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Research Article

Co-integration and Causality: Dynamic Linkages between Conventional and Islamic Indices

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ABSTRACT

The aim of the current study is to examine the long-run and short-run associations among the indices of Islamic and Conventional stock market of India. The Nifty 500 and Nifty Shariah 500 are used as representative of Conventional and Islamic indices, respectively. The study uses daily data for the period 2013–2022. Econometric models such as the Unit root test, VECM, Co-integration test, Granger causality tests, Variance decomposition and IRFs are used to achieve objective of the study. The study found that two indices are coupled in the long-run and short-run and a bi-directional causal association is spotted between them. These results are important and useful for portfolio managers, stock market investors, market participants, and policy makers for making economic and investment decisions.

Keywords: Co-integration, VECM, Causality, Islamic Finance

1. Introduction

After Muhammad's death in 632 AD, during the Islamic "golden age," Islam experienced a significant expansion throughout the Arabic-speaking world as well as in significant portions of Europe, Asia and Africa (Masoud, 2014). In the Medieval Period, when most Muslim nations were colonized, Islamic money was derelict and replaced by Western financial systems, which prevents Islamic finance from becoming institutionalized in the form of banks and financial markets (Wilson, 2002; Vogel and Hayes, 1998; Wilson, 1995; Baldwin and Wilson, 1988; Masoud and Abu Sabha, 2014) and thus, the capitalist economy effectively superseded the previous financial system that adhered to Sharia (Masoud, 2014). Commercial banks began to play an imperative role in the economies of the Muslim world in the 1940s (Hamid, 2006; Masoud and Abu Sabha, 2014). In a small Egyptian village in 1963, Islamic banking was introduced at a small scale on an experimental basis (El-Galfy and Khiyar, 2012; Tabash and Dhankar, 2014; Alam and Seifzadeh, 2020). The success of this experiment allowed for the establishment of a distinct markets for Islamic finance & banking, which led to the gradual emergence of Islamic banking in the 1970s and the later introduction of a number of full-fledged Islamic banks in Arab & Asian nations. The operations of Islamic banks and other non-banking financial institutions have recently increased on more intensive level (Masoud and Abu Sabha, 2014).
Until 1983, spiritual Islamic investors were not able to invest their money in equities. The Bank Islam Malaysia Berhad took initiative to make available a list of Shariah-compliant stocks in Malaysia in 1983 (OICU-IOSCO, 2004; Aarif et al., 2020). Eventually, the procedure of determining whether equities adhere to Shariah makes it easier to develop Shariah indices. RHB Unit Trust Management Berhad introduced the first Islamic equity index in May 1996.
Recently, The Islamic finance industry has experienced tremendous expansion, averaging six percent annually (Islamic Finance Development Report, 2018). The involvement of both Muslim and non-Muslim investors has been the catalyst for such unprecedented development. Islamic finance fundamentally differs from the conventional financial model in that it is founded on a set of rules known as Shariah or Islamic law and has its own religious identity (Syed Faiq Najeeb, 2011; Khamlichi *et al.*, 2014). In contrast to conventional finance, where these are common practices and Islamic finance is built on profit and loss sharing, Riba (interest), Maysir (gambling) and Gharar (uncertainty), are strictly forbidden in Islamic capital markets (Majid and Shabri, 2018; Sahabuddin *et al.*, 2020). By investing in Islamic indices as instead of conventional indices, the investor will not have any significant advantage. However, Islamic indices might be less turbulent and more peaceful

(Albaity and Mudor, 2012). Islamic products attracted non-Muslim investors because of their prominent risk-return features and ethical roots (Barnes, 2012; Hayat and Malik, 2014; Aarif *et al*., 2020).

A brief overview of Shariah investing in India includes the inception of the practice, the areas that fall beyond its purview, the accounting criteria, and the timeline of its development (Krishnanunni, 2020). Over the past two decades, Shariah investment in India has gradually increased (Natarajan and Dharani, 2012). With an estimated 177 million Muslims around 12% of the country's population, India has the largest Muslim minority in the world (Kumar and Sahu, 2017). Approximately 61% of Indian firms adhere to Shariah law as compared to 57% of Malaysia firms followed by 51% in Pakistan, and only 6% in Bahrain (Nisar, 2007; Kumar and Sahu, 2017).

The Nifty Shariah indexes in India are developed to provide investors with venture options that comply to Islamic law. In order to give Shariah screens and filter the equities using Shariah investment screens, TASIS team up with India Index Services and Products Limited (IISL) (Munusamy, 2018). On the basis of both daily returns and the volume of transactions, the NSE's NIFTY index is taken into consideration for the study (Mohanasundaram and Karthikeyan, 2015).

Islamic indices do not exist in isolation. They co-exist with their conventional equivalents in every nation. Coordination between Conventional and Islamic systems is crucial in nations that adopt both (Isa *et al*., 2020). Investors in the stock market often worry about the effectiveness, independence, and soundness of the markets' fundamentals (Menon *et al*., 2009). A capital flow in the form of portfolio and direct investments provides the opportunity for increased earnings and portfolio diversification which finally results in stock market integration. Risks from interdependencies across stock markets include the ripple effect and the spillover effects of economic events (Palamalai *et al*., 2013; Mohanasundaram and Karthikeyan, 2015; Gkillas *et al*., 2019; Devereux and Yu, 2020).

In contemporary financial economics literature that covers many aspects of the interlinkages between stock markets, the theory of dynamic financial market assimilation across stock markets has emerged as a key area (Sharma and Seth, 2011). The two markets are integrated if investors may liberally switch between them and if there is a mechanism for arbitration to guarantee that the stock prices on both exchanges are equally integrated (Jawadi and Arouri, 2008). By making investments in different indexes, portfolio investors and analysts diversify their funds to increase returns and decrease risks. When stock markets are integrated, diversification of capital from one Index to another is futile. In order to diversify the funds, shareholders and professional investors look at how integrated these markets are, because of which the idea of stock market integration has been more popular (Sharma and Seth, 2011).

However, the Shariah Index is what this study is primarily focused on. Stocks that adhere to the Islamic Shariah guidelines defined by Shariah scholars are included in the Shariah index (Aarif *et al*., 2020). Researchers and academics have been trying to analyse how conventional and Islamic indices are performing for numerous years. In an effort to confirm this, Alam and Ansari (2020), Hassan *et al.,* (2019), Saiti *et al*., (2019), Hassan *et al.,* (2019), Jebran *et al*., (2017), Alexakis *et al*., (2015), Khamlichi *et al*., (2014), Al-Khazali *et al.,* (2014), Ho *et al*., (2014), Abbes (2012), Albaity and Mudor (2012), Guyot (2011), Karim *et al.,* (2010), Hassan and Girard (2010), Albaity and Ahmad (2008), Hussein and Omran (2005), Hussein (2005), and Ahmad and Ibrahim (2002) reported mixed findings when comparing the performance of the two indices (Conventional and Islamic) which needs further research. Additionally, it is vital to understand the comparative performance of the two indexes because Muslims or other ethical investors may be interested in learning how much it costs to invest in the Shariah index (Castro *et al*., 2020). Stulz (1981) characterised integrated stock markets as having the same price for investments with perfectly correlated earnings regardless of the market in which they trade. There are several studies investigating the co-integration among Conventional and Islamic stock markets (Ahmad *et al.,* 2018; Kaiser and Welters, 2019; Shahzad *et al*.,2019; Umar *et al*., 2020; Karim and Naeem, 2022). Many empirical studies have dealt with the subject of integrated stock markets perspectives and stock market co-movement in advanced nations. (Hakim and Rashidian, 2004; Albaity and Ahmad, 2008; Majdoub and Mansour, 2014; Das et al., 2018; Nitoi and Pochea, 2019; Das and Manoharan, 2019; Huang, 2020). India is one of the few growing nations with a dearth of literature on the topic. Because of this, it is necessary to investigate how the findings of research based on developed markets may differ from those based on developing markets.

The present research paper is divided into five sections. The first section gives an overview followed by section review of literature. Section three describes the research methodology followed in the research. The analysis and interpretation of the data has been done in section four whereas final section incorporates findings and gives recommendation for future work.

2. Review of Literature

2.1 Co-integration and Causality among World Stock Markets

A numerous studies were focusing on the co-integration and causality between a country's national stock indices with the national stock indices of other countries. The brief description of the major studies is given here under.

Using risk-adjusted return performance and co-integration techniques, Hakim and Rashidian (2002) showed comparable risk-return characteristics between the DJIMI (Islamic) and Wilshire 5,000 (Conventional) indices. Even though DJIMI is a subset and contains about 25% of the stocks in the board index (Wilshire

5,000), its performance is unaffected by this. Instead of a much broader basket of stocks, Muslim investors can place their money in Islamic stocks and receive the same profits. Al-Zoubi and Maghyereh (2007) concluded that the Dow Jones Islamic index outperforms the Dow Jones World Index in terms of risk. As a result, it is thought that investing in Islamic stocks is not worse for Muslim investors than investing in benchmark stocks. According to Alam and Ansari (2020), despite the fact that Islamic indices have somewhat higher risk-adjusted returns than conventional ones. The implications of the Dhaka Stock Exchange Shariah (DSES) on the stock markets of six Gulf and developed countries are examined by Chowdhury et al. (2017). The Dhaka Shariah Compliant Stock Index (DSES), which was the subject of the study's investigation, revealed evidence of a substantial long-term co-integration link among Islamic stock indexes. The study did however also show that the contagion effect differs between different marketplaces. In addition, all stock markets save the Islamic stock market in Kuwait are only marginally impacted by the Shariah-compliant stock market in Bangladesh. However, it has also been shown that Bangladesh's Shariah-compliant stock market is somewhat prejudiced by global Islamic stock markets. Aamir *et al.,* (2018) examines the co-movements of Pakistani stock market with 18 emerging stock markets from South American, African, European and Asian countries and concludes that there is no co-integration in long run between the stock markets of Pakistan with Argentina, Republic Czech, Hungary, the Philippines and Peru. The investors in those countries could benefit from cross-market diversifications to alleviate the unsystematic risk inherent in their investment portfolios. Meanwhile, investors from Turkey, Brazil, Egypt, China, India, Korea, Indonesia, Thailand including Malaysia could not adopt cross-market portfolio diversification with Pakistan because there is presence of long run co-integration among the countries' stock markets, respectively. Majid (2018) reveals that Indonesian Islamic stock market co-integrates with Islamic stock markets of Japan, the UK and the US. Further, co-integration between the Indonesian with Japanese market is dominant compared to with the other two developed markets. Therefore, both Indonesian and Japanese Islamic stock markets are more interdependent and the Japanese markets have more impact on the Indonesian market compared to the markets of UK and the US. According to Hamidi et al. (2018), the frequency of adjustment for negative movement is faster than that of positive deviation in the long-run equilibrium. The study also noted that investors exhibit a greater inclination to invest their funds during periods of increasing stock prices. Furthermore, the partial adjustment model proposes an asymmetric adjustment whereby negative news results in negative returns while positive news leads to positive returns. The efficacy of good news is comparatively lower than that of bad news.

Abidin and Banchit (2019) found that relationship among Hong Kong and Shanghai and Shenzhen stock indices and most probably driven by similar macroeconomic variables of China compared to other Asian countries. Further, unidirectional causality is running from Hong Kong stock index to the stock indices of Thailand and Korea and also, Malaysian stock index causes Hong Kong and Indonesian stock indices, respectively. In addition, Shanghai stock index causes Indonesian and Shenzhen stock indices. Shanghai stock index causes movements in Shenzhen but Shenzhen stock index does not cause movements in Shanghai stock index. The Philippines stock index is also found to have significant impact on those Asian stock indices. But Hong Kong stock index has largest effect on these Asian triangle stock indices and encourage emerging markets' performance. Goyal and Bansal (2019) prove that there is no existence of long-run equilibrium relationship between stock market of the US and India. Hasan (2019) illustrates the co-integration of traditional and Islamic stock indexs, the transmission of volatility, and the observed short-run and long-run relationships. Additionally, it shows that Islamic stock indices have an extraordinary volatility transmission mechanism when compared to traditional stock indices. Benefits of portfolio diversification therefore do not apply to either series. According to Mansoor and Siddiqui (2019), there is no co-movement among the Islamic fund markets in Pakistan and those in North America, Europe, and the MENA. The maintenance of an international portfolio in certain nations does not offer risk reduction to investors, as the movements of the Islamic fund of Pakistan are found to be parallel with those of the Islamic funds in the Asia Pacific region. Mohammed *et al.,* (2020) analyze the historical trend between Saudi's stock market (Tadawul All Share Index) and the US stock markets (DJIA and S&P500) and found a long-run relationship between these two markets. Delle Foglie and Panetta (2020) observed that there is not a thorough assessment of the safe place discussion between Western and Islamic stock markets. Global influences compel the interconnectedness of financial markets, especially during demanding times (Karim and Naeem, 2022).

2.2 Co-integration and Causality among Sectoral Indices

Maysami *et al.,* (2004) concluded that the US and Singapore Electronic sectoral indices are co-integrating in long-run. This limits the investors to gain diversification benefits by investing in the two indices at the same time. Wong and Zhang (2011) concluded that there is a non-existence of no long-run relationship among Shanghai Stock Exchange (ShSE), Shenzhen Stock Exchange (SzSE) and Hong Kong Exchanges (HKE). Surprisingly, the two mainland stock markets, namely ShSE and SzSE are relatively not moving together in long run. Nevertheless, the HKE is Granger-caused by both mainland stock markets in short run, more prominently by the ShSE. According to Majdoub and Mansour's (2014) findings, there exists a weak correlation between Islamic stock markets and US stock markets. Al-Khazali *et al.,* (2014) use nine pairs of Islamic indices and their conventional counterparts selected from both developed and emerging countries and obtain mixed results about the performance of the sample indices. Abu-Alkheil *et al.,* (2017) revealed that the conventional indices outperform Islamic indices based on 32 pairs of Islamic and conventional indices. Further the study

noticed that the conventional indices surpass the Islamic indices during the pre-financial crisis and financial crisis periods, while there is no significant difference in performance between them during the post-crisis periods. Ahmed *et al.,* (2017) found that most of the sectors on the Karachi Stock Exchange (KSE) do not vary together in the long-run except the Automobile and Cement sectors. The Granger causality test proves unidirectional causality from Banking, Chemicals and Cement sectors to other sectors, whereas the movement of indices of Biotechnology, Oil and Gas, Textiles and Pharmaceuticals, and Electricity sectors due to by other sectors. With the exception of the Islamic developing markets indexes, there is no sustained correlation between the performance of the Islamic indices and that of their conventional equivalents, per (Henda and Taher,2017). Jebran et al. (2017) showed a strong short and long-term correlation between the Islamic and Conventional indexes. Kumar and Sahu (2017) discovered a long-term correlation between the Dow Jones index and the macroeconomic variables (exchange rate, money supply, WPI, and Treasury bill rate). However, the analysis found that there was a one-way causal relationship between the money supply, exchange rate, and Dow Jones index in the short term. Siddiqui and Abdullah (2017) looked at six pairs of conventional and Shariah indices and found that the conventional indices were more successful than the Shariah ones. According to Sahabuddin et al. (2018), the composite and ten sectoral indexes follow the Shariah compliant stock index in the long run, while in the short run, the rate of adjustment changes depending on the variables. Rejeb and Arfaoui (2019) discovered that the conventional and Islamic stock markets in Pakistan move in tandem with Pakistan's Islamic funds. During periods of global crisis, the conventional indexes are more vulnerable, although being less volatile than Islamic Indices. Trabelsi *et al.* (2020) revealed no appreciable performance differences between Islamic, conventional, and mixed portfolios on the US and emerging markets and asserted that preferring Islamic indexes over conventional ones would not harm Muslim investors. Aarif *et al.* (2020) discovered that the Shariah index beats its conventional equivalent based on risk-adjusted returns. There is no visible causal relationship among the two indexes; their association is only long-term. According to Khamlichi *et al*., (2021), the traditional stock market performs better from the viewpoint of emerging nations. However, from the perspective of the industrialised countries' stock markets, Islamic stock markets do better. The effect of the COVID-19 pandemic on Islamic and conventional stock markets is examined by Hasan et al. in 2021. Both markets exhibit a similar tendency of higher co-movement and increased volatility during the pandemic period. According to Arif *et al.,* (2021) there is low interaction among green bonds and traditional financial markets. In contrast to the long-run, connectedness is more obvious in the short-term. Qoyum *et al.,* (2021) revealed that firms' level performances varied from the perspectives of social, environmental, and governance. The performance of Islamic businesses is superior from a social and environmental perspective, but not from a governance perspective.

3. Data and Methodology

3.1 The Data

This section observes whether there is a significant difference between the returns of Conventional and Shariah Indices or not. The sample comprises daily closing prices data of two indices i.e., Nifty 500 and Nifty Shariah 500. The collection of daily data enables a more precise capture of the information content pertaining to fluctuations in stock prices and currency rates, as compared to the utilization of weekly or monthly data. Additionally, it facilitates a deeper comprehension of the interrelationships between various variables (Agrawal *et al*., 2010; Jebran and Iqbal, 2016). The data has been obtained from the official website of NSE from the index segment for the period 1 January, 2013 to 31 December, 2022 forming a total of 2478 observations. The closing prices data is then used to calculate the daily return for each index. The initial difference in the logarithm of the closing price of the index for consecutive days is used to compute the continuously compounded returns, which are used to calculate the daily returns. The mathematical expression is given as below:

$$R_t = \ln\left(\frac{P_t}{P_{t-1}}\right)$$

Where,
R_t = individuals'daily return on stock.
P_t = daily price in time period't'.
P_{t-1} = daily price one period before't'.

3.2 The Methodology

Co-integration test, Granger Causality, Impulse Response, Vector Error Correction Model, and Variance decomposition techniques are used to measure the Nifty 500 and Nifty Shariah 500 Indices' long and short-term relationships. Time-series data's primary issue is non-stationarity. Because non-stationary time series yield erratic and unclear results, drawing conclusions from them is statistically questionable (Liu, 2008; Mansoor and Siddiqui, 2019). The non-stationary problem can be resolved with the aid of co-integration analysis (Liu and Shrestha, 2008). According to EL Amri and Hamza (2017), the co-integrating technique is a particularly intriguing tool for determining whether long-term relationships exist between time series. To investigate the short-run relationship, the Vector Error Correction Model is employed. The Granger Causality

test is used to ascertain the variables' direction after VECM. The process of variance decomposition involves determining the proportion of a given variable's forecast error variance that can be attributed to its own innovations, as well as to the innovations of other variables. Impulse Response Function (IRF) shows how the indexes respond to the short-run temporary shocks. Stationarity of data is essential to apply Co-integration test. To check stationarity of data, Unit root test is employed.

Unit Root

Generally, ADF (Augmented Dickey-Fuller Test) and PP (Phillip Perron) test are used to examine the stationarity of the data (Jebran *et al.*, 2017). It is determined by whether or not the time series that are being studied are integrated into the order (I) based on whether or not the ADF and PP statistics are significant for all variables at the first difference (Mansoor and Siddiqui, 2019).

Johansen Co-integration Test

There is a need to test the existence of long-run association among the indices after determining the order of integration of each variable (Valadkhani and Chancharat, 2008). Johansen and Juselius (1990) co-integration test is used to examine the integration among the selected Conventional and Shariah indices. It is a popular method that works well for analyzing the long-term association between variables with plenty of data. A large sample period is needed to find a co-integration connection throughout time (Bo Sjo, 2008; Hendry and Juselius, 2000). If the sample size is quite big, Johansen's technique is the best co-integration approach (Mohanasundaram and Karthikeyan, 2015). Johansen co-integration test is used if the data is stationary at same order (Tanwar and Irfan, 2017). The Trace test and the Eigen value test form the basis of the study's co-integration test (Jebran, 2017). To determine the number of co-integrating vectors or existence of co-integration in long-run among various indices, Johansen and Juselius (1990) is performed.

VAR Lag Order Selection Criteria

The VAR model has a lag length of 5 because the data is daily (Hoque, 2007). The best lag time for every variable is found by applying the Vector Autoregression (VAR) lag order selection method. The (log L) Log-Likelihood value, the sequentially modified (LR) Likelihood Ratio test statistic, the (FPE) Final Prediction Error, the (AIC) Akaike Information Criteria, the (SC) Schwarz Information Criteria, and the (HQ) Hannan-Quin Information Criteria are the six criteria to take into account when determining the optimal lag length. All the others minimise lag length functions, with the exception of the LR statistic (Mohanasundaram and Karthikeyan, 2015).

VECM

If data series are co-integrated, the restricted VAR model needs to be used, otherwise unrestricted VAR model has to be developed. As the Nifty 500 and Nifty Shariah 500 indices series are co-integrated, the restricted VAR model, i.e., Vector Error Correction Model has to be estimated. VECM test, check the speed of adjustment of each index for any deviation from the long-run equilibrium. There is still more research to be done on the short-run dynamics. It is not indicated how a variable will react to modifications and advancements in other variables or how it will modify to account for any departures from the long-run equilibrium connection. Accordingly, Vector Error Correction Models (VECM) is applied to capture short-run dynamics (Hoque, 2007). Generally, a VEC model can be amplified to allow past short-run deviations to also stimulus present short-run deviations or to embrace deterministic trends.

Granger Causality

The causal relationships between the Indices are traced using the Granger causality approach. The Granger causality test examines the relationship between variables' causes and effects. In essence, this analysis looks at which variables are just causes and which ones have an effect on other variables (Mansoor and Siddiqui, 2019). The pairwise Granger causality test (Engle and Granger, 1987) is employed to discover unidirectional, bidirectional or no causal relationships among indices. The Granger causality investigation is conducted to see whether one stock market index may have some predictive capacity for another (Mohanasundaram and Karthikeyan, 2015).

Variance Decomposition

A technique for evaluating the degree of causal links and dynamic interactions among variables in a system is called variance decomposition, or VDC. A variable's prediction error variance as a function of both its own innovation and innovations in other variables is displayed by the variance decomposition coefficient (VDC). Thus, the VDC can be used to estimate the role that Islamic finance development plays in accounting for growth and variables related to economic activity that vary over time (Abduh and Omar, 2012).

Impulse Response Functions (IRFs)

IRFs are applied to examine the dynamic impact of a shock to one variable on other variables in the same model. This test demonstrates how the indices react to temporary, short-term shocks. Whether the estimate is significant or not depends on the point estimate of the variables, which might be either positive or negative. An

indication that the relevant response is positive is provided by the impulse response function (IRF) point estimate being positioned above the zero line. On the other hand, the comparable reaction is considered negative if the impulse response function (IRF) point estimate is below the zero thresholds. Furthermore, the reaction is considered statistically insignificant when the impulse response function's point estimate crosses the zero line. There are many options available for transforming impulses. This work also used the Cholesky decomposition adjusted response functions, which is in line with Djedovic and Ergun (2018). An analytical method known as impulse response is used to determine how a standard deviation shock to one variable in the VAR system affects other variables over time. It can be applied to examine the short-term dynamic interactions of a VAR system's variables (Hoque, 2007). It is also related to causality because, according to Lutkepohl (1991), zero impulse responses between two variables signify the absence of a dynamic causal relationship between them.

4. Analysis

4.1 Descriptive statistics

Table I: Descriptive Statistics

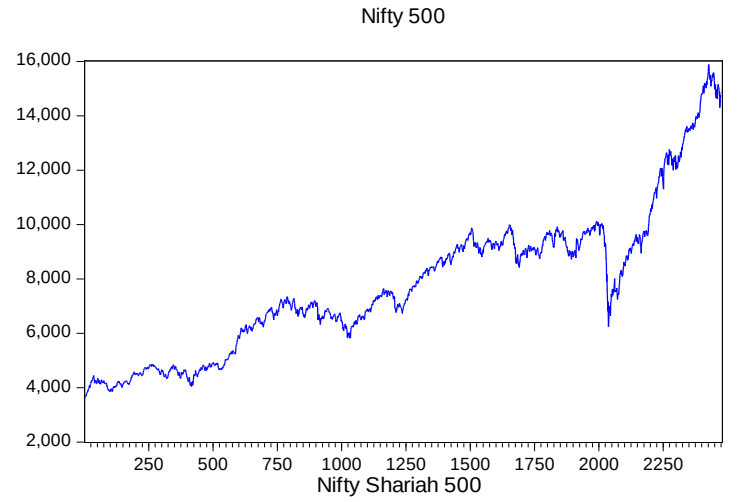
Statistic	Nifty 500	Nifty Shariah 500
Mean	0.000576	0.000637
Median	0.001276	0.001104
Maximum	0.074094	0.074852
Minimum	-0.137063	-0.110254
Std. Dev.	0.010509	0.009255
Skewness	-1.461396	-1.176323
Kurtosis	20.94960	18.54490
Jarque-Bera	34147.97	25521.22
Probability	0.000000	0.000000
Sum	1.426169	1.579092
Sum Sq. Dev.	0.273547	0.212169
Observations	2478	2478

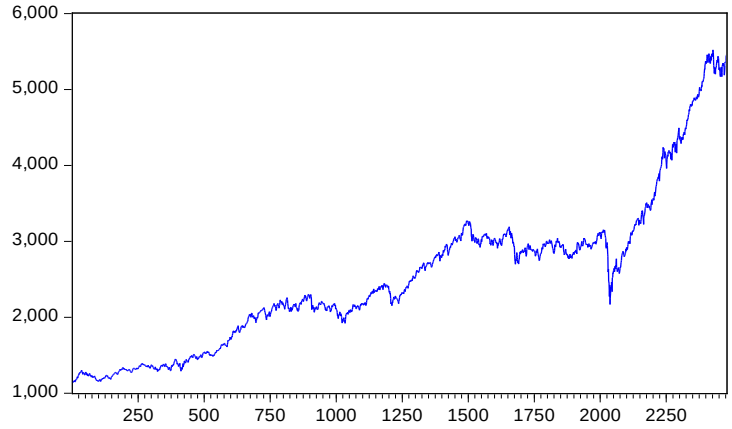
Source: Authors' Compilation

Table I presents the descriptive statistics of the Nifty 500 and Nifty Shariah 500 index return dataset. The results indicate that the Nifty Shariah 500 offers the highest mean returns (0.0637%) as compared to conventional counterpart (0.0576%). This suggests that buying Islamic stocks can increase an investor's profits rather than investing in conventional stocks (Sahabuddin *et al*., 2020). The skewness value is -1.461396 and -1.176323 for Nifty 500 and Nifty Shariah 500 respectively. The standard deviation is considered as a yardstick to measure the risk associated with the Indices. The standard deviation of the given return series has been used to estimate a stock's risk (Natarajan and Dharani, 2012). The standard deviation of the conventional index (0.010509) is higher than the Islamic index (0.009255) which indicates that the former is a more volatile or riskier market than the later. It is interesting to note that the Nifty 500 and Nifty Shariah 500 return series do not follow the normal risk-return relationship. The higher return series of Nifty Shariah 500 (0.000637) is associated with lower risk (0.010509). To obtain higher returns on low-risk investments, these findings initially advise investors to place their money in Shariah stocks as opposed to conventional stocks. The kurtosis statistics are positive and higher than 3 for both indices, 20.94960 for Nifty 500 and 18.54490 for Nifty Shariah 500, reflecting leptokurtic distribution. The findings also show that the datasets of both indices are negatively skewed indicating left-skewed index distribution which is similar to the results of Sahabuddin *et al*., 2020. The Jarque-Bera test results for Nifty 500 and Nifty Shariah 500 are 34147.97 and 25521.22 respectively which indicates that returns are not normally distributed. On the basis of the above, the statistics suggest that Nifty Shariah 500 index gives more return and it is less risky index than Nifty 500.

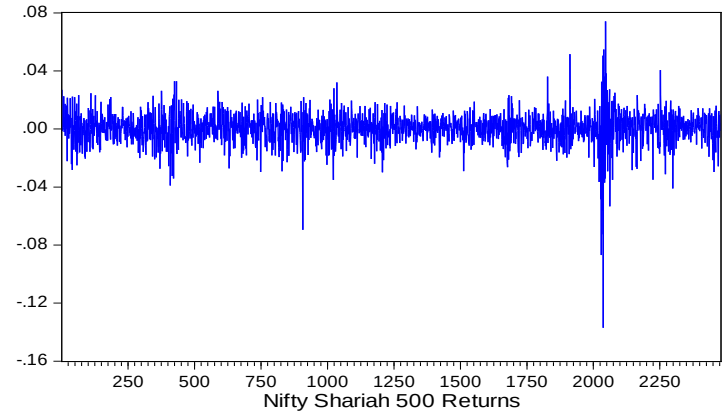
Figure I(a) states that the closing price series of Nifty 500 and Nifty Shariah 500 are non-stationary since stock-market indices are not moving around the constant mean and variance. Both stock-market indices (Nifty 500 and Nifty Shariah 500) display a clear upward slope which is an indication of no constant mean. In addition, the vertical fluctuations are not similar at different points of time series indicating that variance is not constant. Thus, it is said that the indices are non-stationary in the present form.

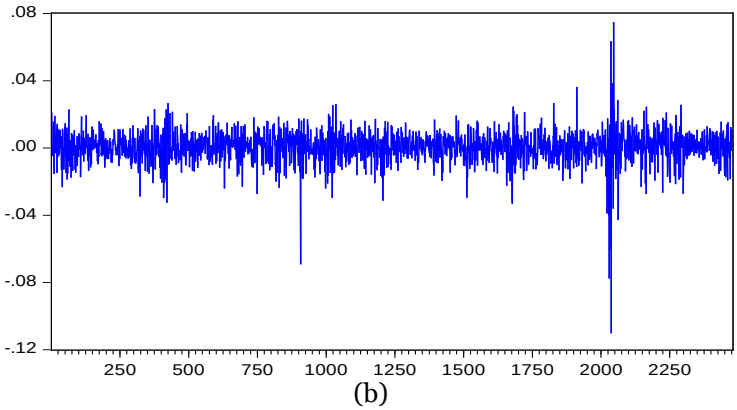
Figure I(b) depict the graphical representation of Nifty 500 returns and Nifty Shariah 500 returns for the period 2013-2022. When the series are converted into first difference, it shows that series become stationary at first difference in both the cases, i.e. Nifty 500 returns and Nifty Shariah 500 returns.





(a)





(b)

Figure: I: Closing Prices and Returns of Nifty 500 and Nifty Shariah 500

4.2 Unit root test for stationarity

Table II: Unit Root Test for Stationarity at Level

Null Hypothesis: Series has a unit root					
Exogeneous: Constant					
ADF			PP		
Level Data	t-Statistic	Probability	t-Statistic	Probability	5% Significance Level
Nifty 500	0.547878	0.9883	0.569219	0.9889	-2.862506
Nifty Shariah 500	1.786908	0.9998	1.955494	0.9999	-2.862506
Exogeneous: Constant, Linear Trend					
Nifty 500	-1.418391	0.8557	-1.321211	0.8823	-3.411626
Nifty Shariah 500	-0.094215	0.9950	0.113377	0.9974	-3.411626

Source: Author's Compilation

Note: * indicates probability at 5% significance level.

Table II reported the test results for ADF and PP test at Level. Null hypothesis for the test is that Nifty 500 and Nifty Shariah 500 has a unit root. The p-value and t-statistics at 5 % critical value for both the ADF and PP test are more than 0.05 which means that the series is non-stationary and has a unit root. The t-statistics value for ADF test is 0.547878 and 1.786908 at constant, -1.418391 and -0.094215 at constant and, at constant and linear trend for Nifty 500 and Nifty Shariah 500 respectively. P-value at constant is 0.9883 for Nifty 500 and 0.9998 for Nifty Shariah 500 and at constant and linear trend p-values are 0.8557 and 0.9950 for Nifty 500 and Nifty Shariah 500 respectively. T-statistics values for Philip Perron test are 0.569219 and 1.955494 at constant, and -1.321211 and -0.113377 at constant and linear trend for Nifty 500 and Nifty Shariah 500 respectively. P-value at constant is 0.9889 for Nifty 500 and 0.9999 for Nifty Shariah 500 and at constant and linear trend p-values are 0.8823 and 0.9974 for Nifty 500 and Nifty Shariah 500 respectively. And the 5% significance level is -2.862506 at constant and -3.411626 at constant and linear trend for both ADF and PP tests. The above analysis reveals that the t-statistics, p-value and 5% significance level in case of Nifty 500 and Nifty Shariah 500 considering both constant as well as constant and linear trend is more than 0.05. Therefore, it is concluded that series is not stationarity at level.

Table III: Unit Root Test for Stationarity at First Difference

Null Hypothesis: Series has a unit root					
Exogeneous: Constant					
ADF			PP		
First Differenced Data	t-Statistic	Probability	t-Statistic	Probability	5% Significance Level
Nifty 500	-17.40008	0.0000	-47.38881	0.0001	-2.862509
Nifty Shariah 500	-17.32811	0.0000	1.955494	0.0001	-2.862509
Exogeneous: Constant, Linear Trend					
Nifty 500	-1.418391	0.0000	-47.40054	0.0000	-3.411626
Nifty Shariah 500	-17.45116	0.0000	-46.88387	0.0000	-3.411626

Source: Author's Compilation

Note: * indicates probability at 5% significance level.

Table III depicts the results of stationarity using the ADF and PP test at the first difference of data for constant and constant and linear trend. Null hypothesis for the test is that Nifty 500 and Nifty Shariah 500 has a unit root. The t-statistics value for ADF test is -17.40008 and -17.32811 at constant, -17.44070 and -17.45116 at constant and linear trend for Nifty 500 and Nifty Shariah 500 respectively. P-value at constant and, at constant and linear trend is 0.0000 for Nifty 500 as well as for Nifty Shariah 500 respectively. The t-statistics values for PP test are -47.38881 and -46.80058 at constant, and -47.40054 and -46.88387 at constant and linear trend for Nifty 500 and Nifty Shariah 500 respectively. The p-value at constant is 0.0001 for Nifty 500 and Nifty Shariah 500, and at constant and linear trend is 0.0000 for Nifty 500 as well as Nifty Shariah 500 respectively. The 5% critical values are -2.862509 at constant and -3.411626 at constant and linear trend for Nifty 500 and Nifty Shariah 500 for both ADF and PP test. The calculated value of t-statistics for all the variables for ADF and PP test is more (in absolute value) than the 5% critical value and p-value is less than 0.05(Table 6.3), it means that variables are stationary and the null hypothesis is rejected. Hence, it is concluded that the data series is stationary or integrated of I (1). This result fulfils the precondition to perform the next test of the Johansen co-integration and the results are consistent with Mansoor and Siddiqui, 2019.

4.3 Co-integration test

Table IV: Co-integration Rank Test (Trace)

Null Hypothesis: There is no Co-integration			
Number of Cointegrating Vectors	Trace Statistics	0.05 Critical value	Probability*
r =0	25.26226	15.49471	0.0013
r ≤ 1	4.294321	3.841465	0.0382

Source: Author's Compilation
Note: * indicates probability at 5% significance level

Table IV depicts the value of trace statistics (25.26226) is more than the critical value at 5% level (15.49471) at r=0 which reveal the presence of co-integration among the Indices. The null hypothesis taking on at most one co-integrated equation r<1 is also rejected because the trace statistics (4.294321) is more than the critical value (3.841465) which reveal the presence of a long-run relationship among Nifty 500 and Nifty Shariah 500. The p-value for the test at r=0 is 0.0013 and at r<1 is 0.0382. Trace statistics result indicates one-cointegrating equation among variables.

Table V: Co-integration Rank Test (Maximum Eigen Value)

Null Hypothesis: There is no Co-integration			
Number of Cointegrating Vectors	Max-Eigen statistic	0.05 Critical value	Probability*
r =0	20.96794	14.26460	0.0038
r ≤ 1	4.294321	3.841465	0.0382

Source: Author's Compilation
Note: *Indicates Probability at 5% significance level

Table V depicts the value of Max-Eigen statistics (20.96794) is more than the critical value at 5% level (14.26460) at r=0 and also at r<1, the value of Max-Eigen value (4.294321) is more than the critical value (3.841465) which reveal the existence of a long-run relationship between Nifty 500 and Nifty Shariah 500. The p-value for the test is 0.0038 and 0.0382 at r=0 and r<1 respectively. So, the Max-Eigen value test also showed there is co-integration among variables.
The Trace statistic and Max-eigen value statistic show the presence of 1 co-integration equation at a 0.05 level of significance (Table 4.4 and Table 4.5). From this, it is concluded that there is a long-run association among the stock-market indexes. In other words, this implies that the considered variables are co-integrated. There is co-movement between the two indexes, so the series cannot move independently or far apart from one another. These results are consistent to Hoque, 2007; Albaity and Ahmad, 2008; Zainol and Kassim, 2010; Palamalai *et al.*, 2013; Jebran *et al.*, 2017; Mansoor and Siddiqui, 2019 and contrary to Beik and Wardhana, 2011; Mohanasundaram and Karthikeyan, 2015. These findings allow researcher to conduct the next test namely VECM test to estimate the short-run relationship among the stock-market indices.

4.4 VAR Lag Length Criteria

Table VI: VAR Lag Length Criteria

Lag	Log L	LR	FPE	AIC	SC	HQ
0	-38354.08	NA	1.00e+11	31.00734	31.01204	31.00905
1	-23818.68	29035.55	793565.8	19.26005	19.27415	19.26517
2	-23802.87	31.54387	786029.3*	19.25050*	19.27400*	19.25904*
3	-23800.95	3.828873	7873523	19.25219	19.28508	19.26414
4	-23798.72	4.443858	788479.7	19.25362	19.29597	19.26898
5	-23791.43	14.52959*	786380.8	19.25095	19.30265	19.26973

Note: Each Test at 5% significance level
*Indicates Lag order selected by the criteria

Lag length is selected by VAR Lag length selection criteria. The lag suggested by LR is 5 but FPE, AIC, SC and HQ has suggested Lag length of 2 at 5 % significance level. Since optimum lag length suggested by the most of the criteria is 2, so the foregoing analysis in the present research is based on 2 lag length.

4.5 Vector Error Correction Model (VECM)

Table VII: VECM

Error Correction	D (Nifty 500)	D (Nifty Shariah 500)
Co-integrating Equation 1	-0.022624 [-4.47219]	-0.006300 [-4.21171]
D (Nifty 500(-1))	0.149111 [3.26061]	0.026946 [1.99272]
D (Nifty 500(-2))	-0.029594 [-0.64701]	0.002040 [0.15086]
D (Nifty Shariah 500(-1))	-0.376540 [-2.42946]	-0.026370 [-0.57540]
D (Nifty Shariah 500(-2))	0.119044 [0.76739]	0.007935 [0.17299]
Constant	4.474565 [2.68895]	1.655844 [3.36524]

Source: Author's Compilation
Note: Values in parenthesis are t-static

Table VIII: Wald Test

Variable	Test Statistic	Probability
Nifty 500	-0.3765	0.0434
Nifty Shariah 500	0.1190	0.0433

Source: Author's Compilation

Table VII represents the estimated results of VECM for Nifty 500 (N500) and Nifty Shariah 500 (NSH500). The VECM measures two types of causalities, that is long-run as well as short-run causality. One is long-run causality and another is short-run causality. The Co-integrating Equation 1 in the model is the coefficient for long run causality and it is also termed as ECT. The first term in both models is the Error Correction Term (ECT), that measures the speed of adjustment towards the equilibrium in the long-run. D(N500(-1)), D(N500(-2)), D(NSH500(-1)), D(NSH500(-2) and Constant are the coefficients of short-run causality. If the sign of ECT is negative and statistically significant, it can be said that there is a long-run causality running from Nifty 500 to Nifty Shariah 500 and Nifty Shariah 500 to Nifty 500 respectively. It is witnessed from Table 6.6 that ECT i.e. (-0.022624) is negative and less than 0.05, which is significant at the 5% level, implying that there is a long-run causality running from the Nifty 500 index to Nifty Shariah 500 index and the Nifty Shariah 500 index to Nifty 500 index. The coefficient of ECT (-0.02), is the speed of adjustment of any equilibrium towards long-run equilibrium and suggests that the correction is happening at the rate of 2.2 %. These results further confirm a long-run relationship between the Nifty 500 and Nifty Shariah 500 indices. Therefore, the previous period short-run disequilibrium would be corrected toward the long-run equilibrium. The evidence for the long-run association among the indexes is expected, as because the Nifty Shariah 500 index is formed as a subset of the Nifty 500 index, and includes all stocks included in the Nifty 500 index that pass rules-based screens for Shariah-compliance. By applying Wald test, it is clear that short-run coefficients are also significant as the p-value is less than 0.05. The text suggests (Table VIII) that there is also short-run causality among the variables and these results are consistent with Hoque, 2007; Albaity and Ahmad, 2008.

4.6 Granger causality test

Table IX: Granger Causality Test

Null Hypothesis	F-statistic	Prob.
Nifty 500 does not granger cause Nifty Shariah 500	12.0915	0.0000*
Nifty Shariah 500 does not granger cause Nifty 500	8.63012	0.0002*

Source: Author's Compilation, Note: * Significance at 5 %.

The table IX shows that there is Bidirectional causality among Nifty 500 and Nifty Shariah 500. The test is based on F-statistics and P-value. The F-statistics for Nifty 500 is 8.63012 and for Nifty Shariah 500 is 12.0915 which are more than 0.05. As the p-value for both Nifty 500 (0.0002) and Nifty Shariah 500 (0.0000) are less than 0.05 so we reject null hypothesis of there is no causal relationship among variables. Therefore, both Nifty 500 and Nifty Shariah 500 have cause and effect to each other. The results are consistent with (Albaity and Ahmad, 2008; Zainol and Kassim, 2010; Jebran *et at*., 2017).

4.7 Variance Decomposition

Table X: Variance Decomposition

Variance Decomposition of N_500:

Period	S.E.	N_500	N_SH_500
1	82.37452	100.0000	0.000000
2	119.0882	99.92001	0.079987
3	146.6662	99.93202	0.067976
4	169.5504	99.94666	0.053343
5	189.4964	99.95727	0.042728
6	207.3489	99.96334	0.036660
7	223.6111	99.96462	0.035383
8	238.6124	99.96096	0.039039
9	252.5812	99.95228	0.047716
10	265.6840	99.93852	0.061476

Variance Decomposition of N_SH_500:

Period	S.E.	N_500	N_SH_500
1	24.35731	80.56467	19.43533
2	35.39336	81.75306	18.24694
3	43.92018	82.05037	17.94963
4	51.03481	81.99450	18.00550
5	57.26136	81.80178	18.19822
6	62.86390	81.54366	18.45634
7	67.99756	81.24759	18.75241
8	72.76252	80.92692	19.07308
9	77.22790	80.58904	19.41096
10	81.44380	80.23841	19.76159

Cholesky One S.D. (d.f. adjusted)
Cholesky ordering: N_500 N_SH_500

Table X reported that in the short-run (quarter 3), impulse or shock or innovation to Nifty 500 accounts for 99.93 percentage variation of the fluctuation and Nifty Shariah 500 is causing 0.06 % fluctuation to Nifty 500. But in the long-run (quarter 10), a shock to Nifty 500 accounts for 99.94 percentage to itself and 0.06 % fluctuation from Nifty Shariah 500. Variation from Nifty Shariah 500 to Nifty 500 is 82.05 % and 17.94 % from its own in the short-run (quarter 3) and in the long-run (quarter 10), a shock to Nifty Shariah 500 to Nifty 500 is 80.23 % and variation from its own is 19.76 %.

4.6 Impulse Response Functions

Figure II: Impulse Response

Response to Cholesky One S.D. (d.f. adjusted) Innovations

± 2 analytic asymptotic S.E.s

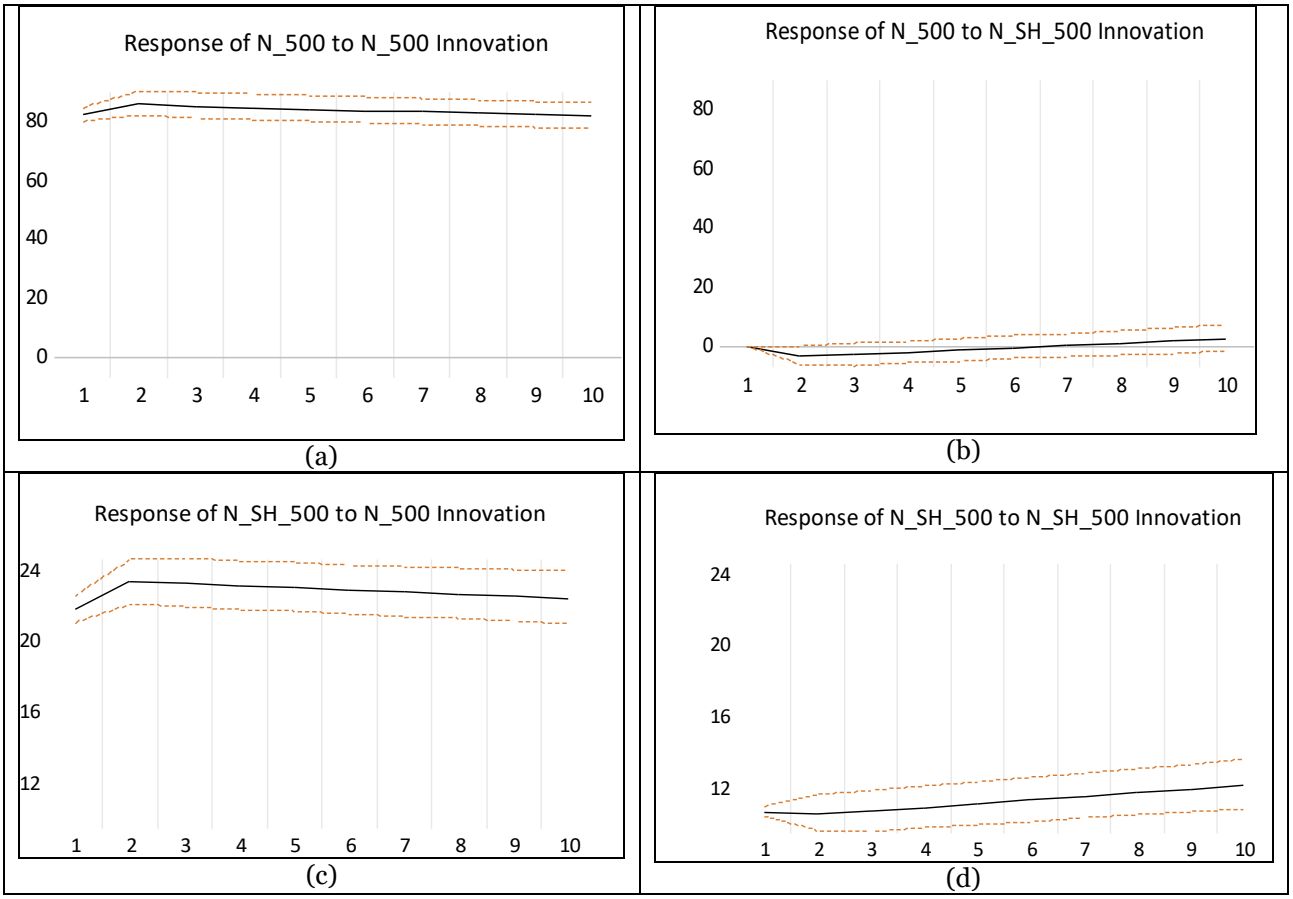


Figure II (a) shows that an effect of shocks from Nifty 500 to its own is positive and there is a constant trend but Figure II (b) Nifty 500 shock to Nifty Shariah 500 is negative till seventh year but after that there is a rising trend from seventh to tenth year. Figure II (c) The response of Nifty Shariah 500 to Nifty 500 is positive and it is rising up to second year and after that it becomes stable. Figure II (d) Response of Nifty Shariah 500 to Nifty Shariah 500 shock is positive.

5. Findings and Recommendations

The present research examines the relationship and degree of Co-integration between the Nifty 500 and Nifty Shariah 500 indices. At level data, both indices are discovered to be non-stationary; however, following the first differencing, they both become stationary. There is a long-term association between these stock markets, according to the Maximum Eigen value and Trace statistic. In other words, they eventually become co-integrated. With the use of the VECM, the short-term link between the stock markets is examined, and the findings show that both indexes are susceptible to changes in other stock markets. Hakim and Rashidian (2004), Albaity and Ahmad (2008), Hakim and Rashidian (2002), Hassan and Girard (2010), Majdoub and Mansour (2014), Albaity and Mudor (2012), Jebran *et al.,* (2017), Bayram and Othman (2019), Arif *et al.,* (2020) who also find a long-run relationship between the Conventional and Islamic indices. In contrast to the studies conducted by Kok et al. (2009), Karim et al. (2010), Guyot (2011), Khamlichi et al. (2014), and Alexakis et al. (2015), our research indicates a disagreement regarding the existence of cointegration between the Conventional & Islamic indices.

The lack of independence among stock market indices over extended periods of time precludes the potential for investment diversification opportunities for investors (Mohanasundaram and Karthikeyan, 2015). Every move by one indices cascades throughout other indices (Menon *et al.*, 2009). The mean returns of the Nifty Shariah 500 are more than the Nifty 500 and the Nifty 500 is more volatile or riskier than the Nifty Shariah 500. But when long-run & short-run relationship is examined between the indices, there are dynamic linkages between the indices in both long-run and short-run. And because of co-movement in these two indexes, diversification of stocks is not fruitful. Islamic indices, however, could be less erratic and more calming (Albaity

and Mudor, 2012). When financial integration is flawless, investors cannot profit from arbitrage possibilities (Abbes and Trichilli, 2015). Investors can get benefit only by investing in any one index. These findings conflict with those of Saiti et al. (2014), who claimed that there may be prospects for diversification within the same nation. These findings provide valuable information to financial advisers and stock market investors since they may assist them to predict the future trend of the indices, which will help them plan and make the best possible investment decisions. The results will aid policymakers in planning and improving stock market operations (Isa *et al*., 2020). Financial interdependence data suggests that market-wide financial disruptions will affect other markets. Such policies may be created by the policy makers to address the interdependence of the indices from the standpoint of financial stability. Additionally, for local and foreign investors looking to diversify their portfolios, an understanding of market linkages is crucial. The combination of conventional and Islamic indices in India has revealed that investors who hold both indices in their portfolios may not be able to profit from diversification. To get profit from diversification, however, Investors have the option to include an index into their investments. Investors can also place money in Islamic indexes, which provide higher returns than their conventional counterparts. Future study could also make a comparison between Indices of different countries and co-integration among Indices and macroeconomic variables.

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