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VOLATILITY SPILLOVERS EFFECTS BETWEEN ENERGY COMMODITIES AND ISLAMIC STOCK MARKETS

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ABSTRACT

Empirical research exploring the relationship between capital markets and energy prices plays a crucial role in shaping policies for the growth of the Islamic financial system. This study aims to investigate potential shock transmission and volatility spillover effects among Islamic stock indices from selected Middle East and Northern Africa countries as well as crude oil prices and natural gas, over the period from August 2007 to September 2020. Applying VAR-BEKK-GARCH representation, the results reveal the evidence of bidirectional cross-market shock and volatility spillover effects between Kuwait and Qatar Islamic stock indexes, crude oil prices, and natural gas. Moreover, the results indicate the existence of bidirectional/unidirectional shock and volatility spillovers between Islamic indexes and all other variables, meaning there are information flows between these variables in all four countries except Turkey. Regarding the results of volatility spillovers, there is no spillover effect between Turkey's MSCI Islamic index and Brent crude oil. These findings bear significant implications for portfolio management, offering valuable insights to financial market participants for making improved portfolio

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allocation decisions. Also, comprehending the volatility transmission mechanism across these markets is vital to provide policymakers and regulatory authorities with insight into the impact of energy prices on Islamic stock markets.

Keywords: Commodity markets, Energy, Islamic equity markets, Volatility Spillover Effects

INTRODUCTION

Oil, an essential natural resource powering the global economy, is subject to considerable episodic volatility and uncertainty. This was evident when its prices skyrocketed from USD92 per barrel in January 2008 to a record peak of USD147 per barrel in July 2008. However, these prices took a severe downturn in 2014, eventually plummeting to less than USD30 per barrel in January 2016. A gradual rebound began in the summer of 2017, with oil prices surpassing USD86 per barrel in early October 2018. Yet, a similar market correction ensued soon after, causing a 40% price decrease by the close of 2018. In 2019, Brent crude oil had an average cost of USD64 per barrel, which decreased from USD71 per barrel in 2018 (French, 2020). A historic low was witnessed in April 2020 when the price plunged to less than USD0 for the first time. This substantial decline in oil prices can be primarily attributed to two factors. The first is the 2020 Russia–Saudi Arabia oil price conflict, and the second is the worldwide demand reduction for oil due to lockdowns imposed in response to the COVID-19 pandemic (OECD, 2020; Gharib et al., 2021).

The volatile movement significantly impacts the economic growth of countries. This applies regardless of whether these nations adhere to traditional or faith-based business practices. Many top oil-producing countries predominantly practice the Islamic faith, leading to a shared and transferred risk, especially during financial instability. This was seen in the 2008–2009 global financial crisis, the 2011–2012 European sovereign debt crisis, and Brexit in 2016, during which the interconnections among different financial markets and between financial and oil markets intensified. The influence of oil price fluctuations on Islamic stock markets has garnered substantial interest. This is relevant to trading and risk management in Islamic stocks and crucial for the hedging strategies of international investors interested in faith-based investments.

Islamic finance has grown remarkably, particularly after the 2008–2009 global financial crisis. This faith-based investment is broadly categorised as an ethical and socially responsible investment. This sector is witnessing substantial global growth and continues to attract investors worldwide. It has attracted significant interest as an alternative investment option, appealing not only to faith-based investors but also to traditional investors seeking diversification or potentially higher returns (Reddy et al., 2017; Umar, 2017; Umar et al., 2020; Delle Foglie & Panetta, 2020). The Refinitiv Islamic Finance Development Report (Refinitiv, 2022) highlighted that global Islamic finance assets saw a double-digit increase of 17%, reaching USD4.0 trillion in 2021. The burgeoning interest in Sharia-compliant investment products, primarily driven by the significant oil wealth in Islamic nations and the notable resilience of Islamic stocks during the global financial crisis, has led to the expansion of the Islamic stock market. It also predicted that the Islamic finance industry is poised for further growth, with an estimated value of USD5.9 trillion by 2026. This growth is expected to be primarily driven by its most significant segments: Islamic banks and Sukuk.

Markowitz portfolio theory (developed by Harry Markowitz in 1952), which provides a general framework for building optimal portfolios that align with Islamic principles while optimising risk-adjusted returns, is so relevant in the context of Islamic stock markets and other assets and commodities. Considering the fact that Islamic finance offers different risk-sharing instruments such as Sukuk and Mudarabah, investors have the opportunities to integrate these into their diversified portfolios to enhance risk-adjusted returns.

Given that many oil-producing nations predominantly adhere to the Islamic faith, Islamic markets often experience the impact of oil price fluctuations, signifying a direct correlation between these variables. While an established body of research investigates the relationship between oil and stock markets, studies explicitly focusing on the interplay between Islamic stock returns and oil prices are scarce. This scarcity is particularly evident in research examining upside and downside risk measures despite Islamic stock markets' significant role in the global economy. An early study by Hussin et al. (2013) indicated that oil price fluctuations had only short-term impacts on Islamic stock returns in Malaysia. Ghorbel et al. (2014) noted that volatility in oil prices influenced the Islamic indices in Malaysia and Indonesia. Conversely, Abdullah et al. (2016) discovered that the correlation between the Philippine Islamic stock index and crude oil was relatively weak in the short term. Further, Nagayev et al. (2016) noted a decreasing dynamic correlation between oil and Islamic equity, aligning with the surge in stock prices and the decline in oil prices post-2013. Badeeb and Lean's (2018) study echoed this sentiment while examining the asymmetric relationship, and it was substantial.

The relationships between oil prices and many Islamic sectoral stocks tend to follow a nonlinear pattern in the longer horizon (Ftiti & Hadhri, 2019; Mishra et al., 2019). Shahzad et al. (2018), adopting the copula approach, found positive dependence between oil prices and Islamic stock returns, while Narayan et al. (2019) showed that only 32% of these stocks reacted to oil price movements. Exploring the dynamic conditional correlation and volatility linkage between Islamic indexes and oil for BRIC countries, Hassan et al. (2019) found an increasing correlation during the global financial crisis for India and China but not for Brazil and Russia. Investigating the asymmetric volatility connectedness between the Dow Jones Islamic Market Index (DJIM) and the Brent crude oil, gold and silver markets, Suleman et al. (2021) show that DJIM and Brent oil markets were the most significant contributors to spillover connectivity. Some studies have found evidence of significant spillover effects, with movements in oil prices affecting stock market returns in Islamic countries (Khan et al., 2022; Chkili, 2022). Using the same methodology, Bahloul and Khemakhem (2021) showed that commodities exhibited the highest source of shocks to the Islamic equity market for both full periods and sub-periods. The relationship between energy commodities and Islamic stock markets is multifaceted, governed by various influencing factors. Additional research is paramount to comprehend the volatility spillover effects between these two markets completely. Consequently, this study seeks to broaden the existing literature on the volatility spillover impacts between oil, natural gas, and Islamic stock markets. Through the implementation of risk management, diversification and long-term investing strategies, this knowledge expansion will benefit international investors and individuals interested in faith-based investments, offering them more profound insights into these market dynamics.

The current study enhances the existing body of literature by offering four novel insights. Firstly, while few studies are concentrating on Islamic stock markets at the national level, we make a pioneering endeavour to examine the return and volatility spillovers between the most strategic commodity, oil, and Islamic stock markets for a large sample of five Middle East and Northern Africa (MENA) countries, Turkey, Morocco, Kuwait, Qatar and Oman from August 2007 to September 2020. Except for Turkey, these countries are selected according to their risk exposure and business models, which comply with the Sharia rules and dependency on oil. Secondly, we employ a newly developed multivariate econometric technique, VAR-GARCH-in-mean framework with the BEKK representation, which does not impose the restriction of constant correlation among variables over time. This model captures the volatility and shock transmission among markets since shocks can spillover from one country to another because these countries process common oil-related information. Thirdly, selected MENA countries are heavily oil-dependent; therefore, natural gas, West Texas Intermediate (WTI) and Brent crude oil prices are used as proxies for global crude oil prices to analyse the volatility pattern between Islamic stock and oil markets. Lastly, Islamic stocks are essential since they have unique revenue-sharing characteristics and prohibit specific industries. This would provide a deeper understanding of potential opportunities for diversifying investments where it serves as vital avenues for individual and institutional investors seeking new hedges and safe havens. As such, they form the groundwork for making informed decisions that can contribute to the stability and expansion of the Islamic financial system.

DATA AND METHODOLOGY

We use a dataset of the Morgan Stanley Capital International (MSCI) Islamic indices for the five MENA countries[1], namely Turkey, Morocco, Kuwait, Qatar and Oman, as well as WTI, and Brent crude oil and natural gas covering the period spanning from 1 August 2007 to 8 September 2020[2] with a total of 3,303 daily observations. The MSCI Islamic index is employed as a proxy for the global Islamic stock market and reflects Sharia investment guidelines and is designed to measure the performance of the large, mid and small cap segments across markets that are relevant for Islamic investors. With regard to oil prices, we use WTI and Brent crude oil prices as a proxy for global crude oil prices. The daily frequency data are obtained from Datastream and expressed in U.S. dollars to preserve homogeneity and to avoid exchange rate risk. Our sample period covers major international events such as the Lehman Brother collapse (15 September 2008) and the extreme market movements around the 2008–2009 global financial crisis and the 2009–2012 Eurozone sovereign debt crisis. The daily returns of each series were calculated as the first difference of the natural logarithm of prices multiplied by 100.

We apply the Augmented Dickey-Fuller (ADF) unit root tests and as shown in Table 1. The test results indicate that all series are stationary, coinciding with the descriptive statistics findings. These highlight the importance of using a time varying volatility model for the implementation of an empirical analysis of spillover effects among variables.

Table 1
The unit root test results

		Level				First difference			
		ADF				ADF			
Country	Variable	Lag length		Constant	Constant trend	Lag length		Constant	Constant trend
	WTI	0	0	–0.578	–0.963	0	0	–57.823*	–57.816*
	BRENT	0	0	–2.762***	–2.775	0	0	–58.664*	–58.659*
	Natural gas	3	3	–2.090	–3.081	2	2	–39.342*	–39.337*
Turkey	Islamic Price Index	1	1	–2.818***	–2.804	0	0	–53.354*	–53.348*
Morocco	Islamic Price Index	1	1	–1.236	–2.186	0	0	–58.893*	–58.884*
Kuwait	Islamic Price Index	2	2	0.027	–1.463	1	1	–49.352*	–49.398*
Qatar	Islamic Price Index	0	0	–2.344	–2.650	1	1	–38.695*	–38.691*
Oman	Islamic Price Index	1	1	–2.354	–2.602	0	0	–68.748*	–68.754*

Note: *, ** and *** indicate statistical significance at the 1%, 5% and 10% level, respectively.

Multivariate GARCH models with dynamic covariances and conditional correlation, such as the BEKK parameterisation (Baba, Engle, Kraft and Kroner), CCC (constant conditional correlation) or DCC (dynamic conditional correlation) models, have been extensively used to investigate volatility spillover among financial variables. In this study, a multivariate GARCH with BEKK specification developed by Engle and Kroner (1995) appears to be the most suitable for inspecting not only for volatility persistence of oil, natural gas and Islamic stock markets but also for the own- and cross-volatility spillover effects between these markets.

For the empirical analysis on return spillovers between oil, natural gas and Islamic stock markets, the conditional mean equation is modelled through a Vector Autoregressive (VAR) model. Based on the principle of minimum Akaike Information criterion values, VAR (1) model has the following specification for the conditional mean:

$$R_{1,t} = \mu + \delta_{1,1} R_{1,t-1} + \delta_{1,2} R_{2,t-1} + \varepsilon_{1,t} \tag{1}$$

$$R_{2,t} = \mu + \delta_{2,2} R_{2,t-1} + \delta_{2,1} R_{1,t-1} + \varepsilon_{2,t} \tag{2}$$

Where $R_{1,t}$ and $R_{2,t}$ are the return of the Islamic stock market index-oil price, and Islamic stock market and natural gas, respectively. The coefficients, $\delta_{1,1}$ and $\delta_{2,2}$ provide the measures of the own-mean spillover of the variables, which variable 1 denotes return of one of the Islamic stock market indices and 2 denotes the return of oil price index and natural gas as well. $\delta_{1,2}$ and $\delta_{2,1}$ measure the cross-mean spillover between Islamic stock and oil markets and between Islamic stock and natural gas, respectively.

Based on VAR (1) model, the residuals $\varepsilon_{1,t}$ and $\varepsilon_{2,t}$, are derived and the conditional variance-covariance matrix (H_t) of the residuals is defined as follows;

$$\varepsilon_t \mid \Omega_{t-1} \sim N(0, H_t), \quad H_t \equiv \begin{bmatrix} h_{11,t} & h_{12,t} \\ h_{21,t} & h_{22,t} \end{bmatrix} \tag{3}$$

Where ε_t is the 2 × 2 vector of residuals obtained from VAR model. BEKK representation of multivariate GARCH model, the conditional variance equation is specified as:

$$H_t = C'C + A' \varepsilon_{t-1} \varepsilon_{t-1} A + B' H_{t-1} B \tag{4}$$

Where C is a lower triangular matrix to represent constant components; A is a (2 × 2) matrix of ARCH coefficients, a_{12}, measures the impact of lagged shocks originating in Islamic stock return on the current volatility of oil price as well on the natural gas, whereas a_{21} captures the impact in the opposite direction. B is a (2 × 2) matrix of GARCH coefficients, b_{12}, measures the spillover effect of the last period's variance Islamic stock returns on the current variance of the oil price and natural gas as well, whereas b_{21} measures the spillover effect in the opposite direction.

The quasi-maximum likelihood (QML) method is applied to estimate the parameters of VAR- BEKK-GARCH model. The conditional log likelihood function $L(\theta)$ are denoted as follows:

$$\mathrm{L}(\theta) \Sigma_{t=1}^{T} \mathrm{L}_t(\theta),$$

$$L_t = - In2\pi - \frac{1}{2} In \left| H_t(\theta) \right| - \frac{1}{2} \varepsilon'(\theta) H_t^{-1}(\theta) \varepsilon_t(\theta) \tag{5}$$

Where T is the number of observations, θ denotes the vector of all estimated unknown parameters.

EMPIRICAL RESULTS

The empirical results of return and volatility spillovers between Islamic price index and global energy prices, namely, WTI, and Brent crude oil prices and natural gas obtained from a multivariate GARCH model with BEKK parameterisations are reported in Tables 2, 4 and 6 while Tables 3, 5 and 7 summarises the estimated results of the model. The coefficient δ_{11} and δ_{22} measure own-mean spillovers; whereas the coefficient δ_{12} and δ_{21} provide the measures of the cross-mean spillover and in this VAR-mean equation, 1 and 2 denote Islamic price indices and proxies of global energy prices, respectively.

Table 2
Estimated results of volatility spillover between Islamic Price Index and Brent based on VAR-BEKK-GARCH model

Variable	Turkey	Morocco	Kuwait	Qatar	Oman
Panel A: Mean equation					
$\delta(1)_{11}$	0.996 [556.943]*	0.996 [20921.218]*	0.975 [1137.138]*	0.997 [771.328]*	0.993 [3182.118]*
$\delta(1)_{12}$	–0.000 [–0.205]	0.002 [23.314]*	0.009 [13.405]*	–0.001 [–2.352]**	–0.000 [–2.079]**
μ_1	0.022 [1.997]**	0.011 [50.637]*	0.103 [23.123]*	0.023 [2.380]**	0.050 [59.545]*
$\delta(1)_{21}$	–0.000 [–0.122]	–0.004 [–32.825]*	0.000 [2.469]**	0.005 [3.336]*	0.002 [1.981]**
$\delta(1)_{22}$	0.998 [961.743]*	0.998 [5183.285]*	0.998 [7864.198]*	0.997 [912.966]*	0.998 [914.761]*
μ_2	0.006 [0.558]	0.033 [471.438]*	0.003 [5.836]*	–0.031 [–2.627]*	–0.011 [–1.178]
Panel B: Variance equation					
c_1	0.006 [22.656]*	0.006 [37.464]*	0.000 [7.325]*	0.001 [11.786]*	0.001 [17.936]*
c_{21}	0.001 [0.558]	0.000 [0.482]	–0.000 [–1.384]	–0.001 [–3.322]*	0.000 [0.363]
c_{22}	–0.002 [–7.004]*	–0.002 [–8.295]*	–0.002 [–7.046]*	0.002 [7.786]*	–0.002 [–14.927]*
a_{11}	0.323 [43.166]*	0.691 [26.221]*	0.380 [100.559]*	0.372 [34.739]*	0.362 [397.437]*
a_{12}	0.013 [3.088]*	–0.000 [–0.198]	0.011 [2.330]**	0.012 [3.300]*	–0.019 [–36.372]*
a_{21}	0.001 [0.295]	–0.010 [–3.237]*	0.038 [5.414]*	–0.015 [–3.177]*	0.019 [20.703]*

(*Continued on next page*)

Table 2 (*Continued*)

Variable	Turkey	Morocco	Kuwait	Qatar	Oman
Panel B: Variance equation					
a_{22}	0.324 [32.627]*	0.322 [23.239]*	0.341 [25.159]*	0.324 [40.571]*	0.398 [716.143]*
b_{11}	0.901 [242.652]*	0.625 [30.880]*	0.944 [599.780]*	0.933 [364.205]*	0.944 [774.607]*
b_{12}	0.002 [1.051]	0.000 [0.455]	–0.006 [–3.142]*	0.002 [2.753]*	0.003 [10.908]*
b_{21}	0.002 [0.801]	0.015 [3.148]*	–0.007 [–2.983]*	0.009 [4.071]*	–0.006 [–4.055]*
b_{22}	0.944 [289.913]*	0.943 [220.469]*	0.941 [204.107]*	0.943 [463.336]*	0.922 [884.061]*

Notes: μ_1 and μ_2 are constant term of the mean equations. $\delta(1)_{11}$ and $\delta(1)_{22}$ capture variables' own lagged effects in mean, which variable 1 denotes Islamic Price Index *2* denotes Brent, respectively. $\delta(1)_{12}$ stands for lagged spillover effects in mean from Islamic Price Index to Brent, and $\delta(1)_{21}$ indicates the same effect in the opposite direction. c_{11}, c_{21} and c_{22} are constant terms of the variance equations. a_{11} and a_{22} represent the ARCH effect in two variables. a_{12} measures the spillover effect of a previous shock in Islamic Price Index on the current volatility of Brent, and a_{21} measures the spillover effect in the opposite direction. b_{11} and b_{22} indicate the GARCH terms, which measure volatility persistence of each series. b_{12} measures the spillover effect of the last period's variance of Islamic Price Index on the current variance of Brent, and b_{21} measures the spillover effect in the opposite direction. Numbers in square brackets correspond to *t*-statistics. * , ** and *** indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 3

Summary of estimated results for the conditional mean and conditional variance equations between Islamic Price Index and Brent

	Turkey	Morocco	Kuwait	Qatar	Oman
Panel A: Mean spillovers					
Brent	-	↔	↔	↔	↔
Panel B: Shock transmission					
Brent	←	→	↔	↔	↔
Panel C: Volatility spillovers					
Brent	-	→	↔	↔	↔

Notes: ↔ indicates a bidirectional volatility transmission, → or ← indicates a unilateral volatility transmission, and - indicates no volatility transmission. ← means the related commodity on the first column is volatility receiver while → is the indication of volatility transmitter.

Table 4
Estimated results of volatility spillover between Islamic Price Index and WTI based on VAR-BEKK-GARCH model

	Turkey	Morocco	Kuwait	Qatar	Oman
Panel A: Mean equation					
$\delta(1)_{11}$	0.997 [1729.097]*	0.996 [10630.356]*	1.002 [1949.495]*	0.996 [2748.293]*	0.991 [2700.683]*
$\delta(1)_{12}$	–0.000 [–0.057]	0.002 [49.636]*	–0.000 [–0.197]	–0.001 [–2.442]**	–0.000 [–0.549]
μ_1	0.018 [17.023]*	0.009 [20.323]*	–0.012 [–4.809]*	0.029 [25.974]*	0.056 [80.766]*
$\delta(1)_{21}$	–0.001 [–73.412]*	-0.002 [14.170]*	0.000 [0.564]	0.005 [2.968]*	0.004 [12.596]*
$\delta(1)_{22}$	0.998 [7764.054]*	0.998 [1571.848]*	0.997 [3110.201]*	0.997 [822.376]*	0.996 [918.612]*
μ_2	0.017 [40.897]*	0.024 [14.132]*	0.009 [13.944]*	–0.032 [–2.314]*	–0.015 [–2.410]**
Panel B: Variance equation					
c_1	–0.005 [–14.595]*	0.008 [53.786]*	0.006 [23.595]*	0.001 [11.255]*	–0.001 [–16.761]*
c_{21}	–0.002 [–8.497]*	0.000 [2.667]*	–0.003 [–9.053]*	–0.001 [–3.544]*	–0.000 [–0.983]
c_{22}	0.004 [13.239]*	0.003 [18.378]*	0.000 [1.373]	–0.004 [–13.082]*	–0.005 [–25.707]*
a_{11}	0.287 [19.939]*	0.689 [32.027]*	1.018 [34.231]*	0.397 [174.677]*	0.443 [52.422]*
a_{12}	0.001 [0.392]	0.093 [4.697]*	0.118 [7.448]*	–0.007 [–66.000]*	0.005 [2.266]**
a_{21}	0.016 [3.573]*	–0.006 [–1.455]	–0.115 [–8.883]*	–0.017 [–5.466]*	0.008 [1.565]
a_{22}	0.396 [32.353]*	0.381 [29.228]*	0.344 [31.461]*	0.409 [204.074]*	0.385 [53.189]*
b_{11}	0.920 [121.260]*	0.468 [64.852]*	0.514 [21.982]*	0.929 [535.402]*	0.926 [403.933]*
b_{12}	–0.020 [–11.241]*	–0.138 [–18.192]*	–0.071 [–4.574]*	0.011 [96.603]*	0.000 [0.543]
b_{21}	–0.006 [2.471]**	0.013 [2.246]**	0.085 [12.471]*	0.011 [4.487]*	–0.005 [–2.807]*
b_{22}	0.906 [193.612]*	0.919 [193.982]*	0.935 [236.266]*	0.905 [551.639]*	0.896 [1728.950]*

Notes: μ_1 and μ_2 constant term of the mean equations. $\delta(1)_{11}$ and $\delta(1)_{22}$ capture variables' own lagged effects in mean, which variable 1 denotes Islamic Price Index *2* denotes WTI, respectively. $\delta(1)_{12}$ stands for lagged spillover effects in mean from Islamic Price Index to WTI, and $\delta(1)_{21}$ indicates the same effect in the opposite direction. c_{11}, c_{21} and c_{22} are constant terms of the variance equations. a_{11} and a_{22} represent the ARCH effect in two variables. a_{12} measures the spillover effect of a previous shock in Islamic Price Index on the current volatility of WTI, and a_{21} measures the spillover effect in the opposite direction. b_{11} and b_{22} and indicate the GARCH terms, which measure volatility persistence of each series. b_{12} measures the spillover effect of the last period's variance of Islamic Price Index on the current variance of WTI, and b_{21} measures the spillover effect in the opposite direction. Numbers in square brackets correspond to *t*-statistics. * , and ** indicate statistical significance at the 1%, and 5% level, respectively.

Table 5

Summary of estimated results for the conditional mean and conditional variance equations between Islamic Price Index and WTI

	Turkey	Morocco	Kuwait	Qatar	Oman
Panel A. Mean spillovers					
WTI	→	↔	-	↔	→
Panel B. Shock transmission					
WTI	→	←	↔	↔	←
Panel C. Volatility spillovers					
WTI	↔	↔	↔	↔	→

Notes: ↔ indicates a bidirectional volatility transmission, → or ← indicates a unilateral volatility transmission, and - indicates no volatility transmission. ← means the related commodity on the first column is volatility receiver while → is the indication of volatility transmitter.

Table 6

Estimated results of volatility spillover between Islamic Price Index and Natural Gas based on VAR-BEKK-GARCH model

	Turkey	Morocco	Kuwait	Qatar	Oman
Panel A. Mean equation					
$\delta(1)_{11}$	0.996 [547.765]*	0.998 [8622.425]*	0.979 [755.576]*	0.997 [4499.715]*	0.983 [663.640]*
$\delta(1)_{12}$	0.000 [0.287]	0.000 [3.240]*	–0.001 [–1.408]	–0.002 [–4.120]**	–0.005 [–6.558]*
μ_1	0.022 [1.896]**	0.012 [24.663]*	0.122 [17.885]*	0.021 [14.869]*	0.114 [12.144]*
$\delta(1)_{21}$	–0.003 [–1.340]**	0.008 [40.612]*	0.009 [11.624]*	–0.001 [–0.696]	0.017 [10.055]*
$\delta(1)_{22}$	0.996 [685.236]*	0.992 [1899.698]*	0.989 [1299.561]*	0.995 [684.322]*	0.992 [1188.880]*
μ_2	0.028 [1.651]***	–0.043 [–33.820]*	–0.045 [–7.612]*	0.019 [1.022]	–0.108 [–8.530]*

(*Continued on next page*)

Table 6 (*Continued*)

	Turkey	Morocco	Kuwait	Qatar	Oman
Panel B. Variance equation					
c_1	0.005 [20.302]*	–0.008 [–23.427]*	0.000 [0.536]	–0.001 [–8.657]*	0.002 [9.201]*
c_{21}	0.000 [0.113]***	–0.000 [–0.939]	–0.006 [–6.283]*	0.001 [1.435]	0.000 [0.529]
c_{22}	–0.008 [–13.332]*	0.008 [12.592]*	0.006 [15.845]*	0.008 [13.753]*	0.010 [13.615]*
a_{11}	0.303 [39.312]*	0.692 [26.804]*	0.452 [41.509]*	0.378 [36.985]*	0.450 [18.630]*
a_{12}	–0.002 [–2.396]**	–0.004 [–6.085]*	0.008 [18.717]*	0.005 [3.805]*	–0.002 [–0.757]
a_{21}	–0.000 [–0.040]	0.031 [7.185]	0.007 [3.683]*	–0.008 [–2.037]**	0.026 [4.795]*
a_{22}	0.411 [27.891]*	0.374 [24.848]*	0.416 [29.866]*	0.380 [40.413]*	0.490 [26.365]*
b_{11}	0.912 [275.957]*	0.462 [10.160]*	0.934 [349.216]*	0.935 [316.135]*	0.920 [133.675]*
b_{12}	–0.002 [–5.132]*	–0.017 [–10.725]*	0.011 [6.506]*	0.000 [1.810]***	0.002 [3.301]*
b_{21}	0.000 [0.158]	–0.000 [–1.569]	–0.004 [–9.475]*	0.004 [2.617]*	–0.012 [–3.404]*
b_{22}	0.894 [117.258]*	0.910 [127.115]*	0.890 [122.485]*	0.907 [158.831]*	0.863 [81.933]*

Notes: μ_1 and μ_2 are constant term of the mean equations; $\delta(1)_{11}$ and $\delta(1)_{22}$ capture variables' own lagged effects in mean, which variable 1 denotes Islamic Price Index *2* denotes Natural Gas, respectively; $\delta(1)_{12}$ stands for lagged spillover effects in mean from Islamic Price Index to Natural Gas, and $\delta(1)_{21}$ indicates the same effect in the opposite direction; c_{11}, c_{21} and c_{22} are constant terms of the variance equations; a_{11} and a_{22} represent the ARCH effect in two variables; a_{12} measures the spillover effect of a previous shock in Islamic Price Index on the current volatility of Natural Gas, and a_{21} measures the spillover effect in the opposite direction; b_{11} and b_{22} indicate the GARCH terms, which measure volatility persistence of each series; b_{12} measures the spillover effect of the last period's variance of Islamic Price Index on the current variance of Natural Gas, and b_{21} measures the spillover effect in the opposite direction; Numbers in square brackets correspond to *t*-statistics. * , ** and *** indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Table 7
Summary of estimated results for the conditional mean and conditional variance equations between Islamic Price Index and Natural Gas

	Turkey	Morocco	Kuwait	Qatar	Oman
Panel A. Mean spillovers					
Natural gas	→	↔	→	←	↔
Panel B. Shock transmission					
Natural gas	←	←	↔	↔	→
Panel C. Volatility spillovers					
Natural gas	←	←	↔	↔	↔

Notes: ↔ indicates a bidirectional volatility transmission, → or ← indicates a unilateral volatility transmission, and - indicates no volatility transmission. ← means the related commodity on the first column is volatility receiver while → is the indication of volatility transmitter.

Regarding the return-generating process, there is an existence of bidirectional return spillovers between the Islamic price index and Brent for all countries, except Turkey, where we find no evidence of return spillover. On the other hand, bidirectional spillover exists between the Islamic price index and WTI only for Morocco and Qatar. In contrast, this bilateral relationship exists between the Islamic price index and natural gas only for Morocco and Oman. This result is partly supported by Abdullah et al. (2016), who find evidence of return and volatility spillovers among crude oil and Islamic stock markets. Interestingly, among all these countries, Morocco is the only country where bidirectional spillovers exist between the Islamic price index and all three gas-related variables. The results also reveal the existence of unidirectional spillovers from WTI to the Islamic stock price index in Turkey and Oman, implying that the current period of the one-period influences returns in the Islamic stock price index lagged values of WTI. This result is consistent with the empirical findings (e.g., Hong et al., 2007; Narayan & Narayan 2010; Arouri et al., 2012; Shahzad et al., 2018; Mishra et al., 2019) that investigate the relationship between Islamic stock indices and oil prices, and their results indicate that whether there is no significant interaction between oil prices and Islamic stock indices or the Islamic stock indices are the affected by oil prices but not vice versa.

Additionally, there is a unidirectional spillover from natural gas to Islamic price index in Turkey and Kuwait. As for the case of Qatar, the presence of unidirectional mean spillover from Islamic price index to natural gas implies that current return in natural gas is determined by past history of Islamic Price Index. These results are in line with many studies that investigate the linkage between oil price and Islamic stock indices (Rithuan et al., 2014; Hassan et al., 2019; Abdulkarim et al., 2020; Devi & Prasetyo, 2020; Asl et al., 2022).

Turning out the empirical results of the conditional variance equation, conditional volatility of the Islamic stock market and oil market is determined by their both own past shocks ($a_{i,i}$) and the conditional past volatility ($b_{i,i}$) where $i = 1, 2$ indicates Islamic price index return and proxies of global gas return, respectively. As for the estimates of ARCH and GARCH coefficients, it is noteworthy that bidirectional cross-market shock (measured by $a_{1,1}$ and $a_{2,2}$) and volatility (measured by $b_{1,1}$ and $b_{2,2}$) effects among all pairs appear to be present for Kuwait and Qatar. Additionally, there is a bidirectional cross-market shock and volatility effects between Islamic price index and Brent in Oman. The results of this study are consistent with Jouini and Harrathi (2014) who document similar findings between stock indices of the Gulf Cooperation Council countries and world oil prices. Energy prices, especially oil and natural gas, are crucial input costs for various industries. If there is a bidirectional spillover, fluctuations in energy prices might affect production costs for companies in Islamic stock indices, impacting their profit margins and overall financial health. Moreover, the existing bidirectional spillovers could indicate that changes in energy markets influence macroeconomic factors that, in turn, affect Islamic stock indices. Islamic economies, particularly those in the MENA region, are heavily reliant on energy exports, making them susceptible to fluctuations in global energy prices. The close connection between energy prices and economic performance in these countries can amplify volatility transmission between energy and financial markets. As energy prices fluctuate, they directly impact production costs, corporate profitability, and macroeconomic indicators, thereby influencing investor sentiment and market dynamics in Islamic stock markets. Investors might adjust their portfolios based on Islamic stock market movements, impacting the demand for energy-related assets. This bidirectional relationship between energy and financial markets underscores the interconnectedness of these sectors and the importance of understanding volatility transmission mechanisms across asset markets.

All pairs show evidence of shock transmission and volatility spillovers in all countries except Turkey. As for the case of Turkey, it is worth mentioning that there is only a shock transmission from the Islamic price index to Brent, whereas the presence of volatility spillover is not observed. This result points out that any short-term shocks in the Islamic price index directly affect the volatility of Brent. This may be explained that investor confidence and risk appetite in Islamic stocks are key drivers of energy market volatility. Positive performance in Islamic stocks could signal increased investor confidence, leading to higher demand for energy assets. Both shock transmission and volatility spillover from Brent to the Islamic price index are pronounced in Morocco. These findings may highlight the vulnerability of Islamic stocks to energy market shocks. While oil prices experience a significant decline, it could negatively impact industries within Islamic stock indices that heavily rely on energy inputs. In contrast, it runs opposite across natural gas and Islamic Price Index. Islamic financial market differs from the conventional financial market because of its financial practices. Sharia prohibits investment in financial instruments that include interest, while it encourages investment due to the principle of sharing profits and losses. Also, Islamic markets may have lower liquidity levels compared to conventional counterparts, which can amplify the impact of shocks and lead to higher volatility. Moreover, investor behaviour in Islamic markets may be influenced by factors such as religious beliefs, ethical considerations, and risk aversion, contributing to heightened sensitivity to market fluctuations and exacerbating volatility transmission dynamics.

CONCLUSION AND POLICY IMPLICATIONS

This research examines the transmission of volatility and shocks between global energy markets (which includes WTI, Brent and natural gas) and Islamic equity markets, using daily data collected from August 2007 through September 2020. The Islamic equity markets selected for this study belong to five MENA countries: Turkey, Morocco, Kuwait, Qatar and Oman. We apply a multivariate GARCH model equipped with BEKK parameterisations to conduct our analysis.

The empirical results reveal some novel patterns in the information transmission between Islamic stock and oil markets, which contains practical implications for portfolio managers seeking optimal portfolio allocations. Employing the VAR-BEKK-GARCH model, the findings point out mean and volatility spillover effects for the pairs of each Islamic stock market in MENA countries and all three gas-related variables under investigation. Specifically, the only bidirectional spillover effects exist between the Kuwait, Qatar, and Oman Islamic Price Indices and Brent and the Qatar Islamic Price Index and WTI pair. On the other hand, for the two Islamic stock market pairs, Kuwait and Qatar, there is a bidirectional shock and volatility spillover with WTI, Brent and natural gas. As for the case of Turkey, it is worth mentioning that there is only a shock transmission from the Islamic price index to Brent, whereas the presence of volatility spillover is not observed. This result points out that any short-term shocks in Turkey's Islamic Price Index directly affect the volatility of Brent. Unidirectional volatility spillover is observed only from the pairs of Brent to Morocco Islamic stock market and WTI to Oman Islamic stock market. However, volatility spillover is unidirectional, transmitted from the Islamic stock market to natural gas in Turkey and Morocco. From here, policymakers should focus on improving the risk management infrastructure in their respective Islamic stock markets. One way is to enhance collaboration to mitigate potential financial instabilities for prudent risk management.

Regarding volatility spillovers, most Islamic stock markets are the net transmitters, while the remaining are the net receivers. The unique characteristics of Islamic stock markets, including Sharia-compliant investment principles and regulatory frameworks, may contribute to their role as net transmitters of volatility. Islamic financial practices often prioritise stability and risk-sharing, which can amplify the transmission of shocks across asset markets. Additionally, investor behaviour in Islamic markets, influenced by religious beliefs and ethical considerations, may lead to heightened sensitivity to external shocks, further exacerbating volatility transmission dynamics. Portfolio theory, pioneered by Markowitz, emphasises the importance of diversification in reducing portfolio risk. In the context of energy and financial markets, portfolio theory highlights the potential benefits of diversifying investments across different asset classes, including energy-related assets, to manage volatility risk. The findings in this study give investors and decision-makers significant investment instructions to improve their hedging and risk management strategies and maintain well-diversified portfolios. Policymakers and regulators can use the results of this analysis to develop better policies and adopt a coordinated approach that could reduce the potential for shocks in oil prices to disrupt stock markets. This will help create a more stable and resilient financial market system, benefiting the MENA countries.

In conclusion, while the study provides valuable insights into the interconnectedness of Islamic indexes in the MENA region, caution should be exercised when extending the findings to other regions or global markets. The study's external validity is also contingent on the robustness of the data and methodology employed. Limitations in data availability or methodological choices may impact the study's generalisability. Future research could explicitly explore the external validity of the results by conducting comparative analyses across diverse regions and considering the impact of global economic factors. This would contribute to a more nuanced understanding of the generalisability of the study's findings.

NOTES

1. The rest of MENA countries are excluded because of lack of sufficient data.
2. The beginning of the sample period is dedicated by the data availability for MENA countries Islamic indices.

REFERENCES

Abdulkarim, F. M., Akinlaso, M. I., Hamid, B. A., & Ali, H. S. (2020). The nexus between oil price and Islamic stock markets in Africa: A wavelet and multivariate-GARCH approach. *Borsa Istanbul Review, 20*(2), 108–120. https://doi.org/10.1016/j.bir.2019.11.001

Abdullah, M. A., Saiti, B., & Masih, M. (2016). The impact of crude oil price on Islamic stock indices of South-East Asian countries: Evidence from MGARCH-DCC and wavelet approaches. *Borsa Istanbul Review, 16*(4), 219–232. https://doi.org/10.1016/j.bir.2015.12.002

Arouri, M. E. H., Jouini, J., & Nguyen, D. K. (2012). On the impacts of oil price fluctuations on European equity markets: Volatility spillover and hedging effectiveness. *Energy Economics, 34*(2), 611–617. https://doi.org/10.1016/j.eneco.2011.08.009

Asl, M. G., Adekoya, O. B., Rashidi, M. M., Doudkanlou, M. G., & Dolatabadi, A. (2022). Forecast of Bayesian-based dynamic connectedness between oil market and Islamic stock indices of Islamic oil-exporting countries: Application of the cascade-forward backpropagation network. *Resources Policy, 77*, 102778. https://doi.org/10.1016/j.resourpol.2022.102778

Badeeb, R. A., & Lean, H. H. (2018). Asymmetric impact of oil price on Islamic sectoral stocks. *Energy Economics, 71*, 128–139. https://doi.org/10.1016/j.eneco.2017.11.012

Bahloul, S., & Khemakhem, I. (2021). Dynamic return and volatility connectedness between commodities and Islamic stock market indices. *Resources Policy, 71*, 101993. https://doi.org/10.1016/j.resourpol.2021.101993

Chkili, W. (2022). The links between gold, oil prices and Islamic stock markets in a regime switching environment. *Eurasian Economic Review, 12*(1), 169–186. https://doi.org/10.1007/s40822-022-00202-y

Delle Foglie, A., & Panetta, I. C, (2020). Islamic stock market versus conventional: Are Islamic investing a 'Safe Haven' for investors? A systematic literature review. *Pacific-Basin Finance Journal, 64*, 101435. https://doi.org/10.1016/j.pacfin.2020.101435

Devi, T. V., & Prasetyo, M. B. (2020). Linkages between crude oil and the Islamic stock market. *International Conference on Business and Management Research, ICBMR 2020*, Atlantis Press, 170–176. https://doi.org/10.2991/aebmr.k.201222.025

Engle, R., & Kroner, K. (1995). Multivariate simultaneous generalized ARCH. *Econometric Reviews, 11*, 122–150. https://doi.org/10.1017/S0266466600009063

Ftiti, Z., & Hadhri, S. (2019). Can economic policy uncertainty, oil prices, and investor sentiment predict Islamic stock returns? A multi-scale perspective. *Pacific Basin Finance Journal, 53*, 40–55. https://doi.org/10.1016/j.pacfin.2018.09.005

French, M. (2020). *Crude oil prices were generally lower in 2019 than in 2018*. U.S. Energy Information Administration (EIA) (Report). Today in Energy.

Gharib, C., Mefteh-Wali, S., Serret, V., & Ben Jabeur, S. (2021). Impact of COVID-19 pandemic on crude oil prices: Evidence from Econophysics approach. *Resources Policy, 74*, 102392. https://doi.org/10.1016/j.resourpol.2021.102392

Ghorbel, A., Abdelhedi, M., & Boujelbene, Y. (2014). Assessing the impact of crude oil price and investor sentiment on Islamic indices: Subprime crisis. *Journal of African Business, 15*(1), 13–24. https://doi.org/10.1080/15228916.2014.881222

Hassan, K., Hoque, A., & Gasbarro, D. (2019). Separating BRIC using Islamic stocks and crude oil: Dynamic conditional correlation and volatility spillover analysis. *Energy Economics, 80*, 950–969. https://doi.org/10.1016/j.eneco.2019.02.016

Hong, H., Torous, W., & Valkanov, R. (2007). Do industries lead stock markets? *Journal of Financial Economics, 83*, 367–396. https://doi.org/10.1016/j.jfineco.2005.09.010

Hussin, M. Y. M., Muhammad, F., Razak, A. A., Tha, G. P., & Marwan, N. (2013). The link between gold price, oil price and Islamic stock market: Experience from Malaysia. *Journal of Studies in Social Sciences, 4*(2), 161–182.

Jouini, J., & Harrathi, N. (2014). Revisiting the shock and volatility transmissions among GCC, stock and oil markets: A further investigation. *Economic Modelling, 38*,486–494. https://doi.org/10.1016/j.econmod.2014.02.001

Khan, A. B., Sharif, A., Islam, M. S. U., Ali, A., Fareed, M., & Zulfaqar, M. (2022). Impact of oil prices on the Islamic and conventional stock indexes' performance in Malaysia during the COVID-19 pandemic: Fresh evidence from the wavelet-based approach. *Frontier Energy Research, 10*, 962017. https://doi.org/10.3389/fenrg.2022.962017

Markowitz, H. (1952). Portfolio selection. *The Journal of Finance, 7*(1), 77–91. https://doi.org/10.2307/2975974

Mishra, S., Sharif, A., Khuntia, S., Meo, S. A., & Khan, S. A. R. (2019). Do oil prices impede Islamic stock indices? Fresh insights from wavelet-based quantile-on-quantile approach. *Resources Policy, 62*, 292–304. https://doi.org/10.1016/j.resourpol.2019.04.005

Nagayev, R., Disli, M., Inghelbrecht, K., & Ng, A. (2016). On the dynamic links between commodities and Islamic equity. *Energy Economics, 58*, 125–140. https://doi.org/10.1016/j.eneco.2016.06.011

Narayan, P. K., & Narayan, S. (2010). Modelling the impact of oil prices on Vietnam's stock prices. *Applied Energy, 87*(1), 356–361. https://doi.org/10.1016/j.apenergy.2009.05.037

Narayan, P. K., Phan, D. H. B., & Sharma, S. S. (2019). Does Islamic stock sensitivity to oil prices have economic significance? *Pacific-Basin Finance Journal, 53*, 497–512. https://doi.org/10.1016/j.pacfin.2018.04.003

OECD (2020). *The impact of Coronavirus (COVID-19) and the global oil price shock on the fiscal position of oil-exporting developing countries*. OECD Policy Responses to Coronavirus (COVID-19). https://www.oecd.org/coronavirus/policy-responses/the-impact-of-coronavirus-covid-19-and-the-global-oil-price-shock-on-the-fiscal-position-of-oil-exporting-developing-countries-8bafbd95/

Reddy, K., Mirza, N., Naqvi, B., & Fu, M. (2017). Comparative risk adjusted performance of Islamic, socially responsible and conventional funds: Evidence from United Kingdom. *Economic Modelling, 66*, 233–243. https://doi.org/10.1016/j.econmod.2017.07.007

Refinitiv (2022). *Islamic Finance Development Report 2022: Embracing Change*. https://www.refinitiv.com/en/resources/special-report/islamic-finance-development-report-2022

Rithuan, S. H. M., Abdullah, A. M., & Masih, A. M. M. (2014). *The impact of crude oil price on Islamic stock indices of gulf cooperation council (GCC) countries: A comparative analysis*. MPRA Paper 56989, University Library of Munich, Germany.

Shahzad, S. J. H., Mensi, W., Hammoudeh, S., Rehman, M. U., & Al-Yahyaee, K. H. (2018). Extreme dependence and risk spillovers between oil and Islamic stock markets. *Emerging Markets Review, 34*, 42–63. https://doi.org/10.1016/j.ememar.2017.10.003

Suleman, M. T., McIver, R., & Kang, S. H. (2021). Asymmetric volatility connectedness between Islamic stock and commodity markets. *Global Finance Journal, 49*, 100653. https://doi.org/10.1016/j.gfj.2021.100653

Umar, Z. (2017). Islamic vs conventional equities in a strategic asset allocation framework, *Pacific- Basin Finance Journal, 42*, 1–10. https://doi.org/10.1016/j.pacfin.2015.10.006

Umar, Z., Kenourgios, D., Naeem, M., Abdulrahman, K., & AlHazza, S. (2020). The inflation hedging capacity of Islamic and conventional equities. *Journal of Economic Studies, 47*(6), 1377–1399. https://doi.org/10.1108/JES-04-2019-0183