,t},t-1}$ is the regime-dependent expected excess return for the emerging market index at time *t*-1 and $\beta^{D}_{E,S_{E,t}}$ is the regime dependent conditional risk exposure of emerging market returns with respect to the advanced market shocks. Note that specifying the conditional risk exposure term ($\beta^{D}_{E,S_{E,t}}$) in a regime-dependent fashion allows for the flexibility of possible segmentation of emerging markets from advanced markets during certain market regimes.

Analogously, the excess returns for the (conventional) global sector index (*G*) and the corresponding Islamic sector index (*l*), $R_{G,t}$ and $R_{l,t}$, are specified as

$$R_{G,t} = \mu_{G,S_{G,t},t-1} + \beta^{E}_{G,S_{G,t}} \varepsilon_{E,t} + \beta^{D}_{G,S_{G,t}} \varepsilon_{D,t} + \varepsilon_{G,t}, \qquad \varepsilon_{G,t} \sim iid\left(0, \sigma^2_{G,S_{G,t}}\right) \qquad \textbf{(3)}$$

$$R_{l,t} = \mu_{l,S_{l,t},t-1} + \beta^{G}_{l,S_{l,t}} \varepsilon_{G,t} + \beta^{E}_{l,S_{l,t}} \varepsilon_{E,t} + \beta^{D}_{l,S_{lt}} \varepsilon_{D,t} + \varepsilon_{l,t},$$

$$\varepsilon_{l,t} \sim iid\left(0, \sigma^2_{l,S_{l,t}}\right) \qquad \textbf{(4)}$$

where $\mu_{G,S_{G,t},t-1}$ and $\mu_{l,S_{l,t},t-1}$ are the regime-dependent expected excess returns for the conventional global sector (G) and the corresponding Islamic sector (*l*) indexes for *t*-1, respectively, while $\beta^{D}_{l,S_{l,t}}$, $\beta^{E}_{l,S_{l,t}}$ and $\beta^{G}_{l,S_{l,t}}$ in Equation (4) represent the conditional risk

[2] The assumption of three regimes is based on a battery of tests that supports the presence of three market regimes. Model comparison tests are not reported for brevity and are available upon request.

exposures of Islamic sector excess returns with respect to the advanced, emerging market and the (conventional) global sectoral shocks, respectively.[3] In the three-factor specification in Equation (4), the unexpected return is decomposed into three components: a conditionally heteroscedastic idiosyncratic shock ($\varepsilon_{l,t}$) and three additional components driven by emerging ($\varepsilon_{E,t}$,), developed ($\varepsilon_{D,t}$) market and (conventional) global sectoral ($\varepsilon_{G,t}$) shocks.

Note that the inclusion of the global sectoral shock term ($\varepsilon_{G,t}$) allows the model to account for the 'industry effect' documented in studies including Chan et al. (2007), Hong et al. (2007) and Chou et al. (2012), among others. In fact, as the findings indicate later, sectoral shocks account for a larger percentage of volatility in certain sectors, compared to that explained by emerging market shocks. Therefore, unlike the models in Ng (2000), Bekaert et al. (2005) and Baele (2005), the three-factor specification in Equation (4) provides a generalized setup in which not only the effects of developed and emerging stock market shocks are considered, but also the shocks in the corresponding (conventional) global sectors are allowed to drive excess returns for Islamic equity sectors.

Finally, the specification is completed by defining the transition probabilities of the Markov chains as $p_{ij}^{l} = P(S_{l,t+1} = i \mid S_{l,t} = j)$.[4] Thus, p_{ij}^{l} for sector or market *l* is the probability of being in regime *i* at time *t*+1 given that the sector/market was in regime j at time *t*, where the regimes *i* and *j* take values in {1,2,3}. The transition probabilities satisfy $\sum_{i=1}^{3} p_{ij}^{l} = 1$.

[3] In the empirical specification, $\mu_{G,S_{G,t},t-1}$ and $\mu_{l,S_{l,t},t-1}$ are specified to depend on the conditional expected excess returns $\mu_{D,S_{D,t},t-1}$, $\mu_{E,S_{E,t},t-1}$ and $\mu_{G,S_{G,t},t-1}$, which are obtained from the respective MS models for the developed, emerging market, and (conventional) global sector index excess returns, respectively.

[4] The MS spillover model is specified with constant transition probabilities (CTP). The time-varying transition probability (TVTP) specification is not always supported by the data and offers no significant advantage for out-of-sample forecasting, which is the major focus of the study. The forecast of the variables in the probability specification converges to the unconditional mean in a few steps and the TVTP model converges to a CTP model.

3.2. Benchmark spillover models

An important advantage of the specification in Equations (1)-(4) is that they allow for an unsynchronized general specification in which the return processes for each variable are governed by market-specific state variables, i.e. $S_{D,t}$, $S_{E,t}$, $S_{G,t}$ and $S_{l,t}$ for developed, emerging markets and the global (conventional) and Islamic equity sectors, respectively.[5] Thus, the model is general in the sense that each process is allowed to follow a completely unsynchronized or a partially synchronized regime rather than a common state for all markets. This feature of the model allows us to accommodate the partial integration of the Islamic sector indexes with the conventional counterparts as well as with the global markets, and thus provides a more comprehensive and realistic framework.

In order to benchmark the findings for the unsynchronized MS spillover model in Equations (1)-(4) against alternative specifications, we also examine two benchmark models based on a constant coefficient GARCH specification and a synchronized MS spillover model. The constant coefficient GARCH model follows a number of papers including Bekaert and Harvey (1997), Ng (2000), Bekaert et al. (2005) and Balli et al. (2013) and utilizes a GARCH(1,1) model for the conditional volatility term with constant spillover coefficients. In this model, the conditional volatility for the error term for market *i* in Equations (1)-(4) is formulated as

$$\sigma_{i,t}^2 = \omega_i + \alpha_i \varepsilon_{i,t-1}^2 + \gamma_i \sigma_{i,t-1}^2 \qquad \textbf{(5)}$$

with $\varepsilon_{i,t} \sim iid\left(0, \sigma_{i,t}^2\right)$ for each market examined *i* = *D*, *E*, *G*, and Islamic sector *l*.

The second benchmark model used against the MS spillover model in Equations (1)-

[5] We do not impose independence restrictions on the state processes, thus they might be fully or partially correlated across a total of $3^4 = 81$ state combinations.

(4) is the synchronized alternative where a common three-state regime process (S_t) is assumed for all markets. This is done by setting $S_{D,t} = S_{E,t} = S_{G,t} = S_{l,t}$ and assumes full integration across the developed, emerging markets as well as the global conventional and Islamic sectors such that these markets experience the same regime due to common fundamental uncertainties. Clearly, this is a strong assumption; however, if one assumes that advanced markets drive global volatility, then it can also be argued that equity markets worldwide will follow the same regime as the advanced markets do, which is consistent with a common, synchronized regime specification.

3.3. Variance ratio analysis

Having formulated risk exposures for Islamic index excess returns with respect to developed and emerging market shocks as well as to shocks in the corresponding conventional sector, we next divert our attention to how much of total volatility in unexplained returns in each Islamic sector index is explained by each of these risk factors. For this purpose, we decompose the total volatility of each Islamic sector excess return into separate components driven by shocks in (i) developed markets, (ii) emerging markets, (iii) corresponding conventional sector, and (iv) an idiosyncratic component. First, we formulate the unexplained component of excess returns for developed ($\xi_{D,t}$), emerging ($\xi_{E,t}$), the conventional sector index ($\xi_{G,t}$) and the corresponding Islamic sector index *l* ($\xi_{l,t}$) using Equations (1)-(4) as follows

$$\xi_{D,t} = \varepsilon_{D,t} \quad \textbf{(6)}$$

$$\xi_{E,t} = \beta^{D}_{E,S_{Et}} \varepsilon_{D,t} + \varepsilon_{E,t} \quad \textbf{(7)}$$

$$\xi_{G,t} = \beta^{E}_{G,S_{G,t}} \varepsilon_{E,t} + \beta^{D}_{G,S_{Gt}} \varepsilon_{D,t} + \varepsilon_{G,t} \quad \textbf{(8)}$$

$$\xi_{l,t} = \beta^{G}_{l,S_{l,t}} \varepsilon_{G,t} + \beta^{E}_{l,S_{l,t}} \varepsilon_{E,t} + \beta^{D}_{l,S_{lt}} \varepsilon_{D,t} + \varepsilon_{l,t} \quad \textbf{(9)}$$

Next, we estimate predictive probabilities, $p^{l}_{i,t|t-1} = P(S_{l,t} = i \,|\, \psi_{t-1})$, i.e. the probability of market *l* being in regime *i* at time *t* given the data through *t*-1, using

$$p^{l}_{i,t|t} = \frac{p^{l}_{i,t|t-1} f_{(i)}(R_{l,t} \,|\, \psi_{t}, \theta)}{\sum_{i=1}^{3} p^{l}_{i,t|t-1} f_{(i)}(R_{l,t} \,|\, \psi_{t}, \theta)} \tag{10}$$

where $f_{(i)}(R_{l,t} \,|\, \psi_{t}, \theta)$ is the likelihood function of $R_{l,t}$ of market *l* being in regime *i* and θ is the parameter vector.[6] Having estimated the predictive probabilities for each regime, we then calculate the conditional variances for the unexplained component of excess returns as

$$\textbf{\textit{Developed market}:}\ h_{D,t} = \sum_{s=1}^{3} p^{D}_{s,t|t-1} \sigma^{2}_{D,s} \tag{11}$$

$$\textbf{\textit{Emerging market}:}\ h_{E,t} = \sum_{s=1}^{3} p^{E}_{s,t|t-1} \left[(\beta^{D}_{E,S} \sigma_{D,t})^{2} + \sigma^{2}_{E,s} \right] \tag{12}$$

$$\textbf{\textit{Conventional sector}:}\ h_{G,t} = \sum_{s=1}^{3} p^{G}_{s,t|t-1} \left[(\beta^{E}_{G,S} \sigma_{E,t})^{2} + (\beta^{D}_{G,S} \sigma_{D,t})^{2} + \sigma^{2}_{G,s} \right] \tag{13}$$

$$\textbf{\textit{Islamic sector (l)}:}\ h_{l,t} = \sum_{s=1}^{3} p^{l}_{s,t|t-1} \left[(\beta^{G}_{l,S} \sigma_{G,t})^{2} + (\beta^{E}_{l,S} \sigma_{E,t})^{2} + (\beta^{D}_{l,S} \sigma_{D,t})^{2} + \sigma^{2}_{l,s} \right] \tag{14}$$

Similarly, the conditional covariances between Islamic index *l* and each of the risk factors are formulated as

$$h_{l,D,t} = \sum_{i=1}^{3} \sum_{s=1}^{3} p^{l}_{i,t|t-1} p^{D}_{s,t|t-1} (\beta^{D}_{l,i} \sigma^{2}_{D,t}) \tag{15}$$

$$h_{l,E,t} = \sum_{i=1}^{3} \sum_{s=1}^{3} p^{l}_{i,t|t-1} p^{E}_{s,t|t-1} \left[\beta^{D}_{l,i} \beta^{D}_{E,i} \sigma^{2}_{D,t} + \beta^{E}_{l,i} \sigma^{2}_{E,t} \right] \tag{16}$$

$$h_{l,G,t} = \sum_{i=1}^{3} \sum_{s=1}^{3} p^{l}_{i,t|t-1} p^{E}_{s,t|t-1} \left[\beta^{E}_{l,i} \beta^{E}_{G,i} \sigma^{2}_{E,t} + \beta^{D}_{l,i} \beta^{D}_{G,i} \sigma^{2}_{D,t} + \beta^{G}_{l,i} \sigma^{2}_{G,t} \right] \tag{17}$$

Having formulated the time-varying and regime-independent variance-covariance terms, we then obtain the variance ratios, i.e. the percentage of the conditional variance of the unexplained component of excess return for Islamic sector *l* explained by risk factors *f* (*f* = *D*, *E*, *G*) as follows

$$VR^{f}_{l,t} = \frac{\sum_{s=1}^{3} p^{l}_{s,t|t-1} (\beta^{f}_{l,s} \sigma_{f,t})^{2}}{h_{l,t}} \times 100 \tag{18}$$

[6] More detail regarding the estimation steps for predictive probabilities is provided in Balcilar et al. (2014).

while the variance ratio for idiosyncratic shocks is formulated as

$$VR_{l,t}^{l} = \frac{\sum_{s=1}^{3} p_{s,t|t-1}^{l} \sigma_{l,s}^{2}}{h_{l,t}} \times 100 \qquad \textbf{(19)}$$

Following the recursive estimation procedure of Bekaert and Harvey (1997) and Ng (2000), however modified in this case for the three-factor case, we first estimate the developed market shocks using Equation (1). Next, we relate shocks in the developed markets to the emerging market shocks using Equation (2), and then use the developed and emerging market shocks to estimate the global sectoral shocks as in Equation (3). Finally, the developed, emerging and conventional sector shocks are used in Equation (4) as the drivers of excess returns in the corresponding Islamic sector index. [7] The models are estimated using the Student *t* distribution where the degree of freedom of the distribution is allowed to switch with regimes, thus allowing the tails of the distribution to vary across regimes.

4. Empirical Results

4.1. Data

The data consist of daily closing prices for global (conventional) and Islamic sector indices obtained from Datastream for the period January 2, 1996 - October 21, 2014, totaling 4,907 observations. The developed and emerging markets are represented by the Dow Jones Developed Market (*DEVELOPED*) and Dow Jones Emerging Market (*EMERGING*) indexes, respectively. The three-month US Treasury Bill rate (*TB3*) is used to calculate the excess returns. Following the sector classifications offered by the Thomson Reuters Business Classification System (TRBC), we focus on ten major Islamic sector indexes and their global conventional counterparts provided by Dow Jones. The Dow Jones Islamic and global

[7] All of the shock terms $e_{D,t}$, $e_{E,t}$, and $e_{G,t}$ are orthogonalized using Cholesky decomposition before they enter Equations (1)-(4).

(conventional) sector indexes include basic materials (*BMTLS*), consumer goods (*CONSGDS*), consumer services (CONSSVS), financials (*FIN*), healthcare (*HEALTHCR*), industrials (*INDUSRTY*), oil & gas (*OILGAS*), technology (*TECH*), telecommunications (*TELECOM*), and utilities (*UTIL*).

Table 1. Descriptive Statistics

	Mea	S.D.	Min	Max	Skewn	Kurto	JB	*Q*(1)	*Q*(5)	ARCH(	ARCH(
Islamic Sectors											
BMTLS	0.02	1.33	-	9.86	-0.51%	8.62	15438.7	223.07*	237.12**	300.62*	1316.9
CONSG	0.02	0.83	-	7.86	-0.24%	6.97	10006.0	66.87**	82.79***	186.90*	963.50*
CONSSV	0.03	1.11	-	8.76	-0.14%	4.89	4904.01*	46.79**	58.16***	131.40*	545.33*
FIN	0.01	1.63	-	17.28	0.21%	14.39	42438.2	1.64	21.08***	441.39*	874.68*
HEALTH	0.03	0.97	-	9.78	-0.23%	6.07	7586.95*	51.93**	92.09***	314.14*	788.91*
INDUST	0.02	1.11	-	8.40	-0.36%	5.67	6688.19*	185.40*	191.14**	179.51*	1081.4
OILGAS	0.03	1.41	-	13.61	-0.52%	9.58	19014.6	34.75**	84.32***	349.54*	1418.6
TECH	0.03	1.65	-	11.72	0.08%	4.37	3918.22*	26.01**	32.01***	192.35*	625.72*
TELECO	0.02	1.14	-	9.96	-0.09%	4.94	5001.33*	83.71**	107.40**	197.90*	787.08*
UTIL	0.01	1.07	-	14.67	0.06%	17.78	64684.0	27.47**	109.79**	372.73*	1383.1
Global Sectors											
BMTLS	0.02	1.26	-	9.35	-0.53%	9.02	16888.9	248.36*	257.38**	314.68*	1416.3
CONSG	0.02	0.79	-	8.94	-0.18%	8.04	13262.8	128.42*	139.88**	98.71**	913.87*
CONSSV	0.02	0.98	-	7.36	-0.28%	4.95	5076.56*	109.12*	120.39**	182.80*	885.32*
FIN	0.01	1.23	-	10.68	-0.19%	9.82	19764.1	147.73*	159.91**	241.43*	944.54*
HEALTH	0.03	0.94	-	9.86	-0.27%	6.64	9084.13*	60.16**	96.64***	323.87*	853.40*
INDUST	0.02	1.05	-	6.87	-0.42%	5.73	6868.34*	197.84*	201.49**	214.05*	1108.5
OILGAS	0.03	1.37	-	13.33	-0.55%	10.33	22076.9	48.88**	94.02***	348.94*	1520.2
TECH	0.02	1.56	-	10.67	0.04%	4.37	3906.99*	54.50**	58.67***	185.90*	642.58*
TELECO	0.01	1.10	-	9.90	-0.12%	5.12	5378.61*	92.62**	119.19**	332.31*	925.06*
UTIL	0.01	0.83	-	11.77	-0.20%	15.76	50889.8	38.18**	74.76***	659.35*	1677.1
Emerging and Developed Market Indices and Daily US 3-Month Treasury Bill Rate											
DEVELO	0.02	1.00	-	8.76	-0.38%	7.16	10606.4	103.10*	120.27**	243.44*	1249.1
EMERGI	0.01	1.24	-	9.46	-0.58%	6.61	9224.97*	256.41*	266.94**	253.41*	1084.4
TB3	0.01	0.01	0.00%	0.02	0.16%	-1.63	566.95**	4904.5	24476.0	4884.9	4882.2

Note: This table reports the descriptive statistics for the daily log returns in percent. The sample period covers 1/2/1996-10/21/2014 with 4,907 observations. Dow Jones Islamic sector and global total market indices include BMTLS (basic materials), CONSGDS (consumer goods), CONSSVS (consumer services), FIN (financials total), HEALTHCR (health care), INDUSTRY (industrials), OILGAS (oil & gas), TECH (technology), TELECOM (telecommunications), and UTIL (utilities). Other variables include the Dow Jones developed (DEVELOPED) and emerging (EMERGING) markets indexes as well as the three-month US Treasury bill rate (TB3). In addition to the mean, standard deviation (S.D.), minimum (min), maximum (max), skewness, and kurtosis statistics, the table also reports the Jarque-Berra normality test (JB), the Ljung-Box first [*Q*(1)] and the fourth [*Q*(4] autocorrelation tests, and the first [ARCH(1)] and the fourth [ARCH(4)] order Lagrange multiplier (LM) tests for the autoregressive conditional heteroskedasticity (ARCH). ***, ** and * represent significance at the 1%, 5%, and 10% levels, respectively.

Table 1 provides several descriptive statistics of the logarithmic returns for the data utilized in the analysis. Despite the fact that Islamic sector indexes offer similar mean returns compared to their global (conventional) sector counterparts, interestingly, they experience greater volatility consistently across all sectors. Technology and Financials are the most

volatile sectors in the Islamic equity market, while Technology dominates volatility among the global (conventional) sector indexes. As expected, the emerging world market index is 24% more volatile than the developed market index, while it offers half the mean return. It is also worth noting that the Islamic sector indexes experience greater volatility compared to their global counterparts, despite their low leverage ratios and the restrictions imposed by the sharia rules on the amount of risk they can undertake. It is possible that these restrictions sre the result of a lack of sufficient diversification in the Islamic equity market, thus leading to higher return volatility compared to their conventional counterparts.[8] However, it must be noted that the reported standard deviations are estimated over the whole return distribution but the recent research suggests that Islamic markets offer lower tail risk compared to conventional counterparts (Mambu et al., 2014).

On the other hand, all excess return series with the exception of Technology and Utilities are found to exhibit negative skewness which suggests a greater likelihood of experiencing losses. Similarly, the high kurtosis values in all return series imply the presence of extreme movements in these markets, providing support for the use of the t-distribution in the subsequent estimations.

4.2. Estimation results

4.2.1. Global and regional spillover analysis

Table 2 reports the estimates for the MS spillover model presented in Equations (1)-(4). As noted earlier, a battery of tests based on the likelihood ratio (LR) statistic and the Akaike Information Criterion (AIC) suggests the presence of three-market regimes describing the return series. The three-market regime specification is consistent with prior research on Gulf Arab stock markets (Balcilar et al., 2013a, 2013b, and 2014). The regime-specific volatility estimates reported in Panel C of Table 2 clearly identify three distinct market

[8] Hedging is also not allowed in Islamic finance which may further contribute to return volatility.

Table 2: Estimates of the MS Spillover Model

	BMTLS	CONSGDS	CONSSVS	FIN	HEALTHCR
	Panel A: ***Spillover parameters***				
$\beta_{l,1}^{G}$	1.1111*** (0.0077)	0.6865*** (0.0213)	1.3103*** (0.0175)	0.2472*** (0.0364)	1.0567*** (0.0025)
$\beta_{l,2}^{G}$	1.0406*** (0.0136)	1.0691*** (0.0167)	1.3353*** (0.0279)	0.2336*** (0.0601)	1.8411** (0.0012)
$\beta_{l,3}^{G}$	1.5724*** (0.3167)	0.6598*** (0.1485)	7.1574*** (0.0026)	0.6246*** (0.0519)	-1.2030*** (0.0006)
$\beta_{l,1}^{E}$	0.3973*** (0.0050)	-0.0013 (0.0083)	-0.1028*** (0.0066)	0.1740*** (0.0000)	-0.1107*** (0.0016)
$\beta_{l,2}^{E}$	0.1035*** (0.0108)	0.0004 (0.0051)	-0.0794*** (0.0123)	0.1240 (0.7177)	0.2381* (0.0561)
$\beta_{l,3}^{E}$	0.1353 (0.1126)	0.0073 (0.0366)	-0.2035*** (0.0081)	0.3157*** (0.0321)	0.0202 (0.0344)
$\beta_{l,1}^{D}$	1.1256*** (0.0042)	0.7603*** (0.0058)	0.8664*** (0.0060)	0.6658*** (0.0127)	0.7371*** (0.0016)
$\beta_{l,2}^{D}$	0.9058*** (0.0111)	0.6595*** (0.0073)	0.9592*** (0.0114)	0.1050 (0.2269)	0.8631*** (0.0003)
$\beta_{l,3}^{D}$	0.6440*** (0.2385)	0.5748*** (0.0002)	-5.1898*** (0.8908)	0.8987*** (0.0275)	0.9616*** (0.0951)
	Panel B: ***Distribution parameters***				
$v_{l,1}$	8.7188*** (2.5509)	27.1683*** (0.0127)	9.8167*** (1.4898)	10.5509*** (2.0440)	3.5232*** (0.2048)
$v_{l,2}$	15.5230*** (0.0037)	6.2878*** (0.8111)	5.5392*** (0.7842)	13.5302 (51.3250)	10.6135 (19.4966)
$v_{l,3}$	12.9732 (18.0293)	20.1288 (34.7477)	35.5737*** (4.0011)	3.5536*** (0.2762)	8.3339*** (1.1025)
	Panel C: ***Standard deviation***				
$\sigma_{l,1}$	0.1548*** (0.0363)	0.1891*** (0.0446)	0.2324*** (0.0473)	0.4769*** (0.0472)	0.0706*** (0.0139)
$\sigma_{l,2}$	0.4002*** (0.0686)	0.2870*** (0.0686)	0.4455*** (0.1180)	1.0412 (1.0682)	0.3570 (0.4060)
$\sigma_{l,3}$	3.8977*** (1.8412)	0.2905** (0.1924)	1.5591*** (0.0002)	1.1694*** (0.2723)	1.2375*** (0.0704)
	Panel D: ***Model Statistics***				
$\tau_{l,1}$	150.5265	63.3661	220.2055	101.0252	584.7953
$\tau_{l,2}$	50.0972	401.2549	127.6222	1.9106	1.9421
$\tau_{l,3}$	1.5448	1.0360	1.0586	9.6525	1.8533
$n_{l,1}$	0.7904	0.6143	0.6280	0.5252	0.9996
$n_{l,2}$	0.2048	0.3748	0.3669	0.0104	0.0003
$n_{l,3}$	0.0048	0.0109	0.0051	0.4644	0.0001
AIC	0.1608	0.1882	0.6049	2.6992	-1.8387
log L	-346.4226	-413.5616	-1435.4240	-6571.7244	4557.3290

Notes: The table reports the parameter estimates for the general MS spillover model described in Equations (1)-(4). The standard errors of the estimates are given in parentheses. In each case, we parameterize $\mu_{l,S_{l,t},t-1}$ as $\mu_{l,S_{l,t},t-1} = f_{l,0,S_{l,t}} + \sum_{l} \sum_{j=1}^{p} f_{m,j,S_{l,t}} R_{m,t-j}$, where $l=k$ (Islamic sectors), G (global sectors), E (emerging market), and D (developed market). Parameter estimates relating to $\mu_{l,S_{l,t},t-1}$ are not reported to save space. The lag order p is specified using the AIC. $n_{l,m}$ is the percentage of observations in regime m (ergodic probability of the regime) and $\tau_{l,m}$ is the duration of regime m. The error distribution is assumed to be the student t distribution, i.e. $\varepsilon_{l,t} \sim t(v_{l,S_{l,t}})$, where $v_{l,S_{l,t}}$ is the degree of freedom. The parameters are estimated using ML. ***, ** and * represent significance at the 1%, 5%, and 10% levels, respectively.

Table 2 (continued)

	INDUSTRY	OILGAS	TECH	TELECOM	UTIL
	Panel A: *Spillover parameters*				
$\beta_{l,1}^{G}$	0.9056*** (0.0117)	1.0552*** (0.0043)	1.0399*** (0.0037)	1.0489*** (0.0084)	0.5964*** (0.0251)
$\beta_{l,2}^{G}$	0.9157*** (0.0346)	1.0388*** (0.0043)	1.1137*** (0.0035)	0.5391*** (0.0261)	0.2829*** (0.0535)
$\beta_{l,3}^{G}$	0.6493*** (0.0251)	-1.4645*** (0.0027)	-0.7483 (1.2250)	-2.4628 (0.7381)	1.2379*** (0.0396)
$\beta_{l,1}^{E}$	0.0868*** (0.0034)	-0.0063 (0.0052)	-0.0404*** (0.0026)	0.1284*** (0.0060)	0.3287*** (0.0144)
$\beta_{l,2}^{E}$	0.1509*** (0.0221)	0.0262*** (0.0037)	-0.0641*** (0.0043)	0.4576*** (0.0138)	-0.0214 (0.0310)
$\beta_{l,3}^{E}$	0.3386*** (0.0392)	-0.0279 (0.0084)	0.0948*** (0.0629)	-0.2407 (0.7748)	0.1274*** (0.0242)
$\beta_{l,1}^{D}$	1.0029*** (0.0032)	0.5622*** (0.0056)	0.9809*** (0.0020)	0.9381*** (0.0061)	0.6259*** (0.0108)
$\beta_{l,2}^{D}$	1.0762*** (0.0167)	1.1720*** (0.0031)	1.7153*** (0.0046)	0.6237*** (0.0100)	0.2697*** (0.0303)
$\beta_{l,3}^{D}$	-0.6043 (0.0223)	-1.0471*** (0.0671)	-1.0469** (0.5172)	4.2922 (0.0022)	0.7756*** (0.0209)
	Panel B: *Distribution parameters*				
$v_{l,1}$	6.3033*** (0.8256)	3.4102*** (0.3306)	17.8614*** (0.0016)	7.7428*** (1.6758)	17.8308*** (0.0041)
$v_{l,2}$	38.9191*** (0.0086)	9.1290*** (0.0059)	4.7645*** (0.5004)	10.8977*** (2.4647)	16.1839** (0.0033)
$v_{l,3}$	19.0245*** (4.0116)	11.4212 (13.1590)	17.5425*** (0.0084)	10.2451 (21.6072)	5.2196*** (0.8260)
	Panel C: *Standard deviation*				
$\sigma_{l,1}$	0.1351*** (0.0294)	0.1393*** (0.0385)	0.0882*** (0.0170)	0.2822*** (0.0707)	0.3722*** (0.0753)
$\sigma_{l,2}$	0.4406*** (0.1324)	0.1496*** (0.0254)	0.1523*** (0.0365)	0.3055*** (0.0718)	0.5442*** (0.1625)
$\sigma_{l,3}$	1.1882*** (0.0604)	1.6831*** (0.0009)	1.2567*** (0.0473)	1.0632*** (0.0913)	0.6977*** (0.2118)
	Panel D: *Model Statistics*				
$\tau_{l,1}$	117.5173	26.7533	89.2061	203.2242	238.9337
$\tau_{l,2}$	26.1652	172.0762	59.2417	270.0761	11.1217
$\tau_{l,3}$	1.3492	1.1678	55.8036	7.9664	18.1489
$n_{l,1}$	0.7580	0.3044	0.4532	0.2997	0.6506
$n_{l,2}$	0.2370	0.6852	0.3259	0.6786	0.1335
$n_{l,3}$	0.0050	0.0105	0.2338	0.0217	0.2159
AIC	-0.3233	-0.5484	-0.9431	0.6540	1.6264
log L	840.9233	1374.9688	2360.9603	-1555.9664	-3940.7872

Notes: See notes in Table 2.

regimes characterized as low, high and extreme volatility for all ten Islamic sectors. We observe that the greatest difference in the level of return volatility between the low and extreme market regimes is in Basic Materials, Healthcare and Technology where the sector index return is at least 10 times more volatile in the extreme volatility regime than in the low volatility regime. For example, in the case of Technology, the standard deviation for excess returns (in Panel C) is estimated as 0.088%, 0.152%, and 1.256% for the low, high and

extreme volatility regimes, respectively, clearly differentiating low and extreme volatility regimes in terms of the level of return volatility.

We observe that the extreme volatility regime is particularly persistent in the case of Financials, Technology and Utilities, where the average duration of the extreme volatility regime for these sectors (reported in Panel D) is 9.6, 55.8 and 18.1 days, respectively. It is worth mentioning that the 2007/2008 global financial crisis started in the U.S. financial sector. Moreover, technology is highly cyclical and volatile due to the high leveraged and competitive nature of this sector. Utilities are also cyclical and are subject to environmental regulations. Clearly, these three sectors require special attention by portfolio managers as 46%, 23% and 21% of the observations in these sectors, respectively, fall in the extreme volatility regime (reported in Panel D).

The smoothed probability plots presented in Figures 1-10 provide further clues on the pattern of market regimes. Remarkably, we observe that the extreme volatility regime generally corresponds to the 2008 global market crisis period for most Islamic sectors. However, in the case of Financials, Industrials and Technology, the late 1990 dot-com crash period and early 2000 recession also fall into the extreme market regime. This period witnessed corporate downsizing and fear in many major economies and a sense of self-doubt. Interestingly, the Oil & Gas and Telecommunications sectors are found to be in the high volatility regime during the most recent period. Petroleum returns are considerably sensitive to global demand which in turn is predisposed to changes in global economic growth. Global growth has been very volatile since the 2007/2008 global financial crisis. Moreover, on the supply side, oil and natural gas in particular experienced the beginning of the shale revolution in 2008, which has increased the oil production in the United States by more than three million barrels a day in the last three years. This is equivalent to the creation of three new small OPEC member states. The shale revolution has also quadrupled the U.S. natural gas

Figure 1: Smoothed Probability of the General MS Spillover Model for BMTLS sector

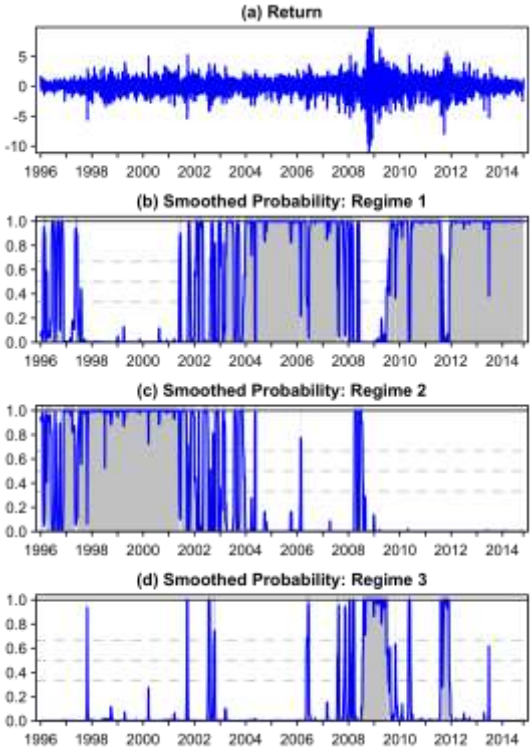


Figure 2: Smoothed Probability of the General MS Spillover Model for the CONSGDS sector

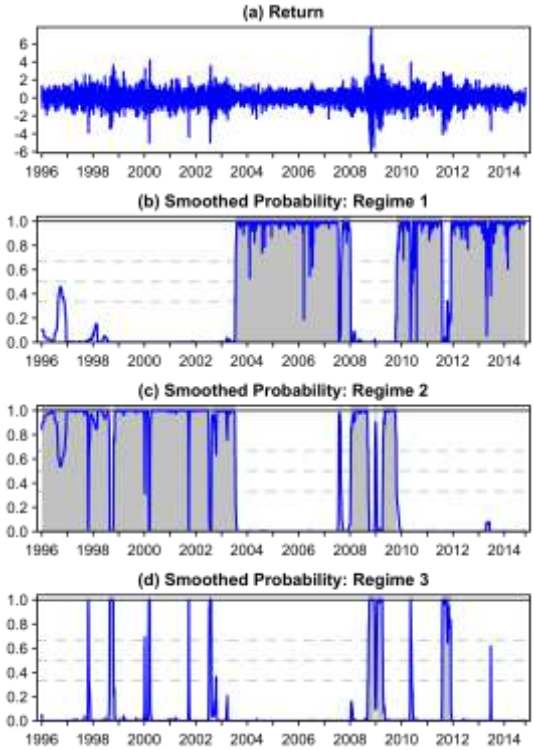


Figure 3: Smoothed Probability of the General MS Spillover Model for CONSSVS sector

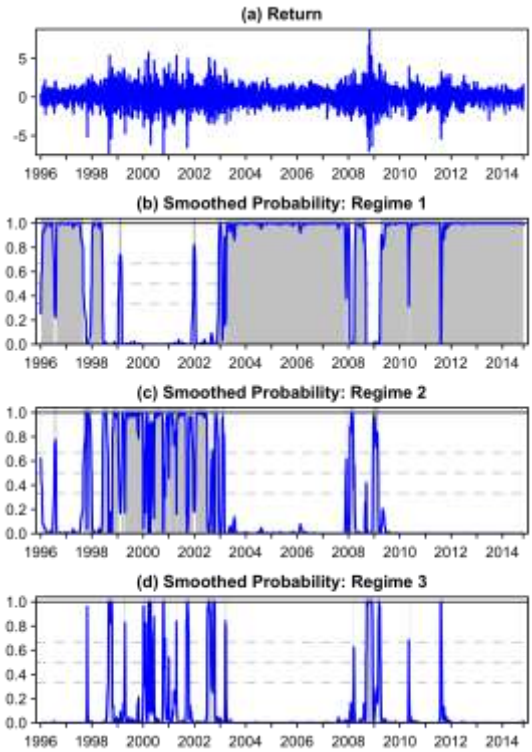


Figure 4: Smoothed Probability of the General MS Spillover Model for FIN sector

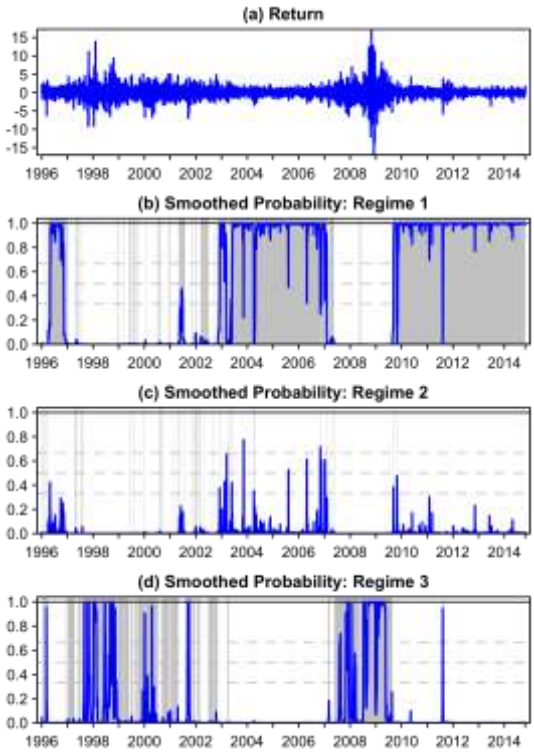


Figure 5: Smoothed Probability of the General MS Spillover Model for HEALTHCR sector

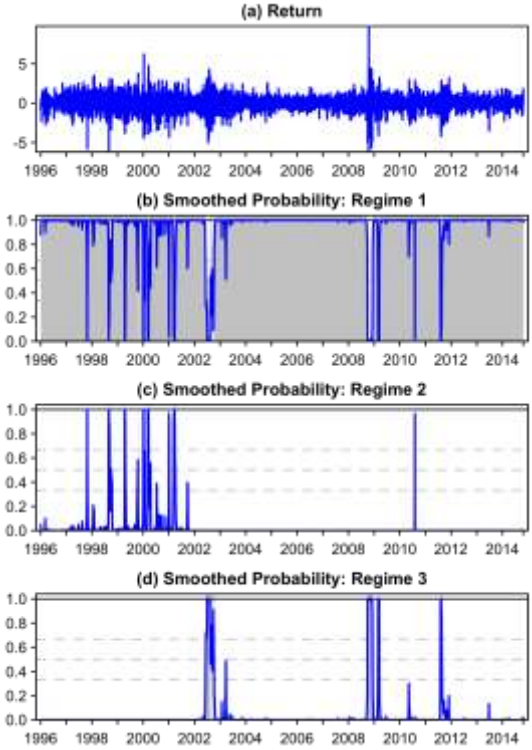


Figure 6: Smoothed Probability of the General MS Spillover Model for IINDUSTRY sector

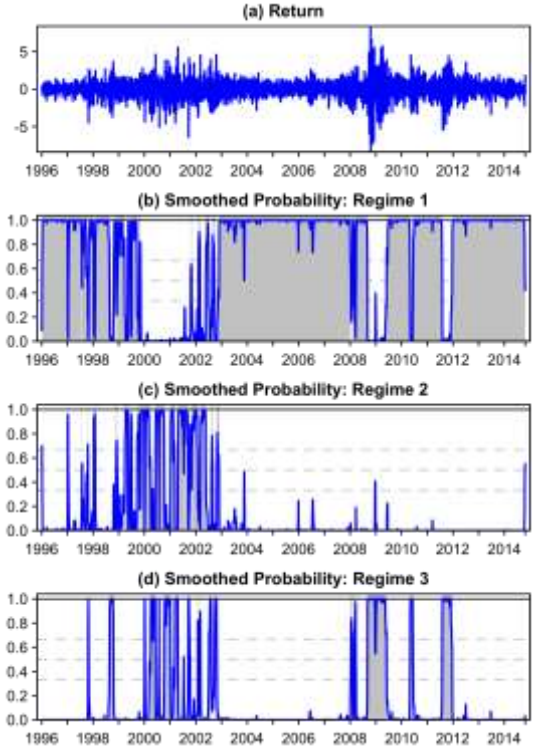


Figure 7: Smoothed Probability of the General MS Spillover Model for OILGAS sector

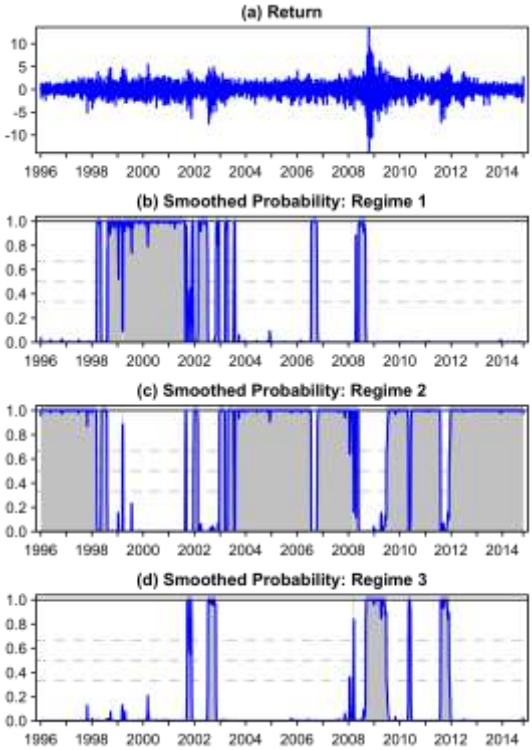


Figure 8: Smoothed Probability of the General MS Spillover Model for TECH sector

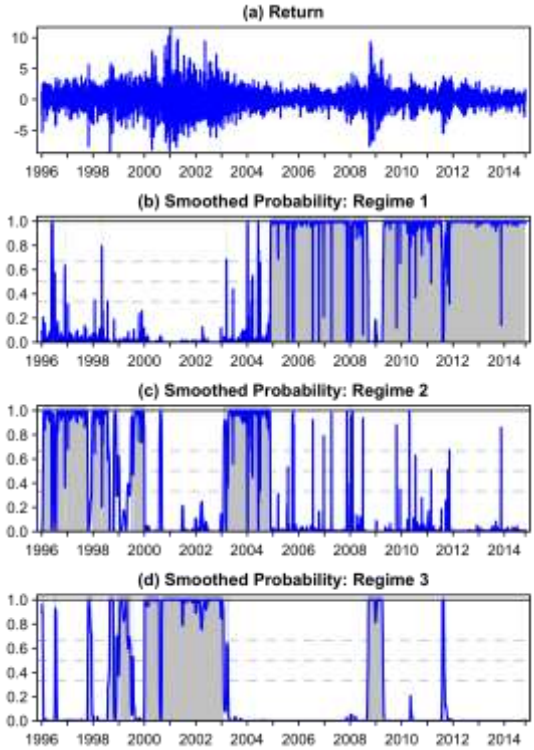


Figure 9: Smoothed Probability of the General MS Spillover Model for the TELECOM sector

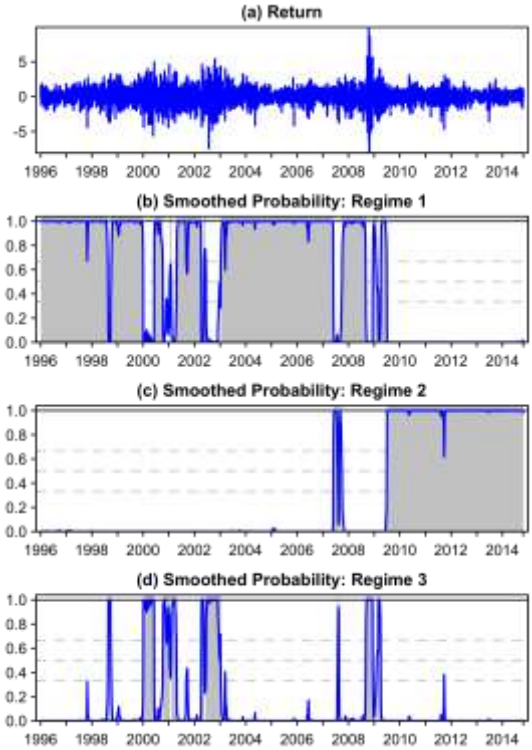
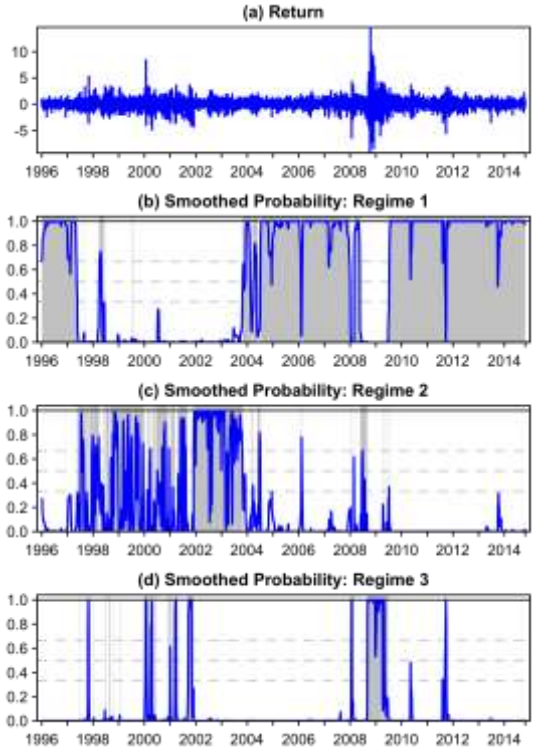


Figure 10: Smoothed Probability of the General MS Spillover Model for the UTIL sector



reserves. These developments have caught up with the petroleum markets, and have eventually led to the plunge of oil prices by more than 40% in just six months in 2014.

The spillover parameters in Equations (1)-(4) are reported in Panel A of Table 2. We generally observe that the Islamic sectors exhibit heterogeneous magnitudes of risk exposures with respect to the developed, emerging and conventional sector shocks. As expected, Islamic sectors generally exhibit positive exposure to developed market shocks, possibly because these markets usually reflect global economic, financial and political fundamentals. This implies that the Islamic sectors in general are not isolated from developed equity markets. On the other hand, Islamic Basic materials and Industrials generally display the greatest risk exposures with respect to developed market shocks, with relatively larger $\beta_{l,i}^{D}$ values observed across the ten sectors.

Interestingly, Consumer Services, Oil & Gas and Technology are found to exhibit negative risk exposures with respect to developed market shocks during the extreme market volatility periods. This suggests that these Islamic sectors could serve as a safe haven for investors in developed markets during periods of extreme market movements. It is possible that the shale oil market, which is sensitive to the prices of benchmarks, may have played a role in this negative relationship. The breakeven price for about 50% of the shale oil producers is about $60 dollars a barrel, while the cost of producing oil in the major Islamic oil-producing countries is about $10 a barrel. To this end, it can be argued that a portfolio that houses stocks of shale oil companies in the U.S. can be strengthened by including stocks of Islamic oil companies.[9]

In the case of risk exposures with respect to emerging market shocks, we observe that the Consumer Goods sector stands out from the rest of Islamic sectors as it does not respond to emerging market shocks after controlling for shocks in the corresponding global (conventional) sector. This suggests that the "industry effect" plays a more significant role in the case of Consumer Goods rendering the effect of emerging market shocks insignificant. On the other hand, we observe that Consumer Services exhibit negative risk exposures with respect to emerging market shocks suggesting that this Islamic sector could serve as hedge/safe haven for emerging market investors. In the case of other Islamic sectors, we observe mixed results regarding their sensitivities to emerging market shocks with no consistent pattern.

In the case of global sector effects, Islamic sectors are generally found to exhibit positive risk exposures with respect to the shocks in their global (conventional) counterparts, suggesting a possible "industry effect" in the Islamic market segment. The Consumer

[9] Jim Kramer posits that the plunge in oil prices has created winners and losers in the oil industry. Oil producers with long run horizons can acquire the losers at cheap prices. See http://finance.yahoo.com/news/cramer-why-exxon-goes-oil-232147285.html

Services sector is found to be more prone to the industry effect, implied by the largest risk exposure values with respect to global (conventional) sector shocks observed for this sector. On the other hand, Islamic Financials are found to show the lowest level of risk exposure to shocks in the global (conventional) financial sector. While the Islamic financial equity sector includes financial institutions that all follow the Sharia's screening rules which were discussed earlier, the countries that host them have different general banking rules. Some Islamic countries do not open their markets to foreign banks, Islamic or non-Islamic (e.g., Saudi Arabia and Kuwait), while others (e.g. Bahrain and Turkey) separate Islamic banks and institutions from foreign counterparts operating in their domestic financial sector in order to allow the former to follow the Sharia's rules. Interestingly, Healthcare and Oil & Gas exhibit (which satisfy the economic activity screening rule but must satisfy the required financial ratios) negative risk exposures to the industry factor during the extreme volatility regime, with estimated risk exposures of -1.203% and -1.465%, respectively. It is possible that these two Islamic sectors can help offset the negative effects of global sectoral shocks during periods of market crisis. Overall, the findings suggest that all Islamic sectors exhibit positive risk exposure to their (conventional) global counterparts, justifying the use of an industry factor in risk models as well as in asset valuations.

4.2.2. Variance ratio analysis

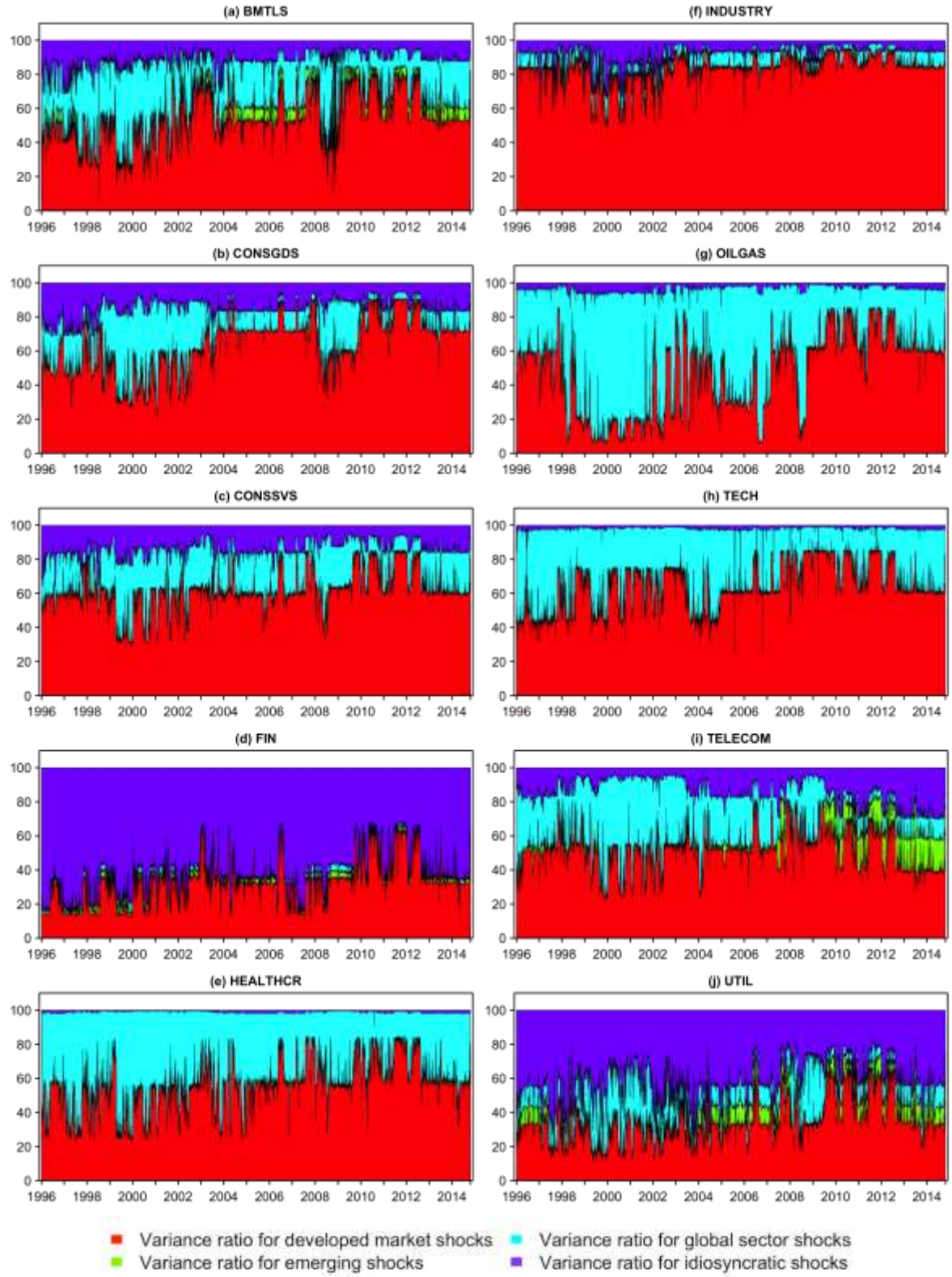
Table 3 reports the summary statistics for the variance ratios described in Section 3.3. Panels A, B and C report the variance ratios for the GARCH, unsynchronized MS and the common state MS spillover models, respectively. In Figure 11, we also provide plots of variance ratios corresponding to each risk factor for easy comparison of each factor's contribution to return volatility. We observe in general that developed market shocks generally account for the largest percentage of variations in the unexplained excess returns of all Islamic sectors. The developed market shocks account for the largest percentage of

Table 3: Summary Statistics for the Variance Ratios

	Variance due to Developed Market Shocks				Variance due to Emerging Market Shocks				Variance due to Global Sector Market Shocks				Variance due to Idiosyncratic Shocks			
	Mean	S.D.	Min	Max	Mean	S.D.	Min	Max	Mean	S.D.	Min	Max	Mean	S.D.	Min	Max
Panel A: ***The GARCH Spillover Model***																
BMTLS	60.071	13.780	20.894	94.627	5.091	2.474	0.778	21.661	28.996	11.764	3.132	72.459	5.842	5.555	0.202	35.555
CONSGDS	68.032	11.866	28.919	96.677	0.035	0.021	0.005	0.185	17.630	8.229	1.185	57.279	14.303	6.401	1.975	44.970
CONSSVS	62.827	15.129	18.516	96.596	0.740	0.435	0.117	4.176	22.072	9.984	2.192	59.738	14.361	7.214	0.997	43.921
FIN	28.438	17.705	1.667	85.305	2.829	1.663	0.291	11.663	1.067	0.705	0.054	6.102	67.667	18.676	11.795	97.879
HEALTHCR	57.540	17.707	12.493	95.202	1.174	0.654	0.164	5.796	39.687	17.162	3.836	86.749	1.599	2.323	0.070	37.233
INDUSTRY	84.703	9.218	32.285	98.739	0.484	0.283	0.059	2.660	7.822	3.898	0.870	35.357	6.991	6.197	0.289	39.313
OILGAS	55.495	19.793	11.822	95.475	0.174	0.104	0.027	0.890	42.814	19.761	4.035	87.975	1.517	1.896	0.102	37.656
TECH	52.678	21.410	8.604	95.633	0.145	0.086	0.013	0.618	45.550	21.050	3.825	91.131	1.627	2.717	0.068	41.027
TELECOM	48.886	14.611	14.587	89.439	2.060	1.235	0.366	10.582	33.648	15.136	4.845	77.680	15.406	9.084	1.365	49.601
UTIL	35.744	14.293	4.966	84.230	6.035	2.627	1.111	23.555	13.197	5.327	2.981	40.925	45.024	14.006	7.361	89.993
Panel B: ***The General MS Spillover Model***																
BMTLS	55.409	14.603	5.404	81.617	4.866	3.330	0.179	20.041	27.757	12.471	5.522	75.567	11.968	6.163	3.492	77.283
CONSGDS	65.027	15.660	20.424	90.909	0.000	0.000	0.000	0.002	20.244	13.843	3.721	68.506	14.729	6.070	4.095	32.130
CONSSVS	62.474	11.601	29.180	85.117	0.744	0.411	0.114	2.952	22.775	8.646	6.782	56.772	14.006	5.271	4.519	36.451
FIN	33.291	13.117	12.119	65.317	2.839	1.127	1.219	7.391	1.945	1.580	0.398	6.018	61.925	12.772	31.422	85.222
HEALTHCR	57.054	14.665	22.574	83.928	1.258	0.563	0.334	4.449	40.529	14.681	14.441	75.947	1.160	0.785	0.469	39.118
INDUSTRY	83.585	8.407	31.892	95.297	0.854	0.485	0.201	3.907	7.695	3.124	2.176	23.049	7.867	6.273	1.726	45.662
OILGAS	48.606	23.613	5.893	85.763	0.022	0.016	0.001	0.109	47.853	22.322	12.790	87.652	3.519	2.088	0.926	39.440
TECH	65.488	13.668	7.916	91.875	0.100	0.044	0.023	0.354	32.366	13.167	4.449	86.377	2.047	2.726	0.639	67.499
TELECOM	52.784	11.770	20.630	82.996	6.547	7.928	0.217	43.114	26.350	15.569	4.325	76.031	14.318	7.780	3.044	30.651
UTIL	35.585	12.588	10.342	66.544	6.001	4.663	0.246	25.857	16.901	9.668	5.441	51.537	41.512	11.949	17.108	79.194
Panel C: ***The Common State MV-MS Spillover Model***																
BMTLS	62.470	13.514	7.114	83.804	6.358	2.286	1.688	24.648	26.748	12.778	10.533	66.584	4.424	2.067	1.745	51.472
CONSGDS	65.828	10.520	37.683	93.635	0.066	0.028	0.017	0.201	19.343	8.146	4.860	47.834	14.764	6.216	1.489	22.346
CONSSVS	64.319	11.067	23.543	83.587	0.811	0.477	0.079	3.000	18.685	7.836	8.502	68.700	16.185	8.822	5.303	46.505
FIN	30.926	11.196	13.207	53.764	4.676	2.626	0.587	14.848	0.763	0.773	0.089	7.323	63.634	12.065	37.183	85.698
HEALTHCR	54.324	14.741	21.608	82.025	1.707	0.700	0.465	5.523	42.558	14.808	15.725	76.563	1.411	0.879	0.580	41.015
INDUSTRY	88.112	5.304	80.947	94.744	0.582	0.282	0.165	2.681	6.879	3.149	2.748	10.680	4.428	2.028	0.941	6.876
OILGAS	49.457	16.838	11.689	83.023	0.051	0.022	0.014	0.194	48.483	17.088	10.919	78.967	2.010	1.532	0.860	77.291
TECH	54.420	19.095	21.509	83.286	0.123	0.065	0.035	2.716	43.986	19.205	2.050	75.557	1.472	1.358	0.658	73.726
TELECOM	50.753	14.514	13.110	76.363	1.081	0.510	0.224	3.285	33.645	15.503	13.303	79.949	14.521	6.478	4.657	54.728
UTIL	33.342	12.225	9.134	62.873	5.519	3.118	0.262	20.151	14.484	6.265	5.755	29.757	46.655	11.229	21.750	75.709

Note: This table reports the mean, the standard deviation (S.D.), the minimum, and the maximum for the percentage variance ratios for the GARCH, general MS, and MV-MS spillover models. The variance ratios are computed over the full sample period 1/2/1996-10/21/2014, which includes 4,907 observations. The GARCH spillover Model is the benchmark model.

Figure 11: Variance Ratio Estimates from the General MS Spillover Model



Note: This figure presents stacked plots of the percentage variance ratios for the general MS spillover model described in Equations (1)-(4). Variance ratios are obtained using Equations (18) and (19). The figure reports variance decomposition for the Islamic total market return series. The total variance is decomposed into components due to developed market shocks, emerging market shocks, global sectoral shocks, and idiosyncratic shocks. The variance ratios are computed over the full sample period 1/2/1996-10/21/2014 including 4,907 observations.

volatility in the case of Industrials, with more than 80% of variations in this sector being explained by the developed market shocks. This is surprising since the Islamic industrial sector depends industries in the developed countries. Consistent with earlier findings on risk exposures, we observe that the emerging market shocks generally account for the lowest percentage of variability in all Islamic sectors, with a zero mean variance ratio being observed in the case of the Consumer Goods which may depend largely on domestic factors.

On the other hand, global sectoral shocks are found to account for a significant percentage of conditional volatility in Oil & Gas and Technology. The lowest mean variance ratio due to global sectoral shocks is observed in the case of Financials, suggesting some degree of separation of Islamic financials from its global conventional counterpart. Interestingly, idiosyncratic shocks are found to explain the largest percentage of conditional volatility of unexplained returns in Islamic financials, further supporting the segmentation of this Islamic sector from global markets. We find consistently in all three spillover models that more than 60% of the return volatility is explained by idiosyncratic shocks in this sector, suggesting that Islamic financials are mostly driven by its sector specific fundamentals, possibly due to the in- place investment filters that affect financial firms the most.

5. Diversification benefits across Islamic sectors

5.1. Alternative portfolio strategies

Having found that the Islamic equity sectors display a moderate to strong exposure to developed market shocks and some significant exposure to corresponding (conventional) global sectoral shocks, we now focus on the international diversification benefits of investing in the Islamic equity sectors. This is done by comparing the risk/return tradeoffs offered by alternative portfolios induced by each spillover model, and examining the in- and out-of-sample performance of these portfolios. For this purpose, we choose 11/21/2012 as the cut-

off point for determining the in-sample period which will leave 500 portfolio points in the out-of-sample period. Given that the covariance matrices are estimated recursively during the out-of-sample period, the computational cost of the recursive estimation procedure is the basis for the choice of 500 portfolio points considered in the out-of-sample analysis. In-sample portfolios are constructed by first estimating each model over the sub-period 1/2/1996-11/21/2012 and then computing the in-sample covariance matrix (S_t) of the ten sector return series from the moments obtained using the predictive probabilities in a manner analogous to the definitions in Equations (15)-(17). The first out-of-sample portfolio is then constructed for 11/21/2012. We then adjust the portfolio holdings on a daily basis using the weights implied by S_{T+1} and update the sample period by adding the next observation and re-computing the predicted covariance matrix for the next day.

Performance comparisons are made across five alternative portfolios given the estimates of the covariance matrix S_t. As the benchmark portfolio, we use the DJ Developed Market index in order to represent the position held by a developed market investor who is currently not invested in Islamic equities. This benchmark portfolio therefore represents the *undiversified* investor who is solely invested in developed markets. We then create portfolios augmented with the ten Islamic equity sectors described earlier. We restrict the portfolio weights to sum to 1 and do not allow short-selling. The portfolio strategies considered are:

Portfolio 1: Undiversified global investor represented by the DJ Developed market index with its historical return and risk obtained from the respective model.

Portfolio 2: Diversified minimum-variance portfolio, i.e. the world portfolio augmented with the Islamic equity sectors, with the historical return and risk obtained from the respective models.

Portfolio 3: Diversified minimum-variance portfolio with the same return as the DJ Developed Market index.[10]

Portfolio 4: Diversified minimum-variance portfolio with the same risk as the DJ Developed Market index.[11]

Portfolio 5: Diversified tangency portfolio with the maximum Sharpe ratio.

5.2. In-sample results

As mentioned earlier, the in-sample analysis contains 4,405 portfolio points for the sub-period 1/2/1996-11/21/2012. Table 4 provides the in-sample summary statistics of the daily returns for the dynamic portfolios constructed using the covariance matrices obtained from the alternative GARCH, unsynchronized MS, and the common state MV-MS spillover models. Panels A, B and C report the findings for the three alternative models respectively. As expected, the diversified minimum-variance portfolio augmented with the Islamic equity sectors (Portfolio 2) yields the lowest level of risk, consistently across the three alternative spillover models. However, the low level of risk for this portfolio is accompanied with the lowest level of mean return as well. On the other hand, the undiversified global investor who does not hold any positions in Islamic equities (Portfolio 1) is clearly dominated by all other portfolio strategies, implied by the lowest Sharpe ratio observed for this portfolio. We observe that the undiversified global investor sustains as large risk as the maximum Sharpe ratio portfolio (Portfolio 5) in all alternative model specifications and yet yields the lowest return.

[10] If the DJ Developed Market **return** is outside the range of returns for efficient portfolios, we replace it with the minimum or maximum efficient portfolio return, depending upon whether the DJ Developed Market **return** is below or above the range of efficient portfolio returns.

[11] If the DJ Developed Market **risk** is outside the range of risk values for efficient portfolios, we replace it with the minimum or maximum efficient portfolio risk, depending on whether the DJ Developed Market **risk** is below or above the range of efficient portfolio risks

Table 4: Summary Statistics for In-sample Portfolios

	Portfolio Return				Portfolio Risk				Sharpe Ratio of Portfolio			
	Mean	S.D.	Min	Max	Mean	S.D.	Min	Max	Mean	S.D.	Min	Max
	Panel A: The GARCH Spillover Model											
Portfolio 1	0.003	1.035	-7.153	8.759	0.919	0.469	0.374	4.298	0.007	1.015	-5.876	3.454
Portfolio 2	0.004	0.836	-7.568	9.280	0.714	0.337	0.328	3.135	0.016	1.044	-6.243	3.960
Portfolio 3	0.162	0.919	-6.560	9.280	0.730	0.348	0.328	3.675	0.211	1.108	-6.243	4.039
Portfolio 4	0.840	1.083	-4.597	14.667	0.899	0.443	0.362	4.298	0.955	1.000	-4.407	5.852
Portfolio 5	1.081	1.213	-4.597	13.669	1.028	0.500	0.362	6.487	1.105	0.990	-4.367	6.163
	Panel B: The General MS Spillover Model											
Portfolio 1	0.003	1.035	-7.153	8.759	0.758	0.214	0.504	1.039	0.006	1.240	-6.943	8.434
Portfolio 2	0.006	0.800	-6.052	9.091	0.575	0.144	0.375	0.885	0.018	1.268	-7.320	10.323
Portfolio 3	0.175	0.901	-6.052	9.091	0.592	0.155	0.375	1.036	0.265	1.353	-7.320	10.323
Portfolio 4	0.827	1.038	-4.723	12.657	0.742	0.205	0.410	1.039	1.100	1.217	-4.622	12.187
Portfolio 5	1.087	1.267	-4.597	13.145	0.862	0.296	0.410	1.992	1.270	1.220	-4.454	12.189
	Panel C: The Common State MV-MS Spillover Model											
Portfolio 1	0.003	1.035	-7.153	8.759	1.417	0.227	1.154	1.720	0.003	0.673	-4.178	5.093
Portfolio 2	0.013	1.235	-7.607	9.263	1.167	0.191	0.694	1.423	0.012	0.991	-5.372	6.511
Portfolio 3	0.196	1.125	-7.153	9.263	1.185	0.198	0.762	1.714	0.168	0.883	-5.038	6.511
Portfolio 4	0.975	1.322	-5.880	13.594	1.401	0.228	0.961	1.720	0.700	0.882	-3.434	7.904
Portfolio 5	1.189	1.380	-4.597	15.281	1.570	0.360	0.961	2.960	0.806	0.856	-2.255	8.459

Notes: This table reports the mean, the standard deviation (S.D.), the minimum, and the maximum for the dynamic in-sample portfolios constructed using covariance matrices obtained from the GARCH, the general MS, and the MV-MS spillover models. The models are estimated for the sub-period 1/2/1996-11/21/2012, and 4,405 portfolios are constructed for the same period. **P1** is the undiversified world portfolio represented by the developed market index (DEVELOPED). **P2** is the diversified minimum variance portfolio which includes the DEVELOPED index and the ten Islamic equity sectors including BMTLS (basic materials), CONSGDS (consumer goods), CONSSVS (consumer services), FIN (financials total), HEALTHCR (health care), INDUSTRY (industrials), OILGAS (oil & gas), TECH (technology), TELECOM (telecommunications), and UTIL (utilities). **P3** is the diversified minimum variance portfolio with a target return equal to the efficient global return. **P4** is the diversified minimum variance portfolio with a target risk equal to the efficient global risk. **P5** is the diversified tangency portfolio with the maximum Sharpe ratio. The GARCH spillover model is the benchmark model.

Focusing on the risk-adjusted returns, we observe that the diversified tangency portfolio (Portfolio 5) offers the best risk/return tradeoff indicated by the greatest Sharpe ratio values in each panel. Comparing the results across the three alternative spillover models, we observe that the dynamic portfolios constructed using the covariance matrices obtained from the unsynchronized MS model (Panel B) yield higher risk-adjusted returns in general. The portfolios constructed using the estimates from the unsynchronized MS model are found to experience the lowest return volatility and generally higher mean returns. Note that the general MS model allows the return processes for advanced and emerging markets as well as Islamic and global conventional sectors to follow independent regimes and thus provides

flexibility for the regime-switching to be partially or fully synchronized. To this end, the comparison of portfolio performances across the alternative models in Table 4 clearly suggests that restricting the return processes to follow a common synchronized state specification is sub-optimal. Overall, our findings suggest that portfolios augmented with positions in Islamic equity sectors yield much improved Sharpe ratios compared to the undiversified global portfolio (Portfolio 1), implying that Islamic sectors can offer international diversification benefits.

5.3. Out-of-sample results

In order to check the robustness of our in-sample findings, we use a recursive portfolio re-balancing procedure based on one-step ahead forecasts of the covariance matrix. As explained earlier, we first estimate each model using data up to 11/21/2012 and obtain the predicted covariance matrix S_{T+1} for 11/21/2012. We then adjust the portfolio holdings on a daily basis using the weights implied by S_{T+1} and update the sample period by adding the next observation and re-computing the predicted covariance matrix for the next day. Continuing recursively in this fashion, we obtain 500 out-of-sample portfolio points over the sub-period 11/22/2012-10/21/2014. Excess returns are then calculated using the three-month U.S. Treasury bill rate.

Table 5 reports the summary statistics for the dynamic out-of-sample portfolios. Panels A, B and C reported the findings for the GARCH, general MS spillover and the common state MV-MS spillover models, respectively. The comparison of the out-of-sample performances further supports the in-sample results reported in Table 4. Consistently across all three spillover models, we observe that the portfolios supplemented with positions in the Islamic equity sectors yield significantly more efficient portfolios, compared to the undiversified global portfolio (Portfolio 1). We observe the highest Sharpe ratios in the case

Table 5: Summary Statistics for the Out-of-sample Portfolios

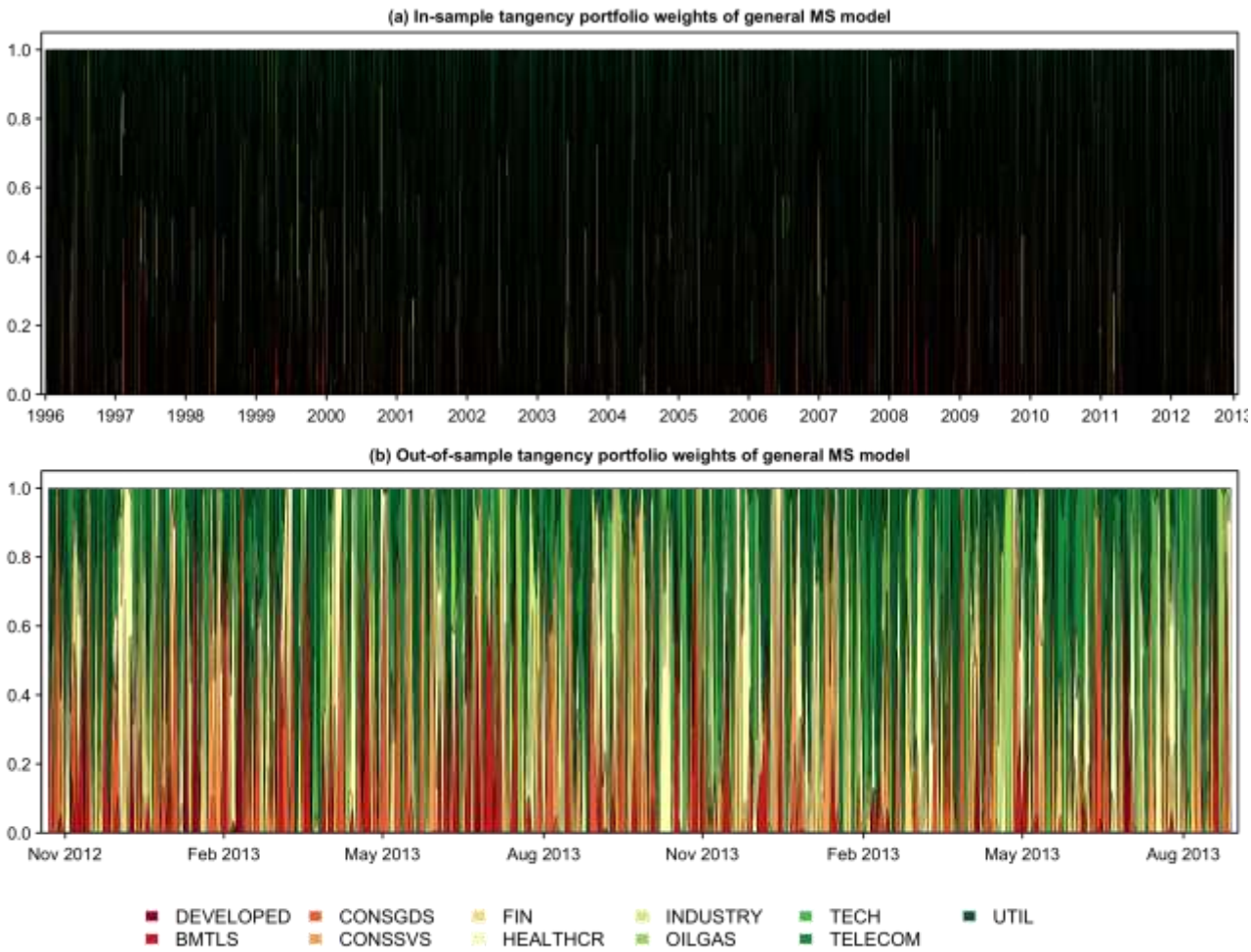
	Portfolio Return				Portfolio Risk				Sharpe Ratio of Portfolio			
	Mean	S.D.	Min	Max	Mean	S.D.	Min	Max	Mean	S.D.	Min	Max
	Panel A: The GARCH Spillover Model											
Portfolio 1	0.051	0.584	-3.522	2.112	0.618	0.127	0.382	1.194	0.063	0.959	-5.307	3.670
Portfolio 2	0.036	0.500	-3.521	1.690	0.479	0.088	0.317	0.879	0.057	1.043	-6.643	3.831
Portfolio 3	0.137	0.527	-3.521	2.112	0.492	0.094	0.323	0.915	0.248	1.073	-6.643	4.238
Portfolio 4	0.516	0.546	-2.883	2.471	0.608	0.120	0.382	1.177	0.839	0.877	-4.344	4.293
Portfolio 5	0.581	0.534	-2.575	2.544	0.649	0.138	0.355	1.160	0.930	0.835	-3.095	4.297
	Panel B: The General MS Spillover Model											
Portfolio 1	0.051	0.584	-3.522	2.112	0.566	0.091	0.504	1.020	0.080	1.038	-6.568	3.955
Portfolio 2	0.036	0.496	-3.523	1.551	0.433	0.060	0.392	0.736	0.075	1.148	-8.384	3.776
Portfolio 3	0.139	0.528	-3.522	2.112	0.445	0.065	0.392	0.766	0.289	1.186	-8.383	4.423
Portfolio 4	0.521	0.543	-2.945	2.359	0.557	0.079	0.419	0.954	0.931	0.961	-5.491	4.417
Portfolio 5	0.569	0.523	-2.575	2.226	0.590	0.120	0.416	1.227	1.019	0.913	-3.422	4.435
	Panel C: The Common State MV-MS Spillover Model											
Portfolio 1	0.051	0.584	-3.522	2.112	1.215	0.093	1.154	1.698	0.039	0.479	-2.972	1.786
Portfolio 2	0.046	0.586	-2.990	2.400	0.997	0.078	0.952	1.404	0.044	0.586	-3.077	2.473
Portfolio 3	0.137	0.577	-2.990	2.400	1.017	0.092	0.952	1.595	0.130	0.567	-3.077	2.473
Portfolio 4	0.498	0.567	-2.575	2.883	1.202	0.099	0.980	1.698	0.415	0.474	-2.330	2.614
Portfolio 5	0.585	0.544	-2.575	2.836	1.326	0.229	0.980	2.208	0.470	0.447	-2.330	2.711

Notes: This table reports the mean, the standard deviation (S.D.), the minimum, and the maximum for the dynamic out-of-sample portfolios constructed using one-step ahead predicted covariance matrices obtained from the recursively estimated GARCH, MS, and MV-MS spillover models. The out-of-sample models are recursively estimated for the sub-period 11/22/2012-10/21/2014 and 500 portfolios are constructed for the same period. **P1** is the undiversified world portfolio represented by the developed market index (DEVELOPED). **P2** is the diversified minimum variance portfolio which includes the DEVELOPED index and ten Islamic equity sectors including BMTLS (basic materials), CONSGDS (consumer goods), CONSSVS (consumer services), FIN (financials total), HEALTHCR (health care), INDUSTRY (industrials), OILGAS (oil & gas), TECH (technology), TELECOM (telecommunications), and UTIL (utilities). **P3** is the diversified minimum variance portfolio with a target return equal to the efficient global return. **P4** is the diversified minimum variance portfolio with a target risk equal to the efficient global risk. **P5** is the diversified tangency portfolio with the maximum Sharpe ratio. The GARCH spillover model is the benchmark model.

of the diversified tangency portfolio (Portfolio 5) in all three alternative models, providing further support for international diversification benefits of Islamic equities. Once again, we observe that the dynamic portfolios constructed using the covariance matrices obtained from the general MS spillover model yield the best risk adjusted returns compared to those obtained from the GARCH and MV-MS models.

In Figure 12, we provide a graphical representation of the optimal portfolio positions in the tangency portfolio based on the general MS spillover model. The most profound result from this figure is the highly time-varying feature of the portfolio weights, implying that

Figure 12: In- and Out-of-sample Tangency Portfolio Weights for the General MS Spillover Model



Note: This figure presents stacked plots for the dynamic tangency portfolio weights (Portfolio 5) based on the general MS spillover model. The in-sample dynamic portfolios are constructed over the subperiod 1/2/1996-11/21/2012 and include 4,405 portfolios. The out-of-sample dynamic portfolios are constructed for the sub period 11/22/2012-10/21/2014 and include 500 portfolios. Each portfolio includes the developed market index and ten Islamic equity sectors including BMTLS, CONSGDS, CONSSVS, FIN, HEALTHCR, INDUSTRY, OILGAS, TECH, TELECOM, and UTIL.

using a static model in a portfolio strategy would be sub-optimal. Interestingly, we observe that the Islamic equity sector allocation in the best performing portfolio (Portfolio 5) exceeds 75 percent for prolonged periods, thus underscoring the potential importance of Islamic sectors in international diversification strategies. Furthermore, Islamic sectors including Financials, Healthcare, Telecommunication, and Utilities are allocated higher weights in optimal portfolios, implying the significance of these particular Islamic sectors in global diversification strategies.

The diversification benefits from the inclusion of Islamic equity sectors in the world portfolio remain still significant even after accounting for transaction costs. In a study that focuses on short sale constraints and transaction costs in emerging markets, De Roon et al. (2001) assume a 0.5% transaction cost with a 6-month investment horizon. Even if one is to follow this estimate, the out-of-sample results reported in Table 5 clearly suggest that Portfolio 5 still yields significantly higher risk-adjusted returns even after transaction costs are taken into account. Overall, both the in- and out-of-sample results support earlier findings on the spillover effects with respect to the global shocks and suggest that the Islamic equity sectors can offer significant diversification benefits for global investors, regardless of the model specifying the spillover effects.

5. Conclusion

This study extends the emerging literature on Islamic financial markets by examining the international diversification benefits of key Islamic sectors. The literature generally views Islamic equity securities to be less risky than their conventional counterparts, largely due to their relatively low leverage ratios, and the restrictions on investable industries and on the use of financial derivatives which might be related to speculative transactions. It is therefore argued that Islamic equity markets may be largely segmented from their conventional counterparts as they avoid much of the fundamental risk factors some of which had contributed to the recent global financial crisis.

We propose a time-varying, three-regime, three-factor spillover model for ten key Islamic stock sector returns and examine the risk exposures of these Islamic sectors with respect to shocks from advanced and emerging markets as well as to shocks in the corresponding global (conventional) sector counterparts. The three-factor risk spillover models is unique to the literature in that it allows for the possible “industry effect” that may

be transmitted from global conventional sectors to their Islamic counterparts. We observe that Islamic sectors generally exhibit positive risk exposures with respect to developed market shocks, implying that the Islamic sectors in general are not isolated from developed equity markets. In particular, Islamic Basic materials and Industrials are found to display the greatest risk exposures with respect to developed market shocks. On the other hand, Consumer Services, Oil & Gas and Technology are found to exhibit negative risk exposures during extreme market volatility periods, suggesting that these Islamic sectors could serve as a safe haven for investors in developed markets during periods of market crisis.

We observe that the Consumer Goods sector stands out from the rest of the Islamic sectors as it does not respond to emerging market shocks after controlling for shocks in the corresponding global (conventional) sector. This suggests that the "industry effect" plays a more significant role in the case of Consumer Goods, rendering the effect of the emerging market shocks insignificant. On the other hand, we observe that the Consumer Services exhibit negative risk exposures with respect to the emerging market shocks, suggesting that this Islamic sector could serve as hedge/safe haven for emerging market investors. At the same time, the Consumer Services sector is found to be more prone to the "industry effect", implied by the largest risk exposure values with respect to global (conventional) sector shocks observed for this sector. Finally, Islamic Financials are found to show the lowest level of risk exposure to shocks in the global (conventional) financial sector, suggesting some degree of segmentation from the conventional financial system.

The variance ratio analysis further supports these findings in that the developed market shocks account for the largest percentage of return volatility in the case of Industrials, while the emerging market shocks generally account for the lowest percentage of variability in all Islamic sectors, with a zero mean variance ratio being observed in the case of Consumer Goods. On the other hand, global sector shocks are found to account for a significant

percentage of return volatility in Oil & Gas and Technology. Interestingly, idiosyncratic shocks are found to explain the largest percentage of conditional volatility of unexplained returns in the Islamic financials, providing further support for the segmentation of Islamic financials from the global markets and the conventional financial system.

The analysis of both the in- and out-of-sample portfolios from all three alternative spillover models suggests that portfolios augmented with positions in Islamic equities yield much improved risk-adjusted returns compared to the undiversified global portfolio, implying significant international diversification benefits from allocating portfolio positions to Islamic equities. In particular, the Financials, Healthcare, Telecommunication, and Utilities sectors are allocated higher weights than their corresponding global conventional counterparts, implying the significance of these Islamic sectors in global diversification strategies. Finally, the comparison of alternative spillover models suggests that the dynamic portfolios constructed using the covariance matrices obtained from the general unsynchronized MS model yield the highest risk-adjusted returns, underscoring the importance of the risk spillover model underlying the model parameters.

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