Risk spillover between Islamic and conventional banking sectors

Risk Spillover between Islamic and Conventional Banking Sectors

Anupam Dutta, Jussi Nikkinen and Timo Rothovius

Abstract

To the best of our knowledge, this is the first study to examine the risk spillover between Islamic and conventional banks in Malaysia. Given that Malaysia is one of the most influential countries for Islamic finance, it is important for market participants to determine the sources of risk spillovers in order to identify appropriate hedges for minimizing the risk linked to Islamic bank stocks. Nevertheless, the time-varying volatility dynamics of Islamic banks' equities remain understudied. This paper aims to fill this void in the existing literature. Employing different versions of the VAR-GARCH approach, we find a bidirectional volatility transmission relationship between Islamic and conventional banks in Malaysia. The analysis of time-varying correlations further shows that the average correlation between these stock indexes appears to be weak implying that investors holding assets in these sectors could successfully minimize the potential risk associated with their portfolios. Hence, the results have important implications for portfolio diversification and hedging strategies.

Keywords: Islamic banks; Conventional banks; Risk spillover; Malaysia; Volatility

Biographies

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1. Introduction

The Islamic banking sector is a relatively new financial industry, which is based on Islamic principles and guided by Islamic economics. In particular, this banking system is based on Islamic rules and regulations called *Sharia* law and hence it is considered to be an ethically oriented trade system along with sustainable banking and finance (Al-Yahyaee et al., 2020). Notably, Islamic banking is strictly prohibited from operating business activities involving gambling, firearms, alcohol, and interest-gaining, which brands it as a unique form of socially responsible investment. The main philosophies of this banking system are sharing of profit and losses, and prohibition of interest during collection and payment by the lenders and investors (Jan et al., 2019). Thus the key objective of Islamic banking is to meet the financial needs of the community through interest-free savings and financing services (Muflih, 2021).

It is worth mentioning that Islamic banking has been one of the fastest growing financial sectors over the last decade. In 2019, for instance, the total assets of this industry amounts to USD2 trillion and according to a recent report published by the Thomson Reuters' State of the Global Islamic Economy, the total asset under Islamic finance is expected to surge to USD3.8 trillion by 2023.

Islamic banks are mainly concentrated in the Gulf Cooperation Council (GCC) countries, Pakistan, Iran, and Malaysia. Among these countries, Malaysia appears to be most influential country for Islamic finance followed by the United Arab Emirates (UAE). Currently, Malaysia has 16 fully-fledged Islamic banks and its total Islamic bank assets amount to US$135 billion which accounts for 21% of the country's total banking assets. UAE, on the other hand, has seven fully-fledged Islamic banks which account for US$95 billion of assets representing around 19% of its total

banking sector[1]. It is also worth mentioning that the combined assets of all Malaysian Islamic banks account for 23% of the 100 largest Islamic banks' assets. Malaysia is thus way ahead of its counterpart when it comes to regulating Islamic finance which has a substantial impact on its national economy.

In this paper, we aim to investigate the volatility spillover effects between Islamic and conventional banks in Malaysia. As Islamic finance is growing rapidly worldwide, a strand of literature investigates the return and volatility dynamics of Islamic equity markets[2]. Some recent contributions include Lean and Badeeb (2017), Mensi et al. (2017), Shahzad et al. (2018), Bali et al. (2019), Mishra et al. (2019), Narayan et al. (2019), Ftiti and Hadhri (2019), Abdulkarim et al. (2020), Godil et al. (2020), Lin and Su (2020), Chang et al. (2020) and Mensi et al. (2020). Lean and Badeeb (2017), for instance, employ the nonlinear autoregressive distributed lag (NARDL) process to explore the impact of oil price variations on the international Islamic equity markets. The study reveals a weak linkage between oil and stock prices, though the association seems increasing the during the turmoil periods. Mensi et al. (2017) examine the effects of gold, crude oil and conventional stock markets on the volatility of Dow Jones Islamic equity indexes. Using the DECO-FIAPARCH and the spillover index of Diebold and Yilmaz (2012), the authors document a significant risk spillover from these markets to Islamic stock prices. They also show that such correlations tend to upsurge amid the crisis periods. Adopting time-varying copula approach, Shahzad et al. (2018) find that asymmetric downside and upside volatility transmission from crude oil to global Islamic stock markets. Moreover, Mishra et al. (2019) apply the wavelet-

[1] The information is sourced from website of theconversation.com

[2] Shariah-compliant stocks such as Islamic banking sector equites are traded on the Bursa Malaysia stock exchange. The development of the Securities Screening Methodology by the Shariah Advisory Council (SAC) of Securities Commission Malaysia (SC) determines the Shariah compliance of securities listed and traded on Bursa Malaysia.

based quantile-on-quantile approach to measure the effects of oil market on Islamic stock prices and show that such impacts appear to be asymmetric. Using a similar approach, Narayan et al. (2019) also find that oil prices exert a significant effect on Islamic equity markets. Ftiti and Hadhri (2019) document that in addition to oil prices, economic policy uncertainty (EPU) and investor sentiment have also predictive contents for Islamic stock indexes. A recent study by Lin and Su (2020) explores the quantile associations between crude oil volatility index (OVX) and Islamic equity returns and indicates that OVX has a negative impact on Islamic stock prices.

Notably, all the above-mentioned studies are focused on aggregate Islamic finance stock indexes and to date, very little is known about the volatility features of Islamic bank equity indexes. However, only a couple of studies (Fakhfekh et al., 2016 and Mensi et al., 2019) estimate the risk linked to Islamic bank stocks. For example, Fakhfekh et al. (2016) study the volatility features of conventional and Islamic banks of the Gulf Cooperation Council (GCC) countries using the FIEGARCH approach and find the presence of asymmetric volatility implying that bad news impacts the volatility more strongly than positive news. The authors also show that bad news tends to have a higher effect on the volatility of conventional banks compared to Islamic banks. The study further documents that following a shock, volatility is more persistent in conventional banks than in Islamic banks. The findings of Mensi et al. (2019) reveal that risk significantly transmits among the conventional and Islamic banks of the GCC countries and that the spillover effects seem increasing during the turmoil periods.

To extend this scarce literature, this paper examines the risk transmission relationship between Islamic and conventional banks in Malaysia. Note that risk may transmit from conventional banks to Islamic banks through two channels. First, volatility spillover effects between these two banking systems have gradually increased over the last decade due to international financial integration and

liberalization. Mensi et al. (2019), for instance, argue that since Islamic banks appear to be less volatile relative to conventional banks, the former have emerged as a good alternative to the distress of the latter. Particularly, Islamic banks offer diversification benefits during the stress periods and hence gain popularity among the financial market participants (Arouri et al., 2013). As a consequence, the correlations between these sectors increase significantly following the 2008 global financial crisis, which in turn elevates the cross-market linkages and volatility connectedness. Second, given that prohibiting investments in sectors that are not compliant with the Sharia board (i.e. alcohol, pork, etc.) could be identified as a major source of risk, Islamic banks could receive volatility from other financial institutions (e.g., conventional banks) which are not bound to follow such restrictions (Fakhfekh et al., 2016). Hence, volatility of Islamic banks is influenced not only by its own lagged values, but also by the volatility stemming from conventional banks.

Our contributions are two-fold. First, while earlier papers studying the risk and return patterns of Islamic bank equity prices are exclusively focused on GCC countries, this study extends the knowledge on volatility dynamics of Malaysian Islamic banks. Given that Malaysia is home to many leading Islamic banks, it is important for market participants to understand the volatility features of Islamic banks in Malaysia. As precise estimates of time-varying volatility and correlation are of paramount importance to understanding the risk of portfolio investments, studying the volatility spillover effects among financial sectors has significant implications to investors and policymakers. Since investing in Islamic assets is a relatively new notion for international investors, such equities could be highly volatile and accordingly, investments in this sector would lead to substantial losses. It is, therefore, crucial to precisely estimate the time-varying volatility of such stocks to realize the underlying risk. Furthermore, it is also worth

mentioning that what matter for both investors as well as policy makers are not the stock returns per se, but the risk (i.e., volatility) linked to conventional and Islamic banks. Hence, proper knowledge on the risk transmission relationship among the sectors under study is essential given that volatility dynamics of conventional banks' equities may contain key information which can be useful for predicting future risk of Islamic banks' assets.

Second, we estimate the time-varying correlations between the conventional and Islamic bank stocks employing the DCC-GARCH process. Note that the unconditional correlations fail to capture the dynamics of the association between two stock indexes as they ignore the time-varying fluctuations of the correlation structure. Investigating the linkage between these stocks in a time-varying setup would allow us to detect how such connection evolves under diverse market conditions (e.g. high and low volatility regimes).

This paper is structured in the following fashion. The next section consists of a brief description of the data used in this research. Section 3 outlines the empirical methodology. Results are presented in Section 4. We conclude in Section 5.

2. Data

The data on stock prices of Malaysian Islamic and conventional banks are retrieved from Thomson Reuters DataStream database. We consider daily closing prices and the sample period spans from January, 2005 to December, 2020. The stock prices are given in Malaysian ringgit. It is noteworthy that we use the information on 6 conventional and 4 Islamic banks to construct these indexes.

Table 1 reports the descriptive statistics of the stock indexes. Of the equity markets, the Islamic banking index appears to be less volatile than the conventional one. Besides, both indexes exhibit

positive skewness and seem leptokurtic. Employing the Jarque-Bera test, we also note that none of these indexes satisfies the normality assumption.

Table 1: Descriptive Statistics

Index	Mean	Standard Deviation	Skewness	Kurtosis	Jarque-Bera Test
Conventional bank	-0.0525	2.49	-0.52	16.85	31329.77***
Islamic bank	-0.0590	2.41	-0.46	21.77	57387.77***

Notes: This table reports the main descriptive statistics for conventional and Islamic banking equity indexes. *** indicates statistical significance at 1% level.

Table 2 displays the results of two unit root tests: augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) unit root tests. The results of these two stationarity tests show that the return series of conventional and Islamic banking stock markets appear to be stationary.

Table 2: Results of unit root tests

Sector	ADF Tests		PP Tests	
	Levels	Log-returns	Levels	Log-returns
Conventional	-1.7638 (.39)	-61.58 (.00)***	-1.7396 (.41)	-61.59 (.00)***
Islamic	-0.9575 (.77)	-62.00 (.00)***	-0.9545 (.77)	-62.01 (.00)***

Notes: This table displays the results for the ADF and PP unit root tests. *** indicates statistical significance at 1% level. The values in parentheses indicate the *p*-values.

Fig. 1 depicts the stock prices of Malaysian conventional and Islamic banks. It is evident from this graph that equity prices tend to fall significantly amid the crisis periods. Both indexes experience a significant drop during the 2008 great recession. Notably, the conventional banking equity prices witness the largest fall amid the 2014 oil market crisis, while the Islamic stock index shows a similar trend during the ongoing COVID-19 pandemic.

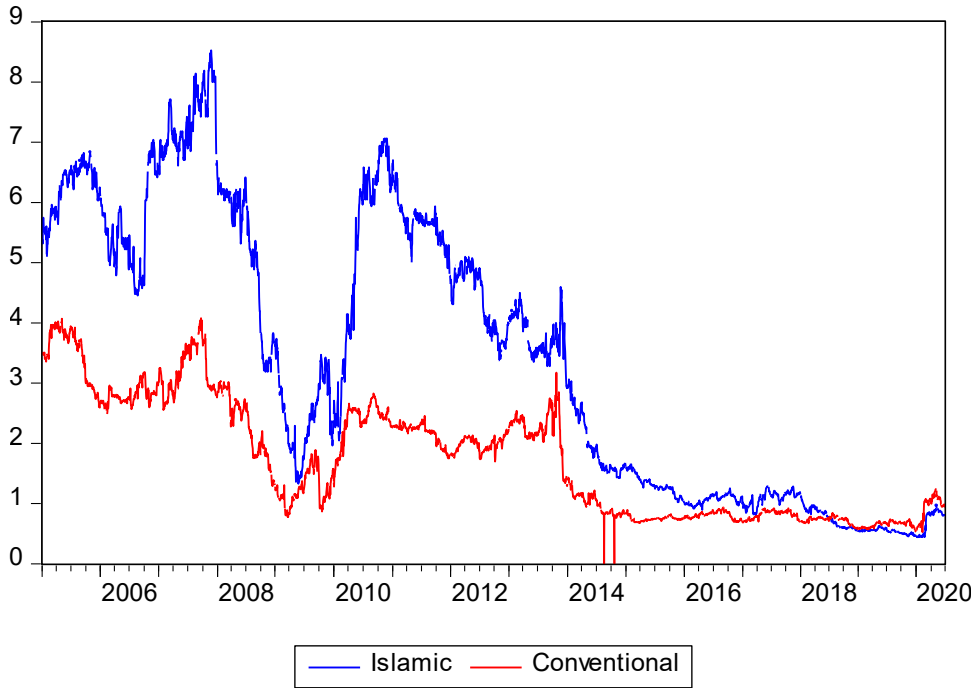

Fig. 1: Stock Prices of Malaysian conventional and Islamic banks

3. Methodology

3.1. VAR-GARCH approach

The VAR-GARCH model, proposed by Ling and McAleer (2003), has earned immense popularity in finance and economics literature in recent years (Arouri et al., 2011; Arouri et al., 2012; Chang et al., 2011; Bouri 2015; Noor and Dutta, 2017; Dutta et al., 2018). This popularity comes from the fact that employing this model allows the investigators to estimate the return and volatility spillover effects amongst the financial assets. Besides, the use of VAR-GARCH approach alleviates the convergence problems as well as computational complications which researchers often experience while working with other multivariate GARCH models including BEKK and VECH models (Arouri et al., 2012; Dutta et al., 2018).

The first step in our bivariate VAR(1)-GARCH (1,1) methodology is to outline the following mean equation:

$$R_t = C + \gamma R_{t-1} + \varepsilon_t \quad (1)$$

$$\varepsilon_t = A_t^{1/2} \eta_t$$

Within this framework, R_t indicates a 2×1 vector of daily returns on conventional and Islamic bank stock market indices at time *t*, *C* denotes a 2×1 vector of constants, γ is a 2×2 matrix of parameters measuring the effects of own lagged and cross mean transmissions between two series, ε_t is the residual of the mean equation for the stock returns at time *t*, η_t indicates a 2×1 vector of independently and identically distributed innovations and $A_t^{1/2} = diag(\sqrt{h_t^C}, \sqrt{h_t^I})$, where, h_t^C and h_t^I refer to the conditional variances of conventional and Islamic bank stock returns respectively, which are given as

$$h_t^C = c_1^2 + b_{11}^2 h_{t-1}^C + b_{21}^2 h_{t-1}^I + a_{11}^2 \varepsilon_{C,t-1}^2 + a_{21}^2 \varepsilon_{I,t-1}^2 \quad (2)$$

$$h_t^I = c_2^2 + b_{12}^2 h_{t-1}^C + b_{22}^2 h_{t-1}^I + a_{12}^2 \varepsilon_{C,t-1}^2 + a_{22}^2 \varepsilon_{I,t-1}^2 \quad (3)$$

Equations (2) and (3) assist us to examine how shocks and volatility would transmit over time and across the price indices. Now, the conditional covariance between the stock indexes is estimated as follows:

$$h_t^{CI} = \rho_t \sqrt{h_t^C} \sqrt{h_t^I} \quad (4)$$

where, ρ_t is the conditional correlation between conventional and Islamic bank stock returns at time *t*. In order to capture the non-normality associated with the stock prices, we employ the quasi-

maximum likelihood estimation method to achieve the estimates of the parameters of the bivariate VAR(1)-GARCH (1,1) model. Later, we utilize these findings to obtain the portfolio weights to analyze the hedging effectiveness.

3.2. VAR-AGARCH approach

McAleer et al. (2009) proposed an asymmetric version of VAR-GARCH (VAR-AGARCH) model arguing that time-series data are usually nonlinear in nature. In this process, the volatilities are defined as follows:

$$h_t^C = d_1^2 + b_{11}^2 h_{t-1}^C + b_{21}^2 h_{t-1}^I + a_{11}^2 A(\varepsilon_{C,t-1})^2 + a_{21}^2 A(\varepsilon_{I,t-1})^2 + B[(\varepsilon_{C,t-1}) \times ((\varepsilon_{C,t-1}) < 0)] \quad (5)$$

$$h_t^I = d_2^2 + b_{12}^2 h_{t-1}^C + b_{22}^2 h_{t-1}^I + a_{12}^2 A(\varepsilon_{C,t-1})^2 + a_{22}^2 A(\varepsilon_{I,t-1})^2 + B[(\varepsilon_{I,t-1}) \times ((\varepsilon_{I,t-1}) < 0)] \quad (6)$$

where, $A(\varepsilon_{C,t-1})^2$ and $B[(\varepsilon_{C,t-1}) \times ((\varepsilon_{C,t-1}) < 0)]$ along with $A(\varepsilon_{I,t-1})^2$ and $B[(\varepsilon_{I,t-1}) \times ((\varepsilon_{I,t-1}) < 0)]$ respectively specify the connection between one market volatility and own past positive (negative) returns.

Note that the estimates of the VAR-AGARCH models are also obtained by adopting the quasi-maximum likelihood estimation method.

4. Empirical results

4.1. Spillover analysis

Table 3 shows the estimates of the symmetric VAR-GARCH approach, while Table 4 exhibits the same for the VAR-AGARCH process. In each of these tables, h_t^C and h_t^I refer to the conditional variances of conventional and Islamic bank stock returns respectively. The squared error terms $\varepsilon_{C,t-1}^2$ and $\varepsilon_{I,t-1}^2$ capture the impacts of unexpected news or shocks in these markets.

Table 3: Results of the VAR-GARCH model

Independent Variable	Islamic	Conventional
r_{t-1}^{I}	0.0435 (.00)***	0.0093 (.43)
r_{t-1}^{C}	0.0024 (.85)	0.0062 (.70)
$\varepsilon_{I,t-1}^{2}$	0.1131 (.00)***	0.0071 (.23)
$\varepsilon_{C,t-1}^{2}$	-0.0058 (.08)*	0.3478 (.00)***
h_{t-1}^{I}	0.8347 (.00)***	0.0679 (.00)***
h_{t-1}^{C}	0.0328 (.00)***	0.5987 (.00)***
CCC		
Conventional	1.000	
Islamic	0.0116 (.43)	1.000
Log Likelihood	-16391.06	

Notes: This table exhibits the estimates of our symmetric VAR-GARCH approach. r_{t-1}^{I} represents the return for Islamic bank stock index at time *t*-1 and r_{t-1}^{C} specifies the same for the conventional index. h_t^C and h_t^I refer to the conditional variances of conventional and Islamic bank stock returns respectively. The squared error terms $\varepsilon_{C,t-1}^{2}$ and $\varepsilon_{I,t-1}^{2}$ capture the impacts of unexpected news or shocks in these markets. CCC indicates the constant conditional correlation between the stock indexes. ***, ** and * indicate statistical significance at 1%, 5% and 10% levels respectively. Values in parentheses refer to *p*-values.

The findings presented in Table 3 suggest that stock returns for the Islamic banks react significantly to their lagged values implying that there exist short-term predictability in this sector. However, we do not find such evidence for the conventional banks. In addition, there does not exist any return spillover between these sectors as corresponding parameters appear to be insignificant at conventional levels. This finding simply indicates that traditional bank stock prices do not have any predictive content for the stock prices of Islamic banking sector. This finding contradicts with that of Hammoudeh et al. (2013), Dania and Malhotra (2013), Balcilar et al. (2015), el Alaoui et al. (2015), Rizvi et al. (2015) and Majdoub et al. (2016). Each of the above-mentioned studies documents a significant return spillover effect between conventional and Islamic equity markets. However, it is worth mentioning that none of these articles has considered disaggregate level data for the Islamic banking stock indexes. As all these authors have used composite equity indexes which comprise data from different sectors, our results cannot be directly compared with their outcomes.

Looking at the volatility equations, we document several interesting findings. First, there exists a bilateral volatility linkage between these two banking sectors. Therefore, risk significantly transmits from one sector to another. Second, the volatility spillover effects are positive meaning that an upsurge in the uncertainty of one banking system causes the other one to increase. Third, the size of the volatility spillover estimate is higher for the Islamic banking sector compared to the conventional sector, which reveals that Islamic banking system in Malaysia plays a pivotal role in its economy. Fourth, any shocks or news emanating from the conventional banking sector has a negative effect on the Islamic banking system, albeit the latter does not have any significant impact on the former. Finally, the ARCH and GARCH parameters are found to be significant for each sector which also indicates the importance of modeling the time-varying volatility dynamics of these stock indexes. The estimates of ARCH and GARCH parameters further confirm the presence of volatility persistence in the Malaysian banking sectors.

Moving to Table 4, we observe that the asymmetric VAR-GARCH model produces similar results as well. That is, we do not find any return spillover effects between these two stock markets, though these banking systems are recipients of volatility from each other. In addition, the size of the volatility spillover estimate is still higher for the Islamic banking sector compared to the conventional sector. The estimates of the VAR-AGARCH model further document the significance of multivariate asymmetric effects for the conventional banking sector only. The positive linkage between negative returns and volatility reveals that 'bad news' leads to an upturn in the volatility of conventional bank stock prices, albeit 'good news' seems to have a higher effect on volatility, as evidenced by the magnitude of the parameter estimates.

Table 4: Results of the VAR-AGARCH model

Independent Variable	Islamic	Conventional
r_{t-1}^{I}	0.0446 (.00)***	0.0060 (.63)
r_{t-1}^{C}	0.0025 (.83)	0.0090 (.59)
$A(\varepsilon_{I,t-1})^2$	0.1124 (.00)***	0.0005 (.94)
$A(\varepsilon_{C,t-1})^2$	-0.0066 (.02)**	0.3047 (.00)***
$B[(\varepsilon_{I,t-1}) \times ((\varepsilon_{I,t-1}) < 0)]$	0.0004 (.98)	
$B[(\varepsilon_{C,t-1}) \times ((\varepsilon_{C,t-1}) < 0)]$		0.1782 (.00)***
h_{t-1}^{I}	0.8315 (.00)***	0.0509 (.02)**
h_{t-1}^{C}	0.0368 (.00)***	0. 6593 (.00)***
CCC		
Conventional	1.000	
Islamic	0.0123 (.42)	1.000
Log Likelihood	-16381.37	

Notes: This table exhibits the estimates of our asymmetric VAR-GARCH approach. r_{t-1}^{I} represents the return for Islamic bank stock index at time *t*-1 and r_{t-1}^{C} specifies the same for the conventional index. h_t^C and h_t^I refer to the conditional variances of conventional and Islamic bank stock returns respectively. The squared error terms $\varepsilon_{C,t-1}^2$ and $\varepsilon_{I,t-1}^2$ capture the impacts of unexpected news or shocks in these markets. CCC indicates the constant conditional correlation between the stock indexes. ***, ** and * indicate statistical significance at 1%, 5% and 10% levels respectively. Values in parentheses refer to *p*-values.

4.2. Time-varying correlations

Table 5 exhibits the summary statistics of time-varying correlations between the conventional and Islamic banking equity indexes. We employ the estimates of symmetric and asymmetric versions of the VAR-GARCH approach to find these numbers. We observe from this finding that the average cross correlation appears to be very close to zero. Both models confirm this finding. Hence, our results indicate the room or opportunity for portfolio diversifications. In other words, investors can participate in these markets in order to minimize the risk associated with their portfolios. These results are also important for financial policy makers, who could consider these estimates while dealing with contagion risks and steering market policies.

Table 5: Summary statistics of time-varying correlations

	Mean	Standard Deviation	Maximum	Minimum
VAR-GARCH	0.0096	0.0167	0.0849	-0.0769
VAR-AGARCH	-0.0005	0.1799	0.6675	-0.7210

Notes: This table reports the summary statistics for the time-varying correlations between conventional and Islamic banking stock index returns. We provide the output from both VAR-GARCH and VAR-AGARCH models.

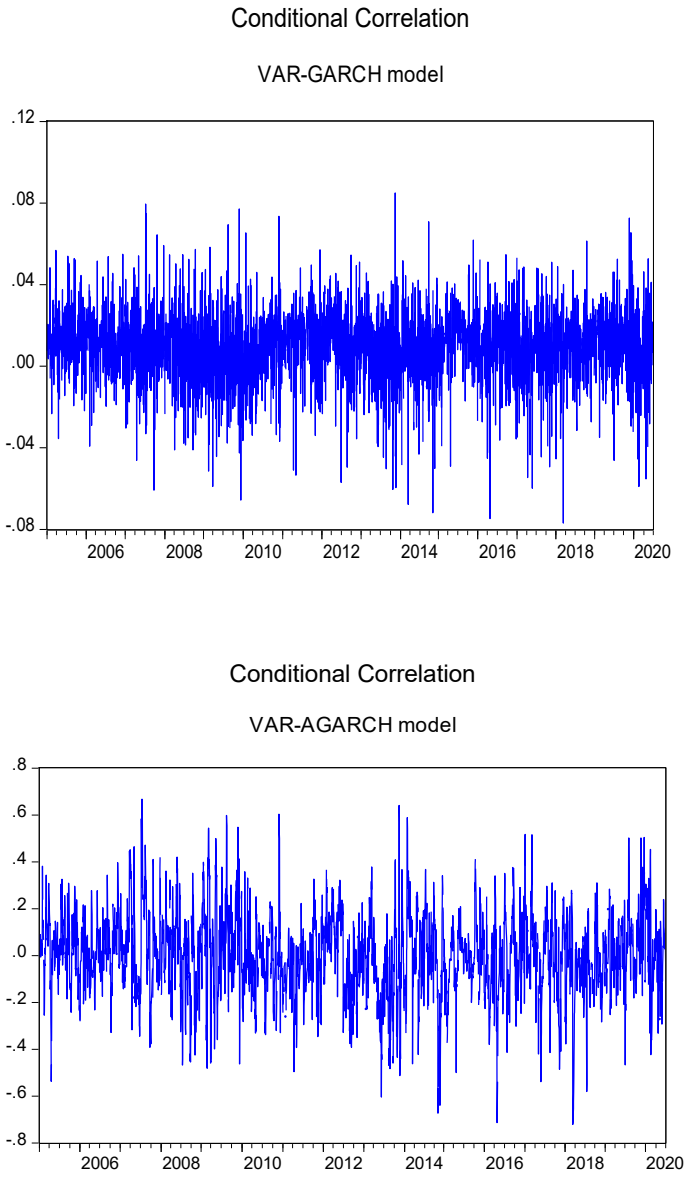

Fig. 2: Time-varying correlations between conventional and Islamic banking stock indexes

Next, Fig. 2 also depicts the time-varying correlations between the markets under study. This diagram demonstrates that these correlations seem time-dependent implying that they are not static over time. These correlations also show evidence of swinging between the positive and negative regions. Therefore, a time-dependent association between these markets is observed throughout the sample period. We further detect that the correlations tend to increase during the 2008 global financial crisis periods. A similar pattern is also observed when oil prices fall substantially amid the 2014-2015 era. These results indicate a less portfolio diversification opportunity amid the volatile periods. Notably, during the low volatility regimes, the correlations appear to be minor, which reveals the possibility of portfolio hedging.

4.3. Economic implications

In this section, we apply the estimates of our bivariate VAR-GARCH models to examine whether holding assets in the conventional and Islamic banking sectors is useful for moderating the risk of the resultant portfolio. To reach this goal, we need to calculate the optimal weights for the portfolio consisting of these two assets. Based on Kroner and Ng (1998), we estimate the optimal portfolio weights as follows:

$$\omega_t^{CI} = \frac{h_t^I - h_t^{CI}}{h_t^I - 2h_t^{CI} + h_t^C} \tag{7}$$

and,

$$\omega_t^{CI} = \begin{cases} 0, if\ \omega_t^{CI} < 0 \\ \omega_t^{CI}, if 0 \le \omega_t^{CI} \le 1 \\ 1, if \omega_t^{CI} > 1 \end{cases}$$

where ω_t^{CI} is the weight of the Islamic banking stock in a one-dollar portfolio comprising of banking sector assets at time *t*, h_t^s and h_t^o refer to the conditional variances of asset returns and h_t^{so}

designates the covariance term between these asset returns at time *t*. The weight for the conventional banking stock index amounts to $(1 - \omega_t^{so})$.

Once the optimal weights are achieved, our next step is to analyze the hedging effectiveness (HE) of the resultant portfolio. In line with Ku, Chen, and Chen (2007), we define HE is as follows:

$$HE = \frac{Var_{unhedged} - Var_{hedged}}{Var_{unhedged}} \tag{8}$$

where $Var_{unhedged}$ is the variance of the conventional banking stock index returns, while Var_{hedged}, which indicates the variance of the portfolio comprising conventional and Islamic banking sector assets, is given as:

$$Var_{hedged} = (\omega_t^{cs})^2 h_t^c + (1 - (\omega_t^{cs})^2) h_t^s + 2\omega_t^{cs}(1 - \omega_t^{cs}) h_t^{cs} \tag{9}$$

Note that a higher HE of a particular portfolio suggests the greater portfolio risk reduction which indicates that the underlying investment strategy is deemed as a superior hedging policy (Arouri et al. 2011). Table 6 presents the unhedged portfolio variance, hedged portfolio variance and hedging effectiveness ratios, which are estimated using equations (7-9). These outcomes demonstrate that hedging strategies consisting of conventional and Islamic assets successfully reduce the portfolio risk and that the reduction in variance amounts to 28.06% and 29.83% for the VAR-GARCH and VAR-AGARCH models, respectively.

These findings have important implications for socially responsible (SR) investors who like to maintain a portfolio with more SR firms. As our findings provide evidence that Islamic banking equities, which are often viewed as SR assets, could diversify the risk of the conventional portfolios, SR investors would aim at including more SR assets in their portfolios to obtain superior

risk-adjusted returns. Given that SR investors are not only interested in ethical investments, but also like to know about the financial performance of such companies, our findings could be of their interest.

Table 6: Hedging Effectiveness

Model ↓	Variance (Unhedged)	Variance (Hedged)	HE (%)
VAR-GARCH	6.20	4.46	28.06
VAR-AGARCH	6.20	4.35	29.83

Notes: This table displays the hedging effectiveness for the portfolio comprising conventional and Islamic banking sector stock indexes. $Var_{unhedged}$ is the variance of the conventional banking stock index returns, while Var_{hedged} indicates the variance of the portfolio comprising conventional and Islamic banking sector assets. Var_{hedged} is estimated using equation (9). HE stands for the hedging effectiveness.

4.4. Discussion

Overall, our results suggest bidirectional volatility linkages between conventional and Islamic banking stock indices. This is a new finding as earlier studies do not shed light on the estimation of such spillover effects. This is an important finding as well given that the information on risk linked to the conventional banking asset can be used to predict that of the Islamic banking asset and vice versa. Such analyses are also important for finding appropriate hedging instruments which can be utilized by investors participating in Malaysian banking sector. The constant conditional correlations (CCC) reported in Tables 3 and 4 further suggest that the correlation between these stock markets is insignificant indicating a room for portfolio hedging. Mensi et al. (2019) also note that to find new hedges or safe havens for Islamic bank assets, the estimates of spillover effects would carry important information. In sum, market participants could apply these findings to acquire precise knowledge on the cross-market relations for developing effective business strategies and planning optimal portfolios.

Moreover, it is observed that during the turmoil periods (e.g., 2008 global financial crisis, COVID-19 pandemic), stock prices of Malaysian banks (both conventional and Islamic banks) have experienced a significant drop and accordingly, the volatility has increased substantially. Hence, these periods involve a growing level of uncertainty on the overall economic evolutions. Regulators, therefore, should take appropriate measures so that they can make prompt decisions to cope with varied market conditions. In particular, more accurate and flexible approaches need to be employed to precisely quantify the risk associated with investor portfolio during the periods of market stress. To this end, our analysis could be of interests to regulators aiming at minimizing the uncertainty. For instance, understanding how shocks and volatility transmit from one banking sector to another plays a crucial role in finding new hedging instruments with a view to protecting investor portfolio. Such knowledge could also help the regulators to act swiftly and provide the investors with better asset allocation strategies during the episodes of financial downturns.

5. Conclusions

In this empirical research, we study the volatility transmission linkage between Islamic and conventional banks in Malaysia. Given that Malaysia is one of the most influential countries for Islamic finance, it is important for market participants to determine the sources of risk spillovers in order to identify appropriate hedges for minimizing the risk linked to Islamic bank stocks. Nevertheless, the time-varying volatility dynamics of Islamic banks' equities remain understudied. This paper aims to fill this void in the existing literature. The application of the VAR-GARCH approach shows that there exists a bilateral volatility transmission relationship between Islamic and conventional banks in Malaysia, albeit no evidence of return spillover is found. The robustness of this finding is further confirmed by employing an asymmetric version of the VAR-GARCH model. The analysis of time-varying correlations further shows that the average correlation

between these stock indexes appears to be negligible implying that investors holding assets in these sectors could successfully minimize the potential risk associated with their portfolios. In other words, this result indicates diversification opportunities for market participants. Hence, based on our outcomes, Islamic bank stocks emerge as a potential hedging tool for diversifying the risk associated with conventional bank stocks.

Our findings are important in that we document the significance of examining the time-varying volatility features of Islamic equity markets in Malaysia. For instance, we show that although stock prices of Islamic banks do not react to the changes in that of conventional banks, risk significantly transmits from one sector to another. That is, Islamic banks in Malaysia are recipients of volatility from their counterparts. Moreover, the estimates of time-varying volatilities are also useful for computing the conditional correlations between these assets. Such analyses are crucial for understanding the hedging effectiveness of Islamic bank equity markets. Moreover, the bilateral volatility linkage between these assets seems important for predicting future risk and returns for Malaysian banks. On the whole, the risk spillovers between Islamic and conventional bank stocks could play a pivotal role in making proper investment decisions. Thus, the results have important implications for investors looking for new hedges and safe havens for protecting their investments.

Future studies could investigate whether time-varying jumps occur in Islamic banking stock indexes given that such analyses would further our knowledge on portfolio diversifications and hedging strategies in the presence of extreme observations.

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