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Risk transmission from the oil market to Islamic and conventional banks in oil-exporting and oil-importing countries

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ABSTRACT

This paper examines the volatility transmission from the oil market to Islamic banks' (IBs) share prices in two sets of data from oil exporters and importers. Our datasets comprise indices developed from banks' stocks of eight oil-exporting countries, including 41 IBs and 90 conventional banks (CBs), and five oil-importing countries, with 23 IBs and 63 CBs. We employ a trivariate version of the non-diagonal GARCH model, which allows for asymmetry in the variance-covariance matrix. Rather than relying on a single window, we perform the estimations through many recursive windows. The results reveal that oil volatility has higher predictive power (in majority recursive significant subsamples) in the exporter dataset compared to the importer dataset. We also find higher significant recursive subsamples for conventional counterparts in the same country. Holistically, IBs show greater bank stability during high oil price volatility horizons, a finding beneficial for policymakers, regulators, financial markets, IBs, and other concerned stakeholders.

1. Introduction

This study investigates how energy (crude oil) price volatility may affect one of the fast-increasing segments of the financial markets, namely Islamic finance. There are manifold reasons to research Islamic banks' stock return–oil price volatility transmission. First, throughout the last two decades, Islamic banks (IBs) that represent around 69% of the total Islamic finance assets, have grown exponentially within the global financial market, accruing more than 428 Islamic banks stretching across nearly 81 majority Muslim and non-Muslim countries and hitting US$2.10 trillion in total assets[1] (Puri-Mirza, 2021; Dinar-Standard, 2022; IFSB, 2022). Nevertheless, the exponential growth of the Islamic banking model might be subdued by the volatility of crude oil prices (Mensi et al., 2019). Oil-linked volatility is of utmost importance as it could delay or change vital decisions, such as production, energy use, market returns (Ding et al., 2017), consumption, investment (Bernanke, 1983), and even investor sentiments (Zhang and Li, 2019), which consequently can be transmitted via the mechanism of the economy and financial market to the financial institutions' pace, including the operations of IBs.

Second, the extant literature offers enough evidence supporting the claim that oil prices are linked to IB returns and growth. For example, amid the oil price hikes between 2010 and 2014, the IB model witnessed a growth rate of 16.1% in the Gulf Corporation Council (GCC) region (Ernst and Young, 2016). This link seems to be explained by prior studies that connect oil-linked revenues to the growth of IBs (Bitar et al., 2017; Cham, 2018; Imam and Kpodar, 2014). Additionally, Alqahtani et al. (2017) argue that due to the volatility of oil prices, GCC economies are left in a vulnerable position more sensitive than that of the prior decade and that the growth rate of IBs in the GCC region—the stronghold of such banks—has slackened to less than 10% in 2014 due to oil price drops. This view suggests that oil volatility might affect IBs' operating performance.

IBs have multiple distinct features that differentiate them from conventional banks (CBs). IBs draw on Islamic (Shariah) laws, principles, finance, and economics (Koçak and Özcan, 2013; Van Greuning

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[1] The total Islamic finance asset size is US$3.06 trillion in 2021, according to the Islamic Financial Services Board (IFSB) estimation (IFSB, 2022).

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and Iqbal, 2007). Noticeably, two fundamental features—profit-and-loss sharing financing and interest-free banking—characterize IBs (Ayub, 2007). Furthermore, IBs have a better capitalization with a higher intermediation ratio and asset quality (Beck et al., 2013). In addition, IBs (including their stocks) experience a streamlined Shariah screening process to retain Shariah-compliant status, ensuring their investment and operational credibility (Tanin et al., 2021a; Tanin, 2022). These credibility features of IBs are particularly important for the level of investors' sentiment that is generally associated with noise trading. Trichilli et al. (2020) report that portfolio optimization under investor's sentiment states is valid for the bearish, depressed, bullish, and calm states in Islamic stocks, while it is significant only for the bullish and the bubble states in the conventional stocks, which reflects less financial asymmetry in Islamic financial markets.

We rely on a few theories that apply directly to the arguments underlying this paper. First, the meteor shower hypothesis indicates that markets are unable to process enough information fully, signaling a violation of the market efficiency hypothesis. This distinction applies to oil price volatility and its spillovers into conventional and Islamic banks, as per Kyle (1985) and Admati and Pfleiderer (1988), who demonstrate that private information is only gradually incorporated into prices. Moreover, we argue that the response to volatility transmission and spillovers from oil prices to IBs are generally more informative in IBs stocks than their conventional counterparts, as per the investor conservatism and gradual information diffusion hypotheses, which can prompt investor overreaction or underreaction. Put differently, following oil price changes, Islamic stock prices are likely to incorporate information differently from conventional stocks (Narayan et al., 2019). In conventional markets, there is a delayed reaction of stock returns to oil price changes, which is consistent with the gradual information diffusion hypothesis proposed by Hong and Stein (1999). The idea behind the gradual information diffusion hypothesis is that conventional stock returns will underreact to oil price shocks, as per the empirical evidence in Phan et al. (2015a, 2015b). This response is due to the higher information asymmetry in conventional markets (Narayan et al., 2019).

By comparison, in Islamic markets, information asymmetry is relatively lower due to the principle of risk-sharing and comparatively low investor sentiment (Di et al., 2021; Narayan et al., 2019). Thus, it can be expected that the underreaction and overreaction to oil price shocks in Islamic markets will be attenuated. This argument is also supported by the conservatism hypothesis, which contends that the degree of information asymmetry is less significant in IBs, as per Narayan and Sharma (2011).

This study examines the volatility transmission from oil prices to IBs and CBs. It seems sensible to investigate the volatility transmission from oil to IBs, employing the reliable econometric estimation(s): causality-in-variance[2] through a trivariate version of the non-diagonal GARCH model, to explore whether oil volatility can predict the volatility of IB stocks. The causality-in-variance test by Hafner and Herwartz (2008) overcomes the shortcomings of earlier methods. For example, it is more robust concerning leptokurtic innovations in samples and has proven realistic for empirical applications. Therefore, we argue that this test is more appropriate to examine the transmission from oil prices to IBs and CBs stock returns in the second moment. Notably, the economic and financial time series appear to communicate rapidly with each other, demonstrating a mechanism for propagating uncertainty (Nazlioglu et al., 2015).

Moreover, by comparing the volatility spillovers over multiple recursive subsamples from different periods, including early COVID-19 effects, the findings are most likely to plainly illustrate how oil price shocks lead to volatility among IB stocks compared to CB stocks for the period under investigation. It is also suitable to see a volatility shift from oil to IBs and understand the volatility intensity or risk spillover from oil to IBs in oil-exporting and oil-importing countries. Eventually, this approach can clarify how the IBs (stock) volatility reacts to the shocks triggered by globally influential commodity prices, such as crude oil.

Following Mensi et al. (2019), we use country-specific banks' stock indices to study Islamic and conventional banks. We use Brent crude oil index (Brent) for two reasons. First, Brent is found to be a better benchmark for oil prices (Jin et al., 2012). Second, the West Texas Intermediate (WTI) oil index fails in the estimation process because of its negative oil price for the first time in history, closing at a negative US $37.63/bbl during the ongoing COVID-19 period (Tanin et al., 2021c; Wallace, 2020). Markets' reactions to oil price shocks vary significantly across countries, as Jones and Kaul (1996) illustrate. Thus, this study acknowledges that oil-exporting and oil-importing countries could behave distinctively, leading to the inclusion of both groups.

Our datasets follow indices developed on banks' stock indices and apply VAR(p)-GARCH-BEKK with three distributions and various lag structures for the mean process to attain the best possible results. It is also worth noting that a proper conditional joint distribution of log returns is essential for anyone seeking to model the expected return or risk (e.g., Chan et al., 2011; Green et al., 2018). Although this study mainly focuses on IBs, we also considered the CBs to see whether they behave differently from IBs while receiving possible` oil impacts. Unlike most studies, which employ a single sample (Ahmed and Huo, 2020; Green et al., 2018; Mensi et al., 2014; Yu et al., 2020; Yun and Yoon, 2019), our investigation collects and processes daily time-series data, but the estimates follow the recursive windows approach, as used by Patra (2021), He and Yin (2021), Perron and Yamamoto (2021), Liu et al. (2020), Uddin et al. (2019), Aretz and Pope (2018), Manzan (2015), and Ravazzolo et al. (2013).

The windowed approach has been gaining ground in recent empirical studies. Notably, the actual model in econometric estimations is unknown in practice, while the typical parameters need to be calculated for a specific model (Wang et al., 2015). Estimation errors, such as bias and variability, can be verified by plotting the parameter estimates (in Islamic banks and oil markets) using recursive windows (Wang et al., 2015). Recursive windows are appropriate for this approach because, unlike rolling windows, they do not have a limited sample size (Pauwels and Hanssens, 2007), which can result in inefficient estimates (Van Heerde et al., 2004). Furthermore, the recursive window approach does not ignore data from the beginning of the sample, unlike the rolling window approach, which follows a constant window length (Białkowski et al., 2015). Hence, one may track structural breaks in the returns with the movements of coefficient estimates across different recursive subsamples. In the presence of structural breaks, the dynamic relationships between the Islamic banks and energy markets exhibit instabilities across different periods.

2. Oil price volatility and Islamic banks

The current literature in economics and finance has established a clear connection between oil and Islamic banks. For example, in an investigation of the determinants of the growth of IBs, Imam and Kpodar (2014) and Cham (2018) document that IBs have expanded as the oil market has grown. Similarly, Bitar et al. (2017) report a linkage between IBs and the oil market. However, the volatility transmission from the oil market to IBs has yet to be assessed adequately. A significant portion of

[2] The study of causality-in-variance has gained considerable attention from academics and practitioners because of its economic and statistical significance. First, causality-in-variance considers volatility spillover effects (or, in other words, spillovers in risk). Second, it indicates whether a lack of diversification benefits exists among financial markets (e.g., oil markets and banking systems). Third, it points to the probable contagion effects between financial markets. Fourth, it can affect investors' decisions and the construction of optimal portfolios. Fifth, it indicates an information spillover effect among financial markets, and hence it allows us to determine which market plays a more dominant role.

the world's oil production comes from Muslim majority countries in the Middle East and North Africa (MENA) region. According to the Organization of Petroleum Exporting Countries (OPEC) estimates (OPEC, 2019), 79.4% of the world's oil reserves are based on OPEC member countries, whereas a bulk amount comes from eight majority Muslim countries,[3] amounts to 72.6% of the total quota of OPEC.

However, the International Monetary Fund (IMF, 2014) indicates that MENA's dependency on oil production could decline precipitously in the future. The same indication might go to other oil-producing countries where IBs exist. Currently, Middle Eastern and some additional Muslim-majority countries mainly depend on fossil fuel (i.e., crude oil) extraction (Uddin et al., 2017). Except for some unfortunate events, the price of oil generally has seen substantial increases over time. In terms of the IB sector, Islamic Banks have a strong presence in many oil-producing Muslim majority countries (Uddin et al., 2017). Thus, Imam and Kpodar (2014) argue that a rise in oil price and improved trade should increase purchasing power and income, eventually igniting IB growth in those countries. Imam and Kpodar further maintain that the IB system has expanded more in oil-exporting Muslim countries than others because of the oil-generated revenues (Gheeraert, 2014). Alqahtani et al. (2017) further note that since the 1980s, the IB system and the GCC region's conventional counterparts grew significantly due to oil and gas production growth.

If we take this stance, we could argue that if a rise in oil prices helps the growth of IBs, a fall in the oil price should negatively impact IBs' performance. However, following the oil price crisis during 1994–2008 and the corresponding weak indicators of the financial sector, some MENA governments had no choice but to interfere with their domestic financial sector, which took many forms[4] (Hesse and Poghosyan, 2016). The eventual result was that banks (in MENA countries) heavily dependent on real estate and equity purchases for lending (financing) experienced losses, signaling the oil price decline transmission (F. Alqahtani et al., 2017; Hesse and Poghosyan, 2016). This view infers that oil dependency could also cause a decline in the growth of IBs. We acknowledge that previous examinations have tried to demonstrate the volatility transmission from oil to IBs but have not succeeded comprehensively. Therefore, it seems fruitful to investigate the volatility transmission from oil to IBs, employing, in our opinion, more robust econometrics estimation(s) to explore whether oil volatility can predict the volatility of IBs (stocks). To the best of our knowledge, this is the first study examining the volatility transmission from oil to Islamic banks within this context.

3. Data and estimation schemes

3.1. Data

When sourcing the data, we followed countries with publicly listed IBs, which continuously report their data to the Refinitiv Eikon. Based on available data, we collected and analyzed daily time-series data from 18 oil-exporting and importing countries with publicly listed IBs (78 banks) and CBs (218 banks). Nevertheless, data quality issues kept three oil-exporting countries, Bahrain, Iraq, and Syria, and two oil-importing countries, Lebanon and Sri Lanka, from passing the estimation process. Therefore, the final sample covers eight oil-exporting (Egypt, Indonesia, Kuwait, Nigeria, Oman, Qatar, Saudi Arabia, and the United Arab Emirates, or UAE) and five oil-importing (Bangladesh, Jordan, Pakistan, Palestine, and Turkey[5]) countries. The eight oil-exporting countries are home to 41 IBs and 90 CBs, while the five oil-importing countries have 23 IBs and 63 CBs.

The sample periods end on July 23, 2020, for all countries under study and start on May 10, 2007, for Bangladesh, Egypt, Jordan, Kuwait, Oman, Palestine, Qatar, Saudi Arabia, and the UAE. The sample period starts[6] for Turkey July 03, 2007, for Pakistan December 15, 2008, for Nigeria September 09, 2009, for Syria March 29, 2011, for Iraq July 03, 2012, and for Indonesia January 16, 2014. We divide the whole sample for a return series into two portions. The first period includes the first T observations, and the second portion covers the last R (from January 1, 2014,[7] to July 23, 2020) observations. We estimate the models described in Subsection 3.2 under various distributional assumptions using the quasi-maximum likelihood method to obtain the first parameter estimates. Here, we use the returns from the first observation through observation T, which we call the first recursive window. We then add one observation to the previous window to obtain the parameter estimates using series from the first observation through observation $T+1$, the second recursive window. We continue accordingly to the end of the period, leaving us with the model estimation results of R windows.

We compute the country-specific indices of stock returns as the weighted averages of the first logarithmic differences in the banks' stock prices (P_{it}):

$$r_{it} = 100\left(\frac{P_{it}}{P_{it-1}}\right), \tag{1}$$

where i denotes the stock market value of i^{th} bank in a country, and t signifies the time under investigation.

The creation of oil returns also takes the same equation. Indices of stock returns of listed IBs (and CBs) are used to estimate the volatility of IBs (and CBs), while the returns of Brent oil prices are used to estimate the volatility of crude oil prices. To create country-specific indices, the initial data for banks' stock prices and crude oil prices were drawn from Refinitiv Eikon and London Brent crude oil index, respectively.

3.2. Methods and model specification

Abdelradi and Serra (2015) highlight that oil price shocks are exogenously determined. Consequently, it is improbable that the financial activity of IBs (and CBs) will affect oil prices. Bouri and Demirer (2016) find unidirectional volatility spillovers from oil prices to emerging stock markets, especially in oil-exporting countries, namely, Kuwait, Saudi Arabia, and the UAE.

We employ the multivariate GARCH model and focus on second-moment equations. It is worth mentioning that the model estimations are computationally more arduous than their univariate counterparts (see, e.g., Hasanov et al., 2016) because these models contain many parameters. Also, they have a complex nonlinear structure of log-likelihood functions.

Specifically, this study uses the following trivariate version of the asymmetric GARCH-BEKK model to examine the variance/volatility transmission from the oil market to the volatility of IBs and CBs.

$$H_t = C'C + A'u_{t-1}u'_{t-1}A + B'H_{t-1}B + D'\xi_{t-1}\xi'_{t-1}D, \tag{2}$$

where, $C = [C_{11}\ 0\ 0\ C_{21}\ C_{22}\ 0\ C_{31}\ C_{32}\ C_{33}]$; $A = [a_{11}\ a_{12}\ a_{13}\ a_{21}\ a_{22}\ a_{23}\ a_{31}\ a_{32}\ a_{33}]$; $B = [b_{11}\ b_{12}\ b_{13}\ b_{21}\ b_{22}\ b_{23}\ b_{31}\ b_{32}\ b_{33}]$;

$$D = [d_{11}\ d_{12}\ d_{13}\ d_{21}\ d_{22}\ d_{23}\ d_{31}\ d_{32}\ d_{33}];\ \xi_{t-1} = \left[\xi_{r_1,t-1}\ \xi_{r_2,t-1}\ \xi_{r_3,t-1}\right].$$

This parameterization considers lagged conditional variances and covariances, H_{t-1}, as well as past values of $u_{t-1}u_{t-1}'$ and $\xi_{t-1}\xi_{t-1}'$ in joint

[3] (1) Saudi Arabia 22.4%, (2) Iran 13.1%, (3) Iraq 12.2%, (4) Kuwait 8.5%, (5) the UAE 8.2%, (6) Libya 4.1%, (7) Nigeria 3.1%, and (8) Algeria 1.0% (OPEC, 2019).

[4] Liquidity support, deposit guarantees, equity purchases (via government-owned vehicles), or capital injections.

[5] IBs are known as Participation Banks in Turkey (Tanin et al., 2021b).

[6] Based on data availability.

[7] From January 1, 2015, for Indonesia.

estimations of contemporaneous volatilities of oil price and IBs (and CBs) stock returns. Here, the term $\xi_{t-1}\xi_{t-1}'$ expresses potential asymmetric responses, as suggested by Grier et al. (2004). More specifically, if the oil price is lower than expected, we presume that to be bad news. Thus, $\xi_{r_1,\,t}$, $\xi_{r_2,\,t}$, and $\xi_{r_3,\,t}$ can be outlined as $\min\{u_{r_1t},0\}$, $\min\{u_{r_2t},0\}$, and $\min\{u_{r_3t},0\}$, respectively. These terms specify negative residuals or bad news about oil prices and IBs (and CBs) stock returns. The trivariate (i.e., oil, IBs, and CBs) asymmetric and unrestricted GARCH-BEKK model is estimated using the maximum likelihood method assuming multivariate Student *t*, GED, and normal distributions.

4. Empirical results and discussion

This section consists of four subsections, beginning with the stages of modeling and analysis. The later subsections discuss the estimation results and robustness and diagnostic tests. The obtained estimations of the parameters are evaluated, and robustness and diagnostic tests for the best possible models are also analyzed. In particular, we review whether oil volatility predicts the volatility of banks (IBs and CBs) stocks.

4.1. The stages of modeling and analysis

The analysis contains several stages: model estimation, model selection, diagnostic checks, and hypothesis testing. Firstly, this study estimates the VAR-BEKK-GARCH models with three distributions: GED, normal (N), and Student *t* (T). Under each distribution, this study considers the VAR component for the conditional mean with five lags from VAR(1) to VAR(5). Provided that the number of variables is three ($n = 3$; e.g., the volatility of IBs, CBs, and crude oil returns) for the available sample size, the maximum VAR order is set at five to ensure sufficient degrees of freedom and to avoid numerical convergence problems. This research predominantly finds that the VAR(1–3)-MGARCH-BEKK are the appropriate models across the different countries under study.

Secondly, the study relies on four widely used information criteria: Akaike information criterion (AIC), Bayesian information criterion (BIC), Hannan–Quinn information criterion (HQ), and Akaike's final prediction error criterion (FPE) to choose the optimal lags, following many earlier studies (see, e.g., Lütkepohl, 2005 and Hasanov et al., 2016). While Tables 2 and 3 and Figs. 1 and 2 report the results for AIC, we have also analyzed the results obtained through BIC, HQ, and FPE for robustness checks. The findings of AIC are consistent with FPE and matched almost completely with BIC and HQ.

Thirdly, several residual diagnostic tests have been performed once the best model based on the information criteria was chosen for each recursive window. Notably, this research only considers the models that have achieved numerical convergence in the selection process. Lastly, the favored model is used in volatility transmission analysis from oil to banks' stock by testing the following null hypothesis (see eq. 1) (An et al., 2020; Reboredo, 2014):

H_0: $a_{31} = b_{31} = 0$ (from oil to Islamic bank stocks).

H_0: $a_{32} = b_{32} = 0$ (from oil to conventional bank stocks).

The stages above are carried out for each recursive window and country. To sum up, the VAR-BEKK-GARCH model is estimated 60 times[8] for four information criteria, with three distributions and five VAR lags for each country and window.

For oil-exporting countries (see Appendix A1), the preliminary analysis suggests that for Egypt (EGY), 131 windows (out of 343) can be best explained by VAR(1)-BEKK-GED, as opposed to ten windows by VAR(2)-BEKK-GED, 178 optimal windows by VAR(1)-BEKK-T, and ten windows by VAR(2)-BEKK-T. In total, the whole available sample size makes the 343rd window. For Indonesia (IDN), VAR(1–2)-BEKK-GED, VAR(1–2)-BEKK-N, and VAR(1–5)-BEKK-T explain the data in most of windows; for Kuwait (KWT), VAR(1–5)-BEKK-GED and VAR(2)-BEKK-T; for Nigeria (NGA), VAR(2)-BEKK-GED and VAR(1–3)-BEKK-T; for Oman (OMN), only VAR(1–4)-BEKK-T; for Qatar, VAR(1–4)-BEKK-GED and VAR(1–2)-BEKK-T; for Saudi Arabia, VAR(1–3)-BEKK-GED and VAR (1–4)-BEKK-T; and for the UAE, VAR(1–4)-BEKK-GED and VAR(1)-BEKK-T are found to be the favored model specifications for most of the windows.

The preliminary analysis finds an almost identical picture for oil-importing countries (Appendix A2). These results lead to three main indications. Thus, to obtain robust results, we have used alternative distributions (GED, T, and N) in model estimations across recursive windows for each country, unlike many earlier studies.

Second, the VAR model with fixed lag (e.g., one lag) is not enough to obtain the best results. Hence, we have estimated the mean model with five lags and identified the best one. Third, in this study, VAR(*p*)-BEKK with normal distribution is found to be the inferior model in explaining variables under consideration for each recursive window across the countries under investigation. The only exception is Indonesia, where the model with normal distribution explains two recursive windows well. Nevertheless, this result signals that the VAR(*p*)-BEKK model with normal distribution is inappropriate for this study.

Table 1 presents the total listed banks and their percentages both in oil-exporting and oil-importing countries. However, this research analyzes and discusses only the optimal models for each recursive window throughout the study. Tables 2 and 3 summarize the best possible model's findings estimation results, which are obtained from 15 models based on AIC. The information given in these tables is extracted from Figs. 1 and 2. The summary of the results obtained based on other information criteria (i.e., BIC, HQ, and FPE) is available in the robustness checks section (4.5). This study first discusses the findings for oil-exporting countries, followed by oil-importing countries. For convenience, we present the results in graphical form.

4.2. Volatility transmission from oil to Islamic banks

4.2.1. Oil-exporting countries

The results (see Table 2 and Fig. 1) suggest that the null hypothesis of no volatility transmission is rejected in 262 windows out of all 343 (76.38% of all recursive windows) for Nigerian (NGA) IBs, which is the highest among all oil-exporting countries. This finding indicates that IBs in Nigeria are more vulnerable to oil volatility than the IBs in other oil-exporting countries. This finding is somewhat[9] consistent with Ahmed and Huo (2020), who finds that oil market volatility significantly impacts the stock market in Nigeria, which is the largest oil producer in Africa (Omgba, 2015). It also concurs with Babatunde et al. (2013), who conclude that the volatility of the price of oil depresses Nigeria's stock market returns.

There is evidence of significant volatility transmission from the oil market to Kuwaiti (KWT) IBs in 189 out of 343 recursive windows. Hence, the volatility of IB stocks in Kuwait appears to be comparatively less affected by oil volatility than those in Nigeria. Basher et al. (2018) find that the shocks of flow oil demand, idiosyncratic oil market, speculative (oil inventory), and flow oil supply affect stock returns in Kuwait, yet the authors do not differentiate between Islamic and conventional stocks.

Oil volatility also affects IB stocks in Egypt (EGY), the UAE, and Indonesia (IDN) in 37.03%, 22.74%, and 18.56% of all recursive windows, respectively. These results indicate that IBs in those countries are

[8] Four information criteria multiplied by three distributions of VAR-BEKK-GARCH models multiplied by five lags for the VAR model equals a total of 60 models (for each country and window). In this paper, we have reported 15 models based on AIC, and the other 45 models (based on BIC, HQ, and FPE) are used for robustness checks. However, we have not reported the latter results due to space limitations.

[9] They studied the overall stock market, which is dominated by conventional stocks.

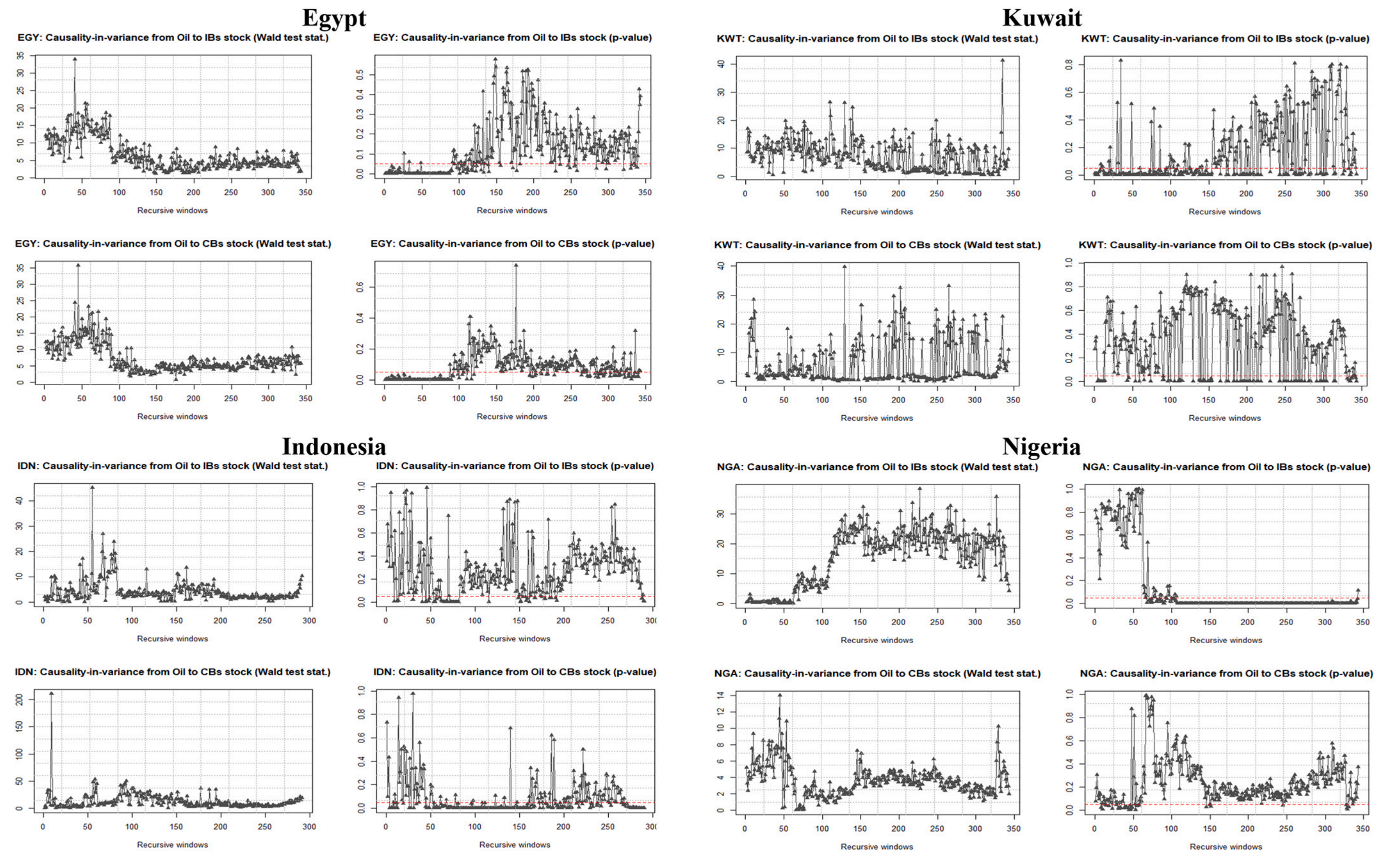

Fig. 1. Volatility transmission: oil-exporting countries.
Notes: (1) The red line represents the 5% significance level of the p-value. (2) Within red line = significant windows. (3) These results are based on the Akaike information criterion

less prone to oil volatility, implying that these countries' Islamic banking policies and practices may make them resilient to oil volatility. For example, Indonesian policymakers have revised regulations to better assist Islamic investments (Nazlan et al., 2016), which might be true for Egypt and the UAE. The listed IBs in Egypt (25.00%), the UAE (38.89%), and Indonesia (6.98%) remain the lowest compared to other oil-exporting Muslim countries where IBs are present. To some extent, this study is consistent with Ahmed and Huo (2020), who find that higher oil prices raise stock market returns. Basher et al. (2018) note that the UAE stock market's extraordinarily high volatility gives a heuristic perception that the market is vulnerable to speculative attacks, yet the current study finds different dynamics for IBs stocks.

In contrast, the IB stocks in Oman (OMN), Qatar (QAT), and Saudi Arabia (SAU) are most likely to be affected by the oil volatility in a small number of windows (3.21%, 7.87%, and 5.54%, respectively), suggesting the possible strong standing and resilience of IBs in these countries. The GCC countries, including Oman, Qatar, and Saudi Arabia, are the "heart of the Islamic world" and are ruled by Shariah law (Wilson, 2009). Consequently, these three countries might house a well-structured Islamic finance and banking system coupled with the sound practice of Shariah rules and regulations, which may have helped IBs in those countries resist the negative consequences of oil volatility. Furthermore, Oman's stock market is comparatively less vulnerable to oil volatility (Alqahtani et al., 2019), and oil volatility's variance was found insignificant in Oman's stock market by Naifar and Al Dohaiman (2013). Additionally, Mensi et al. (2015) find a weak positive average dependence between the Qatari Islamic equity index and Brent oil, suggesting Islamic stocks as safe havens for Qatari investors. For Saudi Arabia, Mensi et al. (2019) witness that the Islamic bank indexes do not receive oil volatility spillovers, yet the current study finds very minimal oil volatility spillovers to IB stocks.

4.2.2. *Oil-importing countries*

Among oil-importing countries (Table 2 and Fig. 2), the null hypothesis of no volatility transmission is rejected in 100 windows out of all 343 (29.15% of all recursive windows) for IBs stock in Palestine (PSE), which is the highest among all oil-importing countries. This finding highlights that IBs in Palestine are more vulnerable to oil volatility than the IBs in other oil-importing countries, albeit oil volatility has comparatively less predictive power (than that of the group of oil-exporting countries) for the volatility of Palestinian IBs stock. Palestine is facing acute challenges, including war, a lack of security, and political instability (Al Qudra, 2007), which might be external reasons why IBs stock in Palestine is volatile compared to that of other oil-importing countries.

In contrast, the IBs stock in Bangladesh (BGD), Jordan (JOR), Pakistan (PAK), and Turkey (TUR) depict promising results, as shown by minimal significant recursive windows. Oil volatility transmits negligible to no volatility to IBs stocks in other oil-importing countries in all recursive windows, starting from Bangladesh at 4.37%, Jordan at 5.25%, Pakistan at 6.12%, and Turkey at 0.00%. These results suggest that the volatility among IBs in oil-importing countries is less impacted by oil volatility, signaling that oil volatility has minimal general effects compared to IBs in oil-exporting countries.

This study then argues that oil volatility has relatively higher spillovers in oil-exporting countries, making IBs volatile. Oil-exporting countries rely on oil (Uddin et al., 2017), and thus, it may be transmitted to their IBs. Like GCC governments (Mensi et al., 2019), the

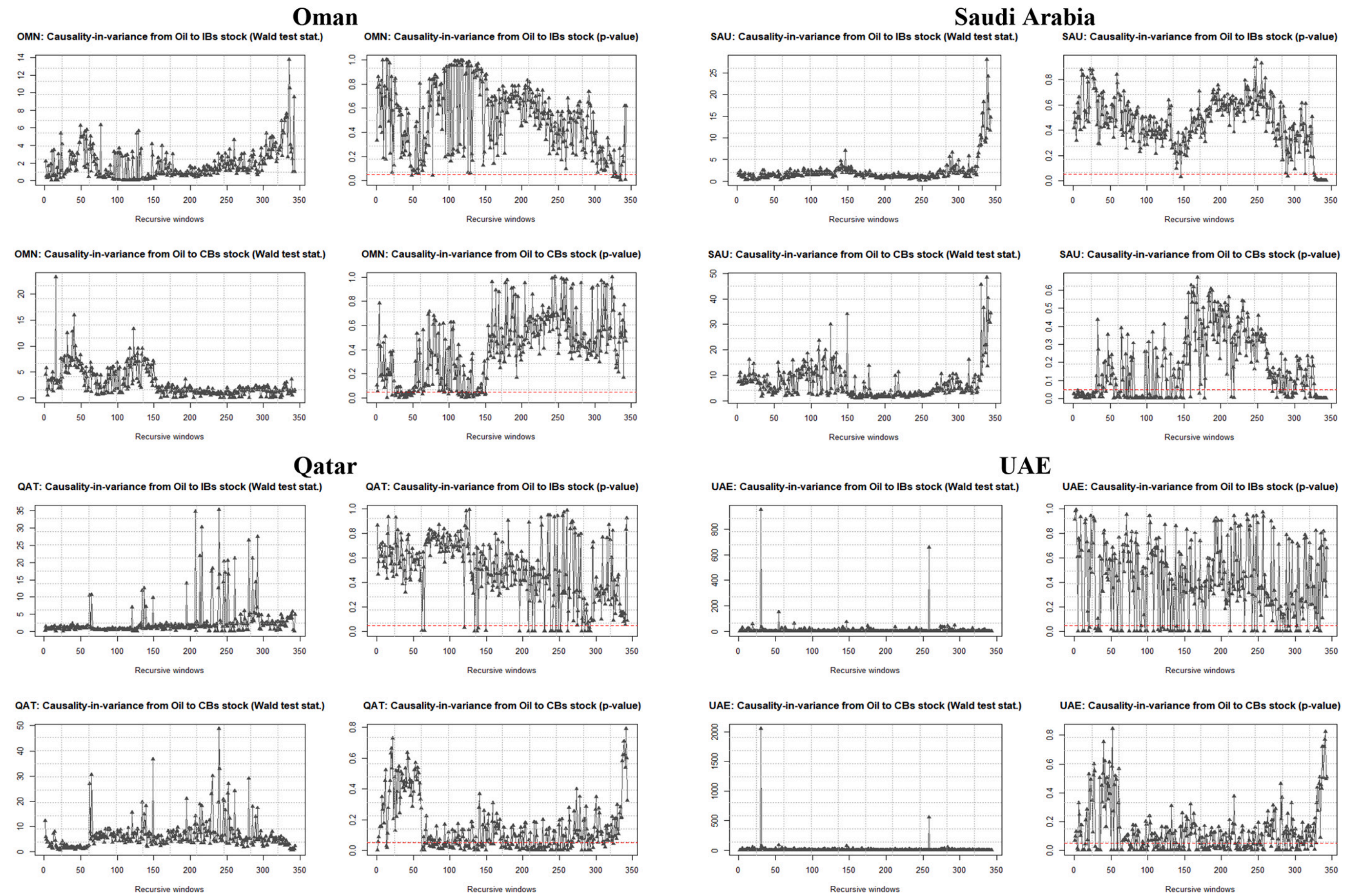

Fig. 1. (*continued*).

governments in other oil-exporting countries might deposit their oil revenues in the banks, which is not the case in oil-importing countries.

4.3. *Volatility transmission from oil to conventional banks*

4.3.1. *Oil-exporting countries*

Table 3 (and Fig. 1) depicts the summarized results for CB stock. The results suggest that the null hypothesis of no volatility transmission is rejected in 186 windows out of all 291 (63.92% of all recursive windows) for Indonesian (IDN) IBs, the highest among all oil-exporting countries. The result suggests that for 63.92% of recursive windows under investigation, Indonesian CBs volatility would be impacted by oil price volatility, which is approximately more than three times more (18.56%) than Indonesian IBs', supporting the view that Islamic stocks outperform their conventional counterparts during and after crises[10] (Al-Yahyaee et al., 2020). Moreover, the percentage of CBs in Indonesia is 93.02%, indicating that they are the market leader, which may also link CBs stock more closely with oil.

CBs stock in Saudi Arabia (SAU) shows an almost identical picture as the Indonesian case, with 40.23% significant windows of all recursive windows. This result suggests that Saudi CBs stocks are vulnerable to oil volatility, unlike IBs, which show almost no (5.54% of all recursive windows) oil volatility susceptibility. Bouri and Demirer (2016) find unidirectional volatility spillovers from oil prices to Saudi Arabian stock markets. However, this study argues that the investors in Saudi IBs, including IBs stock, operate prudently and are likely to enjoy relatively stable returns.

CBs stock from Egypt (EGY), Kuwait (KWT), Qatar (QAT), and the UAE are also prone to oil volatility with significant recursive windows of 42.86%, 39.69%, 34.69%, and 30.90%, respectively of all recursive windows. These results underscore that CBs stock in these countries could be affected by oil volatility from 30%–43% of the time. Such findings may justify the arguments of Ahmed and Huo (2020), who find significant volatility spillovers from oil to the Egyptian stock market, and Bouri and Demirer (2016), who witness oil volatility transmission to stock markets in Kuwait and the UAE. Although Bouri and Demirer (2016) find no evidence of oil volatility shocks affecting Qatari stock markets, this study finds otherwise.

Comparing these results with IBs stock, Egyptian IBs enjoy comparatively less oil volatility (37.03% versus 42.86% of all recursive windows), while Qatari IBs stock is in a much more advantageous position than those of CBs (7.87% versus 34.69% of all recursive windows). However, Kuwaiti IBs stock is comparatively affected by oil volatility when compared CBs. In Kuwait, the significant windows are 55.10% of all recursive windows for IBs stock and 30.90% of all recursive windows for CBs stock, which may justify why Mensi et al. (2019) find that CBs in Kuwait are a source of volatility spillovers.

There have been a small number of recursive windows with evidence of significant volatility transmission from the oil market to CBs stock in Nigeria (NGA) and Oman (OMN) in 34 (9.91%) and 49 (14.29%), respectively, out of 343 recursive windows. Hence, the volatility of Nigeria (NGA) and Oman (OMN) CBs stocks appears to be less affected by oil volatility than IBs. While IBs stock in Nigeria has been exposed to significantly higher oil volatility than CBs stock (76.38% versus 9.91% of all recursive windows), Omani IBs stock has been affected minimally by oil volatility compared to CBs stock (3.21% versus 14.29% of all recursive windows). This result leads us to conclude that investors in

[10] The global financial crisis and the European sovereign debt crisis.

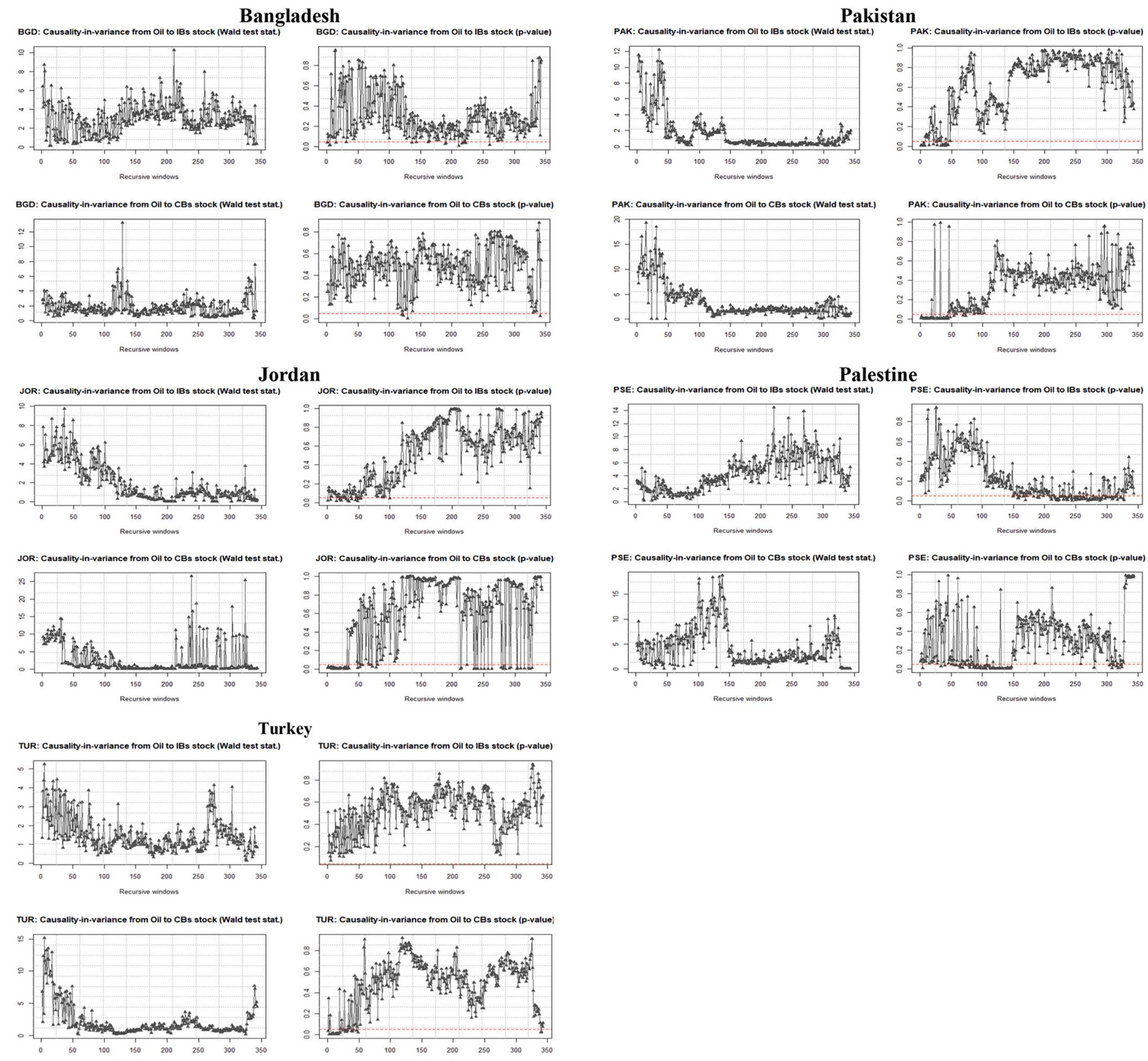

Fig. 2. Volatility transmission: oil-importing countries.
Notes: (1) The red line represents the 5% significance level of the p-value. (2) Within red line = significant windows. (3) These results are based on the Akaike information criterion

Omani IBs could expect better and more stable returns. Further, while Babatunde et al. (2013) document that oil volatility depresses Nigeria's stock market returns, we find that this effect is more pronounced for IBs stock in Nigeria.

4.3.2. Oil-importing countries

Among all oil-importing countries (Table 3 and Fig. 2), Jordanian (JOR) and Palestinian (PSE) CBs stock experience oil volatility in the highest number of recursive windows, with 20.12% and 24.49%, respectively. IBs stock in Jordan, on the other hand, obtain almost negligible oil volatility (5.25% of all recursive windows), indicating their immunity to oil volatility and attractiveness to investors. Bouri, 2015a, b finds unidirectional volatility spillover from the oil market to the Jordanian stock market, yet the author fails to mention the distinction between Islamic and conventional stocks, whereas this study fills the gap. Oil volatility is slightly higher (29.15% versus 24.49% of all recursive windows) for IBs stock in Palestine than among CBs. The unstable environment caused by war, the lack of security, and political instability (Al Qudra, 2007) may again justify this finding.

CBs stock in Bangladesh also experiences almost no oil volatility, with 1.17% of all recursive windows. However, IBs stock in Bangladesh shows slightly higher oil volatility, as exhibited in 4.37% of all recursive windows. The banking and financial system in Bangladesh is dominated by CBs, which may entail certain advantages that avoid the effects of oil volatility. Furthermore, Bangladesh imports oil mainly through state-owned companies such as Petrobangla and the Bangladesh Petroleum Corporation, and these companies are linked to state-owned CBs, which may help CBs stock harvest the benefits of declining oil prices, which would outweigh IBs stock.

Oil volatility has over 4% more predictive power to cause volatility

Table 1
Total banks and their percentages.

Oil-exporting countries							Oil-importing countries						
#	Countries	IBs	IBs (%)	CBs	CBs (%)	Total	#	Countries	IBs	IBs (%)	CBs	CBs (%)	Total
1	Egypt	3	25.00%	9	**75.00%**	12	1	Bangladesh	7	19.44%	29	**80.56%**	36
2	Indonesia	3	6.98%	40	**93.02%**	43	2	Jordan	9	**81.82%**	2	18.18%	11
3	Kuwait	5	50.00%	5	50.00%	10	3	Pakistan	3	14.29%	18	**85.71%**	21
4	Nigeria	8	40.00%	12	**60.00%**	20	4	Palestine	3	**60.00%**	2	40.00%	5
5	Oman	4	50.00%	4	50.00%	8	5	Turkey	1	7.69%	12	**92.31%**	13
6	Qatar	6	**66.67%**	3	33.33%	9							
7	Saudi Arabia	5	45.45%	6	54.55%	11							
8	UAE	7	38.89%	11	**61.11%**	18							
	G. Total	41		90		131		G. Total	23		63		86
Total Islamic banks (Oil-exporting and oil-importing countries)													64
Total Conventional banks (Oil-exporting and oil-importing countries)													153
Total Banks													**217**

(1) The symbol "#" refers to the serial number. (2) IBs and CBs refer to Islamic and conventional banks, respectively. (3) This table is generated based on IBs and CBs under investigation in this study and may not depict the actual number of banks and their percentages for the respective countries. (4) "G. Total" denotes "Grand Total."

Table 2
Volatility transmission from Oil to Islamic banks.

Oil-exporting countries				Oil-importing countries			
Countries	Significant windows	Total windows	Significant windows (%)	Countries	Significant windows	Total windows	Significant windows (%)
EGY	127	343	37.03%	BGD	15	343	4.37%
IDN	54	291	18.56%	JOR	18	343	5.25%
KWT	189	343	**55.10%**	PAK	21	343	6.12%
NGA	262	343	**76.38%**	PSE	100	343	**29.15%**
OMN	11	343	3.21%	TUR	0	343	**0.00%**
QAT	27	343	7.87%				
SAU	19	343	5.54%				
UAE	78	343	22.74%				

(1) These results are based on the Akaike information criterion. (2) EGY = Egypt, IDN = Indonesia, KWT = Kuwait, NGA = Nigeria, OMN = Oman, QAT = Qatar, SAU = Saudi Arabia, UAE = United Arab Emirates, BGD = Bangladesh, JOR = Jordan, PAK = Pakistan, PSE = Palestine, and TUR = Turkey. (3) Significant windows indicate that the null hypothesis of no variance/volatility transmission is rejected.

Table 3
Volatility transmission from oil to conventional banks.

Oil-exporting countries				Oil-importing countries			
Countries	Significant Windows	Total Windows	Significant Windows (%)	Countries	Significant Windows	Total Windows	Significant Windows (%)
EGY	147	343	42.86%	BGD	4	343	**1.17%**
IDN	186	291	**63.92%**	JOR	69	343	20.12%
KWT	106	343	30.90%	PAK	46	343	13.41%
NGA	34	343	9.91%	PSE	84	343	24.49%
OMN	49	343	14.29%	TUR	31	343	9.04%
QAT	119	343	34.69%				
SAU	138	343	40.23%				
UAE	136	343	39.65%				

(1) These results are based on the Akaike information criterion. (2) EGY = Egypt, IDN = Indonesia, KWT = Kuwait, NGA = Nigeria, OMN = Oman, QAT = Qatar, SAU = Saudi Arabia, UAE = United Arab Emirates, BGD = Bangladesh, JOR = Jordan, PAK = Pakistan, PSE = Palestine, and TUR = Turkey. (3) Significant windows indicate that the null hypothesis of no variance/volatility transmission is rejected.

for CBs stock in Pakistan (PAK) than in Turkey (TUR), as shown by 13.41% versus 9.04% of all recursive windows. In contrast, while Pakistani IBs stock oil volatility appears for 6.12% of all recursive windows, Turkish IBs stock exhibits no volatility (0.00% of all recursive windows). Islamic banks have a long history in Pakistan but are expanding in Turkey. In the early 1980s, General Zia's administration issued an injunction mandating that all banking operations in Pakistan be conducted according to Islamic law (Mian, 2006). Conversely, the Turkish government recently took numerous actions, such as formulating new strategies and rules to support Islamic bank growth. This process begins with fostering education and talent among youths, leading to more human capital, and building new universities (e.g., Istanbul Sabbattim Jaim University) and research centers (e.g., İslam İktisadı Araştırma Merkezi or İKAM) to facilitate and promote Islamic banking and finance, making Istanbul a potential hub of the Islamic finance world (Daily Sabah, 2020). All of these initiatives may make Turkish IBs stock slightly more resilient to oil volatility than those in Pakistan.

4.4. *Periods and intensity of oil volatility*

As mentioned, Figs. 1 and 2 present the results graphically and comprehensively; hence, the results they depict clearly illuminate when IBs and CBs stocks are affected by oil volatility.

4.4.1. *Oil-exporting countries*

Fig. 1 shows that although **Egyptian** (EGY) IBs and CBs stocks experienced high oil volatility during the 2014–2015 oil price collapse periods (Mensi et al., 2019), IBs stock experienced volatility in fewer significant recursive subsamples than their conventional counterparts during the early COVID-19 period. **Indonesian** (IDN) CBs stock was volatile in all recursive subsamples, but IBs stock was not volatile in the second half of 2017 and 2019, and IBs stock experienced comparatively less volatility during early COVID-19 than their counterparts. This finding outlines that Islamic stocks have been resilient during this uncertain period (i.e., the ongoing COVID-19 pandemic), supporting Al-Yahyaee et al. (2020). **Kuwaiti** (KWT) IBs and CBs stocks were volatile between 2014 and mid-2020, possibly because of the 2014 oil price drops and COVID-19, respectively; however, the volatility intensity was higher for IBs stock than for CBs during 2014–2016.

Nigerian (NGA) IBs stock was volatile in all years, except for 2014, while CBs stock was not volatile from the second half of 2015–first half of 2016, the first half of 2017–first half of 2018, and throughout 2019. IB stock in Nigeria also appears to demonstrate high volatility intensity in comparison to that of CBs from 2016–mid-2020. Nigeria has the most significant recursive samples among the oil exporters. The Nigerian stock market is strongly connected to oil prices as the country is an active member of OPEC (Balcilar et al., 2019). Locally, changes in oil prices alter the operation cost of the industrial sector, which is transmitted to the financial institution's performance (Okorie and Lin, 2020). Further, IBs stock in **Oman** (OMN) was volatile only during the second half of 2014, the first half of 2015, and the early months of COVID-19, while CBs stock was volatile from 2014 to 2016 and during COVID-19. However, IBs stock in Oman exhibits way less volatility than at CBs, inferring the resilience of IBs stock, which supports the findings of Al-Yahyaee et al. (2020).

In **Qatar** (QTR), IBs stock was not volatile during 2014, the second half of 2015, and the first half of 2017, while CBs stock was not volatile in the second half of 2014 and during the pandemic, yet the volatility intensity was higher than that of its Islamic counterparts. In **Saudi Arabia** (SAU), oil volatility made CBs stock volatile in all years, except the second half of 2017 and 2018, where IBs stock possessed very low volatility in the second half of 2016 and 2019 and high volatility during early COVID-19. Finally, IBs and CBs stocks in the **UAE** were volatile in all recursive subsamples or years, supporting Bouri and Demirer (2016), who find oil volatility transmission to the UAE stock market.

4.4.2. Oil-importing countries

Figure 2 shows that the stocks of both IBs and CBs demonstrate very minimal volatility in **Bangladesh**, though CBs stock exhibits volatility during early COVID-19. However, this effect did not apply to IBs stock, making Bangladesh lucrative to investors, particularly those looking to diversify, during this pandemic. In **Jordan**, IBs stock was moderately volatile only during 2014, whereas CBs stock was volatile in most significant recursive subsamples, including early COVID-19. IBs stock in Jordan also offers the same diversification benefits as Bangladesh. **Pakistani** IBs stock was moderately volatile only in 2014, but CBs stock was highly volatile during 2014 and exhibited very low volatility during the first half of 2015. Additionally, **Turkish** IBs stock has had no volatility, but its CBs stock was volatile in 2014 and early COVID-19. IBs stocks in Pakistan and Turkey present the same diversification pathway as Bangladesh and Jordan. While Palestinian IBs stock was volatile during 2017–mid-2020, its CBs stock was volatile in all periods except between 2017 and 2018.

In sum, oil volatility predicted the volatility for most IBs and CBs stocks in oil-exporting countries. IBs stock from all oil-exporting countries was affected by oil volatility during the early COVID-19 period, while IBs stock from oil-importing countries, namely, Bangladesh, Jordan, Pakistan, and Turkey, were not affected during this pandemic, making them uniquely lucrative to investors. Finally, the volatility intensity appears to be the highest in 2014, followed by 2015 and the early COVID-19 period, as the graphs clearly demonstrate. Specifically, the 2014–2016 oil volatility is intense for the Egyptian IBs and CBs (2014–2015), Indonesian CBs (2015–2016), Kuwaiti IBs (2014–2016), Nigerian IBs (2015–2016) and CBs (2014), Omani CBs (2014 and 2016), Qatari CBs (2015–2016), Saudi Arabian CBs (2014–2016), and UAE CBs (2015–2016). This finding supports Fantazzini's (2016) discovery that oil prices experienced a negative bubble between 2014 and 2015 due to the robust global production exceeding (Eraslan and Ali, 2018), decreasing the prices beyond what economic fundamentals would support. Hereafter, the OPEC and non-OPEC producers agreed to cooperatively reduce oil production for the first time since 2001 from 2016.12.01 until 2016.12.31, leading to another collapse in the oil prices across countries (Eraslan and Ali, 2018). In 2017, OPEC and non-OPEC members agreed to prolong output curbs for nine months, and Syria's Shayrat Airbase experienced a US missile strike (Eraslan and Ali, 2018), perhaps making oil prices volatile in Indonesian CBs, Nigerian IBs, Qatari CBs, and the UAE's CBs. Furthermore, oil prices have been impacted by the COVID-19 pandemic like never before, as suggested by the investigations on the extended period of COVID-19 (e.g., Tanin et al., 2022), which may justify the latter finding.

4.5. Robustness analysis

This study validates the obtained findings, relying on three information criteria: BIC, HQ, and FPE, as mentioned previously. Appendix B1 and B2[11] present estimation results for all windows: oil-exporting and oil-importing countries, respectively, obtained from BIC, HQ, and FPE. The results based on the FPE criterion are in line with those obtained according to AIC and HQ. Also, the results of BIC mostly confirm the findings of AIC. On the other hand, Tables 4 and 5 illustrate an overview of the volatility transmission results from oil to IBs and CBs. Similar to the previous case, the results of FPE are consistent with AIC, while HQ almost confirms, and BIC mostly confirms the findings of AIC. Moreover, Appendix A3 and A4 (findings of FPE) and Appendix B3 and B4 (findings of BIC and HQ) show the detailed findings of volatility transmission from oil to IBs and CBs stocks. These graphs also confirm the data from prior cases.

Nevertheless, we also run the test by Cheung and Ng (1996) as a robustness analysis.[12] This test uses standardized residuals from univariate GARCH models. We employed three types of GARCH models: the standard GARCH of Bollerslev (1986), the GJR-GARCH model of Glosten et al. (1993), and the EGARCH model of Nelson (1991), depending on how well these models achieve numerical convergence. We note that the cross-correlation function (CCF) test is sensitive to underlying GARCH specifications and lag lead orders of CCF. Similar to what we did in the multivariate GARCH-based test reported in the manuscript, we have estimated the univariate models through the expanding window of increment of five days returns. Overall, two of these results do not contradict each other regarding the decision of the null hypothesis (i.e., no variance causality), although we could not obtain the same results as we did in the MGARCH models. This research then argues that this study's findings are robust and comprehensive, which may help formulate future research strategies.

We further performed several specification and error diagnostic tests to inspect the estimated models' adequacy for each recursive window by following previous studies (e.g., Grier et al., 2004; Hasanov et al., 2016). We examine diagonal VAR with a null hypothesis that all the off-diagonal elements are jointly zero and find, in general, that the conditional mean process tends to be valid across countries and windows. Also, we tested the null hypothesis of no GARCH $a_{ij} = b_{ij} = d_{ij} = 0$, and we rejected the null hypothesis across all countries, implying that the GARCH specification is appropriate for this study. We evaluate the null hypothesis of no asymmetry and reject it for almost all countries. This

[11] We are not presenting results here for brevity but in a separate Appendix B that comprises over 115 pages. Appendix B will be available upon reasonable request.

[12] Thanks to an anonymous reviewer, who advised us to include further robustness analysis.

Table 4
Robustness test: volatility transmission from oil to Islamic banks

	BIC			HQ			FPE		
Countries	Significant Windows	Total Windows	Significant Win. (%)	Significant Windows	Total Windows	Significant Win (%)	Significant Windows	Total Windows	Significant Win. (%)
(a) Oil-exporting Countries									
EGY	129	343	37.61%	129	343	37.61%	127	343	37.03%
IDN	45	291	15.46%	47	291	16.15%	53	291	18.21%
KWT	135	343	39.36%	184	343	**53.64%**	188	343	**54.81%**
NGA	268	343	**78.13%**	268	343	**78.13%**	262	343	**76.38%**
OMN	8	343	2.33%	7	343	2.04%	11	343	3.21%
QAT	24	343	7.00%	20	343	5.83%	27	343	7.87%
SAU	30	343	8.75%	28	343	8.16%	19	343	5.54%
UAE	24	343	7.00%	65	343	18.95%	77	343	22.45%
Oil-importing Countries									
BGD	14	343	4.08%	14	343	4.08%	15	343	4.37%
JOR	7	343	2.04%	7	343	2.04%	18	343	5.25%
PAK	22	343	6.41%	22	343	6.41%	21	343	6.12%
PSE	100	343	29.15%	100	343	29.15%	100	343	29.15%
TUR	1	343	0.29%	0	343	0.00%	0	343	0.00%

(1) These results are based on the Bayesian information criterion (BIC), Hannan–Quinn information criterion (HQ), and Akaike's final prediction error criterion (FPE). (2) "Significant Win. (%)" denotes "Significant Windows (%)." (3) EGY = Egypt, IDN = Indonesia, KWT = Kuwait, NGA = Nigeria, OMN = Oman, QAT = Qatar, SAU = Saudi Arabia, UAE = United Arab Emirates, BGD = Bangladesh, JOR = Jordan, PAK = Pakistan, PSE = Palestine, and TUR = Turkey.

Table 5
Robustness test: volatility transmission from oil to conventional banks

	BIC			HQ			FPE		
Countries	Significant Windows	Total Windows	Significant Win. (%)	Significant Windows	Total Windows	Significant Win. (%)	Significant Windows	Total Windows	Significant Win. (%)
(a) Oil-exporting Countries									
EGY	145	343	42.27%	145	343	42.27%	147	343	42.86%
IDN	173	291	59.45%	178	291	61.17%	186	291	63.92%
KWT	90	343	26.24%	138	343	40.23%	106	343	30.90%
NGA	33	343	9.62%	35	343	10.20%	34	343	9.91%
OMN	29	343	8.45%	39	343	11.37%	49	343	14.29%
QAT	80	343	23.32%	95	343	27.70%	119	343	34.69%
SAU	186	343	**54.23%**	185	343	**53.94%**	139	343	40.52%
UAE	80	343	23.32%	119	343	34.69%	135	343	39.36%
(b) Oil-importing Countries									
BGD	8	343	2.33%	5	343	1.46%	4	343	1.17%
JOR	41	343	11.95%	53	343	15.45%	69	343	20.12%
PAK	55	343	16.03%	50	343	14.58%	46	343	13.41%
PSE	81	343	23.62%	84	343	24.49%	84	343	24.49%
TUR	32	343	9.33%	31	343	9.04%	31	343	9.04%

(1) These results are based on the Bayesian information criterion (BIC), Hannan–Quinn information criterion (HQ), and Akaike's final prediction error criterion (FPE). (2) "Significant Win. (%)" denotes "Significant Windows (%)." (3) EGY = Egypt, IDN = Indonesia, KWT = Kuwait, NGA = Nigeria, OMN = Oman, QAT = Qatar, SAU = Saudi Arabia, UAE = United Arab Emirates, BGD = Bangladesh, JOR = Jordan, PAK = Pakistan, PSE = Palestine, and TUR = Turkey.

test justifies employing an asymmetric version of VAR(p)-GARCH-BEKK models. These tests imply that adopting multivariate VAR(p)-GARCH-BEKK models is appropriate for this study.

Finally, we performed the portmanteau Q test statistics proposed by Hosking (1980) for each recursive window. This test is applied to the vector of the series as a whole (see Bauwens et al., 2006; Hasanov et al., 2016; Lütkepohl, 2005). The null hypothesis in this test is that the autocorrelation coefficients for standardized residuals are jointly zero. The results reveal that we do not reject the null hypothesis across most recursive windows in all countries except a few countries. This test generally indicates that the standardized residuals behave like white noise. Hence, the models are well-specified in most windows across all oil-exporting and oil-importing countries. These diagnostic tests infer that the flexible trivariate version of the asymmetric VAR(p)-GARCH-BEKK models are appropriate to obtain robust findings. We did not report the results of specification and error diagnostic tests due to space considerations.

The analysis so far seeks to answer why IBs are less affected by oil price volatility. It could be due to better capitalization and intermediation ratio, higher asset quality (Beck et al., 2013), less risk in general, more government and community (customer) support, and interbank connectedness. However, another possible answer is the wealth of the Muslim population. Specifically, oil is a significant source of this wealth, which may affect the growth of Islamic banking in the long run. Volatility is inherently related more to financial stability and bank risk, and the results of this study support this conclusion. Sharawy (2001) argues that some Islamic countries' domestic economies almost instantaneously moved from insolvency to great wealth by accumulating wealth from the oil industry, which may have helped IBs in those countries rise. Furthermore, government support has likely affected the growth of Islamic banking. Lajuni et al. (2017) find that government support, customer attitude, and social influence drive customers' intentions to use Islamic banking products, which eventually could help Islamic banking growth.

5. Summary of the findings and conclusion

This study investigates volatility transmission from oil to Islamic and conventional banks. The results suggest that oil volatility more greatly affects oil-exporting countries and the conventional banks in oil-exporting and oil-importing countries. We discover the highest oil volatility transmission for Islamic banks in Kuwait and Nigeria among oil-exporting countries and Palestine among oil-importing countries. We find that Islamic banks in Oman, Saudi Arabia, and Qatar are significantly less sensitive to oil volatility—the negligible number of recursive windows show evidence of significant volatility transmission among oil-exporting countries. Moreover, we find insignificant oil volatility transmission in all the recursive windows for the Islamic banks in Turkey and very small (or negligible) oil volatility transmission for those in Bangladesh, Jordan, and Pakistan, all oil-importing countries.

Oil-exporting countries show mixed results. In Indonesia, Saudi Arabia, the UAE, Oman, and Egypt, Islamic banks are affected by oil volatility in around 45%, 35%, 17%, 11%, and 4%, respectively, less recursive windows than conventional counterparts. In contrast, the Islamic banks in Nigeria, Qatar, and Kuwait exhibit oil volatility in around 66%, 27%, and 24%, respectively, more recursive windows than conventional counterparts. Conversely, we find different results for oil-importing countries. Islamic banks in Jordan and Pakistan demonstrate oil volatility in around 15% and 7%, respectively, less recursive windows, while Islamic banks in Palestine and Bangladesh show oil volatility in around 5% and 3%, respectively, more recursive windows than conventional banks. Finally, we observe no oil volatility transmission for Islamic banks but find volatility in 9.04% recursive windows for conventional banks in Turkey.

The granular view of our graphs reveals some valuable findings, as every 52.14 windows (or weeks) represent one year. For example, it is possible to review which banks were most affected by oil volatility in a specific year or timespan. The most significant volatility is seen during 2014, followed by 2015 and the early months of COVID-19. Interestingly, Islamic banks in Nigeria, Qatar, Saudi Arabia, and Palestine were not affected by oil volatility in 2014, but they were impacted during the early months of the COVID-19 pandemic. Conversely, Islamic banks in Bangladesh, Jordan, and Pakistan were affected by oil volatility in 2014 but not during early COVID-19. Further, conventional banks in Oman and Pakistan were not affected by oil volatility during early COVID-19.

In sum, oil volatility holistically has more predictive power for banks in oil-exporting countries and conventional banks in oil-exporting and oil-importing countries. In other words, volatility transmission from the oil market to oil-importing countries and Islamic banks is comparatively less common. Based on our robust and reliable findings, we expect that the resilience of Islamic banks and oil-importing countries, when appreciating risk transmission from the oil market, will remain the same in the future, offering a comparatively safer avenue for international investors.

This study argues that Islamic banks' resilience to oil volatility is region- and location-specific. As prior studies have claimed, oil revenues have helped Islamic banks expand, but this is not necessarily the prime driver of growth. Our data evidence that Islamic banks perform better than their conventional counterparts when oil volatility persists. This finding contrasts with Zia (2008), who claims that Shariah (Islamic law) does not significantly influence functional operations in the banking industry. However, our results align with Koçak and Özcan (2013), who contend that Islamic banks are different from conventional banks, and Beck et al. (2013), who note that Islamic banks are better capitalized and have a greater intermediation ratio and higher asset quality. The study thus provides crucial insights for stakeholders in Islamic banks, particularly regulators and policymakers. Importantly, Islamic banks must run the extra mile and carry out further practical initiatives to increase their resilience against extreme market conditions (i.e., oil volatility). This study reveals that investors, including ethical and Islamic, who seek sustainable investing, can rely more on Islamic banks and their stocks than on conventional banks and earn relatively safer returns.

Data availability and the low data quality of most countries limit the expansion of this study to the years before 2007. Additionally, if this study had the opportunity to examine the entire COVID-19 period, which is still ongoing, the results might show different outcomes following COVID-19. Future research ought to reexamine these results after COVID-19 ends to explore the outlook and resilience of Islamic banks. Future research focusing on second-moment spillover analysis may consider recent developments in multivariate GARCH-class models, such as the hyper-rotated GARCH-BEKK model proposed by Asai and McAleer (2022) and Asai et al. (2022) and the dynamic conditional correlation (DCC-GARCH) model as in Al Rahahleh et al. (2017) through the rolling window procedure.

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Declaration of Competing Interest

None.

Appendix A

A.1. Favored models: oil-exporting countries

EGY			IDN			KWT		
#	Model Names	Opt. Win.	#	Model Names	Opt. Win.	#	Model Names	Opt. Win.
1	VAR(1)-BEKK-GED	131	1	VAR(1)-BEKK-GED	54	1	VAR(1)-BEKK-GED	9
2	VAR(2)-BEKK-GED	10	2	VAR(2)-BEKK-GED	19	2	VAR(2)-BEKK-GED	261
3	VAR(3)-BEKK-GED	0	3	VAR(3)-BEKK-GED	0	3	VAR(3)-BEKK-GED	52
4	VAR(4)-BEKK-GED	0	4	VAR(4)-BEKK-GED	0	4	VAR(4)-BEKK-GED	0
5	VAR(5)-BEKK-GED	0	5	VAR(5)-BEKK-GED	0	5	VAR(5)-BEKK-GED	17
6	VAR(1)-BEKK-N	0	6	VAR(1)-BEKK-N	1	6	VAR(1)-BEKK-N	0
7	VAR(2)-BEKK-N	0	7	VAR(2)-BEKK-N	1	7	VAR(2)-BEKK-N	0
8	VAR(3)-BEKK-N	0	8	VAR(3)-BEKK-N	0	8	VAR(3)-BEKK-N	0
9	VAR(4)-BEKK-N	0	9	VAR(4)-BEKK-N	0	9	VAR(4)-BEKK-N	0
10	VAR(5)-BEKK-N	0	10	VAR(5)-BEKK-N	0	10	VAR(5)-BEKK-N	0
11	VAR(1)-BEKK-T	178	11	VAR(1)-BEKK-T	141	11	VAR(1)-BEKK-T	0
12	VAR(2)-BEKK-T	24	12	VAR(2)-BEKK-T	54	12	VAR(2)-BEKK-T	4
13	VAR(3)-BEKK-T	0	13	VAR(3)-BEKK-T	13	13	VAR(3)-BEKK-T	0
14	VAR(4)-BEKK-T	0	14	VAR(4)-BEKK-T	4	14	VAR(4)-BEKK-T	0

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EGY			IDN			KWT		
#	Model Names	Opt. Win.	#	Model Names	Opt. Win.	#	Model Names	Opt. Win.
15	VAR(5)-BEKK-T	0	15	VAR(5)-BEKK-T	4	15	VAR(5)-BEKK-T	0
		343			**291**			**343**
	NGA			**OMN**			**QAT**	
1	VAR(1)-BEKK-GED	0	1	VAR(1)-BEKK-GED	0	1	VAR(1)-BEKK-GED	8
2	VAR(2)-BEKK-GED	9	2	VAR(2)-BEKK-GED	0	2	VAR(2)-BEKK-GED	209
3	VAR(3)-BEKK-GED	0	3	VAR(3)-BEKK-GED	0	3	VAR(3)-BEKK-GED	82
4	VAR(4)-BEKK-GED	0	4	VAR(4)-BEKK-GED	0	4	VAR(4)-BEKK-GED	7
5	VAR(5)-BEKK-GED	0	5	VAR(5)-BEKK-GED	0	5	VAR(5)-BEKK-GED	0
6	VAR(1)-BEKK-N	0	6	VAR(1)-BEKK-N	0	6	VAR(1)-BEKK-N	0
7	VAR(2)-BEKK-N	0	7	VAR(2)-BEKK-N	0	7	VAR(2)-BEKK-N	0
8	VAR(3)-BEKK-N	0	8	VAR(3)-BEKK-N	0	8	VAR(3)-BEKK-N	0
9	VAR(4)-BEKK-N	0	9	VAR(4)-BEKK-N	0	9	VAR(4)-BEKK-N	0
10	VAR(5)-BEKK-N	0	10	VAR(5)-BEKK-N	0	10	VAR(5)-BEKK-N	0
11	VAR(1)-BEKK-T	81	11	VAR(1)-BEKK-T	20	11	VAR(1)-BEKK-T	0
12	VAR(2)-BEKK-T	236	12	VAR(2)-BEKK-T	240	12	VAR(2)-BEKK-T	31
13	VAR(3)-BEKK-T	17	13	VAR(3)-BEKK-T	75	13	VAR(3)-BEKK-T	6
14	VAR(4)-BEKK-T	0	14	VAR(4)-BEKK-T	8	14	VAR(4)-BEKK-T	0
15	VAR(5)-BEKK-T	0	15	VAR(5)-BEKK-T	0	15	VAR(5)-BEKK-T	0
		343			**343**			**343**
	SAU			**UAE**				
1	VAR(1)-BEKK-GED	48	1	VAR(1)-BEKK-GED	252			
2	VAR(2)-BEKK-GED	0	2	VAR(2)-BEKK-GED	59			
3	VAR(3)-BEKK-GED	10	3	VAR(3)-BEKK-GED	26			
4	VAR(4)-BEKK-GED	0	4	VAR(4)-BEKK-GED	5			
5	VAR(5)-BEKK-GED	0	5	VAR(5)-BEKK-GED	0			
6	VAR(1)-BEKK-N	0	6	VAR(1)-BEKK-N	0			
7	VAR(2)-BEKK-N	0	7	VAR(2)-BEKK-N	0			
8	VAR(3)-BEKK-N	0	8	VAR(3)-BEKK-N	0			
9	VAR(4)-BEKK-N	0	9	VAR(4)-BEKK-N	0			
10	VAR(5)-BEKK-N	0	10	VAR(5)-BEKK-N	0			
11	VAR(1)-BEKK-T	122	11	VAR(1)-BEKK-T	1			
12	VAR(2)-BEKK-T	30	12	VAR(2)-BEKK-T	0			
13	VAR(3)-BEKK-T	125	13	VAR(3)-BEKK-T	0			
14	VAR(4)-BEKK-T	8	14	VAR(4)-BEKK-T	0			
15	VAR(5)-BEKK-T	0	15	VAR(5)-BEKK-T	0			
		343			**343**			

Notes: (1) The symbol "#" refers to the serial number. (2) These optimal windows (Opt. Win.) are based on the Akaike information criterion. (3) EGY = Egypt, IDN = Indonesia, KWT = Kuwait, NGA = Nigeria, OMN = Oman, QAT = Qatar, SAU = Saudi Arabia, and UAE = United Arab Emirates.

A.2. *Favored models: oil-importing countries*

BGD			JOR			PAK		
#	Model Names	Opt. Win.	#	Model Names	Opt. Win.	#	Model Names	Opt. Win.
1	VAR(1)-BEKK-GED	276	1	VAR(1)-BEKK-GED	0	1	VAR(1)-BEKK-GED	139
2	VAR(2)-BEKK-GED	59	2	VAR(2)-BEKK-GED	288	2	VAR(2)-BEKK-GED	15
3	VAR(3)-BEKK-GED	0	3	VAR(3)-BEKK-GED	41	3	VAR(3)-BEKK-GED	125
4	VAR(4)-BEKK-GED	3	4	VAR(4)-BEKK-GED	14	4	VAR(4)-BEKK-GED	43
5	VAR(5)-BEKK-GED	0	5	VAR(5)-BEKK-GED	0	5	VAR(5)-BEKK-GED	21
6	VAR(1)-BEKK-N	0	6	VAR(1)-BEKK-N	0	6	VAR(1)-BEKK-N	0
7	VAR(2)-BEKK-N	0	7	VAR(2)-BEKK-N	0	7	VAR(2)-BEKK-N	0
8	VAR(3)-BEKK-N	0	8	VAR(3)-BEKK-N	0	8	VAR(3)-BEKK-N	0
9	VAR(4)-BEKK-N	0	9	VAR(4)-BEKK-N	0	9	VAR(4)-BEKK-N	0
10	VAR(5)-BEKK-N	0	10	VAR(5)-BEKK-N	0	10	VAR(5)-BEKK-N	0
11	VAR(1)-BEKK-T	5	11	VAR(1)-BEKK-T	0	11	VAR(1)-BEKK-T	0
12	VAR(2)-BEKK-T	0	12	VAR(2)-BEKK-T	0	12	VAR(2)-BEKK-T	0
13	VAR(3)-BEKK-T	0	13	VAR(3)-BEKK-T	0	13	VAR(3)-BEKK-T	0
14	VAR(4)-BEKK-T	0	14	VAR(4)-BEKK-T	0	14	VAR(4)-BEKK-T	0
15	VAR(5)-BEKK-T	0	15	VAR(5)-BEKK-T	0	15	VAR(5)-BEKK-T	0
		343			**343**			**343**
	PSE			**TUR**				
1	VAR(1)-BEKK-GED	162	1	VAR(1)-BEKK-GED	220			
2	VAR(2)-BEKK-GED	0	2	VAR(2)-BEKK-GED	2			
3	VAR(3)-BEKK-GED	6	3	VAR(3)-BEKK-GED	0			
4	VAR(4)-BEKK-GED	4	4	VAR(4)-BEKK-GED	0			
5	VAR(5)-BEKK-GED	6	5	VAR(5)-BEKK-GED	0			
6	VAR(1)-BEKK-N	0	6	VAR(1)-BEKK-N	0			
7	VAR(2)-BEKK-N	0	7	VAR(2)-BEKK-N	0			

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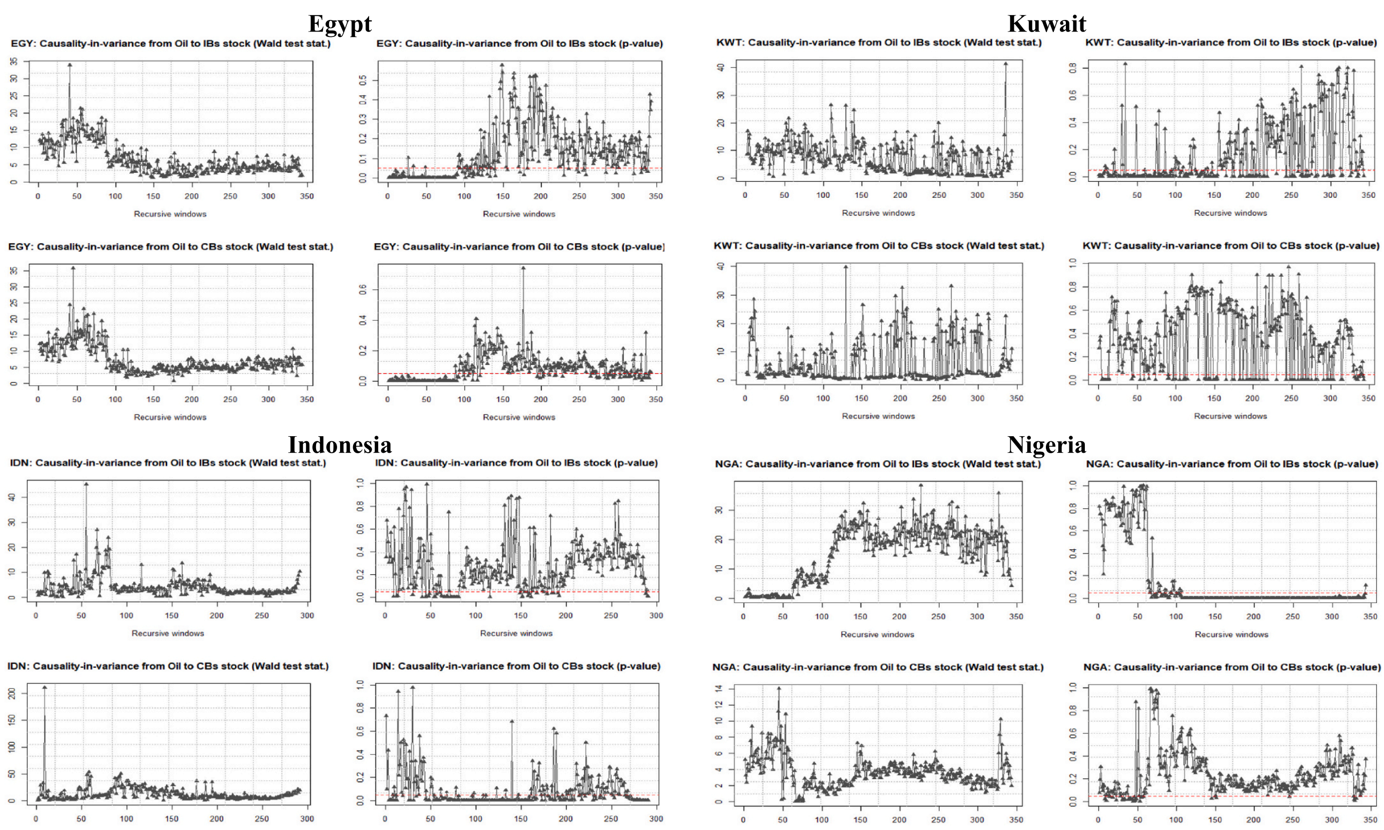
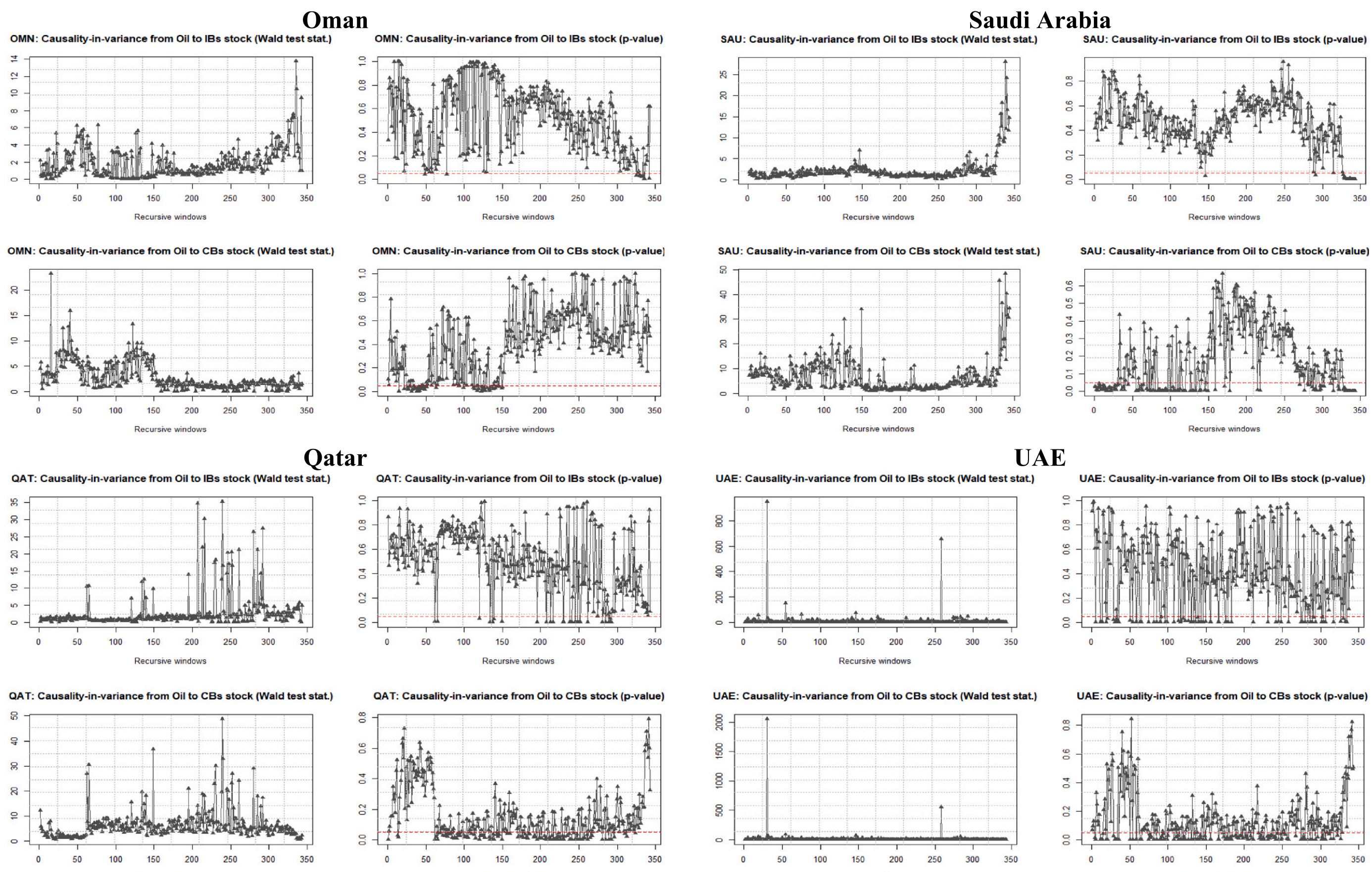
BGD			JOR			PAK		
#	Model Names	Opt. Win.	#	Model Names	Opt. Win.	#	Model Names	Opt. Win.
8	VAR(3)-BEKK-N	0	8	VAR(3)-BEKK-N	0			
9	VAR(4)-BEKK-N	0	9	VAR(4)-BEKK-N	0			
10	VAR(5)-BEKK-N	0	10	VAR(5)-BEKK-N	0			
11	VAR(1)-BEKK-T	149	11	VAR(1)-BEKK-T	121			
12	VAR(2)-BEKK-T	4	12	VAR(2)-BEKK-T	0			
13	VAR(3)-BEKK-T	12	13	VAR(3)-BEKK-T	0			
14	VAR(4)-BEKK-T	0	14	VAR(4)-BEKK-T	0			
15	VAR(5)-BEKK-T	0	15	VAR(5)-BEKK-T	0			
		343			**343**			

Notes: (1) The symbol "#" refers to the serial number. (2) These optimal windows (Opt. Win.) are based on the Akaike information criterion. (3) BGD = Bangladesh, JOR = Jordan, PAK = Pakistan, PSE = Palestine, and TUR = Turkey.

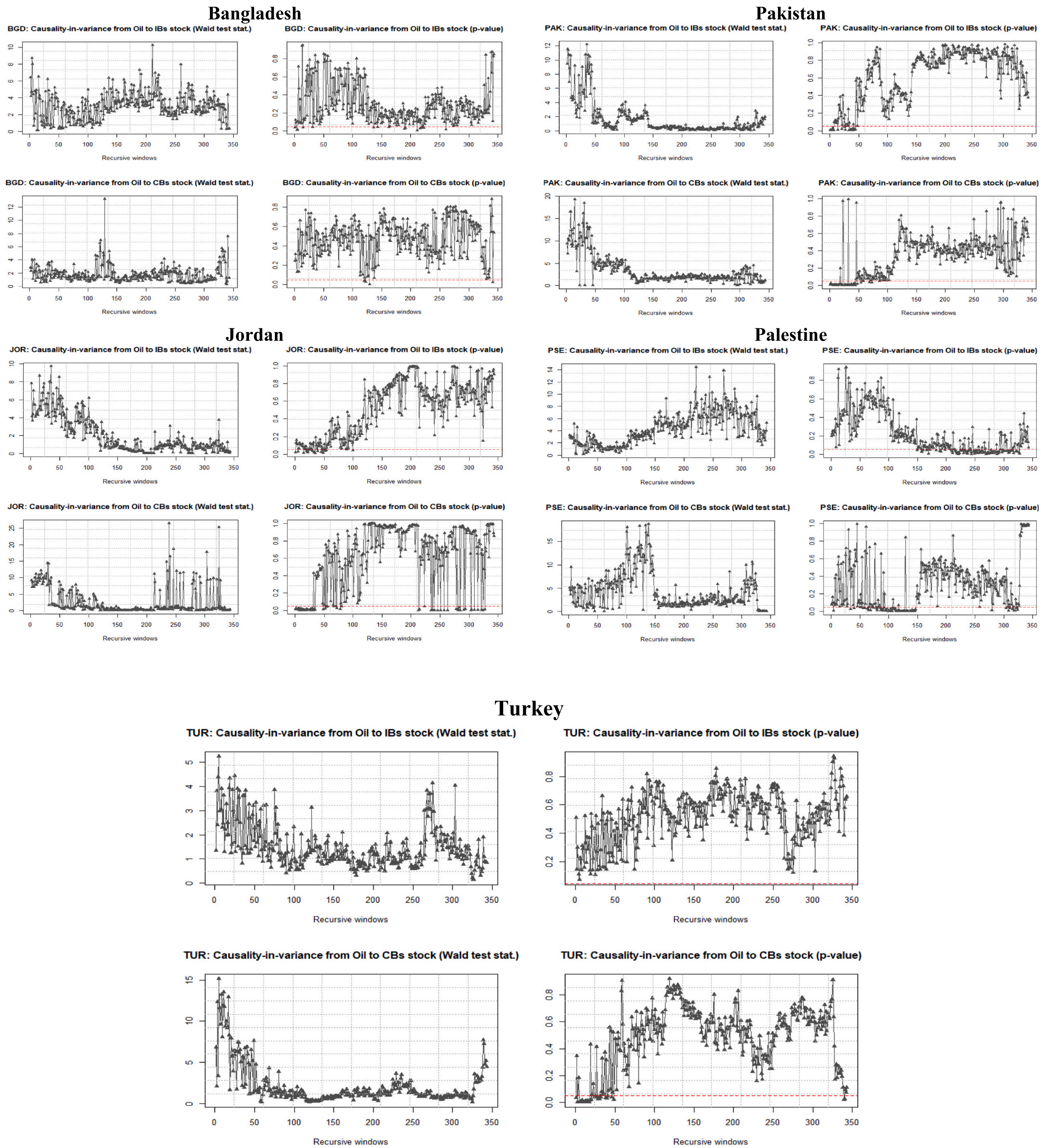
A.3. Robustness tests: oil-exporting countries





Notes: (1) The red line represents the 5% significance level of the *p*-value. (2) Within red line = significant windows. (3) These results are based on Akaike's final prediction error criterion (FPE).

A.4. Robustness tests: oil-importing countries



Notes: (1) The red line represents the 5% significance level of the *p*-value. (2) Within red line = significant windows. (3) These results are based on Akaike's final prediction error criterion (FPE).

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