Co-Movement and Information Transmission Between Conventional and Islamic Equities in Sri Lanka

Hussainey, Khaled; Riyath, Mohamed

Review of Accounting and Finance

DOI:
10.1108/RAF-10-2023-0357

Published: 04/03/2025

Peer reviewed version

Co-Movement and Information Transmission Between Conventional and Islamic Equities in Sri Lanka

Mohamed Ismail Mohamed Riyath
Department of Accountancy and Finance,
Faculty of Management and Commerce,
South Eastern University of Sri Lanka,
Oluvil, Sri Lanka.
riyath@seu.ac.lk

Professor Khaled Hussainey
Professor in Accounting,
Bangor Business School,
Bangor University, Bangor,
United Kingdom
Email: k.hussainey@bangor.ac.uk

Abstract
Aim: This study investigates the co-movement and information transmission between conventional and Islamic equity indices in Sri Lanka.
Methodology: This study uses daily data of All Share Price Index and Dow Jones Islamic Market Sri Lanka Index from 2013 to 2023 for conventional and Islamic proxies. Descriptive statistics, cross-correlation, DCC-GARCH, and wavelet analysis were used for the investigation.
Findings: Analyses reveal synchronous correlation yet lead-lag dynamics between the indices. The Islamic index has lower volatility, clustering, and persistence than the conventional index. Localized volatility patches and scale-dependent synchronicity suggest diversification opportunities to optimize risk-adjusted returns.
Originality: This study uniquely integrates DCC-GARCH and wavelet analysis to examine the dynamic, time-varying relationships between Islamic and conventional equity markets in Sri Lanka's dual financial system. This approach helps embrace both short-run changes and long-run movements to gain in-depth co-movement and spillovers, as well as potential diversification gains within an emerging financial market.
Implications: The insights from this study are important for investors to optimize diversified portfolios by exploiting time-varying correlations. The identified lead-lag dynamics, bidirectional information flows, and scale-dependent synchronization between the indices enable both investors to predict market movements for effective asset allocation and regulators to monitor market efficiency, stability, and implement shock mitigation measures.

Keywords: *coherence, cross-correlation, DCC-GARCH, Islamic stock, scalograms, Sri Lanka, wavelet*

Introduction

Many empirical studies prominently investigate the behaviour of the Islamic and conventional markets in recent decades (Naqvi et al., 2018). The global growth of Shariah-compliant assets across European, African and Asian jurisdictions has also enhanced the imperative beyond the Muslim-majority nations (Jubilee et al., 2021). Islamic finance has rapidly expanded in recent decades. The assets of Islamic banks totaled $150 billion in the mid-1990s and grew to $1.5 trillion by 2017 (Jusupova et al., 2018). Saleem et al. (2023) state that Islamic finance continued robust expansion in 2020, with total Sharia-compliant assets rising from 10.7% to $2.7 trillion despite challenging conditions. Growth was seen worldwide, led by the GCC at 48.9%, Southeast Asia at 24.9%, the Middle East at 20.3%, and other regions. The 2020 increase extends the positive trajectory of recent years, following gains of 9.6% in 2017-18 and 11.4% in 2019. Islamic finance has grown substantially in Sri Lanka over the past few decades (Shah and Hussain, 2014). Within Sri Lanka, Islamic finance now constitutes 10% of the banking sector and represents the fastest-growing segment (Nairoos, 2022).

Theoretical financial models posit potential diversification and risk reduction benefits from integrating Islamic assets into portfolios alongside conventional assets (Sahabuddin et al., 2023). Such models attribute these projected gains to Islamic finance adhering to ethical precepts, real economic activity, and risk-sharing arrangements. This paradigm of ethical business practices and the avoidance of speculation also characterizes Islamic finance (Yesuf and Aassouli, 2020). However, skepticism persists regarding whether Islamic and conventional assets substantively differ in financial performance and risk exposures (Neifar et al., 2022). Various statistical techniques have investigated the linkages between Islamic and conventional equity markets, finding notable correlations and volatility spillovers, especially during market turbulence (Saiti and Noordin, 2017, Sahabuddin et al., 2023). Rising co-movement is often observed as Islamic finance matures within dual financial architectures (Ibrahim and Sanusi, 2022). Advanced empirical analysis directly comparing Islamic and conventional financial indices can provide data-driven insights to advance this unresolved academic debate.

Substantial empirical studies exist on larger Islamic finance hubs in Asia and the Gulf, but analyzing emerging South Asian economies with unique macro-financial conditions is limited (Alvi and ul Hassan, 2021). Further, the co-movement and information transmission between Islamic and conventional equity markets in emerging South Asian economies is relatively unexplored in the literature despite the global interest in Islamic finance. Country-specific analyses have provided contextual insights into shaping Islamic-conventional interconnections (Muhammad Ryan and Siti, 2023, Hasan, 2019). Sri Lanka's secular legal environment and long-established conventional equity market, represented by the All Share Price Index (ASPI), contrasts with the recently introduced Dow Jones Islamic Market Sri Lanka Index (DJISLK). Sri Lanka's unique dual financial system provides an underexplored context for examining the relationship between conventional and Islamic equity markets. Despite this proliferation, scholarly research on Islamic finance in the Sri Lankan context remains limited, particularly empirical analyses contrasting Islamic instruments with their conventional counterparts (Nairoos, 2022). This creates a timely opportunity for scholarly investigation as the dual market progresses.

Therefore, this study attempts to fill this gap by empirically investigating the complex co-movement and information between them within the context of the Sri Lankan financial markets. Compared to Hasan (2019), who used ARDL and a bivariate GARCH model over six years in Bangladesh, this study provides a more extensive analysis of Sri Lanka's dual financial system from 2013 to 2023. This study undertakes a more detailed investigation of time-varying correlations and volatility spillovers using advanced econometric techniques, namely wavelet analysis and improved DCC-GARCH modeling. Key findings include significant synchronous correlation, variable lead-lag relationships, periods of lower volatility in the Islamic index, and opportunities for diversification. Both indices provide evidence of volatility clustering and long-term volatility persistence. Wavelet and coherence analyses highlight localized volatility patches and scale-dependent synchronization.

The findings of the study have important economic significance. First, the lower volatility persistence of the DJISLK and co-movement between the indices provide an opportunity to enhance risk-adjusted returns in diversified portfolios. In addition, Islamic assets are attractive for investors trying to hedge market volatility, especially during times of stress. Second, Islamic assets are more stable by reducing volatility than other markets when market stress. Moderate correlation and co-movement are found during stable market conditions. It suggests that investors would get diversified benefits without losing returns when the market is stable. Third, the lead-lag dynamics, bidirectional information transmission, and scale-dependent synchronization were identified between the indices. These dynamics help investors predict subsequent movements of Islamic indices as a function of conventional indices and vice versa. It helps investors with asset allocation effectively. These temporal relationships also have regulatory implications. This information enables authorities to monitor market efficiency, detect localized volatility patches, enhance cross-market stability, and take stabilization measures during shocks.

This paper makes several theoretical, practical, and methodological contributions. By challenging the traditional understanding of static correlations, identifying temporal shifts in the ASPI and DJISLK indices undermines the one-size-fits-all approach to portfolio management. These findings cohere with Modern Portfolio Theory and Information Transmission Theory, stressing dynamic strategies that respond to changing correlations and the lower volatility of Islamic indices in line with the principles of ethical finance. These insights allow investors to build timely portfolios that combine ethical values with risk-adjusted returns. Methodologically, the research employs wavelet analysis to investigate equity interconnections, underscoring the suitability of multivariate time-series modeling for localized empirical contexts and capturing time-varying relationships.

Literature Review

I. Introduction

Ethical considerations and risk mitigation characterize Islamic finance. Islamic stock indices governed by Shariah principles avoid prohibited sectors like alcohol and gambling (Jabeen and Kausar, 2022). Empirical studies state considerable complex co-movements between the returns of Islamic and conventional indices, offering unique portfolio diversification opportunities (Ilhan and Masih, 2014, Khan et al., 2022). The co-movements have different volatility transmission patterns, which could benefit portfolio diversification during financial crises (Mirza et al., 2022). This literature review section introduces Islamic-compliant equities and their performance, followed by empirical studies on volatility spillover, contagion and transmission with diversification prospects of Islamic and conventional stock indices. Further, it synthesizes theoretical and methodological advancements in empirical studies. Finally, it proposes eight hypotheses grounded in the modern portfolio, information transmission, market integration, and signal processing theories.

II. Ethical Guidelines and Performance Differences

Unlike conventional stocks, Islamic stocks are significantly influenced by ethical guidelines, resulting in distinct performance and risk profiles. Studies indicate that Islamic stocks often exhibit lower volatility than conventional stocks due to their avoidance of high-risk sectors (Jabeen and Kausar, 2022, Balcilar et al., 2016). This ethical screening can help reduce the risk and stabilize the volatile markets. Significant co-movement in Islamic and conventional indices has been reported especially for higher frequencies (Sahabuddin et al., 2022, Ilhan and Masih, 2014). Specifically, during the COVID-19 pandemic, certain Islamic equity funds outperformed conventional funds regarding risk-adjusted performance and resilience (Mirza et al., 2022). However, the short-term correlation between these markets was very low(Khan et al., 2022), and both markets were very volatile, implying short-term diversification potential. Further, Islamic indices have different volatility and co-movement properties than they might at first sight and potentially create diversification potential during certain types of crises. The risk management and investment diversification strategies benefit from the trade-offs between Islamic and conventional indices.

III. Empirical Studies on Volatility and Risk Spillovers

The dynamic relationship between Islamic and conventional stock indices is empirically investigated in many markets using various models. Hasan (2019) found that Islamic and conventional equity markets are long-run cointegrated, with volatility spillovers, strong interconnections and time-varying correlations emphasizing lower possibility of diversification. However, Mensi et al. (2017) assess spillovers among Islamic sector indices and commodities, showing intricate dependence, uncertainty transmission, and the necessity of performing time-dependent portfolio diversification and optimization. According to Miniaoui et al. (2015), Islamic indices and funds perform better than conventional indices in the bull market and worse in the bear market. These results pave the way for using Islamic assets to diversify investors' portfolios in bull market conditions. These findings imply that the diversification benefit could be limited because of co-movements and spillover effects. Further, the volatility and spillover of the Islamic indices are also associated with the conditions and commodity markets and are subject to the context.

IV. Market Contagion and Spillovers Across Borders

Research has been conducted on the transmission and contagion of global markets. Al Rahahleh and Bhatti (2017) study on international equity markets found bidirectional co-movements and asymmetric volatility spillovers between Australian and Asian markets. However, despite non-overlapping trading hours, the US and UK showed significant price impacts and volatility transmission, with persistent time-varying correlations across time zones. Jung and Maderitsch (2014) found transmission and contagion in Hong Kong, European, and US stock markets reminiscent of sophisticated dependencies where volatility spillovers are unstable from one market to the next. El Alaoui et al. (2015) found international co-movement between Islamic and conventional indices. Choudhry (2004) and Matar and Bekhet (2015) noted these dynamics among various financial instruments across markets. Ben Amar et al. (2023) claim high time-varying volatility spillovers among the financial markets. Economic conditions also influence equity market interdependence, which is more apparent in uncertainty. Shahzad et al. (2017) found that interdependencies can magnify shocks and instability, evidenced by the rising co-movement of Greek and European markets during economic downturns.

V. Recent Empirical Research on Global Events and Market Responses

Recent studies have examined the performance of Islamic and conventional indices during significant events. Islamic indices delivered higher returns and lower risks than conventional indices during COVID-19 (Nomran and Haron, 2021, Mirza et al., 2022, Asutay et al., 2021). Response to the 2007 global financial crisis and performance dynamics were investigated, and it was found that Islamic equities perform better than conventional stocks (Abdul Karim et al., 2010, Ali et al., 2021). Mateev et al. (2022) found that efficiency and competition influenced conventional banks more than Islamic banks during COVID-19. Ahmad and Sulaeman (2023) claimed that external variables, including COVID-19, shaped Islamic banking profitability in Indonesia. The Islamic index in Indonesia was the most volatile but more efficient than its conventional/SRI counterpart during the pandemic (Hidayah and Swastika, 2022). Ben Amar et al. (2023) found increased volatility connectedness during Ramadan, a religious holiday. These findings highlight the resilience and uniqueness of different instruments during crises and events.

VI. Multivariate GARCH Models on Linkages and Risk Transmission

Multivariate GARCH models are commonly used to investigate the complicated volatility transmission between Islamic and conventional equity markets. Hasan (2019) discovered strong co-movement and volatility transmission between Islamic and conventional equity markets in Bangladesh. Aloui et al. (2015) find significant bidirectional volatility between sukuk and Dow Jones Islamic stock indices and flight to quality patterns during crises. Mseddi and Benlagha (2017) investigated the spillover effects between the returns and volatilities of stocks related to Islamic and conventional banks in GCC countries. They found a strong bidirectional returns spillover between conventional banks and a very weak spillover from Islamic banks to conventional banks. In addition to volatility analysis, the model also analyzes asymmetrical conditional correlations between regional markets, e.g. between Asian Pacific markets (Dewandaru et al., 2014). Further, Hammoudeh et al. (2014) used the model and found time-varying integration and weak form efficiency among Islamic indices. Al-Khazali et al. (2014) found comprehensive volatility spillovers in the Gulf region. Tabash et al. (2022) identify asymmetric, crisis-sensitive spillovers between the Islamic and conventional banking sectors as a result of short-term dynamics.

VII. Wavelet Approach and Complex Co-Movement Analysis

The wavelet technique for financial markets research offers multi-scale, multi-frequency co-movements and transmission mechanism analysis. Rua and Nunes (2009) adopted a wavelet-based co-movement measure to find temporal relationships in financial systems. Meng and Huang (2019) examined the co-dynamics of effective exchange rates between Asian economies, while Masih et al. (2010) studied the systematic risk of the Gulf Cooperation Council. Further, the wavelet approach clarifies the propagation of liquidity shocks during the 2007 Financial Crisis (Brunnermeier and Pedersen, 2009) and disturbances in China's money market (Lu et al., 2018) dynamic oil-stocks interactions (Jiang and Yoon, 2020) and volatility spillovers across equities (Jung and Maderitsch, 2014). Beyond statistical inquiry, the application of the wavelet extends to the generation of movement signals, not because of the signals but because of the insights that they provide into market interconnection, contagion, and risk transmission of assets and markets.

The institutional setting of Sri Lanka

Sri Lanka's financial market with cultural and religious diversity (Nazliben et al., 2023) provides a distinct background to study the relationship between conventional and Islamic finance. Sri Lanka is one of the few non-Islamic countries that have Islamic banking legislation. Banking operations are controlled by Banking Act No.30 of 1988, amended in December 2005 (Majith, 2010). The conventional stock market has colonial roots, but Islamic finance is a new activity with its principles (Mihular, 2014). The contrast provides an opportunity to explore the relationship between these paradigms within Sri Lanka's financial system. The advent of Islamic finance in Sri Lanka dates back to 1997, marked by the pioneering establishment of Amana Investments Limited, the country's inaugural Shariah-compliant financial institution (Kaushala and Rajapakse, 2017, Nairoos, 2011). This represented a significant milestone, as

Islamic jurisprudence prohibits interest-based financing. Guided by a vision to provide "world-class Islamic financial solutions," Amana Investments entered the market, espousing an alternative to conventional finance aligned with religious values (Nairoos, 2011). Sri Lanka's Islamic financial system witnessed steady growth in subsequent decades, gaining traction within the Muslim community. Recognizing the importance and need for Shariah-compliant financial services has intensified, with Amana emerging as a viable substitute for conventional banks and institutions among Sri Lankan Muslims (Nairoos, 2023). Islamic banking has appealed to a wide range of communities in Sri Lanka. Presently, non-Muslim consumers make up over 20 percent of the entire market share of Islamic banking in the country (Mihular, 2014). The proliferating footprint of these Sharia-compliant instruments reflects the rising demand for Islamic finance in Sri Lanka.

In the emergence of Islamic finance, new investment avenues based on Shari'ah principles appear with increased interest by scholars and practitioners. Among these, the Dow Jones Islamic Market Sri Lanka Index (DJISLK) stands out as a noteworthy benchmark launched on December 19, 2008 (S&P Global, 2023). Rigorous screening of stocks in this index follows the Shari'ah guidelines (Rahman et al., 2010). The index excludes other activities, such as gambling, alcohol, and interest-based financial services, so that the index holds ethical and moral standards (Zakri et al., 2018).

Existing Gap

Many markets around the globe have extensively researched the interaction of conventional indices with Islamic indices (Sahabuddin et al., 2022, Khan et al., 2022). While the Sri Lankan market is diverse, its consumers are from diverse religions, including Buddhists, Hindus, Muslims, and Christians, although this has not been investigated. Despite the evolution of Islamic finance since 1997 (Kaushala and Rajapakse, 2017) and a distinct regulatory environment, the dynamics between Islamic and conventional finance remain underexplored. Specifically, the concentrations of research attention in Sri Lanka, where cultural and religious diversities can be found, are also scant and need more study. In addition, applying advanced methodological tools, including the multivariate GARCH and wavelet techniques, provides a more profound understanding that can be utilized in Sri Lanka.

Theoretical Framework and Hypotheses Development

Modern Portfolio Theory

According to Modern Portfolio Theory (MPT), rational investors are expected to diversify their portfolios by optimally balancing risk and returns (Markowitz, 1952). A risk-return trade-off, diversification, and an efficient frontier are associated with the MPT principles. Thus, it evaluates whether building portfolios with specific market risk levels is possible if the desired return is maximized. In Sri Lanka's dual financial system, the MPT is particularly relevant for examining the relationship between Islamic and conventional equity indices. Since Islamic finance is unique, Islamic indices differ from conventional indices. They are geared toward ethical screening processes. This study uses an MPT framework to investigate the possible relationship between Islamic and conventional equity indices. However, with its reduced volatility and different sector concentrations, this specific market inherently differs from a regular market, being a Shariah-compliant index, and offers the opportunity to test MPT-based principles. Balcilar et al. (2016). state that Shariah-compliant equity is less volatile since high-risk sectors are excluded. Al-Khazali et al. (2014) observed that sector allocations resulting from Islamic principles-based screening are dissimilar to those in conventional benchmark indices. Hakim et al. (2021) observed that faith-based equities demonstrate more stability during crises, attributed to their ethical guidelines and strict principles. Research indicates that portfolio returns rise by combining Islamic and conventional equities. Saiti and Noordin (2017) show that Islamic investments offer risk-mitigation benefits to conventional investors during market turbulence. Saâdaoui et al. (2017) also find a lower short-term correlation between Islamic indices and conventional indices, suggesting that the Islamic indices could be used as a diversification strategy during the COVID-19 pandemic. Ilhan and Masih (2014), Sahabuddin et al. (2023) and Jebran et al. (2017) emphasized the unique opportunities for portfolio optimization using Islamic equities. Based on MPT principles, Islamic equity attributes, and empirical evidence, we propose the following hypothesis:

H1: Islamic and conventional equity indices show low to moderate correlations.

H2: Incorporating the Islamic index into a portfolio with a conventional index improves the risk-adjusted returns.

Information Transmission Theory

Information transmission theory is a robust framework for studying lead-lag dynamics among financial markets. According to this theory, asynchronous information spreads more quickly, and the market is more efficient (Li et al., 2023). (Engle and Ng, 1993) applied this concept to financial markets, arguing that price moves and volatility asymmetrically to news reflect information transmission from one market segment to another. This theory is particularly applicable to Sri Lanka's dual financial system, which consists of conventional and Islamic indices. An analysis of asymmetric information transmission can vary depending on the degree of market integration and regulatory framework. This context allows us to study the information flows between disparate market segments and possibly uncover market efficiency and permeability clues. Ajmi et al. (2014) demonstrated important causation between the global conventional and Islamic equity markets. Hammoudeh et al. (2014) show that global conventional markets and risk factors significantly influence Islamic indices, implying that informational mechanisms are complex. According to Abdullah et al. (2016), Islamic indices follow standard benchmarks less quickly and accurately. Abdulkarim et al. (2020) discover instances of Islamic indices creating bidirectional flows, indicating context dependency. Global events, such as COVID-19, have increased market connectedness and created asymmetric lead lags, possibly due to Shariah constraints, behavioral factors, and liquidity shifts (Adekoya et al., 2022). Multi-scale analyses by Saâdaoui (2023) revealed strong short-term correlations, justifying methodologies capable of capturing multihorizon dynamics. Basnarkov et al. (2020) provide more evidence on lead-lag relationships across forex markets, industry portfolios, and commodities, further extending the applicability of the theory. Based on the Information Transmission Theory and empirical evidence, we propose the following hypothesis in the context of Sri Lanka's dual financial system:

H3: Significant lead-lag relationships exist between Islamic and conventional equity returns.

H4: Information transmission from conventional to Islamic markets may be faster but can also run bi-directionally.

H5: Lead-lag dynamics exhibit both co-movement and divergence across various time scales.

Market integration theory

The Market Integration Theory examines the interrelationships among several market segments (Click and Plummer, 2005). This theory postulates that highly integrated markets exhibit co-movements and increased exposure to common factors that transmit spillovers (Singh et al., 2010). In contrast, lower levels of integration may suggest that markets are segmented (Volosovych, 2011), and asset value is driven by its own dynamics. Islamic finance is relevant to this theory, given its unique regulatory and ethical compliance Akhtar et al. (2017). In this context, the theory is applicable to examine the integration of conventional and Islamic equities within Sri Lanka's dual financial system. In this particular application, the framework enables the testing of co-movements and spillover effects. Sahabuddin et al. (2022) also observed complex integration patterns. In country-level studies, Majdoub and Mansour (2014) found high integration with domestic factors, while Hammoudeh et al. (2014) showed segmentation and regional influence in global studies. Mensi et al. (2019) and Shahzad et al. (2017) provided evidence of asymmetric and time-varying integration patterns. El Mehdi and Mghaieth (2017) further confirmed the temporal nature of the integration. El Alaoui et al. (2015) also noted that the temporary integration of international co-movement analysis is affected by economic crises and global volatilities. Bekaert and Harvey (1995) also noted that increased integration could enhance market efficiency, while reducing diversification benefits. Based on this theoretical framework and empirical facts, we propose the following hypothesis for Sri Lanka's dual financial system:

H6: There is high co-movement between Islamic and conventional indices.

Signal processing theory

Signal Processing Theory offers sophisticated techniques for decomposing complex financial time series patterns (Gençay et al., 2001). Time-frequency analysis combined with wavelet transform depicts the combined time-frequency localization (Fernandez, 2005, Hasan et al., 2021). These methodologies provide useful instruments for investigating cyclical fluctuations, volatility patterns, and asset correlations on various timescales (Rua and Nunes, 2009). This theory is essential and applicable when analyzing integration and spillovers between these indices, and wavelet analysis reveals the mechanism and relationship between Islamic and conventional equities. Renneboog et al. (2008) argued that Islamic finance principles that follow an ethical code can lead to better long-term performance and lower risk. This also supports the Ethical Investment approach. Hayat and Kraeussl (2011) established that during the financial crisis 2008, Islamic equity funds outperformed conventional indices in terms of risk-adjusted performance and systemic risk. Ashraf et al. (2022) further proved that Islamic indices have lower systematic risk than conventional indices. Ilyas et al. (2022) applied methodologies of volatility modelling and found that dependency between Islamic and conventional equity markets exists across changing market situations, having asymmetric interactions. Umar and Suleman (2017) explore the return and volatility spillovers between Islamic and conventional equities, and report relatively limited evidence of market segmentation in the post-crisis period, underscoring the relevance of time-varying research. These results imply that ethical screening in Islamic banking provides protection and reduces risks. Based on the capabilities of wavelet analysis, signal processing theory, and empirical evidence, the following hypotheses are proposed.

H7: Localized volatility patches exist in Islamic and conventional indices.

H8: Scale-dependent synchronization exists between Islamic and conventional indices

Research Methodology

This study uses daily closing prices of the All Share Price Index (ASPI) and Dow Jones Islamic Sri Lanka Index (DJISLK) from 2013 to 2023 for conventional and Islamic proxies. The ASPI data was collected from the official website of the Colombo Stock Exchange (CSE), while DJISLK was collected from investing.com. Equation 1 is employed to calculate the daily returns for each index. This sample covers various economic conditions, political and policy changes, financial crises, and pandemics in Sri Lanka during the last decade.

$$R_t = LN\left[\frac{P_t}{P_{t-1}}\right] X\ 100 \qquad 1$$

where R_t is natural log return at time t; P_t is index value at time t; and P_{t-1} is index value at the previous time (trading day). Log returns are commonly used in time series analysis. The analysis of descriptive statistics, standard deviation, and charts of prices and returns series reveal market behavior, volatility trends, and patterns.

Cross-correlation analysis

Cross-correlation analysis quantifies the relationship between the returns of two or more assets over time (Shi et al., 2014) encompassing time-lagged cross-correlation (Basnarkov et al., 2020). The ASPI and DJSLK cross-correlations are determined by quantifying the cross-correlation for different lags using Equation 2.

$$Cross - Correlation(k) = \left[\frac{\sum_{t=k+1}^{n}\left(R_{1,t} - \overline{R_1}\right)\left(R_{2,t-k} - \overline{R_2}\right)}{(n-k)\sigma_1\sigma_2}\right] \qquad 2$$

where $R_{1,t}$ and $R_{2,t}$ are returns of the two indices, $\overline{R_1}$ and $\overline{R_2}$ are mean returns, σ_1 and σ_2 are the standard deviations, n is number of data points, and k is lag. The study changed k for correlated movements and leading/lag behaviors. It reveals how one index moves in response to another's prior or subsequent movement path, which provides insight into the relationship between the indices in the stock market.

DCC-GARCH Model

ARMA(1,1)-GARCH(1,1)

The ARMA(1,1)-GARCH(1,1) model effectively captures temporal relationships, volatility clustering, and persistence in financial time-series return data. We model the conditional mean return ARMA (1,1) using Equation 3. The GARCH(1,1), as given in Equation 4, captures time-varying volatility based on past shocks and prior variance. This model especially captures volatility clustering and persistence in volatility patterns. The presence of volatility clustering and persistence was validated using ARCH and GARCH effects (Andrikopoulos et al., 2016, Glantz and Kissell, 2014).

$$R_t = \phi\, R_{t-1} + \theta\epsilon_{t-1} + \epsilon_t \qquad 3$$

$$\sigma_{i,t}^2 = \alpha_{i,0} + \alpha_{i,1}\epsilon_{i,t-1}^2 + \beta_{i,1}\sigma_{i,t-1}^2 \qquad 4$$

where,ϕ is AR(1) coefficient; θ is MA(1) coefficient and ϵ_t is White noise error term at time t, $\sigma_{i,}^2$ Conditional variance at time t; α_{i0} is constant; α_{i1} is ARCH term, β_i is GARCH term parameters.

Time-varying conditional asset correlations can be induced by an extended Dynamic Conditional Correlation (DCC) GARCH model (Bai et al., 2019). Using a two-stage program to capture time-varying return correlations (Ho et al., 2016), this study examines convergence, divergence, and correlation shifts between the indices. The DCC mechanism then models the residual correlations between filtered series is calculated using Equation 5-7.

$$H_t = \text{diag}\,(\sigma_t)M_t\text{diag}\,(\sigma_t) \qquad 5$$

$$Q_t = (1-\alpha-\beta)\bar{Q} + \alpha(\epsilon_{t-1}\epsilon_{t-1}') + \beta Q_{t-1} \qquad 6$$

$$M_t = \text{diag}\,(Q_t)^{-1/2} Q_t \text{diag}\,(Q_t)^{-1/2} \quad 7$$

Wavelet Analysis

Advanced wavelet analysis based on dual time-frequency analysis of complex interactions is conducted, outperforming conventional time domain analysis. A Continuous Wavelet Transform (CWT) decomposes univariate time series into resonant wavelets at all scales. Specific properties are revealed, and the multiresolution is obtained directly. In addition, it is convenient to use the Morlet wavelet for the detection of periodicity and volatility clustering (Liu and Yan, 2021, Tang et al., 2021). This approach offers a microscope on correlations, volatility, and cyclicality over a range of time horizons for studying non-stationary financial data (Ogawa et al., 2020). It discloses the structures and transient features. The CWT is given in Equation 8.

$$\text{CWT}_x(a,b) = \frac{1}{\sqrt{|a|}} \int x(t)\psi^*\left(\frac{t-b}{a}\right) dt \quad 8$$

where a represents scale parameter, b denotes translation parameter, ψ^* complex conjugate of the Morlet wavelet, and $x(t)$ refers to each time series. CWT scalograms are used for visualizing time-frequency dynamics series (Jalón-Rojas et al., 2016), which is then extended to the Cross Wavelet Transform (XWT) in Equation 9 to find multi-scale patterns and relationships (He, 2015), as well as wavelet coherence (Equation 10) to assess series co-movements (Uckol and Ilhan, 2023).

$$\text{XWT}_{xy}(a,b) = \text{WT}_x(a,b) \cdot \text{WT}_y^*(a,b) \quad 9$$

$$\text{R}^2(a,b) = \frac{\left|S\left(a^{-1}\text{XWT}_{xy}(a,b)\right)\right|^2}{S(a^{-1}|\text{WT}_x(a,b)|^2) \cdot S\left(a^{-1}\left|\text{WT}_y(a,b)\right|^2\right)} \quad 10$$

where WT_x and WT_y are the wavelet transforms of RASPI and RDJISLK, respectively. S denotes a smoothing operator. This coherence was plotted against scale and time to allow a very detailed interpretation of the intricate interaction between the series across frequencies. High coherence regions close to 1 and low coherence regions close to 0.

This study integrates DCC-GARCH and wavelet analysis to investigate co-movement, which denotes the transmission of a set of conventional and Islamic equity indices in Sri Lanka. Bai et al. (2019) and Al Rahahleh and Bhatti (2017) depict that the properties of time-varying correlations and volatility clustering prevalent in emerging markets may be well captured by the DCC-GARCH model. The DCC-GARCH framework was enhanced by wavelet analysis, which offered a multi-scale decomposition of financial relationships, time-frequency localization of market behaviors, and differentiation between short-term market shocks and long-term structural changes. In comparison to traditional methods, this approach overcame issues with VAR models (restricted to linear dependencies), single horizon analyses (no scale dependent relationships), and regime switching models (only for sudden changes). The wavelet methodology particularly excelled at identifying gradual and cyclical shifts in market behavior, revealing both sudden disruptions and continuous evolution of market relationships. Using wavelet analysis combined with DCC-GARCH allowed for complete market analysis by tracking dynamic correlation, volatility pattern identification and multi temporal dependency mapping to better understand non linear interaction and transient market behavior. The dual methodology framework was applied to Sri Lanka's unusual financial environment, which also includes dual market structure, emerging market dynamics, evolving regulatory framework, and complex market interactions. Through this approach, the study is able to effectively track relationships between market segments across multiple scales and capture market changes while accounting for regulatory evolution. It permitted robust analysis of the interaction between Islamic and conventional markets in Sri Lanka's rapidly changing financial environment, and provided insights that simpler analytical methods could not access.

Findings

Descriptive analysis

The ASPI, DJISLK, return of ASPI (RASPI), and return of DJISLK (RDJISLK) show complex trends over various periods, reflecting the market dynamics and economic conditions. As shown in Figure 1A, ASPI exhibited a growth phase from September 2013 to January 2015, increasing by approximately 35.71%. A contraction followed, with the index declining by 22.01% by March 2016. Between 2015 and 2022, the ASPI experienced considerable volatility, with a low of 4248 points and a peak of 13475 points. The most recent trend began in July 2022, marked by a 43.10% increase followed by a decline. In contrast, Figure 1B illustrated that DJISLK exhibited a sharp surge of 66.85% from March to June 2013, followed by contraction and recovery. This demonstrates extreme volatility between 2015 and 2021, declining substantially by 40.44% in early 2022. Figure 1C shows that RASPI fluctuated considerably between 2013 and 2023. The index experienced a robust positive year in 2014, with mean and median returns of 0.0867 and 0.0717, respectively. A downturn was discerned in 2022, characterized by the most significant negative mean and median returns and the highest standard deviation. Conversely, Figure 1D reveals that RDJISLK had a favorable year in 2014, with affirmative mean and median returns of 0.1052 and 0.0812, respectively. It experienced high volatility in 2020 and 2022, with the latter year demarcating the maximum returns. Both RASPI and RDJISLK exhibit unique volatility trajectories and returns. Although RASPI's volatility escalated markedly from 2020 onward, RDJISLK generally displayed higher levels, particularly between 2020 and 2022. The indices also denote substantial maximum and minimum returns, with 2022 constituting a watershed year for the RDJISLK. The partial 2023 data indicate a potential rebound for the RASPI and a more consistent positive trend for RDJISLK. These intricate dynamics underscore the indices' distinct market behaviors, furnishing valuable perspectives for investment considerations.

<Insert Figure 1: Behaviour of index and return series here>

Unit Root Tests

Augmented Dickey-Fuller (ADF) tests were conducted to assess the stationarity of the daily return series for the RASPI and RDJISLK, and the results are presented in Table I. The ADF test on the level data yielded t-statistics of -10.3537 for RASPI and -17.8918 for RDJISLK, both significant at the 1% level. Because the observed t-statistics are more negative than the critical values, the null hypothesis of a unit root is rejected for both series. This result indicates that RASPI and RDJISLK are stationary processes, without unit roots. Stationarity suggests that returns do not exhibit long-term trends or wandering behavior.

<Insert Table I: Augmented Dickey-Fuller (ADF) tests here>

Cross-correlation

Table II explains the intricate cross-correlation dynamics between the conventional RASPI and Islamic RDJISLK equity indices across multiple temporal movements. At lag/lead 0, a robust synchronous correlation of 0.7201 was observed, suggesting substantial concurrent co-movement between the two indices. This strong contemporaneous correlation initially appears at odds with Hypothesis H1, which anticipates low-to-moderate correlations. However, a closer examination reveals that this strong correlation substantially weakens and even inverts (e.g., -0.0501 at lag 11), thereby lending support to Hypothesis H1. The analysis further uncovered statistically significant lead-lag relationships, in alignment with Hypothesis H3. Granular lag series correlations show that changes in RDJISLK tend to precede similar changes in RASPI at positive lags up to 9 periods, and the inverse at negative lags 10-12. Lead series correlations echo these patterns, suggesting symmetrical predictive abilities between indices. Positive correlations at shorter lags and leads imply bidirectional information transmission, thus supporting Hypothesis H4's assertion of potential bidirectional flows contingent on the context. Moreover, the observed positive and negative correlations at different lags point to periods of both co-movement and divergence, thereby substantiating Hypothesis H5's expectation of varying temporal dynamics. These findings offer a multifaceted portrait that substantiates the complex intertemporal hypotheses proposed, highlighting the intricacies of the lead-lag relationships and their potential predictive utilities.

<Insert Table II: Cross-correlation here>

ARCH model

Mean equation

Table III presents the results of the two-stage DCC-GARCH model. The ARMA(1,1) model estimated for RASPI returns reveals significant autocorrelation and mean reversion effects. The AR(1) term was positive and statistically significant ($\beta = 0.512$, $p < 0.0001$), which denotes the positive autocorrelation where above-average returns on one day predict above-average returns on the next day. The significant negative MA(1) term ($\beta = -0.282$, $p = 0.0172$) shows that the model corrects for errors in the expected returns. The ARMA(1,1) model for RDJISLK returns yielded significant AR(1) and MA(1) coefficients. The AR(1) term was negative but insignificant ($\beta = -0.075$, $p = 0.7707$), suggesting little autocorrelation. The insignificant positive MA(1) term ($\beta = 0.152$, $p = 0.5365$) indicates corrections for errors in expected returns. ARMA modeling revealed noteworthy distinctions between the return behaviors of the RASPI and RDJISLK indices. The RASPI exhibited significant momentum and mean reversion effects, indicating predictable dynamics that are useful for forecasting. In contrast, RDJISLK showed minimal autocorrelation, with fluctuations conforming more closely to random walk. These findings demonstrate the value of fitting individual ARMA models to uncover the unique return characteristics of each index. Properly characterizing these conditional mean dynamics can inform the respective indices' more accurate modeling, forecasting, and trading strategies.

Variance equations

The ARCH(1) terms estimated for the RASPI ($\alpha = 0.210$, $p < 0.0001$) and RDJISLK ($\alpha = 0.172$, $p < 0.0001$) variance equations are statistically significant and positive. These significant coefficients provide evidence of volatility clustering in both return series, whereby large price changes tend to be followed by larger changes. Periods of high and low volatility are clustered. However, the RASPI model exhibits a slightly higher ARCH coefficient, suggesting stronger short-term volatility dynamics than RDJISLK. The presence of volatility clusters indicates that volatility shocks today will continue to affect volatility in the future. This generates time-varying persistent volatility patterns rather than constant volatility. Properly accounting for the ARCH effects leads to better volatility forecasts.

The estimated GARCH(1) coefficients for RASPI ($\beta = 0.793$, $p < 0.0001$) and RDJISLK ($\beta = 0.799$, $p < 0.0001$) were positive, significant, and close to one, respectively. This indicates a strong degree of volatility persistence, where lags in the conditional variance significantly predict future volatility levels. Although both indicate substantial volatility persistence, the RASPI returns demonstrate a slightly higher degree of long-term volatility dependence than the RDJISLK returns. High volatility persistence magnifies the impact of ARCH effects. Not only do volatility shocks affect future volatility, but this impact also decays slowly over long horizons. The estimated volatility tends to gravitate toward its long-run average level. The significant GARCH terms demonstrate long memory in both series' volatility processes.

Dynamic Conditional Correlation

A statistically significant positive relationship between RASPI and RDJISLK based on dynamic conditional correlation ($\rho_{21} = 0.624$, $p < .0001$) indicated that substantial co-movement between Sri Lankan Islamic and conventional stock markets tends to occur. Our findings have implications for portfolio diversification, hedging, and risk management. DCC analysis showed several vital trends from March 2013 to July 2023 (Figure 2). From late 2014 to mid-2015, an upward trend was observed, with the DCC going from 0.42 to 0.77, demonstrating either potential market alignment or broader economic expansion. However, from late 2017 until early 2018, a marked downward trend occurred for the DCC, with the DCC decreasing from 0.75 to 0.53, potentially marking diverging market behaviors attributable to sector-specific events. The indices respond to transient conditions with a complex interplay between the two, resulting in a sharply fluctuating value from 0.48 to 0.73 in mid-2021, then down to 0.52. At last, a downward trend in the DCC between early 2022 and early 2023, from 0.68 to 0.43, may imply increasing divergence due to region-specific factors. These findings add to the knowledge of the dynamic relationship between Islamic and conventional stock markets in Sri Lanka.

<Insert Table III: Multivariate GARCH here>

The DCC model yielded a significant short-term impact parameter ($\alpha = 0.057$, $p < 0.0001$). This result indicates that recent return innovations have substantially influenced current volatility. Investors should closely monitor recent news, events, and price movements, which can rapidly alter volatility expectations and risks. The significant long-term impact coefficient ($\beta = 0.904$, $p < 0.0001$) revealed strong volatility persistence. Today, volatility shocks continue to affect future volatility over the long term. This long-term volatility memory highlights the importance of historical trends in forecasting the long-term volatility. The low estimated degrees of freedom ($df = 4.78$, $p < 0.0001$) provided evidence of heavy-tailed return distributions. This indicates an elevated likelihood of extreme outlier events beyond normal distributions.

The empirical analysis offers preliminary support for Hypothesis H2, which proposes that incorporating Islamic and conventional indices in a portfolio can improve risk-adjusted returns. The results reveal that the Islamic index (RDJISLK) exhibits different return patterns with insignificant autocorrelation ($\beta = -0.075$, $p = 0.7707$) and lower short-term volatility dynamics ($\alpha = 0.172$ vs 0.210), contrasting with the significant momentum and mean reversion effects in the conventional index (RASPI) ($\beta = 0.512$, $p < 0.0001$). Combining these differentiated assets with dynamic correlations varying substantially from 0.42 to 0.77 may enable diversification and reduce portfolio risk particularly during documented periods of market divergence (e.g., 2017-2018 and 2022-2023). Therefore, these empirical findings support Hypothesis H2, suggesting that risk-adjusted returns can be improved by incorporating Islamic and conventional indices. Furthermore, the time-varying correlation coefficient (averaging $\rho21 = 0.624$, $p < 0.0001$) reveals a dynamic pattern of synchronized movements between these markets, supporting Hypothesis H6. Further buttressing this finding, the model parameters indicate that short-term return innovations ($\alpha = 0.057$, $p < 0.0001$) significantly impact current volatility, and the long-term impact parameter ($\beta = 0.904$, $p < 0.0001$) reinforces the concept of strong volatility persistence with temporal variation in market co-movement. This collective evidence moderately supports Hypothesis H6, while acknowledging significant periods of market divergence.

<Insert Figure 2: Dynamic conditional correlation between RASPI and RDJISLK here>

Wavelet Analysis

The Continuous Wavelet Transform (CWT) scalograms for RASPI and RDJISLK are presented in Figure 3, revealing distinct patterns in their time-frequency representations. A comparative examination of the lower scales, especially during 2015, early 2016, late 2017, mid-2019, and late 2019, unveils more light blue regions in RDJISLK, indicative of lower magnitudes in wavelet coefficients. These patterns show differential time-frequency characteristics between the indices. It is interesting to note that the two series diverged distinctly in the mid-2020 period. Wavelet transforms of RASPI demonstrate a dark red hue, indicative of a large magnitude of transforms, which may indicate periods of heightened market activity. RDJISLK, on the other hand, had a lighter red tone and exhibited lower coefficient magnitudes in the time-frequency domain. By late 2021, the analysis reflected the presence of light red, indicating medium to high magnitudes across various scales suggesting sustained periods of moderate coefficient magnitudes. By mid-2022, the comparison between the two series is even more pronounced as RDJISLK continues in light red, indicating persistent moderate magnitudes, versus RASPI shifting to light blue, indicating lower coefficient magnitudes in this period.

<Insert Figure 3: CWT Scalogram here>

Cross-wavelet analysis

Figure 4 presents a cross-wavelet analysis of the return rates for the ASPI and DJISLK indices for the study period of notable co-movement showing varying degrees of joint variation over time. The strength and duration of these relationships varied across time and were most pronounced at lower scales (0-20), reflecting the short-term interactions between the indices representing higher frequency components. As the scale increased, these patterns became less distinct, suggesting synchronization was more pronounced indicating stronger co-movement at higher frequencies (shorter periods). A moderate relationship co-movement was observed between late 2013 and late 2015 with a magnitude of approximately 130. This pattern resumed from early 2016 to late 2017, albeit slightly stronger with higher magnitude, approximately 140. Notably, the relationship co-movement temporarily intensified in mid-2019 (magnitude of approximately 110), late 2019 to early 2020 (magnitude of approximately 280), and mid-2020 (magnitude of approximately 340). In each of these instances, the higher magnitude of the cross-wavelet power indicates strong synchronization suggests stronger co-movement in the return rates of the two indices. This suggests that, during these periods, the indices exhibited a similar pattern of returns over the corresponding scale (short-term). These varying magnitudes reflect different degrees of joint variation between the indices at different time-frequency locations.

From early 2022 to late 2022, the magnitude decreases to approximately 90, indicating moderate co-movement. Outside these periods, lower magnitudes were observed, with values of approximately 40, indicating weaker co-movement in the return rates of the indices. However, it is critical to note that these magnitudes represent the strength of co-movement in the indices at a given time and scale, not the direction or rate of their returns. Moreover, the cross-wavelet transform results are localized and do not provide insights into the global behavior of the series. In light of Hypothesis H7, the wavelet analysis conducted on the RASPI and RDJISLK indices provides evidence for the presence of regions of distinct time-frequency behavior in Islamic and conventional financial markets. Continuous Wavelet Transform (CWT) scalograms showed varying patterns of wavelet coefficient magnitudes during specific timeframes. Periods of divergence and sustained patterns indicate localized regions of distinct market behavior, showing time-varying characteristics at different scales. Additionally, cross-wavelet assessments demonstrate different magnitudes of co-movement in returns across different scales and periods, further supporting the existence of time-frequency varying market behavior. These findings provide empirical support for Hypothesis H7 and emphasize the dynamic nature of the financial markets.

<Insert Figure 4: Cross wavelet transformation (XWT) here>

Wavelet Coherence Analysis

The wavelet coherence between the ASPI and DJISLK return series exhibited distinct patterns across different timescales (see Figure 5). In wavelet coherence analysis, we observed varying degrees of coherence between the ASPI and DJISLK series across different scales and periods. Minimal coherence was observed at a fast frequency (scale 4, corresponding to daily movements), suggesting that the two series did not exhibit synchronized movements daily. However, at an intermediate frequency (scale 64, approximately two months), we found strong coherence between 2014, 2016, and 2018-2020, as indicated by the wavelet coherence plot's red and dark red regions. This suggests that the two series tend to move together during these periods. Interestingly, this coherence weakened during 2017, 2021, and late 2022–2023, as indicated by the cold colors. At a slower frequency (scale 256, approximately eight months), we observed strong coherence from mid-2015 to 2019, with particularly strong coherence (dark red) from 2016 to 2018. This coherence was reduced to a moderate level (yellow) from 2019 to early 2022 and weakened significantly afterwards. At frequencies slower than 256 (yearly movements), the coherence was consistently weak, suggesting that the ASPI and DJISLK series do not move together on a year-to-year basis.

<Insert Figure 5: Wavelet coherence here>

Under Hypothesis H8, wavelet coherence analysis has highlighted a scale-dependent synchronization pattern between Islamic and conventional indices, denoted as RASPI and RDJISLK, respectively. This revealed coherence on different timescales, which signifies the dynamic relationship between these financial series. Indeed, there were periods of robust coherence at intermediate frequencies of around two months, suggesting that the indices tended to move in tandem in certain time windows. Conversely, coherence weakened during other times and scales, underlining the nuanced nature of synchronization between the indices. These findings support the notion of scale-dependent synchronization, which emphasizes that market dynamics exert differential influences on the indices over various timescales, supporting Hypothesis H8.

Discussion

This study finds a complex interrelationship between the conventional and Islamic equity indices, furnishing new perspectives on their co-movements and lead-lag dynamics within the Sri Lankan context and corroborates the extant literature. First, the contemporaneous correlation of 0.7201 (lag/lead 0) is robust and shows substantial synchronous co-movement between the ASPI and DJISLK, consistent with studies that have documented important co-movements across Islamic and conventional indices (Sahabuddin et al., 2022, Khan et al., 2022). However, it should be noted that this strong correlation weakens markedly and even reverses at certain lags, which can be seen in the correlation variability found in previous research (Ilhan and Masih, 2014, Jabeen and Kausar, 2022). These results are consistent with Modern Portfolio Theory (MPT) and Information Transmission Theory, evidencing low to moderate correlations (H1), statistically significant lead-lag associations (H3), possible bidirectional information flows (H4), and heterogeneous temporal dynamics (H5). This concordance validates the relevance of these theories in comprehending the behaviour of Islamic and conventional indices within the Sri Lankan context.

The empirical evidence from this study supports hypothesis H2, which is mapped from the Modern Portfolio Theory framework and considerations of ethical principles and performance divergences. It is found that the Islamic (RDJISLK) index exhibits different return characteristics with insignificant autocorrelation in mean returns and lower sensitivity to short-term volatility shocks, while showing slightly higher long-term volatility persistence. In contrast, the conventional (RASPI) index demonstrates significant momentum effects in returns and stronger reactions to short-term volatility shocks. These differences, along with Islamic equities' ethical screening principles, suggest potential diversification benefits as per the literature (Balcilar et al., 2016, Al-Khazali et al., 2014). Therefore, this study further strengthens our view that when the Islamic index is integrated with the conventional index in a portfolio, it offers the potential for improved risk-adjusted returns consistent with modern portfolio theory (Saiti and Noordin, 2017).

Empirical support is given to Hypothesis H6 by confirming a moderate and dynamic DCC between RASPI and RDJISLK. This finding is congruent with the theoretical framework of market integration theory, though suggesting partial rather than complete integration. The dynamic interplay between these two indices over time suggests a varying level of financial market integration in Sri Lanka, with correlation ranging from 0.42 to 0.77. This observation agrees with the larger body of literature on the co-movement between Islamic and conventional stock indices across different global contexts (El Alaoui et al., 2015, Sahabuddin et al., 2022). For instance, as Hasan (2019) shows, Islamic and conventional market indicators are long-run cointegrated with bidirectional causality in Bangladesh, which essentially means a strong interlinkage between these two. Al Rahahleh and Bhatti (2017) utilized DCC models to explain the dynamic correlations and volatility spillovers among international equity markets and highlighted transmission. Additionally, it is consistent with the literature review on multivariate GARCH models regarding the ARCH and GARCH models' application to studying volatility patterns in conventional and Islamic indices. The ARCH and GARCH coefficients identified as significant by the algorithm reflect the notions of clustering and long memory of volatility captured by Aloui et al. (2015) and Tabash et al. (2022). This finding supports the argument of paying attention to time-varying volatility in the dynamics of Islamic and conventional stock indices to gain a holistic understanding.

The wavelet analysis that has been implemented in this study supports Hypothesis H7, which posits that there are localized volatility patches in these indices. The finding comes within the larger theoretical framework of wavelet analysis on financial markets. Indeed, as it has been emphasized in the past literature as well, such as in Rua and Nunes (2009) and Fernandez (2005), wavelets are exceptionally apt to reveal localized features in financial time-series data. The market reaction and different behaviours of volatility could thus vary on specific time scales and be examined as localized volatility patches have been revealed by this study. The results confirmed the presence of localized patches in these indices and were complementary to the theoretical background of wavelet analysis and the existing literature (Hasan et al., 2021).

In this study, the wavelet coherence analysis provides very strong empirical support for Hypothesis H8 to prove the presence of scale-dependent synchronization in the Islamic and conventional indices. By employing distinctly volatile patterns on time frames, one can study the dynamic behavioral reaction of the market to the localized patches of volatility. This verification reinforces the theoretical bases of wavelet coherence analysis, both quantitatively and quantitatively, to different time scales. According to many previous studies (Meng and Huang, 2019, Jung and Maderitsch, 2014), the time series of financial markets may also have coherence on the relevant scale. Empirical confirmation of this scale dependence of synchronization thus provides strong additional evidence on Islamic and conventional stock indices behavior within the literature.

This study explores the potential advantages of portfolio diversification in the financial market of Sri Lanka, drawing on the complex interrelationship between the indices. A strong moderate contemporaneous correlation against the background of with variable time-lagged correlations patterns opens up sophisticated potential diversification opportunities, consistent with Modern Portfolio Theory (Markowitz, 1952). Islamic equities' ethical and risk-reducing screening and distinct volatility characteristics appeal to value-based investors and the emerging trend toward responsible investment by institutional investors internationally (Renneboog et al., 2008). The positive moderate dynamic conditional correlation between the indices suggests a certain partial degree of financial market integration that could be useful to policymakers in developing stability-enhancing measures during economic turmoil.

This constitutes a literature contribution concerning the temporal dynamics of correlations between Islamic and conventional indices. While various previous studies have documented co-movement evidence, this analysis provides far more details on how such correlations have evolved. Furthermore, empirical proof of lower volatility and ethical adherence by Islamic indices within the market context provides a robust, practical justification for Islamic finance. In addition, the dynamic conditional correlations and volatility patterns in the national context further extend the knowledge about market integration and volatility clustering obtained from global markets. This wavelet analysis of the localized volatility patches and their scale-dependent synchronization in both index series provides in-depth, frequency-specific scrutiny of their behavior patterns, which the current literature lacks. These findings contribute to developing knowledge in dual financial systems and have practical implications for investment strategies and regulatory frameworks in emerging economies with Islamic finance components.

This study has considerable implications for investors and policymakers in terms of market efficiency, regulatory frameworks, and financial innovation. The significant correlations and lead-lag relations between the indices indicate potential areas of regulatory arbitrage, calling for coordinated monitoring to enhance market efficiency. These are the volatility patterns identified, and different crisis response techniques can be designed based on these, including customized liquidity support mechanisms and circuit breakers, depending on the peculiar characteristics of each market segment. This could further help to gain insights into and improve the competitiveness of Sri Lanka's position in Islamic finance on market integration and the ethical attributes of Islamic indices, which has implications for the flow of capital and positioning in the international financial architecture of countries.

Wavelet analysis detects this scale-dependent synchronization, thus opening perspectives for financial innovation in constructing structured products by using changing correlations across multiple timescales. Furthermore, the time-varying conditional variances and correlations between the indices call for a re-evaluation of systemic risk models, which in turn has implications for developing stress-testing methods and designing macroprudential policies. Bi-directional information flows revealed the possibilities for inefficiencies in cross-market information transmission that could further open up ways to develop more intricate price-discovery processes and market-making strategies. Furthermore, the findings concerning the ethical principles and stability of Islamic indices suggest long-term market development strategies and may, for this reason, influence policy decisions that seek to develop this aspect of the Islamic finance industry as part of a method to enhance overall market stability and attract more ethical international investors to the market.

Conclusion

This study rigorously examines the Sri Lankan conventional (ASPI) and Islamic (DJISLK) equity indices from 2013 to 2023, identifying their behavior, correlations, volatility, and spillover. A descriptive analysis reveals intricate trends and responds to market conditions and economic events. Cross-correlation analysis shows lead-lag associations and bidirectional information flows. The dynamic conditional correlation modeling shows a time-varying positive correlation with periods of convergence and divergence between the indices. Wavelet analysis reveals differences and similarities in the time-frequency domain, indicating disparities in volatility exposure, return synchronicity, and coherence. These findings suggest disparities in risk exposures between the indices. This multi-method investigation provides a comprehensive view of the equities' intrinsic dynamics, relationships, and risk profiles.

The temporal dynamics identified between the indices challenged the static correlation assumptions used in portfolio management. The observed dynamic correlations suggest that dynamic portfolio allocation strategies can enhance risk-adjusted returns and should be adopted by investors. From this perspective, the dynamic fits well with modern portfolio theory (MPT) and information transmission theory, necessitating flexible investment strategies. Moreover, as empirical support for the theoretical basis of ethical finance as a risk-mitigation tool, Islamic indices have lower volatility and are ethical. This insight is useful for investors seeking ethical investments and stable returns to build ethical and better risk-adjusted portfolios.

These findings provide Sri Lankan investors with opportunities for dynamic portfolio diversification. The correlation between the indices varies for different time lags, allowing us to create portfolios to mitigate risk and enhance returns. Furthermore, the study demonstrates that socially responsible and Islamic equity investments are attractive to socially responsible investors, who can align their ethical values with stable returns. This trend allows financial and asset managers to meet socially conscious investor preferences regarding new products. Policymakers and regulators can use insights into market integration to develop policies to increase the efficiency and stability of Sri Lanka's financial market. To ensure market stability, the relationship between these indices must be understood especially during periods of economic uncertainty. Finally, the volatility pattern findings facilitate the design of appropriate risk-management strategies for Sri Lanka's changing financial environment, financial institutions, and fund managers.

This study has some limitations that provide opportunities for future research. First, it could offer more insights if the data set period and indices can be expanded and complemented with other statistical and computational methods. Second, the contextual factors of the other dual-system economies can be compared. As Islamic finance grows in Sri Lanka, we must develop and update research to monitor how the underlying patterns evolve and examine their relationships with macro-financial variables. Third, investigations are warranted for sector-specific assessments of individual stocks, smaller companies, and other asset classes. Fourth, broader regulatory and industry collaboration can help with evidence-based policymaking. The findings of this study provide a springboard for subsequent research on the combination of conventional and Islamic finance in Sri Lanka and elsewhere.

References

Abdul Karim, B., Akila Mohd. Kassim, N. and Affendy Arip, M. (2010), "The subprime crisis and Islamic stock markets integration", *International Journal of Islamic and Middle Eastern Finance and Management,* Vol. 3 No. 4, pp. 363-371.

Abdulkarim, F. M., Akinlaso, M. I., Hamid, B. A. and Ali, H. S. (2020), "The nexus between oil price and islamic stock markets in Africa: A wavelet and Multivariate-GARCH approach", *Borsa Istanbul Review,* Vol. 20 No. 2, pp. 108-120.

Abdullah, A. M., Saiti, B. and Masih, M. (2016), "The impact of crude oil price on Islamic stock indices of South East Asian countries: Evidence from MGARCH-DCC and wavelet approaches", *Borsa Istanbul Review,* Vol. 16 No. 4, pp. 219-232.

Adekoya, O. B., Oliyide, J. A. and Tiwari, A. K. (2022), "Risk transmissions between sectoral Islamic and conventional stock markets during COVID-19 pandemic: What matters more between actual COVID-19 occurrence and speculative and sentiment factors?", *Borsa Istanbul Review,* Vol. 22 No. 2, pp. 363-376.

Ahmad, M. and Sulaeman (2023), "Determining the main factors of Islamic banks' profitability in Indonesia: Does Covid-19 crisis play an important role?", *Asian Journal of Islamic Management (AJIM),* Vol. 4 No. 2, pp. 138-149.

Ajmi, A. N., Hammoudeh, S., Nguyen, D. K. and Sarafrazi, S. (2014), "How strong are the causal relationships between Islamic stock markets and conventional financial systems? Evidence from linear and nonlinear tests", *Journal of International Financial Markets, Institutions and Money,* Vol. 28, pp. 213-227.

Akhtar, B., Akhter, W. and Shahbaz, M. (2017), "Determinants of deposits in conventional and Islamic banking: a case of an emerging economy", *INTERNATIONAL JOURNAL OF EMERGING MARKETS,* Vol. 12 No. 2, pp. 296-309.

Al-Khazali, O., Lean, H. H. and Samet, A. (2014), "Do Islamic stock indexes outperform conventional stock indexes? A stochastic dominance approach", *Pacific-Basin Finance Journal,* Vol. 28, pp. 29-46.

Al Rahahleh, N. and Bhatti, M. I. (2017), "Co-movement measure of information transmission on international equity markets", *Physica A: Statistical Mechanics and its Applications,* Vol. 470, pp. 119-131.

Ali, A., Audi, M. and Sadiq, A. (2021), "Performance Evaluation of Islamic and Non-Islamic Equity and Bonds Indices. Evidence from Selected Emerging and Developed Countries", *Journal of Applied Economic Sciences (JAES),* Vol. 16 No. 16, p. 251.

Aloui, C., Hammoudeh, S. and Hamida, H. B. (2015), "Co-movement between sharia stocks and sukuk in the GCC markets: A time-frequency analysis", *Journal of International Financial Markets, Institutions and Money,* Vol. 34, pp. 69-79.

Alvi, M. H. and ul Hassan, S. S. (2021), "Analyzing the Financial Trends of Islamic and Non Islamic Emerging Markets of South Asia", *Journal of Accounting and Finance in Emerging Economies,* Vol. 7 No. 2, pp. 435-442.

Andrikopoulos, P., Gregoriou, G. N. and Kallinterakis, V. (2016), *Handbook of Frontier Markets,* Elsevier.

Ashraf, D., Rizwan, M. S. and Ahmad, G. (2022), "Islamic equity investments and the COVID-19 pandemic", *Pacific-Basin Finance Journal,* Vol. 73, p. 101765.

Asutay, M., Wang, Y. and Avdukic, A. (2021), "Examining the performance of Islamic and conventional stock indices: a comparative analysis", *Asia-Pacific Financial Markets*, pp. 1-29.

Bai, L., Zhang, X., Liu, Y. and Wang, Q. (2019), "Economic risk contagion among major economies: New evidence from EPU spillover analysis in time and frequency domains", *Physica A: Statistical Mechanics and its Applications,* Vol. 535, p. 122431.

Balcilar, M., Cerci, G. and Demirer, R. (2016), "Is there a role for Islamic bonds in global diversification strategies", *Managerial Finance*, Vol. 42, pp. 656-679.

Basnarkov, L., Stojkoski, V., Utkovski, Z. and Kocarev, L. (2020), "Lead–lag relationships in foreign exchange markets", *Physica A: Statistical Mechanics and its Applications,* Vol. 539, p. 122986.

Bekaert, G. and Harvey, C. R. (1995), "Time-varying world market integration", *the Journal of Finance,* Vol. 50 No. 2, pp. 403-444.

Ben Amar, A., Goutte, S., Hasnaoui, A., Marouane, A. and Mzoughi, H. (2023), "The Ramadan effect on commodity and stock markets integration", *Review of Accounting and Finance,* Vol. 22 No. 3, pp. 269-293.

Brunnermeier, M. K. and Pedersen, L. H. (2009), "Market Liquidity and Funding Liquidity", *The Review of Financial Studies,* Vol. 22 No. 6, pp. 2201-2238.

Choudhry, T. (2004), "International Transmission of Stock Returns and Volatility : Empirical Comparison Between Friends and Foes", *Emerging Markets Finance and Trade,* Vol. 40 No. 4, pp. 33-52.

Click, R. W. and Plummer, M. G. (2005), "Stock market integration in ASEAN after the Asian financial crisis", *Journal of Asian Economics,* Vol. 16 No. 1, pp. 5-28.

Dewandaru, G., Rizvi, S. A. R., Masih, R., Masih, M. and Alhabshi, S. O. (2014), "Stock market co-movements: Islamic versus conventional equity indices with multi-timescales analysis", *Economic Systems,* Vol. 38 No. 4, pp. 553-571.

El Alaoui, A. O., Dewandaru, G., Azhar Rosly, S. and Masih, M. (2015), "Linkages and co-movement between international stock market returns: Case of Dow Jones Islamic Dubai Financial Market index", *Journal of International Financial Markets, Institutions and Money,* Vol. 36, pp. 53-70.

El Mehdi, I. K. and Mghaieth, A. (2017), "Volatility spillover and hedging strategies between Islamic and conventional stocks in the presence of asymmetry and long memory", *RESEARCH IN INTERNATIONAL BUSINESS AND FINANCE,* Vol. 39, pp. 595-611.

Engle, R. F. and Ng, V. K. (1993), "Measuring and testing the impact of news on volatility", *The journal of finance,* Vol. 48 No. 5, pp. 1749-1778.

Fernandez, V. P. (2005), "The international CAPM and a wavelet-based decomposition of value at risk", *Studies in Nonlinear Dynamics & Econometrics,* Vol. 9 No. 4.

Gençay, R., Selçuk, F. and Whitcher, B. J. (2001), *An introduction to wavelets and other filtering methods in finance and economics,* Elsevier.

Glantz, M. and Kissell, R. (2014), "Chapter 4 - Price Volatility

Price Volatility", in Glantz, M. and Kissell, R. (Eds.) *Multi-Asset Risk Modeling*, Academic Press, San Diego, pp. 119-154.

Hakim, A., Dewanta, A. S., Sidiq, S. and Astuti, R. D. (2021), "Modeling the interaction across international conventional and Islamic stock indices", *Cogent Economics & Finance*.

Hammoudeh, S., Mensi, W., Reboredo, J. C. and Nguyen, D. K. (2014), "Dynamic dependence of the global Islamic equity index with global conventional equity market indices and risk factors", *Pacific-Basin Finance Journal,* Vol. 30, pp. 189-206.

Hasan, D. M. A. (2019), "Co-movement and volatility transmission between Islamic and conventional equity index in Bangladesh", *Islamic Economic Studies,* Vol. 26 No. 2.

Hasan, M. B., Mahi, M., Hassan, M. K. and Bhuiyan, A. (2021), "Impact of COVID-19 pandemic on stock markets: Conventional vs. Islamic indices using wavelet-based multi-timescales analysis", *NORTH AMERICAN JOURNAL OF ECONOMICS AND FINANCE,* Vol. 58.

Hayat, R. and Kraeussl, R. (2011), "Risk and return characteristics of Islamic equity funds", *Emerging markets review,* Vol. 12 No. 2, pp. 189-203.

He, T.-X. (2015), "Wavelet analysis and applications in economics and finance".

Hidayah, N. and Swastika, P. (2022), "Performance of Conventional, Islamic, and Social Responsible Investment (SRI) Indices During Covid-19: A Study Of Indonesian Stock Market", *Journal of Islamic Monetary Economics and Finance,* Vol. 8 No. 4, pp. 517-534.

Ho, K.-Y., Shi, Y. and Zhang, Z. (2016), "It takes two to tango: A regime-switching analysis of the correlation dynamics between the mainland Chinese and Hong Kong stock markets", *Scottish Journal of Political Economy,* Vol. 63 No. 1, pp. 41-65.

Ibrahim, S. S. and Sanusi, H. (2022), "Testing The Effect of Islamic Financial Inclusion, Infrastructural Quality on Economic Growth in Nigeria: New Insight From Bootstrap and Non-Linear ARDL", *MALIA: Journal of Islamic Banking and Finance,* Vol. 6 No. 2, pp. 87-104.

Ilhan, B. C. and Masih, M. (2014), "Do Portfolio Diversification Opportunities exist across the Euro Zone Islamic Equity Markets? MGARCH-DCC and Wavelet Correlation Analysis", in.

Ilyas, R. M. A., Kayani, S. and Fazil, A. (2022), "Volatility between Conventional and Islamic Stock Market", *Journal of Accounting and Finance in Emerging Economies,* Vol. 8 No. 2, pp. 387-398.

Jabeen, M. and Kausar, S. (2022), "Performance comparison between Islamic and conventional stocks: evidence from Pakistan's equity market", *ISRA International Journal of Islamic Finance,* Vol. 14 No. 1, pp. 59-72.

Jalón-Rojas, I., Schmidt, S. and Sottolichio, A. (2016), "Evaluation of spectral methods for high-frequency multiannual time series in coastal transitional waters: advantages of combined analyses", *Limnology and Oceanography: Methods,* Vol. 14 No. 6, pp. 381-396.

Jebran, K., Chen, S. and Tauni, M. Z. (2017), "Islamic and conventional equity index co-movement and volatility transmission: Evidence from Pakistan", *Future Business Journal,* Vol. 3 No. 2, pp. 98-106.

Jiang, Z. and Yoon, S.-M. (2020), "Dynamic co-movement between oil and stock markets in oil-importing and oil-exporting countries: Two types of wavelet analysis", *Energy Economics,* Vol. 90, p. 104835.

Jung, R. C. and Maderitsch, R. (2014), "Structural breaks in volatility spillovers between international financial markets: Contagion or mere interdependence?", *Journal of Banking & Finance,* Vol. 47, pp. 331-342.

Jusupova, L. M., Kokh, I. A. and Nikonova, T. V. (2018), "Islamic Banking: Modern Trends and Problems", in *International conference" Economy in the modern world"(ICEMW 2018)*, pp. 318-322.

Kaushala, H. N. and Rajapakse, R. M. D. A. P. (2017), "Profitability Determinants of Islamic Banking in Sri Lanka", *Econometric Modeling: International Financial Markets - Emerging Markets eJournal*.

Khan, S., Bhutto, N. A., Khan, U. A., Rehman, M. Z., Alonazi, W. B. and Ludeen, A. (2022), "Ṣukūk or Bond, Which Is More Sustainable during COVID-19? Global Evidence from the Wavelet Coherence Model", *Sustainability,* Vol. 14 No. 17, p. 10541.

Li, G., Jing, Z., Feng, Y. and Li, J. (2023), "Drivers of risk correlation among financial institutions: A study based on a textual risk disclosure perspective", *Economic Modelling,* p. 106468.

Liu, W. and Yan, J. (2021), "Financial Time Series Image Algorithm Based on Wavelet Analysis and Data Fusion", *Journal of Sensors,* Vol. 2021, pp. 1-11.

Lu, R., Bessler, D. A. and Leatham, D. J. (2018), "The transmission of liquidity shocks via China's segmented money market: Evidence from recent market events", *Journal of International Financial Markets, Institutions and Money,* Vol. 57, pp. 110-126.

Majdoub, J. and Mansour, W. (2014), "Islamic equity market integration and volatility spillover between emerging and US stock markets", *The North American Journal of Economics and Finance,* Vol. 29, pp. 452-470.

Majith, Y. L. M. (2010), "The critical success of Islamic Banking in Sri Lanka. the case of Amana investments (Pvt) Ltd", in.

Markowitz, H. (1952), "The utility of wealth", *Journal of political Economy,* Vol. 60 No. 2, pp. 151-158.

Masih, M., Alzahrani, M. and Al-Titi, O. (2010), "Systematic risk and time scales: New evidence from an application of wavelet approach to the emerging Gulf stock markets", *International Review of Financial Analysis,* Vol. 19 No. 1, pp. 10-18.

Matar, A. and Bekhet, H. A. (2015), "Causal interaction among electricity consumption, financial development, exports and economic growth in Jordan: Dynamic simultaneous equation models", *International Journal of Energy Economics and Policy,* Vol. 5 No. 4, pp. 955-967.

Mateev, M., Sahyouni, A. and Al Masaeid, T. (2022), "Bank performance before and during the COVID-19 crisis: Does efficiency play a role?", *Review of Managerial Science*.

Meng, X. and Huang, C.-H. (2019), "The time-frequency co-movement of Asian effective exchange rates: A wavelet approach with daily data", *The North American Journal of Economics and Finance,* Vol. 48, pp. 131-148.

Mensi, W., Hammoudeh, S., Al-Jarrah, I. M. W., Al-Yahyaee, K. H. and Kang, S. H. (2019), "Risk spillovers and hedging effectiveness between major commodities, and Islamic and conventional GCC banks", *JOURNAL OF INTERNATIONAL FINANCIAL MARKETS INSTITUTIONS & MONEY,* Vol. 60, pp. 68-88.

Mensi, W., Hammoudeh, S., Shahzad, S. J. H. and Shahbaz, M. (2017), "Modeling systemic risk and dependence structure between oil and stock markets using a variational mode decomposition-based copula method", *Journal of Banking & Finance,* Vol. 75, pp. 258-279.

Mihular, R. (2014), "Sri Lanka: Putting the Pieces Together", *The Islamic Finance Handbook,* John Wiley & Sons Singapore Pte. Ltd., pp. 461-476.

Miniaoui, H., Sayani, H. and Chaibi, A. (2015), "The Impact Of Financial Crisis On Islamic And Conventional Indices Of The GCC Countries", *Journal of Applied Business Research (JABR),* Vol. 31 No. 2, p. 357.

Mirza, N., Abbas Rizvi, S. K., Saba, I., Naqvi, B. and Yarovaya, L. (2022), "The resilience of Islamic equity funds during COVID-19: Evidence from risk adjusted performance, investment styles and volatility timing", *International Review of Economics & Finance,* Vol. 77, pp. 276-295.

Mseddi, S. and Benlagha, N. (2017), "An analysis of spillovers between Islamic and Conventional stock bank returns: Evidence from the GCC Countries", *Multinational finance journal,* Vol. 21 No. 2, pp. 91-132.

Muhammad Ryan, R. and Siti, M. (2023), "Islamic Capital Market Integration in 5 ASEAN Countries in the Covid-19 Era", *Jurnal Ekonomi Syariah Teori dan Terapan,* Vol. 10 No. 3, pp. 262-274.

Nairoos, M. H. M. (2011), "A study on the establishment of amana investment limited and its importance in offering Shariah compliant products amidst Muslims in Sri Lanka".

Nairoos, M. H. M. (2022), "Key challenges faced by Islamic financial institutions in Sri Lanka in offering shariah compliant products and services", *EPRA International Journal of Research & Development (IJRD),* pp. 18-24.

Nairoos, M. H. M. (2023), "The Contribution of Amana Bank in the Islamic Financial Industry in Sri Lanka", *Cognizance Journal of Multidisciplinary Studies*.

Naqvi, B., Rizvi, S. K. A., Mirza, N. and Reddy, K. (2018), "Religion based investing and illusion of Islamic Alpha and Beta", *Pacific-Basin Finance Journal,* Vol. 52, pp. 82-106.

Nazliben, K. K., Renneboog, L. and Uduwalage, E. (2023), "Corporate governance from colonial Ceylon to post-civil war Sri Lanka", *Journal of Management and Governance*.

Neifar, M., Charfeddine, S. and Kammoun, A. (2022), "Financial Performance of Islamic Versus Conventional Banks a Comparative Analysis for Jordan", *International Journal of Economics and Financial Issues,* Vol. 12 No. 6, p. 65.

Nomran, N. M. and Haron, R. (2021), "The impact of COVID-19 pandemic on Islamic versus conventional stock markets: international evidence from financial markets", *Future Business Journal,* Vol. 7 No. 1, pp. 1-16.

Ogawa, H., Hama, Y., Asamori, K. and Ueda, T. (2020), "Theoretical Consideration on the Application of Continuous Wavelet Transform to Time-Series Processing for Magnetotelluric Data", Research Square Platform LLC.

Rahman, A. A., Yahya, M. A. and Nasir, M. (2010), "Islamic norms for stock screening: A comparison between the Kuala Lumpur Stock Exchange Islamic Index and the Dow Jones Islamic Market Index", *International Journal of Islamic and Middle Eastern Finance and Management,* Vol. 3, pp. 228-240.

Renneboog, L., Ter Horst, J. and Zhang, C. (2008), "Socially responsible investments: Institutional aspects, performance, and investor behavior", *Journal of banking & finance,* Vol. 32 No. 9, pp. 1723-1742.
Rua, A. and Nunes, L. C. (2009), "International comovement of stock market returns: A wavelet analysis", *Journal of Empirical Finance,* Vol. 16 No. 4, pp. 632-639.
S&P Global (2023), "Dow Jones Islamic Market Sri Lanka Index".
Saâdaoui, F. (2023), "Using wavelets in the measurement of multiscale dependence between Saudi and selected foreign stock markets", *International Transactions in Operational Research,* Vol. 30 No. 5, pp. 2277-2301.
Saâdaoui, F., Naifar, N. and Aldohaiman, M. S. (2017), "Predictability and co-movement relationships between conventional and Islamic stock market indexes: A multiscale exploration using wavelets", *Physica A: Statistical Mechanics and its Applications,* Vol. 482, pp. 552-568.
Sahabuddin, M., Islam, M. A., Tabash, M. I., Alam, M. K., Daniel, L. N. and Mostafa, I. I. (2023), "Dynamic Conditional Correlation and Volatility Spillover between Conventional and Islamic Stock Markets: Evidence from Developed and Emerging Countries", *Journal of Risk and Financial Management,* Vol. 16 No. 2, p. 111.
Sahabuddin, M., Islam, M. A., Tabash, M. I., Anagreh, S., Akter, R. and Rahman, M. M. (2022), "Co-Movement, Portfolio Diversification, Investors’ Behavior and Psychology: Evidence from Developed and Emerging Countries’ Stock Markets", *Journal of Risk and Financial Management,* Vol. 15 No. 8, p. 319.
Saiti, B. and Noordin, N. H. (2017), "Does Islamic equity investment provide diversification benefits to conventional investors? Evidence from the multivariate GARCH analysis", *International Journal of Emerging Markets,* Vol. 13, pp. 267-289.
Saleem, A., Daragmeh, A., Zahid, R. M. A. and Sági, J. (2023), "Financial intermediation through risk sharing vs non-risk sharing contracts, role of credit risk, and sustainable production: evidence from leading countries in Islamic finance", *Environment, Development and Sustainability*.
Shah, M. and Hussain, S. (2014), "Islamic Banking and Finance in the Corporate Sectors of India and Sri Lanka : An Empirical Estimation", *Journal of Islamic Economics, Banking and Finance,* Vol. 10, pp. 151-170.
Shahzad, S. J. H., Ferrer, R., Ballester, L. and Umar, Z. (2017), "Risk transmission between Islamic and conventional stock markets: A return and volatility spillover analysis", *International Review of Financial Analysis,* Vol. 52, pp. 9-26.
Shi, W., Shang, P., Wang, J. and Lin, A. (2014), "Multiscale multifractal detrended cross-correlation analysis of financial time series", *Physica A: Statistical Mechanics and its Applications,* Vol. 403, pp. 35-44.
Singh, P., Kumar, B. and Pandey, A. (2010), "Price and volatility spillovers across North American, European and Asian stock markets", *International Review of Financial Analysis,* Vol. 19 No. 1, pp. 55-64.
Tabash, M. I., Billah, M., Kumar, S., Alam, M. K. and Balli, F. (2022), "Analysis of the frequency dynamics of spillovers and connectedness among Islamic and conventional banks and their determinants: evidence from Gulf Cooperative Council (GCC) markets", *Applied Economics,* pp. 1-30.
Tang, Q., Shi, R., Fan, T., Ma, Y. and Huang, J. (2021), "Prediction of Financial Time Series Based on LSTM Using Wavelet Transform and Singular Spectrum Analysis", *Mathematical Problems in Engineering,* Vol. 2021, pp. 1-13.
Uckol, H. I. and Ilhan, S. (2023), "Identification of corona discharges based on wavelet scalogram images with deep convolutional neural networks", *Electric Power Systems Research,* Vol. 224, p. 109712.
Umar, Z. and Suleman, T. (2017), "Asymmetric Return and Volatility Transmission in Conventional and Islamic Equities", *Risks,* Vol. 5 No. 2, p. 22.
Volosovych, V. (2011), "Measuring financial market integration over the long run: Is there a U-shape?", *Journal of International Money and Finance,* Vol. 30 No. 7, pp. 1535-1561.
Yesuf, A. J. and Aassouli, D. (2020), "Exploring synergies and performance evaluation between Islamic funds and socially responsible investment (SRIs) in light of the Sustainable Development Goals (SDGs)", *Heliyon,* Vol. 6 No. 8, p. e04562.

Zakri, A. S. I., Razak, S. H. A. and Tahir, Z. A. M. (2018), "Comparison of methodologies of Shari'ah stock screening: the case of SAC SC Malaysia, FTSE Yasaar Dubai and Dow Jones Islamic market indices", *International Journal of Business Forecasting and Marketing Intelligence,* Vol. 4, pp. 458-485.

Tables

Table I: Augmented Dickey-Fuller (ADF) tests

	RASPI	RDJISLK
t-Statistic	-10.3537	-17.8918
Prob.	0.0000	0.0000

Sources: Authors own creation

Table II: Cross correlation

RASPI,RDJISLK(-i)	RASPI,RDJISLK(+i)	i	Lag	Lead
		0	0.7201	0.7201
		1	0.1459	0.2338
		2	0.0239	0.0052
		3	0.0353	-0.0164
		4	0.0507	0.0180
		5	0.0396	0.0123
		6	0.0887	0.0705
		7	0.0354	0.0551
		8	0.0517	0.0028
		9	0.0331	0.0274
		10	-0.0230	-0.0334
		11	-0.0501	-0.0383
		12	-0.0207	-0.0386
		13	0.0024	0.0134
		14	0.0175	0.0351
		15	0.0099	0.0188
		16	0.0013	-0.0391

Sources: Authors own creation

Table III: Multivariate GARCH

Dependent variable: RASPI; ARMA (1,1) - GARCH				
	Coefficient	Std.Error	t-value	t-prob
Cst(M)	-0.001	0.017	-0.039	0.9687
AR(1)	0.512	0.104	4.905	0.0000
MA(1)	-0.282	0.118	-2.384	0.0172
Cst(V)	0.014	0.004	3.895	0.0001
ARCH(Alpha1)	0.210	0.035	5.975	0.0000
GARCH(Beta1)	0.793	0.026	30.170	0.0000
Dependent variable: RDJISLK; ARMA (1,1) - GARCH				
	Coefficient	Std.Error	t-value	t-prob
Cst(M)	-0.002	0.022	-0.077	0.9389
AR(1)	-0.075	0.258	-0.292	0.7707
MA(1)	0.152	0.245	0.618	0.5365
Cst(V)	0.045	0.014	3.148	0.0017
ARCH(Alpha1)	0.172	0.045	3.806	0.0001
GARCH(Beta1)	0.799	0.042	18.980	0.0000
DCC-GARCH				
	Coefficient	Std.Error	t-value	t-prob
rho_21	0.624	0.027	23.170	0.0000
alpha	0.057	0.012	4.665	0.0000
beta	0.904	0.024	37.980	0.0000
df	4.780	0.242	19.750	0.0000
No. Observations	2440.000	No. Parameters:	16	
No. Series	2.000	Log Likelihood:	4676.625	

Sources: Authors own creation

Figures

Figure 1A: ASPI

Figure 1B: DJISLK

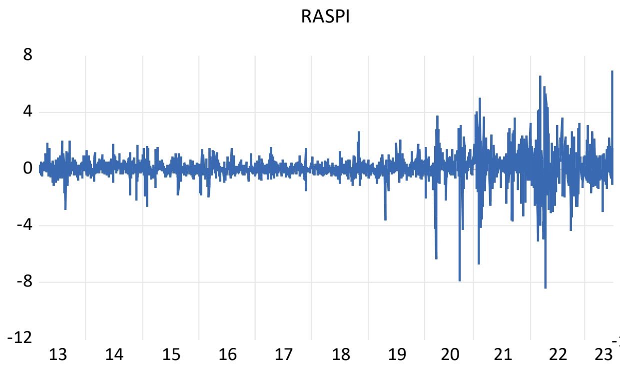

Figure 1C: Return of ASPI

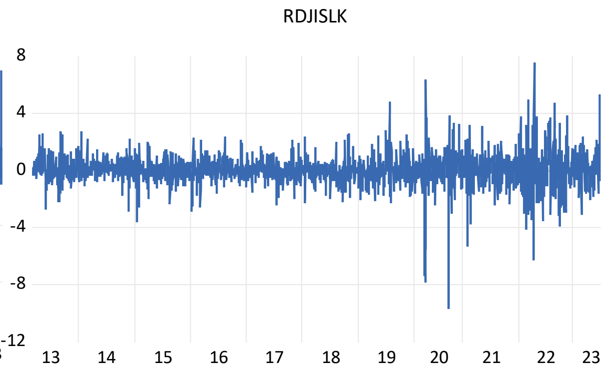

Figure 1D: Return of DJISLK

Figure 1: Behaviour of index and return series

Sources: Authors own creation

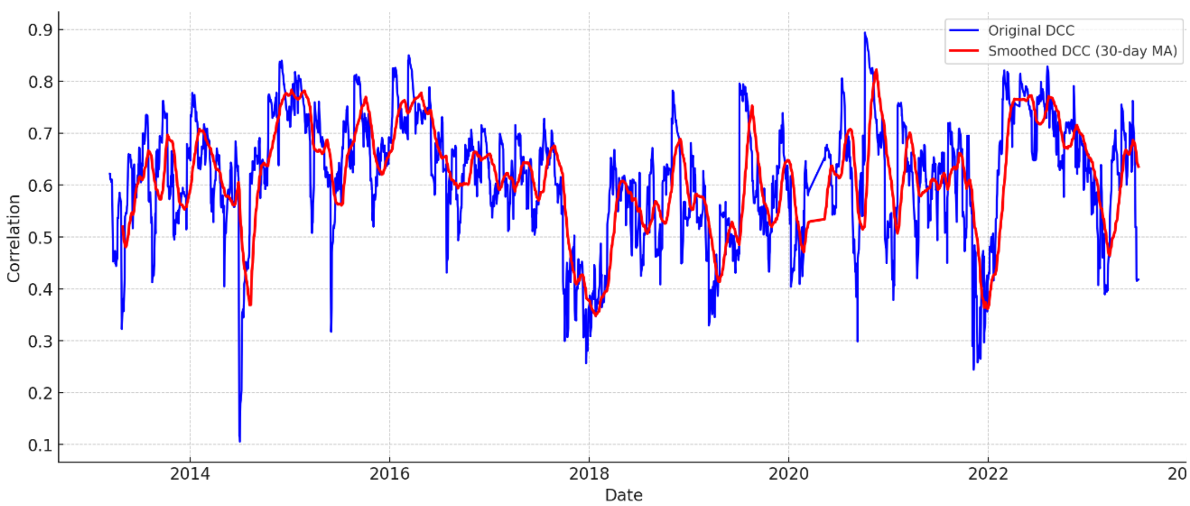

Figure 2: Dynamic conditional correlation between RASPI and RDJISLK

Sources: Authors own creation

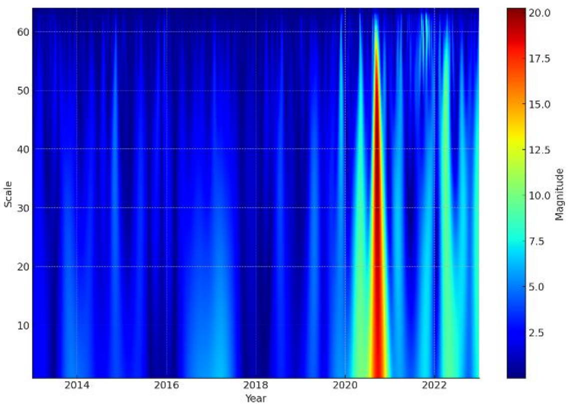

Figure 3A: RASPI

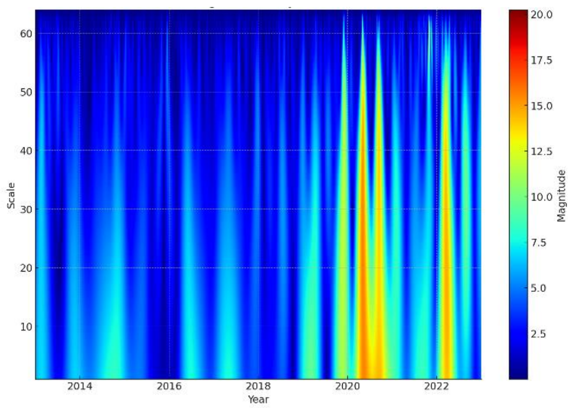

Figure 3B: RDJISLK

Figure 3: CWT Scalogram

Sources: Authors own creation

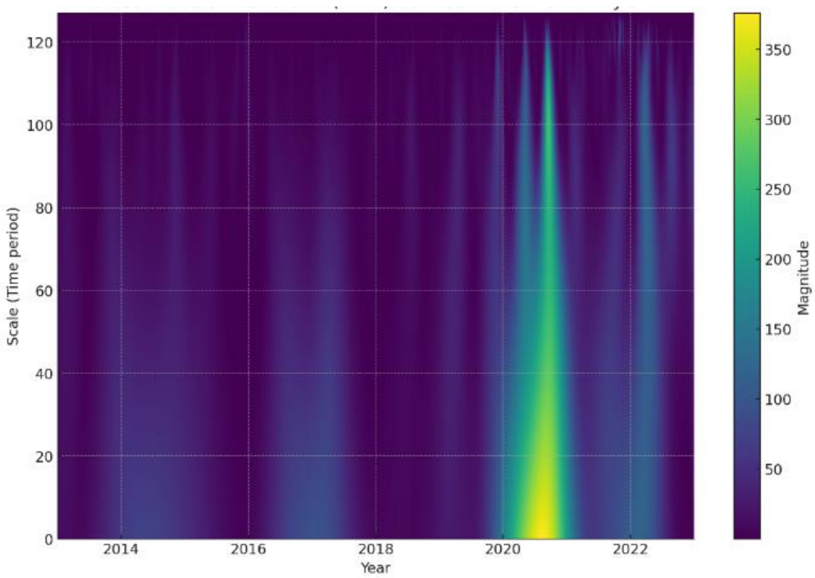

Figure 4: Cross wavelet transformation (XWT)

Sources: Authors own creation

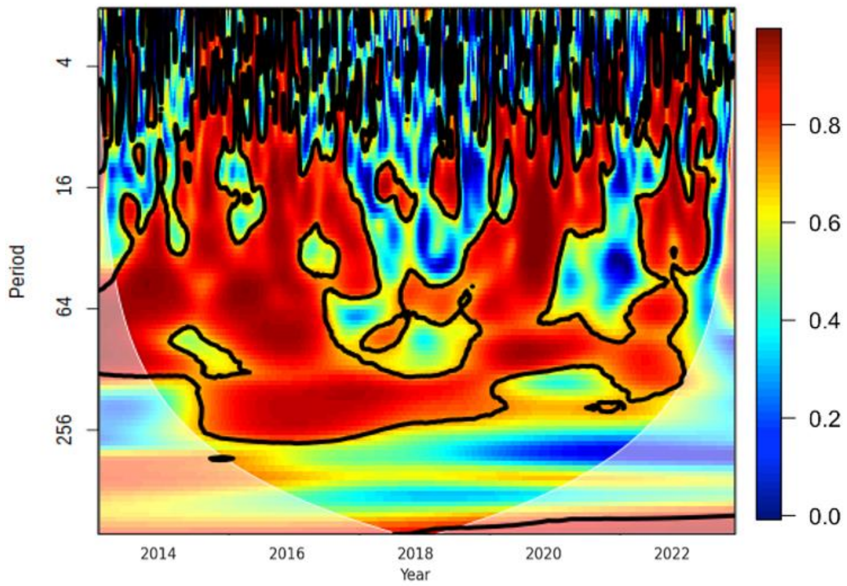

Figure 5: Wavelet coherence

Sources: Authors own creation