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Do *Ṣukūk* and Islamic indexes act as safe refuge to conventional stock markets? Evidence from Markov-switching CAPM approach

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Abstract

Purpose – The objective of this paper is twofold. First, to study the safe-haven characteristic of the Islamic stock indexes and *Ṣukūk* during the crises time. Second, to evaluate this property in the last pandemic. This study employs the daily dataset from June 15, 2015, to June 15, 2020, for the most affected countries by the earlier disease.

Design/methodology/approach – This study uses the Markov-switching Capital Asset Pricing Model (CAPM) approach and the basic CAPM for the main analysis and the safe haven index (SHI) recently developed by Baur and Dimpfl (2021) for the robustness test.

Findings – Based on Baur and Lucey's (2010) definition, empirical findings indicate that Islamic stock indexes cannot be a refuge throughout the crisis regime for all selected conventional markets. However, *Ṣukūk* are a strong refuge in Brazilian, Russian and Malaysian markets. For the remainder countries, except Italy, the USA and Spain, the *Ṣukūk* index offers weak protection against serious conventional market downturns. Similar conclusions are obtained during the COVID-19 global crisis period. Finally, results are confirmed by using the SHI.

Originality/value – To the best of the authors' knowledge, this paper is the first study that evaluates the safe haven effectiveness of the Islamic index and *Ṣukūk* using the SHI in the most impacted countries by the COVID-19 outbreak.

Keywords COVID-19, Islamic indexes, *Ṣukūk*, Safe havens, Markov-switching CAPM, Safe haven index

Paper type Research paper

1. Introduction

The world has recently known a rapid outbreak of the Noble Corona Virus, also called COVID-19. This virus was discovered in China in November 2019 but quickly spread to every region of the globe. However, COVID-19 was not classified as a worldwide epidemic until March 2020, as a result of the aggravation of economic and health damages.

JEL Classification — G01, G11, G15. **KAUJIE Classification** — I73, I75, K16, L31

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The recent outbreak caused the world's economies and financial markets to experience their deepest downturn since 2008 (Yarovaya *et al.*, 2020). Take the USA as an example; the unemployment rate experienced an increase from 3.7% to almost 15% in but a short period of the outbreak incident, while the growth rate has decreased by 3% in 2020 against 2.2% in 2019. A total economic downturn resulted from the efforts made to limit the damage. A series of interventions have been produced by central banks, government agencies and multilateral organizations with the goal of stimulating economies. The International Monetary Fund (IMF) estimation declares that government stimulus packages adopted over the recent pandemic were up to USD5.4 trillion, additional loans, equity injections and guarantees (Congressional Research Service, 2020) [1]. To cope with the financial implications of the recent epidemic, the Federal Reserve also took exceptional measures in March 2020, by announcing a zero-percent interest rate policy and declaring a Quantitative Easing (QE) program of USD700 billion. Central banks of other regions have announced additional financing facilities with interest rate diminution and reserve requirements. Based on IMF predictions, the growth in government borrowing globally will increase from 3.9% of the global gross domestic product (GDP) in 2019 to 13.9% in 2020 (Congressional Research Service, 2020, p. 9) [1].

Researchers, such as Goodell (2020) and Yarovaya *et al.* (2022), compared the economic costs of the quarantine measures with those of the 2008 financial crisis. They also assessed the potential financial consequences of COVID-19's current economic crisis (e.g. Akhtaruzzaman *et al.*, 2021; Corbet *et al.*, 2020). During the subprime crisis time, the failure of conventional finance promoted the emergence of Islamic finance. In addition, compared to the conventional market, Islamic markets have shown an excellent safe haven (Alaoui *et al.*, 2015; Mensi *et al.*, 2015). Interestingly, early studies suggest that throughout the current crisis, both gold and cryptocurrency did not serve as a strong refuge (Corbet *et al.*, 2020). As noted, the Islamic markets demonstrated this property during crisis times. Islamic inclusion criterion indexes differ from conventional ones. The stock must follow the screening criteria determined by Shariah to be included in the Islamic indexes (Anjum and Rajput, 2021). The question is whether these indexes will remain safe havens in the face of the last COVID-19 crisis. This inspired our research to assess the refuge characteristics of bonds and the Islamic index within the framework of new economic conditions created by the COVID-19 crisis.

The objective of this paper is twofold. First, we investigate the safe-haven characteristics of Islamic stock indexes and *Ṣukūk* during times of crisis using Baur and Lucey's (2010) definition. Second, we examine this characteristic in the situation of the COVID-19 pandemic.

Our article contributes to the current strand of literature in various ways. First, as Islamic indexes emerged as an ideal safe haven throughout the global financial crisis (GFC) of 2008, we retest this hypothesis and evaluate a safe protection during the COVID-19 global crisis. Islamic indexes' behavior and their safe haven capacity during the COVID-19 outbreak are still being debated. However, an important number of publications

(e.g. Conlon and McGee, 2020; Corbet *et al.*, 2020) concentrate on conventional assets (bonds, gold, treasury bills, etc.) rather than Bitcoin. Islamic assets have gotten less attention. Second, we study the refuge effectiveness of the Islamic indexes and *Ṣukūk* using the regime-switching approach. Using this earlier method, the various volatility regimes can be described as different discrete states and the parameters are easy to interpret. We check the beta's regime changes of different assets with Markov switching (MS) models under the Capital Asset Pricing Model (CAPM) framework. Third, our contribution to the filament of research is to identify the recent crisis's impact on the safe haven feature of Islamic assets. In this case, we chose the most impacted countries by the COVID-19 virus outbreak. Our findings can guide investors in making educated judgments about adding Islamic indexes and *Ṣukūk* to their portfolios during the pandemic. Finally, for the testing of robustness, we utilize the recent safe haven index (SHI) of Baur and Dimpfl (2021). To the best of our knowledge, this is the first study to evaluate the refuge feature of the Islamic stock market and *Ṣukūk* indexes by analyzing the relationship between the SHI, *Ṣukūk* and Islamic index.

Our article proceeds as follows: Section 2 reviews the available literature. Section 3, we devoted to the methodology, the database and descriptive statistics. Section 4 consists of empirical findings. Section 5 presents the Robustness test. Finally, in Section 6, we conclude the study with a summing up of the outcomes obtained.

2. Literature review

The safe refuge features of Islamic indexes for investors are recently discussed in the literature. Researchers have used different methodologies and have focused on different crisis periods such as the GFC of 2008 or the recent COVID-19 pandemic. Generally, they found different results and thus there is not a conclusive response to the question of the save haven property of the Islamic indexes. Table 1 summarizes the earlier research, with columns specifying: authors, source, the model used, objective and results.

From the above, we will attempt to provide a comprehensive study that fills in some of the gaps in these earlier studies (Table 1). Overall, most of these earlier researches have used an arbitrary quantitative cut-off point to define the safe haven period. For this study, we choose the MS-CAPM approach that permits the data itself to determine the period of safe haven and not use an arbitrary quantitative cut-off point (He *et al.*, 2018). The MS-CAPM is one of the most widely used nonlinear time series models. Huang (2000) extended the MS model to CAPM, and the MS-CAPM has become an active area of recent research (Chen and Huang, 2007; Wang *et al.*, 2021). The MS-CAPM employs multiple CAPM equations to characterize time series behavior in various market regimes. This model, in particular, can capture more complex dynamic patterns and allow beta risk to come from two regimes: a regime of high volatility and a regime of low volatility, by allowing switching between these structures.

We build upon the previous literature by examining the safe-haven effectiveness of Islamic indexes and *Ṣukūk* for conventional markets of most affected countries by COVID-19 during both the crisis regime and the last COVID-19 pandemic.

Table 1. Summary of literature review

Authors	Source	Methodology	Objective	Results
Ajmi *et al.* (2014)	*Journal of International Financial Markets, Institutions and Money*	Linear and Nonlinear Granger Causality tests	Studying the relationships between the Islamic and global traditional stock markets across financial and economic crises	The Islamic stock market is not immune to outside shocks. Due to a lack of hedging, Islamic markets may outperform their conventional counterparts during bull markets but underperform during bear markets. The results point to the rejection of the decoupling hypothesis between Islamic and conventional equities, but they also raise the possibility that the Islamic financial system may not offer sufficient protection against financial shocks that affect conventional markets
Dewandaru *et al.* (2015)	*Journal of Multinational Financial Management*	Wavelet analysis	Examining Islamic indexes' risk-return characteristics at various timescales	At most timescales, the differences in betas between Islamic and conventional indexes are not statistically significant. Both Islamic and conventional indexes exhibit a similar tendency in that betas are becoming generally stronger as scales increase
Alaoui *et al.* (2015)	*Journal of International Financial Markets, Institutions and Money*	Wavelet analysis	Examining the interconnection and co-movement between the stock market and *Ṣukūk*	Some Islamic stock indexes showed pure contagion. The findings suggest that, in comparison to conventional stock markets, Islamic stock markets offer better diversification opportunities, with significant implications for both domestic and international investors
Ghazali *et al.* (2015)	*Pacific–Basin Finance Journal*	Systematic and conditional analyses	Studying the hedge and safe haven characteristics of Shariah-compliant gold in Malaysia	Shariah-compliant gold serves as a hedge against domestic stock, but it completely fails as a safe haven during extreme market conditions
Mensi *et al.* (2015)	*Emerging Markets Review*	vine copulas approach	Examining whether the Islamic index, gold and the U.S. Treasury bills can serve as a hedge and/or a safe-haven asset in the six GCC stock markets	The findings show that GCC and global investors can benefit from portfolio diversification as well as downside risk reduction by including gold or Islamic indexes in their portfolios but not T-bills

(*continued*)

Table 1.

Authors	Source	Methodology	Objective	Results
Rizvi *et al.* (2015)	*Pacific–Basin Finance Journal*	Wavelet analysis	Testing the decoupling and contagion hypothesis by using Islamic indexes as safe havens	Findings suggest that Islamic stocks can be utilized as a safeguard against financial crises and support the decoupling hypothesis of Islamic financial assets
	Pacific–Basin Finance Journal	The generalized vector autoregressive framework	Analyzing the safe haven status of Islamic indexes in order to test the decoupling and contagion hypotheses	The findings imply that there is a decoupling of the Islamic indices from their conventional counterparts during volatility. Therefore, during financial crises, investors can find refuge in the Islamic financial indexes
Hkiri *et al.* (2017)	*Pacific–Basin Finance Journal*	The generalized vector autoregressive model	Analyzing the safe haven feature of Islamic indexes in order to test the decoupling and contagion hypotheses	The findings also imply that the Islamic indexes decoupled from their conventional counterparts during high-volatility situations. Investors can find refuge in the Islamic financial indexes during times of economic crisis
Mwamba *et al.* (2017)	*Pacific–Basin Finance Journal*	Generalized (Block of Maxima Method); Peak Over Threshold Method; Maximum Likelihood	Comparing the conventional and Islamic financial risks during a crisis	The findings show that, in times of crisis, the Islamic stock index is not only significantly less volatile than traditional stock markets, but also markedly distinct from them
Cevik and Bugan (2018)	*Borsa Istanbul Review*	The MS-VAR model and The regime-dependent Granger causality test	Examining regime-dependent link between Islamic and conventional markets	The findings show that Islamic indexes are not used as safe-haven investments during periods of recession
Shahzad *et al.* (2019)	*Applied Economics*	ARMA-FIGARCH models, time-varying and regime-switching time-varying copula models	Examining the safe haven status of Islamic bonds for stocks	The findings demonstrate that benchmark stock portfolios can potentially include the *Ṣukūk* index as a hedge or safe haven
Abdullahi (2021)	*Islamic Economic Studies*	ARDL, GMM and MGARCH models	Testing the correlation and volatility transmission of Islamic stock indexes during the COVID-19 pandemic	The COVID-19 pandemic may have an impact on the volatility of the Islamic stock indexes. The results from the GARCH and GMM models revealed a connection between rising volatility risk and a rise in the rate of COVID-19 instances

(*continued*)

Table 1.

Authors	Source	Methodology	Objective	Results
Arif *et al.* (2022)	*Economic Research-EkonomskaIstraživanja*	The cross-quantilogram model	Evaluating the potential of Islamic stocks as safe haven assets for G7 stock markets by contrasting the GFC with the COVID-19 pandemic crisis	Islamic stocks do not have safe-haven characteristics for G7 stock markets, during the whole analysis period. Islamic stocks have provided some diversification benefits for the G7 stock markets throughout the GFC. During the COVID-19 pandemic crisis, Islamic stocks became a reliable safe-haven asset for the G7 stock markets
Haddad and Trabelsi (2021)	*Journal of Islamic Monetary Economics and Finance*	The DCC-GARCH model and the Markov switching approach	Examining the safe haven properties of six assets during the COVID-19 crisis	The findings imply that various types of investors choose bonds and *Ṣukūk* as safe havens throughout the current COVID-19 issue. The S&P Technology Index, Commodity Index, Bitcoin or DJ Islamic Equity Index, however, do not yet have this property verified
Yarovaya *et al.* (2021)	*Finance Research Letters*	VARMA-BEKK AGARCH model	Analyzing the COVID-19 pandemic's effects on spillover between conventional and Islamic indexes and *Ṣukūk*	The findings indicate that while the spillovers between the conventional and Islamic stock markets increase during the epidemic, Islamic bonds exhibit safe haven features
Bahloul *et al.* (2022)	*International Journal of Islamic and Middle Eastern Finance and Management*	Baur and Lucey's (2010) and Baur and McDermott (2010) methodology	Determining if Islamic indexes serve as "safe-haven" investments or hedges during the COVID-19 outbreak	The findings demonstrate that during the current COVID-19 crisis period, the Islamic index was neither a hedge nor a safe haven asset for the conventional stock market
Bugan *et al.* (2022)	*Borsa Istanbul Review*	Causality-in-variance, optimal hedge ratios, dynamic conditional correlations and causality-in-risk tests	Analyzing the relationship between Islamic and conventional indexes to determine whether Islamic financial markets act as havens during crisis times	The results of the causality-in-variance test demonstrate a causative relationship between Islamic stock returns and all emerging stock returns, indicating that Islamic markets only offer weak shelter. There are positive and significant correlations between emerging stock markets and the Dow Jones Islamic Market Index, according to the results of both time-varying conditional correlations and the hedge ratios. This suggests that Islamic stock markets only provide limited benefits for portfolio diversification

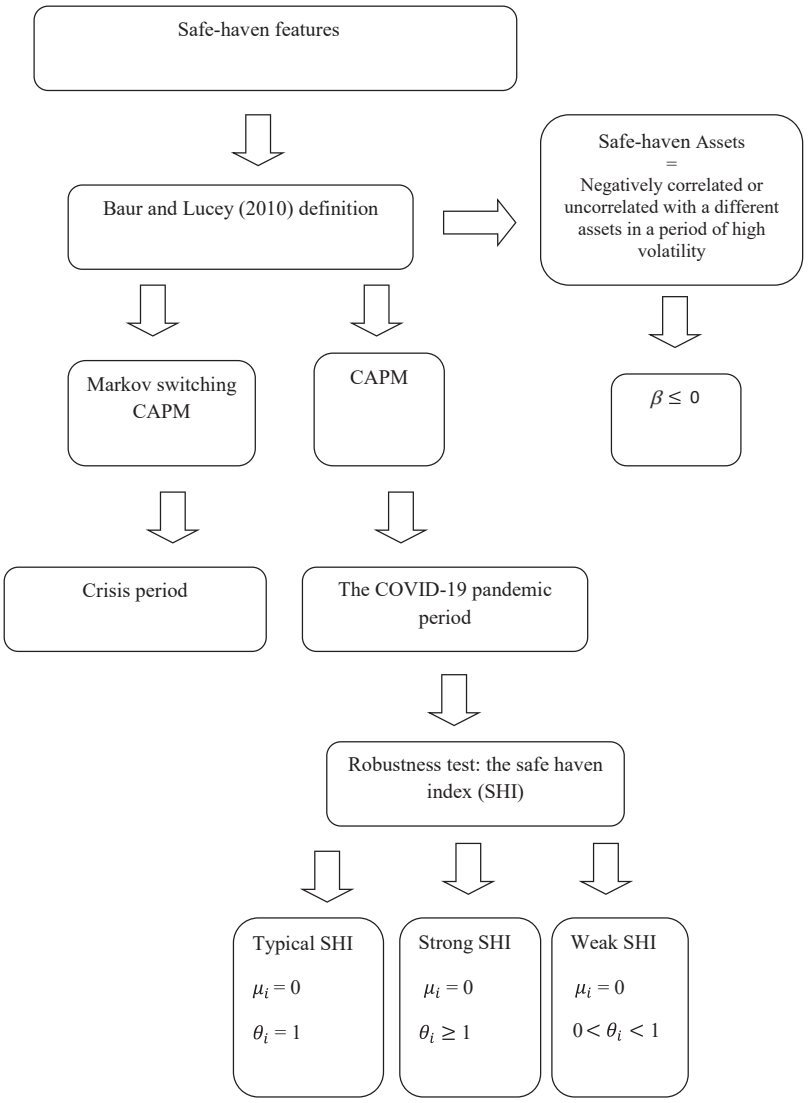
(*continued*)

Table 1.

Authors	Source	Methodology	Objective	Results
Dharani *et al.* (2022)	*Research in International Business and Finance*	Fama and French (2015) five-factor model	Examining the effect of COVID-19 on volatility and return of Islamic and conventional indexes	The findings of a pooled regression highlighted the fact that, generally, Islamic indexes were less volatile than their conventional counterparts. Additionally, it was noted that the COVID-19 period saw lower risk and higher return for the Shariah sectoral indexes
Djedović and Khallaf (2022)	*Eurasian Journal of Business and Economics*	The VAR model, generalized impulse response functions, granger-causality test, and Johansen cointegration tests	Investigating the effect of the conventional stock market index on the Islamic stock market index	The findings indicated that there is a significant bi-directional impact between the Conventional market index return and the Islamic market index return. Furthermore, the Islamic market index is not immune to the fluctuations or shocks that affect conventional market index. Therefore, the Islamic market index is not such a safe-haven assets compared to the conventional counterpart
Ali *et al.* (2022)	*Risks* 2022	GARCH model	Investigating if the Islamic Stock Index Can Safeguard Investors During the COVID-19 Crisis	The findings imply that, throughout COVID-19 period, a conventional index's level of risk is much higher than that of the Islamic stock index. However, compared to the Islamic index, the conventional index has a higher level of COVID shock persistence
Mathlouthi and Bahloul (2022)	*Journal of Capital Markets Studies*	The Markov-switching regression and vector autoregression (MS-VAR) models	Studying co-movement and causality relationships between conventional and Islamic indexes across various financial market regimes	Results show that Islamic indexes cannot act as safe-haven assets during crisis regime
Salisu and Shaik (2022)	*International Review of Economics and Finance*	Single-factor predictive model	Comparing the performance of Islamic stocks to those of their conventional equivalents to see if they have better hedge potential	Despite the fact that Islamic equities' efficacy at hedging decreased during the COVID-19 epidemic, they still outperformed conventional stocks. Consequently, Islamic stocks can be used as a hedge against risk brought on by pandemics, such as the COVID-19 pandemic, albeit the efficiency of the hedging appears to be declining during the present epidemic

3. Methodology and data

3.1 Conceptual model



3.2 Empirical framework

Referring to Baur and Lucey (2010), we study the safe refuge proprieties of the Dow Jones *Ṣukūk* Index (DJSI) and Dow Jones Islamic Stock Market (DJIM) index. These earlier authors stipulate that safe refuges are "assets which are negatively correlated or uncorrelated with a different portfolio or assets in a period of high volatility." For the methodology, we adopt that of He *et al.* (2018). We use, first, MS-CAPM to evaluate the shelter features of the Islamic and *Ṣukūk* Indexes for the studied conventional markets through the period of crisis. Second, we

employ the basic CAPM to explore if these earlier Islamic instruments can be thought of as safe-haven investments during the new COVID-19 pandemic.

3.2.1 Markov-switching CAPM model. We chose the regime-switching model of Markov to check if there is a regime-switching in the beta of different assets under the CAPM framework. To do this, we follow He *et al.* (2018) to verify the fact of two different regimes. According to the two-state regime-switching model of Hamilton (1989), S_t is the state variable that reflects the current market regime. Therefore, the MS-CAPM is written as follows:

$$(R_{I,t} - R_{f,t}) = \alpha_{st} + \beta_{st}(R_{C,t} - R_{f,t}) + \varepsilon_{st} \tag{2}$$

where $R_{I,t}$ is the daily log-return on DJIM or DJSI at period t and $t = 1, 2, \ldots, T$ presents the time horizon. Similarly, $R_{C,t}$ denotes the daily log return on the conventional stock index at time t, whereas $R_{f,t}$ denotes the risk-free rate at period t. S_1 represents the first regime with the listed parameters: α_{s1}, β_{s1} and σ^2_{s1}, while S_2 reflects the second regime with the listed parameters: α_{s2}, β_{s2} and σ^2_{s2}. ε_{st} denotes the error term that is anticipated to be *iid* and follows the normal distribution $N(0, \sigma^2_{st})$. The variable state S_t follows a first-order of Markov chain with the transition probability matrix. It is presented as follows:

$$P = \begin{bmatrix} \Pr(s_t = 1|s_{t-1} = 1)\Pr(s_t = 2|s_{t-1} = 1) \\ \Pr(s_t = 1|s_{t-1} = 2)\Pr(s_t = 2|s_{t-1} = 2) \end{bmatrix} = \begin{bmatrix} p_{11} & p_{12} \\ p_{21} & p_{22} \end{bmatrix} \tag{3}$$

where $p_{ij}(i, j = 1, 2)$ presents the transition probabilities of $s_t = j$ when $s_{t-1} = i$, and $p_{11} + p_{21} = p_{12} + p_{22} = 1$. These probabilities are expressed as constant coefficients independent of the regime. α_{st} is assumed to vary with the regimes in equation (2). According to MS-CAPM output, DJIM and DJSI are a refuge for the conventional stock index if β is significantly (insignificantly) negative throughout the crisis regime.

3.2.2 Capital asset pricing model. The CAPM can be used as a benchmark for calculating relative asset returns. Its economic appeal stems from the evidence that any risk-averse investor would want larger predicted returns in exchange for getting on higher risks. The basic CAPM was introduced by Sharpe (1964), Lintner (1965) and Mossin (1966). His main output is the expected return on assets i at the same time t, assuming that investors are risk-averse and that the market is complete (Blitz *et al.*, 2014). In our study, we utilized the following equation for the CAPM:

$$(R_{I,t} - R_{f,t}) = \alpha + \beta(R_{C,t} - R_{f,t}) + \varepsilon_t \tag{4}$$

According to the estimates coefficients of equation (4) over the COVID-19 period, the DJIM or the DJSI present a strong (weak) safe haven for the conventional stock index if β is significantly (insignificantly) negative.

3.3 Data and descriptive statistics

Our data include DJIM, DJSI and Morgan Stanley Capital International (MSCI) indexes for 12 conventional markets through the period from June 15, 2015, to June 15, 2020. The DJIM and the DJSI are used as a benchmark of the Islamic indexes and *Ṣukūk*, respectively, as is customary in the literature. Daily closing prices in US dollars of these earlier indexes are collected from the Thomson Reuters database.

For conventional indexes, we use daily closing prices in local currency from "Morgan Stanley Capital International" in the same period. We choose the most affected countries by the pandemic of COVID-19. These countries are Brazil, China, France, Germany, India, Italy, Malaysia, Russia, Spain, Turkey, the USA and the UK. This leaves 1,305 observations for each index.

We also collect the three-month Treasury bill rate [2] and the exchange rate for local currency per US dollar [3] for every country throughout the same period. As a proxy for the risk-free rate, we employ three-month Treasury bills. We also apply exchange rates to convert DJIM and DJSI prices from US dollars to local currency for each country.

Daily returns for assets i of the indexes can be represented as follows:

$$R_{i,t} = \ln\left(\frac{p_{i,t}}{p_{i,t-1}}\right) \tag{5}$$

where $R_{i,t}$ denotes the log return on assets i at time t and $p_{i,t}$ denotes the price of an asset i at the time t.

Table 2 summarizes several descriptive statistics for returns series in the US dollar for Dow Jones Islamic stock market and *Ṣukūk* indexes and in local currency for the 12 conventional market indexes [4].

We notice that DJIM is more performing than the DJSI with a positive return, which is equal to 0.0003. Concerning the volatility, the DJSI represents the highest standard deviation equal to 0.0013. For MSCI conventional indexes, Germany, Italy, Malaysia, Spain and the UK have a negative average return. The MSCI US conventional index represents the highest average return with a value equal to 0.0004. The MSCI China conventional index has the least mean return (0.00007). Malaysia has the lowest standard deviation equal to 0.0069, while Brazil has the highest the most important risk equal to 0.0171.

For all indexes, the skewness measurement is negative. This shows that the return time series is tilted to the left. Kurtosis value is more than 3 for all markets, which shows that these series have fat tails in compassion to the normal distribution. The strong negative Skewness combined with a surplus of Kurtosis means a high risk probably in the context of the coronavirus pandemic's consequences. The Jarque–Bera test confirms the normality of the

	Mean	Std. dev	Skwe	Kut	J-B	Prob	ADF	Prob
Dow Jones Islamic market World index (DJIM)	0.0003	0.0010	−1.3076	23.7078	23470.47***	0.00	10.9092***	0.00
Dow Jones World *Sukūk* index (DJSI)	0.0002	0.0013	−2.0291	22.4332	21233.24***	0.00	−12.3001***	0.00
Brazil	0.0003	0.0171	−1.2320	20.3392	16677.97***	0.00	−41.1222***	0.00
China	0.00007	0.0126	−0.4201	5.5273	385.7153***	0.00	−32.7639***	0.00
France	0.00003	0.0125	−1.4084	18.3583	13257.42***	0.00	−23.3425***	0.00
Germany	−0.00004	0.0127	−1.0424	18.1129	12655.72***	0.00	−23.2674***	0.00
India	0.0001	0.0111	−1.8306	30.4964	41839.29***	0.00	−15.3552***	0.00
Italy	−0.0002	0.0156	−2.1471	27.0184	32370.80***	0.00	−24.3376***	0.00
Malaysia	−0.0001	0.0069	−0.4845	17.6865	11779.41***	0.00	−22.6493***	0.00
Russia	0.0003	0.0122	−0.7511	13.8762	6554.948***	0.00	−35.2282***	0.00
Spain	−0.0002	0.0139	−2.0167	24.8491	26842.53***	0.00	−23.4775***	0.00
Turkey	0.0001	0.0136	−0.4470	6.2873	631.0746***	0.00	−35.6376***	0.00
UK	−0.0001	0.0108	−1.9192	19.4372	15000.48***	0.00	−35.6375***	0.00
USA	0.0003	0.0120	−1.1489	25.8507	28679.33***	0.00	−10.7057***	0.00

Note(s): Table 1 shows the descriptive statistics for Dow Jones Islamic and *Ṣukūk* indexes and the MSCI conventional indexes daily returns for 12 countries during the period from June 2015 through June 2020. The ADF test for unit roots is estimated by regression with constant and trend. "***" indicates significance at the 1% level

Table 2.
Descriptive statistics of daily returns

return series. The stationarity of the return-time series is verified by applying Augmented Dickey–Fuller (ADF) test with drift and trend. The results revealed in Table 1 prove that the unit-roots' existence hypothesis is rejected, which affirms the stationarity of these variables.

Table 3 represents the correlation coefficients between local currency returns of the conventional index and both DJMI and DJSI. The correlation matrix demonstrates evidence of a weak correlation between DJMI and conventional indexes. The correlation coefficients are negative for China, India and Malaysia. We notice that the majority of the correlation relationships between conventional indexes and Islamic bonds are negative. This suggests that the two indexes exhibit diametrically opposed variations.

4. Empirical results and interpretation

4.1 Results of Markov-switching CAPM estimation

The aim of this paper is to investigate the idea that the Islamic stock market and *Ṣukūk* indexes have a safe haven characteristic. Baur and Lucey (2010) state that safe haven assets can only be discussed during periods of high volatility. Therefore, we employ the MS-CAPM model to distinguish between periods of low and high volatility. The intuition is to apply the regime-switching model to estimate CAPM beta and the interceptions under the regime change framework.

The excess return for each series is calculated by deducting the risk-free rate from the index return. Table 4 summarizes the results.

The first part of Table 4 represents the estimated result of the DJIM index. The beta coefficient's estimations of Islamic stock indexes are significantly positive in the low volatility period except for Turkey. Result also shows that the beta coefficient was found less than one. Thus, the Islamic indexes in these countries are less volatile than their conventional counterparts during the stability regime. The excess returns on Islamic indexes in the USA are the riskiest as indicated by the highest beta coefficient of 0.8859, while those of Turkey and Brazil are the least risky, as shown by a beta parameter of −0.0954 and 0.1604.

Islamic indexes do not considerably outperform conventional ones in terms of risk-adjusted return during times of crisis, according to the absence of significance of alpha parameters. The beta coefficients for the high volatility regime show growth in the majority of markets until exceeding one in China. Additionally, in the crisis period, the beta coefficient of Islamic indexes is significantly positive. The results lead us to the conclusion that Islamic indexes in all markets do not act as a safe haven for conventional stock markets during times of crisis. Despite the Islamic stock's filtering criteria, external shocks can influence the Islamic index (Ajmi *et al.*, 2014; Abbes and Trichilli, 2015). Islamic indexes, therefore, lack the asset-safe status found in conventional stock markets and are inadequately protected against financial shocks.

Furthermore, unlike Mensi *et al.* (2015), Rizvi *et al.* (2015), our findings disprove the evidence that Islamic indexes are safe-haven instruments. This result confirms rather the conclusion of Ajmi *et al.* (2014), Cevik and Bugan (2018), Arif *et al.* (2022), Bahloul *et al.* (2022), Haddad and Trabelsi (2021), Bugan *et al.* (2022), Djedović and Khallaf (2022) and Mathlouthi and Bahloul (2022), which show that the Islamic indexes cannot provide a good refuge in crisis times.

	BRA	CHIN	FRA	GER	IND	ITA	MAL	RUS	SPA	TUR	UK	US
DJMI	0.03	−0.03	0.02	0.04	−0.07	0.04	−0.02	0.01	0.05	0.02	0.03	0.08
DJSI	−0.02	−0.02	−0.01	0.01	0.01	0.02	0.02	0.01	−0.00	0.01	−0.00	−0.01

Table 3.
Correlation matrix

Note(s): This table reports correlation coefficients between local returns of conventional and Dow Jones Islamic and *Ṣukūk* indexes during the period from June 2015 through June 2020

Table 4.
Results of Markov-switching CAPM estimation

	Low volatility regime			High volatility regime						
	Intercept (α)	Beta (β)	Log (σ)	Intercept (α)	Beta (β)	Log (σ)	P_{11}	P_{22}	$E(d1)$	$E(d2)$
Dow Jones Islamic Stock Market index (DJIM)										
Brazil	0.0006** (0.04)	0.1609*** (0.00)	−4.6627*** (0.00)	0.0006 (0.60)	0.4448*** (0.00)	−3.9501*** (0.00)	0.97	0.93	41.56	15.91
China	0.0023*** (0.00)	0.1609*** (0.00)	−5.5375*** (0.00)	−0.0005 (0.78)	1.1493*** (0.00)	−4.0285*** (0.00)	0.91	0.89	12.41	9.59
France	0.0003*** (0.03)	0.5460*** (0.00)	−5.2443*** (0.00)	−0.0002 (0.88)	0.6829*** (0.00)	−4.1405*** (0.00)	0.98	0.90	63.85	10.85
Germany	0.0005*** (0.00)	0.4737*** (0.00)	−5.2930*** (0.00)	−0.0001 (0.60)	0.7158*** (0.00)	−4.2665*** (0.00)	0.98	0.94	70.05	18.60
India	0.0007*** (0.00)	0.1484*** (0.00)	−5.2789*** (0.00)	−0.0010 (0.33)	0.3515*** (0.00)	−4.0931*** (0.00)	0.98	0.94	74.08	18.20
Italy	0.0006*** (0.00)	0.2791*** (0.00)	−5.1293*** (0.00)	−0.0001 (0.53)	0.6115*** (0.00)	−4.1216*** (0.00)	0.98	0.92	66.19	12.82
Malaysia	0.0008*** (0.00)	01984*** (0.00)	−5.0107*** (0.00)	−0.0026 (0.19)	0.5311*** (0.00)	−3.3396*** (0.00)	0.98	0.85	53.31	6.70
Russia	0.0006** (0.01)	0.1750*** (0.00)	−4.7879*** (0.00)	−0.00009 (0.50)	0.5385*** (0.00)	−3.6584*** (0.00)	0.97	0.86	46.27	7.21
Spain	0.0007*** (0.00)	0.3025*** (0.00)	−5.1702*** (0.00)	0.0001 (0.53)	0.7090*** (0.00)	−4.2505*** (0.00)	0.98	0.93	61.50	15.64
Turkey	0.0007*** (0.00)	−0.0954*** (0.00)	−4.7719*** (0.00)	0.0014 (0.50)	0.3454*** (0.00)	−3.6533*** (0.00)	0.98	0.91	66.53	11.32
UK	0.0005*** (0.00)	0.6114*** (0.00)	−5.1884*** (0.00)	0.0001 (0.55)	0.6625*** (0.00)	−4.0127*** (0.00)	0.98	0.90	83.50	10.39
USA	0.0001 (0.22)	0.8859*** (0.00)	−6.3179*** (0.00)	−0.0002 (0.32)	0.7317*** (0.00)	−5.5806*** (0.00)	0.92	0.85	13.54	6.88
Dow Jones Ṣukūk index (DJSI)										
Brazil	0.0001 (0.65)	−0.0315 (0.17)	−4.9386*** (0.00)	0.0005 (0.31)	−0.0060 (0.60)	−4.2626*** (0.00)	0.97	0.96	44.77	29.76
China	0.0002*** (0.00)	0.0039 (0.44)	−6.5508*** (0.00)	0.00008 (0.32)	−0.0722*** (0.00)	−5.5812*** (0.00)	0.90	0.83	10.32	6.10
France	0.0003** (0.01)	0.0937*** (0.00)	−5.6071*** (0.00)	−0.0002 (0.41)	0.0400 (0.06)	−5.0187*** (0.00)	0.96	0.92	28.17	13.17
Germany	0.0003 (0.06)	0.0682*** (0.00)	−5.5521*** (0.00)	−0.0002 (0.75)	0.0600 (0.06)	−4.8956*** (0.00)	0.96	0.86	29.94	7.29
India	0.00004 (0.47)	−0.0779*** (0.00)	−5.8721*** (0.00)	0.0003 (0.25)	−0.0640*** (0.00)	−5.1135*** (0.00)	0.99	0.95	103.65	20.59
Italy	0.0004*** (0.00)	−0.0746*** (0.00)	−5.5597*** (0.00)	−0.00002 (0.65)	0.1054*** (0.00)	−5.2000*** (0.00)	0.99	0.98	95.21	73.26
Malaysia	0.0002** (0.04)	−0.0033 (0.51)	−5.7267*** (0.00)	−0.00002 (0.75)	−1.234 (0.10)	−2.9445*** (0.00)	0.98	0.53	54.66	2.15
Russia	−0.0001 (0.53)	−0.0364 (0.19)	−5.0734*** (0.00)	0.0005 (0.82)	−0.0465 (0.23)	−4.2558*** (0.00)	0.99	0.98	126.95	65.72
Spain	0.0004** (0.00)	−0.0884*** (0.00)	−5.5672*** (0.00)	0.00007 (0.48)	0.1295*** (0.00)	−5.2265*** (0.00)	0.98	0.98	88.38	76.12
Turkey	0.0002 (0.16)	−0.2249*** (0.00)	−5.0518*** (0.00)	0.0026 (0.20)	−0.2814*** (0.00)	−3.7137*** (0.00)	0.98	0.88	70.20	8.47
UK	0.0003** (0.03)	0.0742*** (0.00)	−5.2506*** (0.00)	0.0006 (0.39)	−0.1930** (0.02)	−4.1341*** (0.00)	0.99	0.86	141.50	7.22
USA	0.0001*** (0.00)	−0.0073*** (0.00)	−7.0691*** (0.00)	−0.0001 (0.73)	0.0256*** (0.00)	−5.7533*** (0.00)	0.96	0.70	28.71	3.37

Note(s): This table reports the estimated results for MS-CAPM of the Dow Jones Islamic Stock Market index and Dow Jones *Ṣukūk* index for the conventional stock market over the total period. "***" and "**" indicate significance at the 1% and 5% level, respectively. *p*-values are shown in parentheses

The second part of Table 4 represents the estimated beta of the DJSI under a regime-switching framework. The betas in India, Malaysia, Spain, Turkey and the USA are insignificantly positive during periods of low volatility. DJSI exhibits low safe-haven effectiveness for conventional indexes in these markets. Additionally, the results demonstrate that, due to the insignificantly negative beta, Islamic bonds in Brazil, Malaysia and Russia can provide a good safe haven during the period of stability. We notice an increase in betas during the period of high volatility. The growth in the beta can be justified by the resistance of *Ṣukūk* to financial crises and the face of high risk.

In a crisis regime, estimated betas are statistically insignificant in almost every market. Therefore, except for Italy, Spain and the USA, the *Ṣukūk* index provides shelter against serious conventional market downturns. As a low volatility period, the beta coefficients in Brazil, Malaysia and Russia are found to be insignificantly negative in the regime of high volatility. These results demonstrate that returns of *Ṣukūk* in these countries move in an opposite direction to movements in conventional market returns. Consequently, referring to Baur and Lucey's (2010) definition, the DJSI in Brazilian, Russian and Malaysian markets is a strong safe refuge in favor of the conventional index.

4.2 The safe haven effect during COVID-19 period

The COVID-19 pandemic is still ongoing. However, our sample covers the period up to June 15, 2020 (date of data collection).

The dates of the first COVID-19 case are listed in Table 5.

Table 6 represents the intercept and beta coefficients estimated by CAPM models for the Islamic index, *Ṣukūk* and conventional indexes throughout the recent crisis of COVID-19. We employ the Durbin–Watson residual autocorrelation test to assess the validity of our model specifications. The outcomes of this section are estimated as a function of equation (4) by applying an OLS regression model. Likewise the previous tables, Table 6 includes two parts. The first part is about the DJIM index, whereas the second part is about the DJSI. Starting with the first part, we noticed that the estimated beta is positive and statistically significant across all countries. This indicates that Islamic indexes are sensitive to market fluctuations. For all markets, the beta of the Islamic index is less than one, meaning that the Islamic stock indexes are less volatile. Turkish and Chinese markets have the highest beta, respectively, 0.8783 and 0.8750. This result implies that Islamic indexes in those markets are more unsafe than other selective markets. However, Malaysia has the weakest beta, which

Country	Date range
Brazil	26/02/2020 to 15/06/2020
China	31/12/2019 to 15/06/2020
France	24/01/2020 to 15/06/2020
Germany	27/01/2020 to 15/06/2020
India	30/01/2020 to 15/06/2020
Italy	31/01/2020 to 15/06/2020
Malaysia	25/01/2020 to 15/06/2020
Russia	31/01/2020 to 15/06/2020
Spain	01/02/2020 to 15/06/2020
Turkey	11/03/2020 to 15/06/2020
UK	31/01/2020 to 15/06/2020
USA	21/01/2020 to 15/06/2020

Table 5.
COVID-19 period

Note(s): This table reports our sample's the period up to June 15, 2020. June 15, 2020 is the date of data collection

Table 6. Results of CAPM estimation (COVID-19 period)

	Dow Jones Islamic Stock Market index (DJIM)				Dow Jones Ṣukūk index (DJSI)			
	Intercept (α)	Beta (β)	*R*-squared	Durbin–Watson	Intercept (α)	Beta (β)	*R*-squared	Durbin–Watson
Brazil	0.0033 (0.17)	0.4833*** (0.00)	0.5138	2.1601	0.0014 (0.40)	−0.0046 (0.90)	0.0001	2.0063
France	0.0007 (0)	0.6431*** (0.00)	0.5047	2.2168	0.00003 (0.95)	0.0156 (0.42)	0.0062	2.0645
China	0.0002 (0.84)	0.8750*** (0.00)	0.4722	2.3057	0.0002 (0.52)	−0.0151 (0.46)	0.0046	2.0770
Germany	0.0004 (0.75)	0.6505*** (0.00)	0.5844	2.0488	−0.0001 (0.99)	0.0145 (0.47)	0.0052	2.0787
India	0.0002 (0.32)	0.5732*** (0.00)	0.2212	2.2903	0.0005 (0.37)	−0.0371 (0.06)	0.0360	2.1891
Italy	0.0010 (0.55)	0.5878*** (0.00)	0.5430	2.0466	−0.00002 (0.95)	0.0225 (0.21)	0.0160	2.0651
Malaysia	0.0005 (0.38)	0.4537*** (0.00)	0.04925	2.2682	0.0005 (0.89)	0.0260 (0.88)	0.0002	2.2288
Russia	0.0015 (0.56)	0.4552*** (0.00)	0.1694	2.0390	0.0006 (0.69)	−0.0597 (0.32)	0.0103	1.9288
Spain	0.0014 (0.22)	0.6451*** (0.00)	0.5824	2.1183	0.0001 (0.89)	0.0296 (0.12)	0.0248	2.020
Turkey	0.0026 (0.21)	0.8783*** (0.00)	0.4924	1.9324	0.0012 (0.18)	−0.1596*** (0.00)	0.1423	1.8462
UK	0.0015 (0.23)	0.6703*** (0.00)	0.4851	2.1946	0.0003 (0.66)	−0.0627 (0.46)	0.0411	1.8727
USA	0.0001 (0.71)	0.7709*** (0.00)	0.9680	1.9539	0.0002 (0.29)	0.0003 (095)	0.0417	2.0701

Note(s): This table reports the estimated results for CAPM of the DJIM and DJSI for the conventional stock market over COVID-19 period. "***" and "**" indicate significance at the 1% and 5% , respectively. *p*-values are shown in parentheses

equals to 0.4537. The CAPM alphas are not significant across all Islamic stock indexes. The empirical findings show that all Islamic market indexes are neither uncorrelated nor negatively correlated with conventional market indexes in the last COVID-19 pandemic. Therefore, we can conclude that Islamic stock indexes are not safe shelter for conventional ones over the COVID-19 period.

Moreover, our results support the findings of Abdullahi (2021), Ali *et al.* (2022), Arif *et al.* (2022), Ben Haddad and Trabelsi (2021) and Bahloul *et al.* (2022), which confirm that Islamic indexes cannot act as safe-haven assets through the COVID-19 pandemic.

When the COVID-19 epidemic is compared with the period of high volatility, we find that beta coefficients are generally lower for all examined markets. The COVID-19 pandemic caused the global economy and financial markets to experience their worst downturn since 2008 (Yarovaya *et al.*, 2020).

We represent the betas for the DJSI in the following part of the table. The beta parameters of all DJSI returns except Turkey are statistically insignificant, implying that they have no relationship with the return of conventional indexes through the last health crisis. The CAPM alphas are also not statistically significant, as we can see. During the recent crisis of COVID-19, the findings confirm that *Ṣukūk* offers a safe refuge for traditional indexes.

During the COVID-19 period, Yarovaya *et al.* (2021), Ben Haddad and Trabelsi (2021) established that *Ṣukūk* could provide a good safe haven for traditional bond markets. As a consequence, Islamic bonds may be beneficial to investors as a low-cost, low-risk source of funds (Ben Haddad and Trabelsi, 2021).

During periods of high volatility, investors always look for safe havens to protect their assets and investments. In this regard, Islamic markets proved their safe-haven properties compared to their conventional counterparts during the GFC of 2008 (Aloui *et al.*, 2018). Indeed, Ghorbel *et al.* (2014) suggested that the use of Islamic assets would reduce the overuse of credit default swaps. These products, which played a role in the global crisis of 2008, are prohibited in Islamic finance. Therefore, it is particularly interesting to test the resilience hypothesis of Islamic stock indexes and Islamic bonds during the period of COVID-19. Contrary neither to our expectations, empirical results verify that the Islamic index cannot provide a safe refuge nor during the crisis period neither during the COVID-19 pandemic. While our results confirm that *Ṣukūk* is a good refuge for the traditional index during the recent financial crisis.

5. Robustness test

To confirm our results and verify the refuge ability of *Ṣukūk* and Islamic index over the COVID-19 epidemic, we perform a robustness analysis using the SHI developed recently by Baur and Dimpfl (2021). The SHI is a performance index that measures the average price change of n safe-haven assets, as given by the following equation:

$$SHI_t = \exp\left[ln(SHI_{t-1}) + R_t^b\right] \tag{6}$$

where R_t^b denotes equally weighted return of n-assets, given as follows:

$$R_t^b = \frac{1}{n}\sum_{i=1}^{n} R_{it} \tag{7}$$

Based on daily closing prices of the ith asset, R_{it} is the logarithmic return of the ith asset in the basket from $t-1$ to t. Following Baur and Dimpfl (2021), the regression can be presented as follows:

$$R_{i,t} = \mu_i + \theta_i \Delta SHI_t + \varepsilon_{i,t} \tag{8}$$

where $R_{i,t}$ indicates the asset i's return at time t and ΔSHI_t indicates the SHI's log-return during time t. For each index, we estimate the μ_i and θ_i parameters. According to this model, a typical SHI would be $\mu_i = 0$ and $\theta_i = 1$. Baur and Dimpfl (2021) describe a strong SHI as an index with $\mu_i = 0$ and $\theta_i \geq 1$, while an index is a weak safe haven if $\mu_i = 0$ and $0 < \theta_i < 1$. Results are reported in Table 7 [5].

Table 7 shows the link between SHI with the Islamic indexes (DJIM) and the Islamic bonds (DJSI). In our study, the SHI is composed of Islamic stock index and *Ṣukūk* for each country. Panel (A) of Table 7 reports the estimated coefficient of the link between SHI and DJIM. Results demonstrate that all Islamic indexes have significant and negative θ, implying that they do not satisfy the definition of a safe refuge index against COVID-19's recent crisis.

Panel (B) of Table 7 reports the estimated coefficient of the link between SHI and DJSI. We notice that *Ṣukūk* in the UK, India and Malaysia have non-zero and insignificant μ, but significant and less than one θ. These findings show that *Ṣukūk* in these markets can offer a weak safe refuge through the last health crises.

These findings are comparable to those obtained by using the MS-CAPM and CAPM. As a result, the preceding approaches' robustness is supported.

6. Conclusion

During volatility times, investors always look for safe haven instruments and diversified Islamic markets proved their safe-haven effectiveness. Several studies proved that Islamic indexes are more resilient and more beneficial than conventional indexes, especially through times of crisis. Islamic finance developed rapidly to become a global phenomenon and an alternative to the conventional counterpart, and Islamic markets had demonstrated significant safe haven ownership during the global recession of 2008, which has motivated us to do our study. The major aim of our paper is to evaluate the safe protection characteristics of *Ṣukūk* and Islamic Market index in financial crises, and recently in the pandemic period. We utilize daily data from the Dow Jones Islamic stock market index, the Dow Jones World *Ṣukūk* Index and MSCI indexes for conventional markets from June 15, 2015, to June 15, 2020. We use CAPM and MS-CAPM to test safe haven property of *Ṣukūk* and Islamic stock indexes returns.

First of all, we start with the MS regression technique in the interceptions and CAPM beta estimation under regime change's context. Empirical results verify that the Islamic index

	Panel A: Safe haven index (DJIM)		Panel B: Safe haven index (DJSI)	
	μ	Theta (θ)	μ	Theta (θ)
Brazil	0.0029 (0.37)	−0.5741*** (0.00)	0.0016 (0.36)	0.0155 (0.85)
France	−0.0008 (0.75)	−0.7216*** (0.00)	0.0000 (0.96)	−0.0468 (0.32)
China	0.0001 (0.93)	−0.4535*** (0.00)	0.0003 (0.35)	0.0510 (0.09)
Germany	−0.0007 (0.77)	−0.7237*** (0.00)	0.0000 (0.98)	−0.0451 (0.34)
India	0.0006 (0.78)	−0.4500** (0.02)	0.0007 (0.18)	0.1339*** (0.00)
Italy	−0.0005 (0.83)	−0.7316*** (0.00)	0.0000 (0.94)	−0.0450 (0.35)
Malaysia	0.0003 (0.92)	−0.5240*** (0.00)	0.0008 (0.79)	0.4400*** (0.00)
Russia	0.0011 (0.70)	−0.3299** (0.03)	0.0011 (0.45)	−0.0039 (0.96)
Spain	−0.0001 (0.95)	−0.7109*** (0.00)	0.0000 (0.98)	−0.0428 (0.38)
Turkey	0.0038 (0.19)	−0.4327 ** (0.04)	0.0012 (0.21)	0.1161 (0.15)
UK	0.0006 (0.78)	−0.8115*** (0.00)	0.0004 (0.65)	0.3333*** (0.00)
USA	−0.0004 (0.85)	−0.4223** (0.02)	0.0002 (0.52)	0.0284 (0.22)

Note(s): This table reports the estimated results for link between SHI with DJIM and DJSI during COVID-19 period. "***" and "**" indicate significance at the 1% and 5% level, respectively. p-values are shown in parentheses

Table 7.
Robustness check test

can't be a safe refuge throughout the crisis period in all selected markets. The DJSI in Brazilian, Russian and Malaysian markets are a strong safe haven in crisis times for conventional index with insignificantly negative beta. For the remainder countries, except Italy, Spain and the USA, the *Ṣukūk* index offers weak shelter against serious conventional market downturns. Then, we employ the CAPM model estimation. The same results are noted in the COVID-19 pandemic. Similar conclusions are obtained. Islamic indexes are not a safe refuge when investors face crisis times as what has recently happened in the epidemic of COVID-19 period. The estimated beta of all DJSI returns has been determined to be statistically insignificant, implying that they have no relationship with the return of conventional indexes during the recent crisis. The results confirm that *Ṣukūk* is a good refuge for traditional index through the last financial crisis.

Despite the evidence that the subprime crisis highlighted international investors' preference for Islamic financial instruments, we observed different findings. We proved that Islamic indexes could be used as alternatives to current conventional indexes with possible diversification advantages throughout the crisis period of June 15, 2015, on June 15, 2020. Our findings substantially support the study of Ajmi *et al.* (2014), Cevik and Bugan (2018), Arif *et al.* (2022), Bahloul *et al.* (2022), Haddad and Trabelsi (2021), Bugan *et al.* (2022), Djedović and Khallaf (2022) and Mathlouthi and Bahloul (2022), who proved that the Islamic index could not prove that they are safe haven propriety during a crisis period.

Additionally, we cannot prove that the Islamic index served as a refuge asset during the current pandemic. Our findings support the points raised by Abdullahi (2021), Ali *et al.* (2022), Arif *et al.* (2022), Ben Haddad and Trabelsi (2021) and Bahloul *et al.* (2022), according to which Islamic indexes do not provide a haven of safety during the COVID-19 pandemic. For the DJSI case, our findings are strongly supported by the empirical research of Shahzad *et al.* (2019), Yarovaya *et al.* (2021) and Ben Haddad and Trabelsi (2021). We verify the idea that *Ṣukūk* can provide a good refuge for conventional markets.

Our research provides important recommendations as well as a useful repercussion for investors, policymakers and regulators. In terms of asset management, investors, traders and asset portfolio managers should consider the safe haven role of Islamic indexes and *Ṣukūk* when incorporating them into their conventional portfolios. Furthermore, our findings will aid in determining if Sharia-compliant assets might be seen as a refuge asset in the face of volatile market conditions. It is useful for policymakers and regulators to understand how the stock market and *Ṣukūk* indexes are responding amid the continuing COVID-19 outbreak. While all countries are rushing to reduce the economic impact of the epidemic as much as possible, such understanding may assist them to devise appropriate solutions from the perspective of regional and global financial stability.

The study's findings have identified a wide range of prospective areas for future investigation. As this study focused on the most affected countries by the COVID-19 pandemic, future research could cover a broader geographical area to produce further convincing empirical findings. Importantly, future research on this topic might compare the safe haven feature during a wider range of cyclical economic events, such as the Russia–Ukraine war.

Notes

1. https://ycharts.com/indicators/3_month_t_bill
2. https://www.investing.com/
3. The descriptive statistics of exchange rates are not reported in Table 1 and are available upon request.
4. We determine the first SHI by using $SHI_0 = 100$, as suggested by Baur and Dimpfl (2021).

5. Global Economic Effects of COVID 19 (2020), *Congressional Research Service*, https://crsreports.congress.gov/product/pdf/R/R46270/50

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