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DYNAMIC CONNECTEDNESS BETWEEN ISLAMIC MENA STOCK MARKETS AND GLOBAL FACTORS

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ABSTRACT

This article examines the volatility spillover from the regional and global *Islāmic* stock markets, global conventional stock market, global commodity markets including oil and gold, and the US long-term interest rates into the *Islāmic* stock and *Ṣukūk* markets of a selected group of the Middle East and North Africa (MENA) nations. We implement the Diebold and Yilmaz (2012, 2014) spillover index, refined with time-varying parameter vector autoregressions (TVP-VAR) of Antonakakis, Chatziantoniou, and Gabauer (2020), on daily data between November 3, 2009 and November 1, 2019. We explore that the volatility spillovers among the *Islāmic* markets are prominently low, posing poorly connected with the *Ṣukūk* market, global *Islāmic,* and conventional stock markets. Our results support the decoupling hypothesis of Islamic stock markets from the conventional stock market; as it follows, the US investors, who add to their portfolios certain *Islāmic* stocks of the MENA countries, may benefit to a large extent from those diversifications. This study is among a few studies deploying country-level data, choosing its locus of the *Islāmic* stock markets in the MENA region. The study is the first one examining the potential risk transmission from global factors to both the *Islāmic* stock markets and the Global *Ṣukūk* market. The econometric framework is, for the first time, used to investigate the volatility spillovers between the global factors and the *Islāmic* markets.

JEL Classification: G11, G15, G32, E44

Key words: *Islāmic* stock index, Dynamic connectedness, Volatility spillover, Hedging, Portfolio strategy

1. INTRODUCTION

Islāmic stocks differ from conventional stocks, for they must meet Shariah rules. Accordingly, investment in some alcoholic, pork-

related products, tobacco, conventional banking and financial services, weapons, entertainment, and defense are forbidden. The Shariah code also delimits the debt level, interest income, and expenses. The central proposition of this study is that *Islāmic* stocks may be less exposed to global risk factors because of their own distinctive and conservative features, and they may offer more diversification benefits for the investors holding conventional stocks (see, inter alia, Saiti and Noordin, 2018; Hkiri, 2017; Shahzad et al., 2017; Kenourgios, Naifar, and Dimitriou, 2016; Naifar, 2016; Najeeb, Bacha and Masih, 2015; Abbes and Trichilli, 2015; Hammoudeh et al., 2014 and Ajmi et al., 2014). Consequently, they might be considered safe-haven instruments, especially during financial crises (see, inter alia, Akhtar and Jahromi, 2017; Jawadi, Jawadi, and Louhichi, 2014; Al-Khazali, Lean, and Samet, 2014; Ho et al., 2014).[1] The increased interest in *Islāmic* stocks, especially after the Great Recession of 2008-2009, supports this argument. Recently, increasing economic and political uncertainties, Covid-19 pandemic outbreak, falling US interest rates, decreasing growth rates, shrinking global commercial activities, and rising global trade tensions have caused fluctuations in the financial markets. In this regard, this paper examines whether the *Islāmic* stock markets, in particular the MENA region countries and the *Ṣukūk* market, are decoupled from regional and global markets and global risk factors. In other words, it tries to explore if these *Islāmic* markets offer safe havens for US investors against recent and future uncertainties. Another development that motivates us to run this research is the remarkable performance of the *Islāmic* global stock markets in comparison with their conventional counterparts after the 2008-2009 global financial crises, which lured investor attention.

MENA region countries are all *Islāmic* consisting of stock markets with a few essential features that set them apart. First, they are mostly state-owned or organized as public institutions. Out of 18, only two of them (located in Palestine and Qatar), are owned by private investors. Second, they have low regional and international integration. Most exchanges remain predominantly owned and oriented domestically. Within the region, markets remain relatively delinked from each other. They are mostly decoupled from global capital markets except for Egypt and some GCC (Gulf Co-operation Council) based markets. In 2009, Qatar Holding and NYSE Euronext signed an agreement to form a major strategic partnership to establish the Exchange as a world-class market (Qatar Exchange, 2020). Third, it is exceptional for domestic companies to list abroad and for foreign

companies to list on MENA exchanges. Cross-listing activity is rare due to differences in regulatory frameworks. Fourth, they are mostly young markets (except for Egypt, Morocco, and Kuwait), dominated by a few sectors, such as banking and infrastructure. Fifth, they have high levels of retail (household) rather than institutional investments because of the slow development of pensions, insurance, and mutual funds and low free float (OECD, 2012).

Chaua, Deesomsaka, and Wan (2014) reported limited evidence that the integration of the MENA markets with international markets has strengthened after the Arab Spring. Following the Arab Spring that began in 2010, investment restrictions have been reduced with some liberalization efforts through market reforms and regulations to attract foreign capital inflows. However, the main reason for market reform is the oil price collapse between 2014 and 2016, resulting in a sharp decline in the GDP growth of GCC countries whose economies are heavily dependent on oil. Government authorities and policymakers have recognized the necessity of diversifying their economy away from such narrowed commodity assets. About a decade ago, the UAE and Qatar opened their markets to international investors (HSBC, 2020). As of 2015, Bahrain Bourse has opened to foreigners up to 49% of a domestic joint-stock company's equity (Bloomberg Terminal Research, 2020), and in 2019, Qatar's cabinet approved a law which increased the foreign ownership ceiling to 100% from the current 49% in most sectors (U.S. Department of State, 2019). The others, such as Saudi Arabia, the largest market in the MENA region, and Kuwait have started to implement a series of extensive market reforms within the last few years, with a hope of attracting foreign capital (HSBC, 2020).

Besides, inclusion of the markets to global benchmark indices, covering the Morgan Stanley Capital International (MSCI), Financial Times Stock Exchange (FTSE), and Dow Jones Islamic Market (DJIM), has accelerated the flow of funds to these countries. Following the past MSCI inclusions of the UAE, Qatar, and Egypt in the emerging market indices, the announcements of the MSCI on the reclassification of Saudi Arabia and Kuwait from frontier market status to emerging market[2] attracted capital inflows through active and passive funds during 2018. As a result, the MENA region countries stock markets have outperformed relative to others. MENA equities rose almost 13% in 2018, outperforming the equities of both emerging developed markets, that decreased by approximately 15% and 9%, respectively[3] (MSCI database, 2020). The market capitalization of domestic companies as a percentage of GDP increased from 1.4 in

2018 to 3.6 trillion US$ in 2019; the main reason for this is the increased market capitalization of domestic companies as a percentage of GDP in Saudi Arabia, from 496 Billion US$ in 2018 to 2.4 trillion US$ in 2019. Currently, the number of listed companies in the MENA region is 1766, of which 204 are traded in Tadawul (The World Bank database, 2020).

The uncertainties in oil prices, regional political tensions, and the improvements and innovations in the stock markets of the MENA countries in the last decade lead us to focus on these markets to examine their connectedness with global factors. This paper examines the validity of the decoupling hypothesis of *Islāmic* markets of MENA region countries from conventional financial markets by presuming that *Islāmic* stocks and *Ṣukūk* are an alternative set of investments thanks to their insulation from global markets as well as their idiosyncrasies. Hence, we investigate the volatility spillover from the regional and global *Islāmic* stock markets, global conventional stock market, global commodity markets including oil, gold, and global risk factor --the US long-term interest rates-- into the *Islāmic* stock *Ṣukūk* markets of a selected group of the Middle East and North Africa (MENA) nations; i.e., Bahrain, Egypt, Jordan, Kuwait, Morocco, Oman, Qatar, and the United Arab Emirates and *Ṣukūk* market. We analyze the Dow Jones *Islāmic* Market (DJIM) indices, which are the first and the most comprehensive, consisting of stocks of companies that are supposed to have met the Shariah requirements.

This study employs the Diebold and Yilmaz (2014, 2012) spillover index framework, with refined measures based on the dynamic covariance structure proposed by Antonakakis, et al. (2020), on daily data between November 3, 2009 and November 1, 2019. Our dynamic connectedness estimations indicate high volatility spillover effects between global conventional and global *Islāmic* stock markets. However, the possibility of spillover among the country based *Islāmic* markets is very low, and they pose poor connection with the *Ṣukūk* market, global *Islāmic*, and conventional stock markets. They also stand independent of the global commodities market and global risk factors. The dynamic connectedness results prove the existence of dense interactions during important global economic and political upheavals. Our results demonstrate that as the global *Islāmic* stock market is a net volatility transmitter, the regional *Islāmic* stock market is a net receiver.

Our results also support the decoupling hypothesis; as it follows, the US investors, who add to their portfolios certain *Islāmic* stocks of the MENA countries, may benefit to a large extent from

those diversifications. Finally, we think that our results are significant for policymakers and both the Muslim and non-Muslim individual investors, institutional investors, global portfolio managers, who actively monitor diverse investment opportunities.

This paper contributes in five dimensions to the relevant literature. First, most previous studies examine the relationship between conventional and *Islāmic* stock markets on a regional basis; however, this study is among a few studies examining the issue by deploying country-level data. Second, as the studies adopted a country-level perspective, they mostly focus on the *Islāmic* stock markets in developed or Asia-Pacific countries. However, this study chooses as its locus the *Islāmic* stock markets in the MENA region. Third, the study is the first one that examines the potential risk transmission from global factors to both MENA *Islāmic* stock markets and the Global *Ṣukūk* market. Fourth, unlike the existing studies, this deploys the most recent data regarding major economic and political uncertainties globally, such as financial contraction, deceleration in economic growth, decreasing risk appetites of US investors, and world trade tensions. Lastly, the refined volatility spillover measures of Diebold and Yilmaz (2012, 2014) are for the first time used to investigate the volatility spillovers between the global factors and *Islāmic* markets in the MENA region.

The rest of the paper is structured as follows. Section 2 documents the literature review. Section 3 explains the methodology. In sections 4 and 5, the data are processed, and empirical results are disclosed. The last section presents concluding remarks.

2. LITERATURE REVIEW

The literature on volatility spillover has regained attention since the Global Financial Crisis and Eurozone sovereign debt crisis (Cardona, Gutiérrez, and Agudelo, 2017); accordingly, the decoupling (-recoupling) hypothesis has been tested heavily, for conventional (see, inter alia, Bekiros, 2014; Dooley and Hutchison, 2009; Liu et al., 2017; Ramirez-Hassan and Pantoja, 2018), as well as, for *Islāmic* financial markets (see Usman et al., 2019, and the references therein). On the one hand, decoupling refers to low, even negative, correlations among financial markets, especially during financial crises, implying significant portfolio diversification opportunities; on the other hand, re-coupling simply means contagion, referring to the phenomenon driving the correlations to unity during turbulent times (Wyrobek, Stańczyk, and Zachara, 2016; Gulko, 2002). Examining the return and

volatility transmissions among financial markets is, therefore, of great importance for investors conducting risk management strategies in bearish times and seeking "safe-haven" assets, the US Treasury bonds, commodities. Though the literature is inconclusive (Saiti and Noordin, 2018), *Islāmic* securities are also empirically proven to be one of the safe-haven assets during times of financial crises (Usman et al., 2019), essentially supporting the decoupling hypothesis; however, Hammoudeh et al. (2014), among others, provide contrary evidence, in favor of the re-coupling, or contagion, hypothesis.

A plethora of studies have used causality and co-integration tests to examine the *Islāmic* financial markets and conventional counterpart interactions (see, Majdoub, Mansour, and Jouini, 2016; Rizvi, Arshad, and Alam, 2015; Alaoui et al., 2015; Abbes and Trichilli, 2015; Yilmaz et al., 2015; Ajmi et al., 2014; Hussin et al., 2013; Abd Majid and Haj Kassim, 2010 and Hakim and Rashidian, 2002). However, here, not to divert from our primary goal, we only consider the studies focusing on volatility spillover analysis. Most of the early studies examining return and volatility spillover between conventional and *Islāmic* stock markets were on regional and developed countries. The majority reject the proposition that *Islāmic* markets can be decoupled from conventional markets. Among these studies, Hammoudeh, Jawadi, and Sarafrazi (2013) examined the spillover between the conventional and *Islāmic* equity markets and investigated how global crises affected *Islāmic* markets in the US, Europe, and Asia. Having employed threshold and Markov-Switching models, they found that conventional stock prices responded positively to changes in *Islāmic* equity markets. In contrast, Dania and Malhotra (2013) found a positive return spillover from conventional to *Islāmic* markets in North America, Europe, and Far East Asia. They also found similar evidence for asymmetric volatility spillover.

Alaoui et al. (2015) studied co-movement dynamics of the Dubai financial market along with some regional *Islāmic* indices, including DJIM Indices of GCC, developed markets, and *Ṣukūk* from April 1, 2008 to March 23, 2011. They applied wavelet analysis and reported risk contagion among closer markets. Nazlioglu, Hammoudeh, and Gupta (2015) investigated volatility spillover between the conventional global markets, including Europe, Asia, the US, and the *Islāmic* market during pre- and post-global financial crises sub-periods; they provide strong evidence that the volatility dynamics are time-varying.

More recently, Uddin et al. (2018) examined the diversification benefits, integration, and efficiency in conventional

and *Islāmic* stock markets. The results show that *Islāmic* stocks offer significant diversification opportunities and allow for variance reductions in asset allocation exercises. Usman et al. (2019) investigated the dependence structure between *Islāmic* and conventional stocks in the US, the UK, Japan, Malaysia, and Pakistan; their results obtained from the copula conditional value at risk (CoVaR) approach showed that the dependence structure between the markets is time-varying, and supported the decoupling hypothesis. They reported that the CoVaR of the conventional stocks' conditional on the *Islāmic* stocks is lower than the unconditional VaR of the conventional stocks, providing evidence in favor of the decoupling hypothesis, implying diversification opportunities for investors. Ahmed and Elsayed (2019) provided empirical proof against the decoupling hypothesis, analyzing the risk contagion effects among the *Islāmic* and conventional stocks and bond/ *Ṣukūk* markets in Malaysia. They employed the Diebold and Yilmaz (2012) spillover index approach and reported empirical evidence contrary to the decoupling hypothesis. Anas et al. (2020) tested the decoupling hypothesis between the developed and emerging markets' equity pairs of conventional and *Islāmic* stock markets from different regions, employing the wavelet and asymmetric dynamic conditional correlation generalized autoregressive conditional heteroskesdasticity (DCC-GARCH) approaches; their findings suggest rejecting the decoupling hypothesis for most of the analyzed markets.

Among the studies examining volatility not only between conventional and *Islāmic* stock markets but also global risk factors and *Islāmic* markets, including commodities, Hammoudeh et al. (2014) investigated the dynamic relationship among the global *Islāmic* stock market and primary global conventional equity indices, including the US, Europe, and Asia, and global risk factors (such as the US 10-year Treasury bond interest rate, implied volatility index (VIX), oil prices, and 10-year European Monetary Union government bond index). They found significant dependence among the major conventional markets, global factors, and global *Islāmic* stock market, providing evidence against the decoupling hypothesis. Their findings suggested that The Sharia norms were not sufficiently rigorous to differentiate the global *Islāmic* stock market index from the conventional indices (Mensi et al., 2017: 23; Majdoub and Sassi, 2017:17).

Shahzad et al. (2017) examined the volatility and return spillovers across major conventional national stock markets consisting of the US, Japan, and the U.K., the global *Islāmic* stock market, and global risk factors including the VIX and US uncertainty indices,

crude oil prices, and the US 10-year Treasury bond yields by using the Diebold and Yilmaz (2012) connectedness framework. They found significant contagion effects among the asset classes. Mensi et al. (2017) investigated the dynamic volatility spillovers between Dow Jones *Islāmic* aggregate and sector indices and commodities, including gold and US crude oil, employing the dynamic correlation models and the Diebold and Yilmaz (2012) spillover index. Their results showed that US crude oil, gold, and *Islāmic* energy, financial, technology, and telecommunications were found as net volatility receivers, whereas the other sectors, including consumer goods, consumer services, health care, industrials, utilities were volatility transmitters. Using the Diebold and Yilmaz (2012) framework, Haddad, Mezghani, and Dohaiman (2020) investigated volatility and return spillovers across seven regional *Islāmic* stock markets, and several global factors reported empirical results supporting those of Shahzad et al. (2017).

Different from these studies, the findings of Kenourgios et al. (2016) and Hkiri et al. (2017), and Azad et al. (2018) supported the decoupling hypothesis. Kenourgios et al. (2016) investigated the contagion effects of the global financial crisis and Eurozone sovereign debt crisis on *Islāmic* equity and bond markets, supporting the decoupling hypothesis for the *Islāmic* securities. Their findings implied that *Islāmic* equities and bonds exhibit safe-haven properties during financial turbulence. Similarly, Hkiri et al. (2017) examined volatility spillovers across six regional/country *Islāmic* stock indices and their conventional counterparts, including the US, the UK, Canada, Japan, Eurozone, and Asia-Pacific, by using the spillover index framework of Diebold and Yilmaz (2012); they confirm the decoupling hypothesis in times of financial crisis. Azad et al. (2018) investigated the relationship between the benchmark Dow Jones *Islāmic* Index and conventional benchmark indices from developed and emerging markets, estimating quantile regressions. The empirical results suggest that *Islāmic* stocks exhibit haven properties and hedge against most international markets in times of crisis.

Rejeb (2017) investigated the interdependencies among the conventional and *Islāmic* financial markets for the period spanning from June 01, 2001 to June 18, 2016, employing the quantile regression technique. They used DJIM Indices such as the global Islāmic market index as well as its conventional counterpart, Islāmic Emerging Markets Index, Islamic Arab Markets Index, Islāmic Arab Markets excluding Saudi Arabia Index, Islāmic Gulf Cooperation Council (GCC) Index, Islāmic Canada Index, Islāmic UK Index,

Islamic US Index, Islāmic Europe, Islāmic Asia/Pacific Index, Islāmic Developed Markets Index. Their findings indicated very strong interdependencies from the conventional stock markets to the *Islāmic* ones, especially from the conventional developed markets to the *Islāmic* emerging and Arab markets and *Islāmic* developed markets. Additionally, they found a lower dependence from conventional Emerging and Arab markets to the *Islāmic* developed markets in financial fragility and crisis periods.

On the other hand, a few studies examined the volatility spillover between conventional and *Islāmic* markets or among *Islāmic* markets for emerging markets with country-level data. Among these studies, Majdoub and Mansour (2014) used a sample of five countries, including Turkey, Indonesia, Pakistan, Qatar, and Malaysia, investigated their relationship with the US market by employing three multivariate generalized autoregressive conditional heteroskedasticity (GARCH) models, Baba, Engle, Kraft, and Kroner (BEKK), constant conditional correlations (CCC), and dynamic conditional correlations (DCC), using Morgan Stanley Capital International (MSCI) *Islāmic* and conventional indices. The estimation results of the three models showed that the US and *Islāmic* emerging equity markets were weakly correlated over time. Additionally, no complete evidence was found to support the US market spillover.

Majdoub and Sassi (2017) examined volatility spillover between China and six other Asian Islamic stock markets by employing a GARCH family model. They found significant positive and negative return spillover from China that was the largest market in Asia to selected Asian Islamic stock markets, and bidirectional volatility spillovers between China, Korea, and Thailand *Islāmic* market, which showed evidence of short-term predictability on Islamic Chinese stock market movements.

Naifar, Hammoudeh, and Al Dohaiman (2016) investigated the *Ṣukūk* markets of Malaysia, Saudi Arabia, and the United Arab Emirates, and their stock markets, the global *Islāmic* stock index, the S&P index for Asia, and the S&P 500 index as the local and global factor, respectively. They found significant dependence between the three largest *Ṣukūk* indices and the stock market volatility. Additionally, the global conventional stock market has a more significant impact on the *Ṣukūk* yields than the global *Islāmic*, regional, and local stock markets.

In summary, the studies examining volatility spillover between *Islāmic* and conventional markets provided inconclusive results. Most of these studies found the existence of volatility spillover

between these markets and rejected the decoupling hypothesis; however, some others indicated low spillover effects and suggested that investors could benefit from adding *Islāmic* stocks or bonds into their portfolios, especially during financial turbulence. On the other hand, the studies that proved volatility spillover between *Islāmic* and conventional markets were particularly for developed markets; they argued that *Islāmic* emerging stock markets might still provide diversification benefits. We pointed out that the volatility spillover might be observed from the major emerging *Islāmic* markets to others in the same region. We also noticed that only a few studies examined the risk transmission between *Islāmic* and global factors; they indicated volatility spillover from global risk factors to *Islāmic* markets. Thus, the dependence of *Islāmic* stocks and bonds on the world markets and global factors is still a question mark for individual and institutional investors.

This study aims at filling the gap in the literature by considering the *Islāmic* markets of the MENA countries. It also fills the gap by considering the volatility spillover between *Islāmic* and other financial markets within a comprehensive context of dynamic connectedness among *Islāmic* stock markets, both at the country and regional level, global risk factors (i.e., the VIX index, and US 10-Year Treasury Bond), and commodities (i.e., the US oil, and gold). Additionally, we contribute to the literature by taking the *Ṣukūk* market into account, which was rarely analyzed in the volatility spillover literature.

3. METHODOLOGY

To examine the volatility spillovers between the *Islāmic* markets and global factors, we apply the spillover index procedures of Diebold and Yilmaz (2012, 2014) with a dynamic covariance refinement proposed by Antonakakis et al. (2020). The modified methodology is used for the first time to examine the dynamic connectedness among the *Islāmic* markets in the MENA region and global factors. The time varying parameter vector autoregressive (TVP-VAR) modification improves the standard model of Diebold and Yilmaz (2012, 2014) dependent on rolling-windows; the modified TVP-VAR model (1) produces more accurate parameters than those of the standard model, (2) is robust to outliers, (3) does not demand to determine the rolling-window size, (4) and thus providing the advantage of not losing any observations (Evrim Mandacı, Cagli, and Taşkın, 2020; Antonakakis et al. 2020). We estimate the following the TVP-VAR(1) model,

where the lag length is determined by the Bayesian Information Criterion (BIC):

(1) $Yt = \beta_t Y_{t-1} + \varepsilon_t, \qquad \varepsilon_t \sim N(0, S_t),$

(2) $\beta_t = \beta_{t-1} + \nu_t, \qquad \nu_t \sim N(0, R_t),$

(3) $Yt = \mathrm{A}_t \varepsilon_{t-1} + \varepsilon_t,$

where Yt, ε_t, and ν_t are $N \times 1$ vectors and A_t, S_t, β_t and are R_t $N \times N$ matrices. Exploiting the generalized VAR framework of Koop, Pesaran, and Potter (1996) and Pesaran and Shin (1998), Diebold and Yilmaz (2012) developed the volatility spillover index. The *H*-step-ahead generalized forecast error variance decompositions (GFEVD) is (Diebold and Yilmaz, 2012; Antonakakis et al., 2018b; Evrim Mandacı et al., 2020):

(4) $$\tilde{\theta}_{ij,t}^{g}(H) = \frac{\sum_{t=1}^{h-1} \psi_{ij,t}^{2,g}}{\sum_{i=1}^{N} \sum_{t=1}^{h-1} \psi_{ij,t}^{2,g}},$$

with $$\psi_{ij,t}^{2,g}(H) = S_{ij.t}^{-\frac{1}{2}} \mathrm{A}_{h,t} \sum_t \varepsilon_{ij,t}, \qquad \sum_{j=1}^{N} \tilde{\theta}_{ij,t}^{g}(H) = 1,$$

$$\sum_{i,j=1}^{N} \tilde{\theta}_{ij,t}^{N}(H) = N$$

We calculate the Total Connectedness Index (TCI), a measure of interconnectedness among the financial markets (Diebold and Yilmaz, 2012; Antonakakis et al., 2018b; Evrim Mandacı et al., 2020):

(5) $$C_t^g(H) = \frac{\sum_{i,j=1, i \neq j}^{N} \tilde{\theta}_{ij,t}^{g}(H)}{\sum_{j=1}^{N} \tilde{\theta}_{ij,t}^{g}(H)} \times 100.$$

We calculate the directional volatility spillovers transmitted by market *i* "TO" all other markets *j* as (Antonakakis et al. 2018b; Evrim Mandacı et al., 2020):

(6) $$C_{i \to j,t}^{g}(H) = \frac{\sum_{j=1, i \neq j}^{N} \tilde{\theta}_{ji,t}^{g}(H)}{\sum_{j=1}^{N} \tilde{\theta}_{ji,t}^{g}(H)} \times 100.$$

We measure the directional volatility spillovers received by market *i* "FROM" all other markets *j*, as (Antonakakis et al. 2018b; Evrim Mandacı et al., 2020):

$$(7) \qquad C_{i\leftarrow j,t}^{g}(H)=\frac{\sum_{j=1,i\neq j}^{N}\tilde{\theta}_{ij,t}^{g}(H)}{\sum_{i=1}^{N}\tilde{\theta}_{ij,t}^{g}(H)}\times 100.$$

Accordingly, we calculate the "NET" spillover from market *i* to all other markets *j* as follows (Diebold and Yilmaz, 2012; Antonakakis et al., 2018b; Evrim Mandacı et al., 2020):

$$(8) \qquad C_{i,t}^{g}(H)=C_{i\rightarrow j,t}^{g}(H)-C_{i\leftarrow j,t}^{g}(H).$$

Finally, we obtain the "Net Pairwise Directional Connectedness" (NPDC) (Antonakakis et al. 2018b; Evrim Mandacı et al., 2020):

$$(9) \qquad NPDC_{ij}(H)=\frac{\tilde{\theta}_{ji,t}^{g}(H)-\tilde{\theta}_{ij,t}^{g}(H)}{N}\times 100.$$

To obtain conditional covariances and correlations among the financial markets, we estimate the Dynamic Conditional Correlation GARCH (DCC-GARCH) model developed by Engle (2002), specified as:

$$(10) \quad r_t=\mu_t(\theta)+\varepsilon_t, \qquad \varepsilon_t\left|\Omega_{t-1}\right. \square\, N(0,H_t),$$

$$(11) \quad \varepsilon_t=H_t^{1/2}u_t, \qquad u_t \square\, N(0,I),$$

$$(12) \quad H_t=D_tR_tD_t,$$

where r_t and $\mu_t(\theta)$ are the vectors, containing the series and conditional means, respectively; H_t, $D_t=diag\left(h_{iit}^{0.5},\ldots,h_{NNt}^{0.5}\right)'$, and R_t are the matrices of the conditional covariances, diagonal square root of the conditional covariances, and dynamic correlations, respectively (Evrim Mandacı et al., 2020):

$$(13) \quad R_t=diag\left(q_{ii,t}^{-0.5},\ldots,q_{NN,t}^{-0.5}\right)Q_t\,diag\left(q_{ii,t}^{-0.5},\ldots,q_{NN,t}^{-0.5}\right),$$

where $Q_t=\left(q_{ij,t}\right)$ is a $N\times N$ symmetric positive definitive matrix:

$$(14) \quad Q_t=\left(1-\alpha-\beta\right)\bar{Q}+\alpha u_{t-1}u_{t-1}'+\beta Q_{t-1},$$

We calculate the hedge ratios and optimal portfolio weights, using the conditional covariances produced by the DCC-GARCH model, as suggested by Kroner and Sultan (1993), Kroner and Ng (1998), respectively:

$$\beta_{jit} = h_{ijt} / h_{iit}, \quad (15)$$

where h_t is conditional (co-)variance. High conditional covariance between *i* and *j* leads to high hedging costs for a long position. We measure the optimal portfolio weights as follows:

$$w_{jit} = \frac{h_{iit} - h_{ijt}}{h_{jjt} - 2h_{ijt} + h_{iit}}, \quad (16)$$

with the following restrictions,

$$w_{jit} = \begin{cases} 0 & if\ w_{jit} < 0 \\ w_{jit} & if\ 0 \le w_{jit} \le 1. \\ 1 & if\ w_{jit} > 1 \end{cases} \quad (17)$$

Finally, following Ederington (1979), we calculate the hedging effectiveness of the strategies:

$$HE_i = 1 - \left(\mathrm{Var}_H / \mathrm{Var}_U \right) \quad (18)$$

where *HE* is hedging effectiveness; Var_H is the variance of the hedged position; Var_U is the variance of the unhedged position (Evrim Mandacı et al., 2020). We apply the well-known variance equality tests of Alexander and Govern (1994) and Kruskal and Wallis (1952) tests for determining the statistical significance of *HE* statistics; while both the tests perform well when variances are non-normal, the former performs better in case of variance heterogeneity, and the latter has good power properties when variances are homogenous (Dag, Dolgun, and Konar, 2018). We use the tests of Bartlett (1937) and Fligner and Killeen (1976), both testing the null hypothesis that variances are homogenous.

4. DATA

The dataset includes daily time series for a number of *Islāmic* and conventional stock markets, *Ṣukūk* market, commodity markets, and global risk factors covering the period from November 3, 2009 to November 1, 2019, with 2517 observations. The Dow Jones (DJ) Islamic Market indices of MENA region countries including the United Arab Emirates (ARE), Bahrain (BHR), Egypt (EGY), Jordan (JOR), Kuwait (KWT), Morocco (MAR), Oman (MAR), Qatar (QAT)

are used as proxies for *Islāmic* stock markets and additionally, the Saudi Arabia Tadawul Index (SAU) is used as an Islamic Stock market for Saudi Arabia[4]. DJ *Ṣukūk* Index (SUK) is used as a proxy for the *Ṣukūk* market. The MSCI Islamic Europe, Middle East, and Africa (MEN) index is used as a proxy for the regional *Islāmic* stock market. DJ Islamic World (WRA) and S&P 500 (SPX) indices are used as proxies for the global *Islāmic* and global conventional stock markets. We consider oil and gold as the most common commodities and use West Texas Intermediate crude oil spot prices (WTI) and Gold spot price per ounce (XAU) as proxies for global commodity markets. We consider the global interest rate, using the US 10-year Treasury yield (USB) as a proxy for the global risk factor. The data are expressed in US dollar terms and collected from the Factset. Table 1 depicts the description of the data.

TABLE 1
Data Description

Type	Markets	Notations
Country Islamic Stock Markets	DJ Islamic United Arab Emirates	ARE
	DJ Islamic Bahrain	BHR
	DJ Islamic Egypt	EGY
	DJ Islamic Jordan	JOR
	DJ Islamic Kuwait	KWT
	DJ Islamic Morocco	MAR
	DJ Islamic Oman	OMN
	DJ Islamic Qatar	QAT
	Saudi Arabia Tadawul All Share	SAU
Ṣukūk Market	DJ *Ṣukūk* Index	SUK
Regional Islamic Stock Market	MSCI Islamic Europe Middle East and Africa	MEN
Global Islamic Stock Market	DJ Islamic World	WRA
Global Conventional Stock Market	S&P 500 Index	SPX
Global Commodity Markets	US Crude Oil - WTI Spot	WTI
	Gold Spot Price	XAU
Global Risk Factor	The US Government Bond - 10-year Yield	USB

Following Forsberg and Ghysels (2017) and Antonakakis et al. (2018a), we analyze the absolute natural logarithmic differences as stock market volatility, calculated as $|\ln(P_{it}/P_{it\text{-}1})|$. The descriptive statistics of the volatility data are reported in Table 2. The volatility series are positively skewed, as expected, and leptokurtic; the Jarque-

Bera tests suggest rejecting the null hypothesis that a series follows a normal distribution, at the 1% level. The ARCH-LM tests reject the null hypothesis of no ARCH effects at the 1% level. We check the integration properties of the data estimating the well-known ADF tests; we reject the null hypothesis of unit root at the 1% level, indicating that the time-series are trend stationary over time.

TABLE 2
Descriptive Statistics

	Mean	Skew.	Kurt.	JB	LM (20)	ADF
ARE	0.008	3.7 [a]	22.6 [a]	59203 [a]	462.6 [a]	-9.1 [a]
BHR	0.008	3.1 [a]	14.7 [a]	26519 [a]	113.2 [a]	-14.8 [a]
EGY	0.008	3.3 [a]	18.2 [a]	39263 [a]	87.7 [a]	-17.0 [a]
JOR	0.005	2.4 [a]	7.9 [a]	8953 [a]	72.4 [a]	-13.3 [a]
KWT	0.006	3.2 [a]	16.9 [a]	34284 [a]	126.7 [a]	-12.1 [a]
MAR	0.006	2.3 [a]	9.2 [a]	11039 [a]	34.6 [a]	-12.0 [a]
OMN	0.004	3.7 [a]	23.1 [a]	61921 [a]	201.5 [a]	-14.7 [a]
QAT	0.006	3.4 [a]	21.3 [a]	52354 [a]	64.4 [a]	-30.3 [a]
SAU	0.006	4.1 [a]	31.4 [a]	110243 [a]	59.8 [a]	-14.0 [a]
SUK	0.001	16.6 [a]	414.3 [a]	18113935 [a]	247.7 [a]	-13.3 [a]
MEN	0.006	2.0 [a]	6.3 [a]	5756 [a]	102.3 [a]	-10.0 [a]
WRA	0.006	2.2 [a]	7.7 [a]	8284 [a]	283.9 [a]	-12.3 [a]
SPX	0.006	2.3 [a]	8.5 [a]	9881 [a]	341.4 [a]	-12.5 [a]
WTI	0.015	2.3 [a]	8.6 [a]	9901 [a]	157.6 [a]	-12.5 [a]
XAU	0.007	2.8 [a]	17.1 [a]	34036 [a]	31.2 [a]	-11.4 [a]
USB	0.016	1.7 [a]	4.3 [a]	3168 [a]	139.7 [a]	-13.3 [a]

Note: JB stands for the Jarque-Bera normality test; LM(20) is the Lagrange-Multiplier test for checking the ARCH effects; the ADF is the unit root test with a constant and trend. [a] denotes the statistical significance at the 1% level.

5. EMPIRICAL RESULTS

We study dynamic connectedness to point out volatility spillover between *Islāmic* markets (including stock and *Ṣukūk* markets) and some regional and global markets. Table 3 shows the pairwise, total, and net directional connectedness based on the TVP-VAR (1). The highest observed pairwise connectedness is from WRA to SPX (32.2%). In return, the second largest pairwise connectedness is from SPX to WRA (30.4%). It shows that the pairwise connectedness measures are relatively high among the global *Islāmic* and global conventional stock markets, indicating high volatility spillovers between them. The next largest pairwise connectedness is from WRA

to MEN (11.5%), indicating volatility spillover from the global *Islāmic* to regional *Islāmic* stock market. We also observe prominent volatility spillovers among a few *Islāmic* stock markets, ARE, QAT, and SAU, which are the major markets in the Middle East region. The pairwise connectedness from SAU to QAT and ARE is 9.2% and 7.9%, respectively; from ARE to QAT and SAU is 8.6% and 7.7%, respectively; and from QAT to SAU and ARE is 8.4% and 8.1%, respectively. It indicates that these *Islāmic* stock markets are well connected. However, the pairwise connectedness results are very low among the rest of the *Islāmic* markets; their pairwise connectedness with the other markets, including SUK, MEN, WRA, SPX, WTI, XAU, and USB are also low. Our results indicate that the *Islāmic* stock markets may provide diversification benefits to investors and portfolio managers.

The "TO" row sums the pairwise connectedness measures: the total directional connectedness from each of 16 markets to others, excluding their own. As the own-effects range between 42.4% and 82.1%, the total directional connectedness in the "TO" row ranges between 12.2% and 78.3%. Similarly, the last column indicates the total directional connectedness of each market "FROM" others, including their own, ranging from 17.9% to 57.6%. It is noteworthy that the global *Islāmic* and global conventional stock markets are both the leading volatility transmitters and receivers in the system, whereas the *Ṣukūk* market and global risk factor, the US 10-year government bond, and the global commodity markets, oil, and gold, do not have a considerable volatility spillover impact on the others. As a result, we can say that the contributions of global *Islāmic* and global conventional stock markets to the overall volatility is higher than those of the country level *Islāmic* stock markets. On the other hand, the contributions of the oil, gold, US Bond, and *Ṣukūk* markets to the overall volatility are prominently low.

According to the "NET" directional connectedness row of Table 3, the largest is from WRA to others (20.7%), indicating that the Islamic World Index is the most important factor influencing the volatility of the others, and the lowest that is from the others to MEN (-10.6%), indicating that the regional *Islāmic* stock market is largely impacted by the other factors. The net receivers are ranked as MEN (-10.6%), EGY (-8.4%), MAR (-5.7%), BHR (-5.5%), USB (-5.1%), JOR (-3.9%), OMN (-1.8%), KWT (-0.5%) and XAU (-0.5%) and the net transmitters are ranked as WRA (20.7%), SPX (8.6%), SAU (5.8%), SUK (4.3), ARE (1.6%), QAT (0.8%) and WTI (0.2%).

Our results indicate that the regional *Islāmic* stock market is the major net volatility receiver, followed by most country-level Islamic Stock Markets, namely Egypt, Morocco, Bahrain, Jordan, Oman, and Kuwait. Additionally, the US 10-year bond market and the gold market are also net volatility receivers. On the other hand, the global *Islāmic* and global conventional stock markets are the major volatility transmitters. Additionally, the rest of the country level *Islāmic* stock markets, namely Saudi Arabia, the United Arab Emirates, Qatar, and the *Ṣukūk* market, are net volatility transmitters. Moreover, the US Crude Oil spot market is also among the net volatility transmitters. *Islāmic* stock markets, such as Kuwait and Oman, are less influenced by the others compared with the other *Islāmic* markets. These are the more segmented markets in the MENA region, offering more diversification benefits to investors. We found that Saudi Arabia, as a major stock market in its region, and the *Ṣukūk* market mostly influence the markets other than global *Islāmic* and conventional stock markets.

The total connectedness index (TCI), reported at the bottom right of Table 3, is estimated at 41.9%, indicating a moderate interconnectedness among the volatilities. Moreover, the connectedness among the *Islāmic* markets; and the regional and global factors might be time varying. Therefore, we examine how these volatility spillovers evolve.

Figure 1 depicts the total dynamic connectedness with a 10-day-ahead forecast horizon[5]. While the total connectedness index is estimated at 41.9%, it fluctuates between 31% to 91% over time. The dynamic connectedness has decreased after the global financial crises and has reached its lowest level in mid-2011. After that, we observe five significant episodes of an upsurge in the connectedness over time; the first beginning in the late 2011 and ending in the mid-2012; the second beginning in the last quarter of 2013 and ending in mid-2014; the third beginning at the end of 2014, and ending in mid-2015; the fourth beginning in the third quarter of 2015 and ending at the beginning of 2016; and the last is beginning at the end of the first quarter of 2019 and ending in the third quarter of 2019.

TABLE 3
Dynamic Connectedness, November 3, 2009 – November 1, 2019

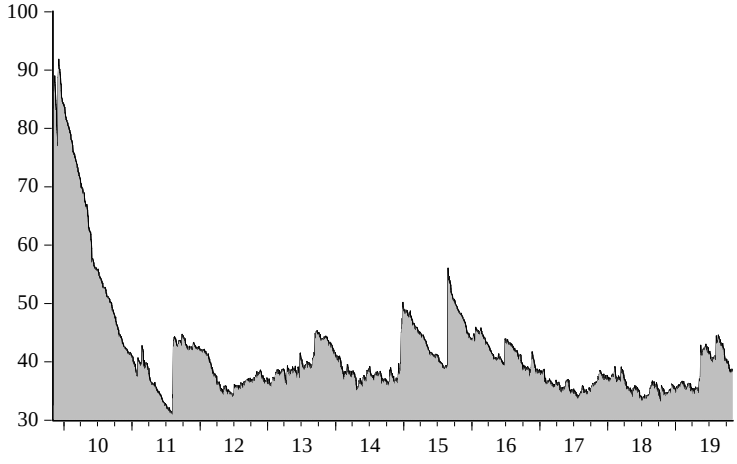
	ARE	BHR	EGY	JOR	KWT	MAR	OMN	QAT	SAU	SUK	MEN	WRA	SPX	WTI	XAU	USB	FROM
ARE	46.1	5.1	3.8	3.6	5.3	0.8	4.3	8.1	7.9	2.9	2.8	2.3	1.9	1.5	2.1	1.6	53.9
BHR	6.1	56.0	4.4	3.9	5.3	0.9	4.8	5.1	4.5	1.2	1.0	1.5	1.0	1.1	1.5	1.6	44.0
EGY	4.4	4.3	57.0	3.2	4.4	0.7	4.2	3.9	6.6	2.4	0.9	2.4	1.3	1.5	1.8	1.0	43.0
JOR	4.9	4.2	2.8	64.7	4.9	0.7	3.2	4.3	3.7	1.6	0.6	1.0	0.7	1.1	1.0	0.5	35.3
KWT	5.9	4.6	3.5	4.0	53.3	0.9	5.7	6.2	6.9	1.0	1.1	1.6	0.9	1.4	1.8	1.2	46.7
MAR	1.0	1.2	0.7	1.0	1.4	82.1	1.7	1.1	1.3	1.3	0.9	1.1	1.2	1.0	1.1	1.9	17.9
OMN	5.3	4.5	4.3	3.0	5.9	0.6	54.4	6.1	6.8	1.6	1.2	1.4	1.0	2	1.0	0.9	45.6
QAT	8.6	4.6	3.8	3.4	5.6	0.9	5.9	49.2	9.2	1.2	1.7	1.2	1.0	1.4	1.5	0.9	50.8
SAU	7.7	3.5	5.6	2.8	6.3	0.7	5.7	8.4	49.3	1.0	1.8	2.2	1.6	1.9	1.0	0.6	50.7
SUK	1.2	0.9	0.9	1.4	1.1	0.8	1.2	1.5	1.3	76.1	1.7	2.8	1.8	1.7	2.2	3.3	23.9
MEN	3.1	1.3	1.0	1.0	1.2	0.7	1.4	2.1	2.0	2.0	54.9	11.5	7.5	4.4	3.4	2.6	45.1
WRA	1.2	0.5	0.5	0.6	0.9	0.6	0.6	0.6	1.2	2.4	7.1	42.4	30.4	3.9	3.6	3.5	57.6
SPX	1.0	0.7	0.7	0.6	0.6	0.9	0.7	0.9	1.2	1.5	4.5	32.2	44.6	3.1	2.6	4.1	55.4
WTI	1.1	0.9	1.0	1.1	1.1	0.8	1.7	1.6	2.0	2.6	3.4	5.7	4.4	66.9	2.7	3.2	33.1
XAU	1.8	1.1	0.8	0.9	1.0	0.9	0.6	0.6	0.7	2.9	3.7	5.7	3.7	2.9	68.9	3.7	31.1
USB	2.1	1.3	1.0	0.9	1.3	1.1	2.0	1.0	1.1	2.5	1.9	5.5	5.8	4.3	3.5	64.5	35.5
TO	55.5	38.5	34.6	31.4	46.2	12.2	43.8	51.6	56.5	28.2	34.5	78.3	64.0	33.3	30.7	30.4	669.7
NET	1.6	-5.5	-8.4	-3.9	-0.5	-5.7	-1.8	0.8	5.8	4.3	-10.6	20.7	8.6	0.2	-0.5	-5.1	TCI
NPDC	9	3	3	4	8	1	5	10	12	9	2	15	14	10	9	6	41.9

The findings are obtained from the TVP-VAR (1) model, with a 10-day forecast horizon.

The first episode might be related to the Arab spring in 2011; it reached peak in the last quarter of 2011The second episode might be related to the sanctions against Iran's oil and gas industry. The third and fourth episodes might be the result of Federal Reserve's (FED) tapering decision and rate hikes, respectively. And the last episode might be related to the increasing tensions of the US-China trade war.

Furthermore, the time-varying 'NET' directional connectedness is presented in Figure 2. Figure 2 shows the net volatility transmitters or receivers. It indicates that the global *Islāmic* and conventional stock markets are mostly 'net transmitters', and the regional *Islāmic* stock market is always a 'net receiver'. The *Islāmic* stock markets, Egypt, Morocco, Bahrain, Jordan, and Kuwait, receive more volatility than those they transmit. The US bond market has become the net volatility transmitter after 2018.

FIGURE 1
Total Dynamic Connectedness



Note: The findings are obtained from the TVP-VAR (1) model, with a 10-day forecast horizon.

FIGURE 2
Net Total Directional Connectedness

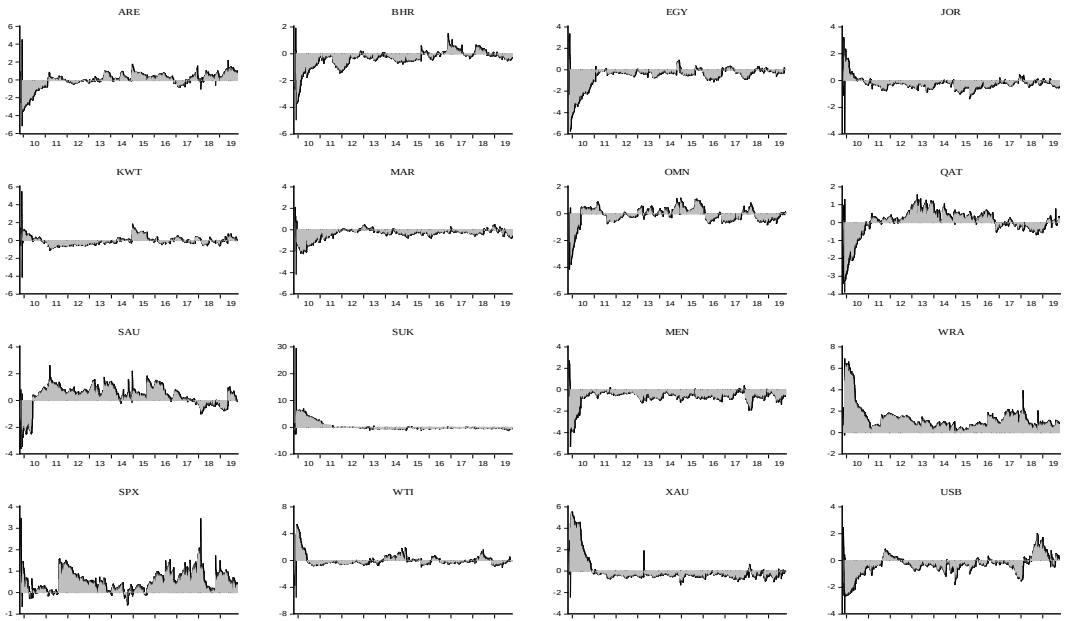


FIGURE 3
Dynamic Optimal Hedge Ratios

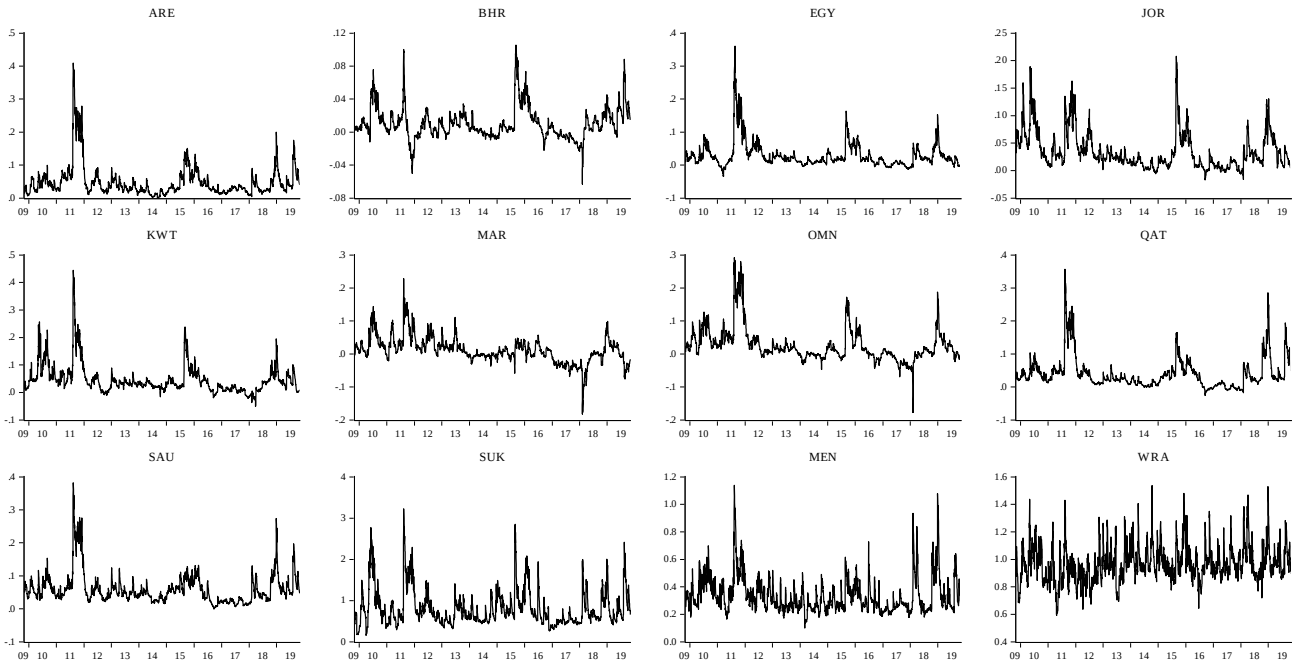
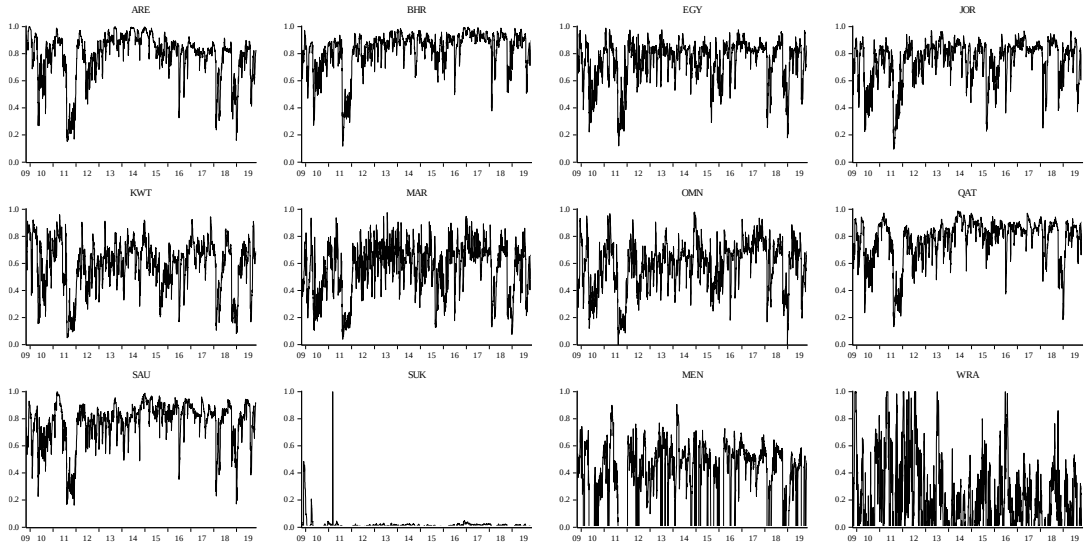


FIGURE 4
Dynamic Optimal Portfolio Weights



Next, we measure the hedging effectiveness of portfolio strategies. We employ the DCC-GARCH model with multivariate student-*t* distribution to obtain the dynamic conditional covariances and correlations among the markets[6]. We exploit dynamic conditional covariances and correlations to determine the hedge ratios and optimal portfolio weights. The optimal hedge ratios are formed under the assumption that investors take a long position in the S&P 500 Index volatility and a short position in the *Islāmic* markets, *Ṣukūk* market, regional *Islāmic* stock market, or Islamic World market volatility (Evrim Mandacı et al., 2020). Figures 3 and Figure 4 depict the dynamic optimal hedge ratios and dynamic optimal portfolio weights calculated from the conditional (co)variance estimates of the DCC-GARCH model.

Figure 3 depicts that the hedge ratios are volatile over time. Most of the hedge ratios for portfolios taking a short position on most of the country *Islāmic* stock markets, including the United Arab Emirates, Egypt, Kuwait, Morocco, Oman, Qatar, Saudi Arabia; *Ṣukūk* market and regional *Islāmic* stock market reach their peak level during 2011 and 2012 as a result of the Arab spring. We observe high hedge ratios for the rest of the portfolios shorting other *Islāmic* markets during the same period. On the other hand, a few of these hedge ratios reach their peak level at the end of 2015 due to the changes in the FED's interest rate policy. These are the portfolios taking short positions on the Bahrain and Jordan stock markets. High levels of hedge ratios are also observed for most of the other portfolios during the same period. Additionally, high hedge ratios are noticed for many portfolios, especially the portfolio taking a short position on global *Islāmic* stock markets at the end of 2018 and the beginning of 2019 due to increasing uncertainties over the US-China trade war.

Figure 4 shows the high volatility of dynamic optimal portfolio weights and indicates the requirement of active portfolio management except for *Ṣukūk*. In some cases, the optimal weights show a zero-dollar investment in S&P 500 volatility, suggesting that the minimum variance portfolio is achieved by the volatility of one of the *Islāmic* markets such as Oman Islamic stock market, *Ṣukūk* market, regional *Islāmic* and global *Islāmic* stock markets.

Tables 4 and 5 give the hedging effectiveness (*HE*) of portfolio strategies. Table 4 shows the calculated average hedge ratios, β_{jit}, denoting the optimal hedge ratio for a \$1 long position in SPX volatility and a \$$\beta jit$ short position in the volatility of each *Islāmic* market.

TABLE 4
Hedging Effectiveness of Hedge Ratios Strategy

	Average β_{jit} (%)	Hedged Portfolio Std. Dev. (%)	Hedging Effectiveness (%)	Tests of Equality of Variances		Tests of Homogeneity of Variances		Normality Test
				Alexander-Govern	Kruskal-Wallis	Bartlett	Fligner-Killeen	Jarque-Bera
ARE	4.81	0.66	4.52 [a]	3.41 [c]	16.92 [a]	1.35	1.12	7151 [a]
BHR	1.02	0.68	0.54	0.16	1.97	0.02	0.07	9785 [a]
EGY	2.95	0.67	3.79 [a]	1.47	8.50 [a]	0.94	0.41	7897 [a]
JOR	3.44	0.67	1.68 [a]	0.90	9.86 [a]	0.18	0.73	9919 [a]
KWT	4.60	0.67	2.31 [a]	2.01	10.74 [a]	0.34	0.64	8271 [a]
MAR	1.18	0.68	1.36	0.16	0.73	0.12	0.40	9693 [a]
OMN	2.52	0.67	1.86	0.23	1.62	0.22	0.07	9652 [a]
QAT	3.97	0.67	3.88 [a]	1.73	9.04 [a]	0.99	0.35	8282 [a]
SAU	5.95	0.67	3.64 [a]	3.29 [c]	14.39 [a]	0.86	0.51	7911 [a]
SUK	80.82	0.66	4.43 [a]	11.86 [a]	19.37 [a]	1.29	0.51	9152 [a]
MEN	33.30	0.61	18.86 [a]	151.86 [a]	216.45 [a]	27.43 [a]	0.35	3079 [a]
WRE	96.53	0.34	75.12 [a]	1204.54 [a]	1456.90 [a]	1130.01 [a]	339.73 [a]	1685 [a]

Note: β_{jit} is the optimal hedge ratio. w_{jit} is the optimal portfolio weight. HE stands for Hedging Effectiveness. Alexander-Govern (1994) and Kruskal-Wallis (1952) test the null hypothesis of variance equality. Barlett (1937) and Fligner-Killeen (1976) test the null hypothesis of variances is homogenous. Jarque-Bera (1980) is the normality test. [a] and [c] denote statistical significance at the 1% and 10% level, respectively.

TABLE 5
Hedging Effectiveness of Portfolio Weights Strategy

	Average w_{jit} (%)	Hedged Portfolio Std. Dev. (%)	Hedging Effectiveness (%)	Tests of Equality of Variances		Tests of Homogeneity of Variances		Normality Test
				Alexander-Govern	Kruskal-Wallis	Bartlett	Fligner-Killeen	Jarque-Bera
ARE	78.55	0.53	38.24 [c]	3.57 [c]	6.51 [a]	144.67 [a]	23.26 [a]	9643 [a]
BHR	82.97	0.54	37.11	2.27	6.80 [a]	134.07 [a]	18.26 [a]	9626 [a]
EGY	74.43	0.56	31.70	0.20	15.21 [a]	90.88 [a]	14.61 [a]	10713 [a]
JOR	75.09	0.49	48.75 [a]	22.14 [a]	0.05	275.95 [a]	54.35 [a]	4340 [a]
KWT	59.20	0.47	51.89 [a]	28.20 [a]	0.00	329.42 [a]	82.55 [a]	19487 [a]
MAR	56.22	0.42	62.15 [a]	24.01 [a]	7.07 [a]	571.52 [a]	115.28 [a]	24740 [a]
OMN	58.65	0.41	64.25 [a]	102.14 [a]	20.53 [a]	638.02 [a]	189.92 [a]	8034 [a]
QAT	77.58	0.52	42.05 [a]	7.28 [a]	3.30 [c]	184.91 [a]	31.76 [a]	6236 [a]
SAU	77.39	0.54	38.07 [a]	11.23 [a]	0.10	142.99 [a]	31.38 [a]	29184 [a]
SUK	1.54	0.16	94.21 [a]	1278.98 [a]	1808.81 [a]	3963.05 [a]	2040.65 [a]	8672294 [a]
MEN	38.49	0.53	40.03 [c]	2.80 [c]	13.01 [a]	162.70 [a]	51.04 [a]	10689 [a]
WRE	22.00	0.59	24.25 [a]	10.41 [a]	2.51	48.34 [a]	20.35 [a]	8557 [a]

Note: See the note for Table 4.

The average hedge ratios take values between 1.02 and 96.53 cents, indicating that the cheapest hedge for a $1 long position in the SPX volatility is obtained with a short position in Bahrain Islamic stock market volatility (1.02 cents). In contrast, the most expensive is obtained with the Global Islamic stock market (96.53 cents). So that the Global Islamic stock market index is the least useful asset to hedge against the investment in the SPX volatility; moreover, the US investors can hedge their portfolios with low costs by taking a short position in most of the country level stock markets such as the United Arab Emirates, Qatar, Egypt, Saudi Arabia, Kuwait, and Jordan.

Table 5 shows the dynamic optimal portfolio weights, w_{jit}, where w_{jit} is the weight of SPX volatility in a portfolio with an Arab market. The portfolio weights range from 1.54 to 82.97; the lowest weight 1.54, for the portfolio consisting of the *Ṣukūk* volatility, indicates that for a $1 portfolio, 1.54 cents should be invested in SPX volatility and 98.46 (1- w_{jit}) cents should be invested in the *Ṣukūk* volatility; the highest level 82.97 indicates that for the $1 portfolio, 82.97 cents should be invested in the SPX volatility and the remaining 17.03 cents should be invested in Bahrain volatility. S&P 500 volatility assumes the highest weight for the portfolios with country *Islāmic* stock markets; however, it does not hold for portfolios with the *Ṣukūk* and the regional and global *Islāmic* stock market indices.

We measure the significance of the *HE* statistics using one of the variance equality tests, Alexander and Govern (1994), and Kruskal and Wallis (1952), that is preferred depending on the variance homogeneity across portfolios, determined by Bartlett (1937), and Fligner and Killeen (1976). The *HE* statistics for both strategies are mostly statistically significant at the 10% level or better. According to the tests of equality of variances, hedging effectiveness following the hedging (ratio) strategy is statistically significant, at the 10% level, or better, for the *Islāmic* markets, except Bahrain, Morocco, and Oman. The hedging effectiveness statistics are statistically significant, at the 10% level, or better, for the *Islāmic* markets, except Bahrain and Egypt.

The results suggest that the S&P volatility can be hedged significantly, with most of the *Islāmic* markets; however, its effectiveness ranges from 1.68% to 75.12%, indicating the risk reduction ranging from 1.68% to 75.12%. For instance, the US Investors can reduce their portfolio risks by 75.12% by investing in the Global Islamic market with a hedging cost (short position) of 96.53 cents for a $1 long position in the SPX volatility. Following the Global

Islamic stock market, the volatilities of the regional stock market, the United Arab Emirates, and the *Ṣukūk* market provide high hedging effectiveness values of 18.86%, 4.52%, and 4.43%, respectively. The results of hedging effectiveness of the optimal portfolio weights strategy show that the highest hedging effectiveness for S&P 500 volatility can be obtained with portfolios consisting of the *Ṣukūk* market, followed by the *Islāmic* stock markets, Oman, Morocco, Kuwait, Jordan, and Qatar.

6. CONCLUSION

In this paper, we examine the volatility spillover from regional and global factors to the *Islāmic* markets. We focus on the *Islāmic* stock markets of the MENA region, which are examined in the related literature rarely. The main reason we consider the MENA countries is that these *Islāmic* markets may be influenced by the sharp decreases in oil prices more adversely than the others. Moreover, the regional political tensions and market reform implementation to attract foreign capital motivate us to examine their relationships within themselves and with global factors. Our data consists of the DJ *Islāmic* markets of United Arab Emirates, Bahrain, Egypt, Jordan, Kuwait, Morocco, Oman, Qatar and Saudi Arabia Tadawul All Shares Index, and the DJ *Ṣukūk* Index. We use the MSCI Islamic Europe, the Middle East, and Africa index as the regional *Islāmic* stock market; the S&P 500 index as the global conventional stock market; the West Texas Intermediate crude oil spot prices (WTI) and Gold spot price per ounce as global commodity markets for oil and gold respectively. As for the global risk factor, we use a 10-year US government bond yield.

The findings of this paper may provide the US investors and portfolio managers who are interested in *Islāmic* assets, particularly the *Islāmic* stock markets of the MENA countries and *Ṣukūk* market, with significant implications and help them to understand whether the *Islāmic* financial markets react differently from their conventional counterparts to major global factors and global financial turbulences. The exploration of the low connectedness between *Islāmic* and global markets despite the increases in total dynamic connectedness during economic and political turbulence may imply diversification opportunities for the US investors and fund managers. It follows that investing in country-level funds offers more diversification benefits to investors than those at the regional or global level because of the lower connectedness between the global conventional stock market and the stock markets of the MENA countries. On the other hand, this study

suggests that it would be more pragmatic to invest in the small MENA countries rather than the major *Islāmic* markets, such as Saudi Arabia, Qatar, and the UAE, for the former offer better diversification opportunities.

Besides, the study suggests that the oil market, a net volatility transmitter, influences less the country and regional-level *Islāmic* stocks than global *Islāmic* markets do; a setting justifying high connectedness among similar asset classes. Hence, the study holds that asset allocation is critical for investors and fund managers. In the same vein, the results of hedging effectiveness demonstrate that in addition to country-level markets, *Ṣukūk* investments may provide diversification opportunities; hence, they offer the US investors a robust alternative to reduce their risk. Also, the study finds that an optimal portfolio strategy may enable reducing risk more than hedging, another important implication to the concern of investors. Besides, the results highlight significant implications also for policymakers now that connectedness between the *Islāmic* and conventional stock markets, particularly during economic and political turbulence, turns out to be a critical factor in developing economic strategies. Lastly, to regulators in the MENA countries, it should be underlined that the more the Sharia rules are loosed in regulating their markets, the less their markets will offer diversification opportunities to outsiders. Consequently, *Islāmic* assets will lose their safe-haven features. In other words, they should maintain the authenticity and unique characteristics of their markets.

The findings of this paper are consistent with the hypothesis of decoupling the *Islāmic* from conventional markets, and they support the findings of Majdoub and Mansour (2014) and Hkiri et al. (2017). They also support the findings of Rejeb (2017), proving the existence of volatility spillover from the developed conventional to regional *Islāmic* stock markets. However, in contrast to Hammoudeh et al. (2014) and Shahzad et al. (2017), who examined the volatility spillover effect between global factors and *Islāmic* markets in developed countries, we find low spillovers from global commodity and risk factors to *Islāmic* stock markets in the MENA region. Opposite to Naifar, Hammoudeh, and Al Dohaiman (2016), our results show that the *Ṣukūk* market is more connected to global *Islāmic* markets than the global conventional stock market.

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ENDNOTES

1. All these studies prove that the Islamic indices perform better relatively than their conventional counterparts during the crises period. Akhtar and Jahromi (2017) argue that their benefits are realized during 2007/08 global financial crises since Islamic institutions are prohibited from holding sub-prime mortgage securities and derivatives.

2. Saudi Arabia was introduced into the MSCI Emerging Markets Index in June 2019, and Kuwaiti equities will be upgraded in 2020 (Reuters, 2020).

3. MENA equities are represented by the MSCI Arabian Markets Domestic Standard (Large+Mid Cap) Index net total returns. Arab Market countries include Bahrain, Egypt, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, and United Arab Emirates (MSCI database, 2020). Developed markets equities are represented by the MSCI World Index net total returns and emerging markets equities are represented by the MSCI Emerging Markets Index net total returns (MSCI database, 2020).

4. Since the DJIM Saudi Arabia Index has been started calculating very recently, we select the conventional Tadawul Index to have adequate observations.

5. The reported results are qualitatively similar to those with 5-, 20-day forecast horizons.

6. The parameter estimates of the DCC-GARCH-*t* model and dynamic conditional correlations are not reported, though available upon request; all parameter estimates, except the intercept in the mean equation, for both WRA and SUK, are statistically significant at the 1% level; the dynamic conditional correlations occasionally take negative values over the sample period, for all country-Islamic markets, except ARE.

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