CAPITAL UNIVERSITY OF SCIENCE AND TECHNOLOGY, ISLAMABAD


# Return and Volatility Spillover among Shariah Compliant Equity Markets

by

Humma Abarat

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*This work is dedicated to my beloved parents and family members who have encourage me to achieve this milestone. I would also like to dedicate this work to my respected supervisor "Dr. Arshad Hassan" for his support and guidance in each step of this study.*


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Humma Abarat

(MMS191012)

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| S. No. | Examiner | Name | Organization |
|---|---|---|---|
| (a) | External Examiner | Dr. Syeda Faiza Urooj | FUUAST Islamabad |
| (b) | Internal Examiner | Dr. Saira Ahmed | C.U.S.T. Islamabad |
| (c) | Supervisor | Dr. Arshad Hassan | C.U.S.T. Islamabad |

Dr. Arshad Hassan
Thesis Supervisor
March, 2021

Dr. Lakhi Muhammad
Head
Dept. of Management Sciences
March, 2021

Dr. Arshad Hassan
Dean
Faculty of Management & Social Sciences
March, 2021

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# *Abstract*

The Purpose of this study is to explore the return and volatility spillover among shariah Compliant equity markets. This study covers time period from 1st July 2012 to 31st June 2020 by employing TVP-VAR methodology of Diebold and Yilmaz(2009) on daily and weekly return and volatility series of shariah Compliant equity markets . This study use extended static approach and as well dynamic rolling window that examine return and volatility spillover in TO and From context. This study has three main purpose that are (i) to capture return spillover across Islamic markets (ii) to capture volatility spillover across shariah Compliant equity markets (iii) to explore directions of spillover across shariah Compliant equity markets. The findings of this study indicate the time varying nature of return and volatility spillover. Return and Volatility spillover among selected sample countries is not constant over time. Return and volatility spillover is high in some periods and lower in other periods.The spillover is generally high during crisis period of June 2014 when Civil war has been started which affect whole economy of world. All markets are net recipient of information in some periods and also disseminate information in other periods. The results show the positive and significant correlation among India (FTSE SHARIAH INDIA) and Thailand (FTSE SET Shariah Index), USA (FTSE SHARIAH USA) and Canada ( S&P-TSX 60), Qatar (QE Al Rayan Islamic) and Dubai (FTSE NASDAQ DUBAI 10 SHARIAH); also indicate the high static and dynamic connectedness among these markets..

**Keywords: Spillover,Return and Volatility, TVP, VAR, Connectedness, Shariah Compliant Equity Markets**

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# Abbreviations

| | |
|---|---|
| **DYCI** | Diebold Yilmaz Connectedness Index |
| **EMH** | Efficient Market Hyphothesis |
| **GARCH** | Generalized Autoregressive Conditional |
| **TVP** | Time-varying parameter |
| **VAR** | vector autoregressions |

# Chapter 1

# Introduction

Co-movement between financial markets is greatly influenced by the globalization. The prices and volatilities of the stock markets are appeared to be sharply connected to each other. Particularly, during the financial crisis period markets move more closely and tighter, as global financial crisis of 1997-1998 and 2008 shows the confirmation of market contagion. Market contagion and market integration are linked to the efficiency of the market.

The investors expectations about the future cash flows are reflected in prices of assets. The precision and rapidness in which the market decodes the prospect in to prices are named as market efficiency. According to Efficient Market Hypothesis (EMH) a market is efficient when prices of the shares pursue an independent path, and this occurs due to existence of numerous macro and micro factors committing towards efficiency.

An overview of the literature provides that researchers generally employ three techniques to study the return and volatility spillover across markets these methodologies include Co-integration analysis, ARMA-GARCH Models, and DCC GARCH Model. The techniques have been criticized by Diebold and Yilmaz as these do not capture the directional spillover and report the magnitude of spillover.

These authors propose a methodology based on variance decomposition in 2009 and further extend in 2012 and 2018. Diebold and Yilmaz (2009) measure directional and total volatility spillover by analyzing global major equity markets.

Yilmaz (2010) use the model to explore connectedness in East Asian markets. Diebold and Yilmaz (2012) measure directional and total volatility spillover by analyzing four markets of the US. Korkmaz et al. (2012) provide a brief study of return and volatility spillover across the frontier countries. Tiwari et al. (2018) present a global image of spillover among asset classes by taking global indices across various countries. Little work has been done in this context and particularly no work is available for shariah-compliant securities.

Those who invests in shariah-compliant securities have a specific school of thought so they have limited opportunities for global diversification across conventional instruments and markets. Many investors prefer cross-border investment in the same asset class markets for diversification. Therefore, it is necessary to test the possibility of diversification regarding shariah-compliant investment. Here, the objective is to investigate the financial connectedness across shariah-compliant markets so the study is not combining conventional and Islamic markets.

Over time investment in Islamic Finance is increasing and the market is expanding. Earlier fewer opportunities are available but with the time countries offering shariah-compliant investment opportunities are increasing. It is need of the time to investigate the interdependency between these markets and identify the benefit of diversification for investors.

Similarly, the level of spillover may vary over time so even in those cases where some research evidence exists; a revisit is desired to substantiate the results of that evidence. As spillover involves time varying characteristics concerning return volatility. The financial crisis begins in 2007 and affects the whole economy of the world. Mostly developing companies affect through these crises and emerging economies are also affected due to financial crises (Roni et al., 2018). Therefore, it is also imperative to see the impact of the said crisis on the connectedness of Islamic equity indices. This study is planned to analyze the Islamic indices to see how the connectedness of the Islamic equity market is affected during financial crises.

This study emphasize on shariah compliance equity market by using Islamic indices of the Muslim world and uses the vector Auto-regression Model and variance

decomposition approach which is presented by Diebold and Yilmaz. This approach reveals whether the Islamic equity market is connected with the world. If they are connected then spillover exists in return or volatility or both. This approach reports the direction of spillover effect too by breaking down the variance. This study deals with flow of information available in the market and its adjustment across markets.

## 1.1 Theoretical Background

There is a lot of debate over the past fifty years on Market Efficiency Theory. The number of studies has been conducted, and still work is being done as dynamics of markets and asset class are not consistent. The finance and economics debates are leaded by the EMH as an imperative theory that comprehensively explain the fluctuation of prices with the injection of any information.

Market Efficiency Theory (EMH) deals with the adjustment of share prices to arrival of information and postulates that prices reflect all available information. The prices of financial instruments change when new information hits the market. Returns increase with the arrival of good news and market discount the prices on the arrival of bad news. Over time, all the markets of the world become inter-dependent with each other due to globalization, cross-border investment, exports and imports, and economic integration in the world. Theatrically markets are not much isolated in the world so the flow of information exists between different markets. This flow of information has always attracted the academician and investors to examine the dynamics of the flow of information across markets.

The early studies of Samuelson (1965) and King and Cootner (1965) set a base for the Efficient Market Theory, but the foundation of theory is achieved by the work of (Fama, 1965). The study of Fama (1965) identify three form of Efficient market Hypothesis i.e. weak form, semi strong form and strong form. Another study done by Fama et al. (1969) observe how assets absorb all the upcoming information in their prices. The result of the study provides the evidence that stock prices strongly show movement with the arrival of any news or making of

any decision in the market, but this process is more fast and rapid after the date of announcement and then slows down at the end of the month. Further, result concludes that market is always efficient and prices of asset quickly respond to the any happening in the global markets.

Malkiel and Fama (1970) states that market should be efficient for resource allocation and it is visible when stock prices fluctuate according to injection of any news in the market. In domain of EMH another study done by Fama (1998) find causality in the anomalies as it adjusted according to any event or happening in the market. It is approximately as common as under-reaction and current-event persistence of past-event unusual returns is approximately as common as current-event turnaround. Further result confirms that frequently anomalies with long term tend to disappear with rational changes, showing consistency with EMH.

The study of Samuelson (1965) and Mandelbrot (1966) also document that market is always efficient as stock prices quickly respond to the arrival of any information from any part of the world. Sweeney (1984) conducts a study showing consistency with the market efficiency theory. Results confirm consistency in three directions, firstly at a macroeconomic level, secondly any change in the monetary policy fully absorbed in the prices of a nominal transaction in the current period, thirdly all large-scale macroeconomic models reject by the rational expectation hypothesis (REH) but support the market efficiency theory.

Kim (2015) investigates the integration between the Korean stock market and other stock markets and observes the weak-form of efficient market theory. Result of the study indicate all stock markets show consistency with the market efficiency theory as their return chase random procedure but collectively their returns are not efficient. Stock market of USA and Japan significantly influence the Korean stock market return, while the volatility of Korean stock market is influenced by Taiwan stock market, supporting the market efficiency theory.

A study based on NSE 50 and Nifty stock market is done by Chavannavar and Patel (2016). This study analyze the linkage between the markets to check whether stock prices fluctuates according to any changes in the other market and past prices reflect in today's return. The result of the study report that stock

prices behave accordingly as any variation is observed in the other market, which confirms that market is always efficient, showing consistency with EMH.

The EMH provides the overall foundation to this study. The Shariah compliance equity market is one of the fundamental components in global financial market which play key role for the economy and offers the chance to investors for investment and make profit. The inflow of information from one market has a great influence on the prices of stock, so on the basis of such information market players adjust their cost appropriately that has no great impact on the value of firm. Asymmetry information also exist in the market and has an impact on investor wealth . This study focuses on shariah compliance equity market by using Islamic indices of the Muslim world to examine whether there exist return and volatility spillover among the shariah compliance equity markets.

## 1.2 Gap Analysis

Many studies discuss the return and volatility spillover across the markets. Most of the studies measure the return and volatility spillover among Asian developed and emerging equity markets. Spillover has been studied between markets, currencies, and between cryptocurrencies but spillover is not analyzed in the context of shariah-compliant securities and indices.

The studies based on shariah-compliant securities are available in the context of correlation not in spillover background. However, a group of shariah-compliant equity markets is an ignored area. No study provides information about measuring return and volatility spillover among the shariah-compliant equity market. This study bridges this gap by examining the spillover across Islamic indices of the world.

## 1.3 Research Questions

Following questions are raised and subsequentially answered keeping in view the research gap of the study:

**Research Question 1**

Does returns of one Islamic market influence the returns of others?

**Research Question 2**

Does volatility spillover exist from one Islamic market to another Islamic market?

**Research Question 3**

What is the direction of spillover across markets?

## 1.4 Research Objectives for this Study

Three main objectives of study are as follow:

**Research objective 1**

To provide insight about the spillover of a return across Islamic markets.

**Research objective 2**

To investigate the volatility spillover across Islamic markets.

**Research objective 3**

To identify the direction of spillover across the market.

## 1.5 Significance of the Study

The Islamic equity market is gradually expanding. The interest of market players is growing rapidly to invest in Shariah-compliant securities. Investors want to get more information about shariah-compliant equity markets especially in the context of return and volatility spillover. Regulators markets are interdependent so regulators should be careful regulations while revising the policies in the context of risk management to protect the investors from external continuous effect.

This study is very beneficial for investors of Shariah Compliant Securities and it provides a detailed analysis of return and volatility spillover with application to shariah-compliant equity markets. The study uses Diebold and Yilmaz's

methodology (2009) that covers the connectedness of markets in the bidirectional setting.

## 1.6 Plan of Study

Introduction, Theoretical Background, Gap Analysis, Research Questions and Objectives and significance of the study is covered in chapter 1. The brief overview of past studies focusing on mean and volatility spillover among different financial markets as well as spillover technique of Diebold and Yilmaz, and hypotheses of the study are discussed in chapter 2. Chapter 3 includes data description, variable description and the spillover methodology proposed by Diebold and Yilmaz. The results obtained by employing the spillover method of Diebold and Yilmaz are presented and discussed in chapter 4. The last chapter covers the conclusion and recommendations of the study.

# Chapter 2

# Literature Review

Many studies discuss return and volatility spillovers. These studies employ GARCH based techniques to capture return and volatility spillover by using data and samples from different markets and time horizons.

## 2.1 Return and Volatility Spillover among Different Financial Markets

Miyakoshi (2003) measures the magnitude of return and volatility spillover to seven stock markets of Asian countries (Malaysia, Taiwan, Indonesia, Singapore, Korea, Thailand and Hong Kong) from US and japan by applying bivariate EGARCH from 01/01/1998 to 30/04/2000. This study use daily data and report the significant volatility spillover from US and Japan to Asian markets and significant return spillover from the US to Asian markets while return spillover from Japan to the Asian market is insignificant. They discuss a volatility spillover framework that deals with the exogenous variable (US shock) for Japan and sample markets of Asian. Firstly, it state that only the impact of the United State is vital for returns of Asian market but Japan has no effect. Secondly, Japan has more effect on the Asian markets volatility as compared to United State. Thirdly, there is an adverse impact of volatility from the stock markets of Asia to the stock markets of Japan.

Harris and Pisedtasalasai (2006) find a significant spillover in return and volatility from portfolios of large indices to the portfolios of small indices by using the MV- AR-GJR-GARCH- M model. The study uses daily stock returns of selected indices which are continuously compounded from January 1986 to December 2002. The study split the whole sample into two equal durations for sub-period analysis. The first sample sub-period is from January 1986 to June 1994 and the second sample sub-period is from July 1994 to December 2002.They investigate spillover effects of return and volatility amongst the FTSE Small Cap, FTSE 250 and FTSE 100 stock indices with the help of MV-GARCH framework.

The study expresses that return and volatility spread pattern among large and small stock indices in the United Kingdom are asymmetric. These results are dependable with a market in which information is firstly merged into the large stocks prices before being confiscated into the smaller stocks prices. The study short term returns because it need to examine spillover effects in mutually the mean and volatility of the three sample indices, but time-series-variation in CV (conditional volatility) inclines to be considerably weaker for long-term returns (Harris and Pisedtasalasai, 2006).

Joshi (2011) uses a sample of stock markets of six countries and measure spillover in terms of return and volatility between sample markets by using the GARCH BEKK (Generalized Autoregressive Conditional HeteroscedasticityBaba-Engle-Kraft-Kroner) model from 2007 to 2010. The study use daily closing prices to observe the return and volatility spillover between stock markets of Asia in Japan (Nikkei 225), Jakarta (Jakarta Composite Index), India (Bombay Stock Exchange), China (Shanghai Stock Exchange), Hong Kong (Hang Seng),and Korea (Korean Stock Exchange). The study chooses these indices as a sample because these indices are representatives of emerging and developed economy of Asian countries. The study further finds indication of bidirectional shocks and return-volatility spillover between most of the sample stock markets. The degree of volatility association is low signifying weak incorporation of Asian-stock markets. The study demonstrate that own-volatility-spillover is higher than cross-market-spillover and Japan lies in highest category of stock market volatility and China

lies in lowest category of stock market volatility.

Mensi et al. (2013) report a significant relationship between the US stock market (S&P 500) and the commodity market by employing the VAR-GARCH model. The study uses daily returns from 03/01/ 2000 to 31/12/2011. Knowing the price-behavior of prices of the commodities and the volatility reception pattern among these markets and the stock exchange markets are critical for each contributors well as governments, producers, portfolio managers, consumers and traders. The results show significant reception of return and volatility spillover between the US stock market (S&P 500) and commodity markets.

The earlier shocks and volatility of the US stock market (S&P 500) greatly affect the oil markets and gold markets. The study reveals that there is a highest conditional-correlation among the US stock market (S&P500) and gold index and the US stock market (S&P 500) and WTI (West Texas Intermediate) index. Their findings are very helpful for portfolio hedgers for making allocations of optimal portfolio, fetching in risk-management and predicting future volatility in equity-and-commodity markets (Mensi et al., 2013).

Majumder and Nag (2015) also find evidence about the presence of a significant return and volatility from the stock market to the foreign exchange market by capturing asymmetric responses to shocks through a bivariate EGARCH model. Return and volatility-spillover among the stock market and the foreign-exchange-market have been considered for the market of India from 2003 to 2013. The study further dissect the sample period between pre-crises (2003 to 2007) and post-crisis (2008 to 2013) period and the analysis reveals that the value of volatility spillover has become robust in the after-crisis period. Policies relating to steadiness of stock-market can cut the volatility of exchange rate as well. Though, dealing fluctuation in exchange rate seems to be ineffective way of diminishing volatility of stock market at the point of stress only. Their results demonstrate that return and volatility spillover are uni-directional from stock to foreign-exchange-market and consequently the study approves the existence of portfolio-balance approach in context of India. The study finds asymmetric behavior of volatility spillover from stock to foreign exchange market.

Mohammadi and Tan (2015) investigate a significant return and volatility spillover among the stock markets of Hong Kong, the US and China by using daily data of SSE (Shanghai-Stock -Exchange), SZSE (Shenzhen-Stock-Exchange), SEHK (Hong-Kong-Stock-Exchange) and the US (US-Stock-Exchange) from January 2, 2001 to February 8, 2013. This study uses Multivariate Generalized Autoregressive Conditional Heteroscedasticity (MV-GARCH) model, Constant Conditional Correlation (CCC) and Dynamic-Conditional-Correlation (DCC) based GARCH model.

Their findings report three evidence : (i) Persistence of uni-directional return-spillovers from the United-State to three sample markets but not availability of spillover among Hong- Kong and two markets of main-land China (ii) Presence of uni-directional ARCH-GARCH effects from the United-State to three sample markets (iii) co-relations of returns diverge from one market to another market. The study find that there is highest correlation among the two markets of China, average correlation between main-land China and markets of Hong-Kong and lowest correlations among the United Stat and two markets of China thus, foreign investors may take advantage through investing in Chinas markets (Mohammadi and Tan, 2015).

Yarovaya et al. (2016) analyze inter and intra-regional return and volatility from 11 emerging and 10 developed markets of Asian, American, European and African countries during the time horizon of 2005 to 2014 by using method of Diebold and Yilmaz (2009). The study uses market value weighted indices on the daily basis that are dominated in local currency. The findings reveal that markets are less vulnerable to inter-regional contamination than region-specific volatility and domestic shocks. The study report a different result in their study is a transformation in outlines of international signals communication among models employing indices and futures data. In short futures data deliver more effectual networks of information spread because the extent of return and volatility spillovers across futures is larger as compare to indices. These findings are applicable to experts, such as investors in stock market, policy-makers and helpful in enhancing their understanding in inter-connectedness of financial markets.

Zhang and Wang (2014) report bidirectional and asymmetric return and volatility spillover between china and the world oil market by applying an extended form of Diebold and Yilmaz (2012) method to capture spillover and significant result shows that world oil markets highly affect the Chinese oil market and employs an impact on worldwide oil markets to some extent. Furthermore, the volatility spillover has increased expressively since the ultimate last financial disaster in September, 2008. Though their results show that oil market of US impacts China's market mostly in terms of spillover, oil market of China effect on the world oil market has exaggerated in current years. The study uses sample period of 12 years from 27/12/2001 through 24/12/2013 and 2871 observations. The study uses daily return and volatility data of twelve years and focus on recent ten-year history to make their workup-to-date.

Diebold and Yilmaz (2013) measure real connectedness for a sample of six developed countries through connectedness measurement methodology to check the global connectedness and time varying nature of business cycles from 1962 to 2010 by using Diebold and Yilmaz (2009), Diebold and Yilmaz (2012) and Diebold and Yilmazs (2014) connectedness measurement framework. Using a connectedness-measurement technology fundamentally grounded in modern network theory, they measure real output connectedness for a set of six developed countries, 1962-2010. The study show that global connectedness is sizable and time-varying over the business cycle, and further study the nature of the time variation relative to the ongoing discussion about the changing nature of the global business cycle. It also show that connectedness corresponding to transmissions to others from the United States and Japan is disproportionately important.

Mallory et al. (2012) use the market efficiency theory to create a conceptual link to explore the relationship between corn and ethanol market and find that there is a link between these market as under certain conditions current spot prices will be influenced by future price expectation and short-term relationship exist between input and output prices.

Lim (2020) also find that stock prices of Malaysian banks are not predictable as they randomly move for a long period and only to divide for short interval

of high linear and non-linear dependency structure. According to Imafidon and Arowoshegbe (2015) the capital market is efficient when stock prices fluctuate or adjust according to the arrival of news or information. Results of the study show consistency with market efficiency theory as with the removal of Director of Nigerian stock exchange a significant change has been seen in the prices of stock.

Zhou et al. (2012) find a significant positive impact of volatility of Chinese equity markets on other equity markets. It analyze the directional volatility spillover between Chinese stock market and world stock markets by using the technique of forecast-error variance decomposition in generalized auto-regressive model which is proposed by Diebold and Yilmaz (2011).

Diebold and Yilmaz (2012) consider a sample of four markets US stock, bond, commodity and foreign exchange market and measure daily volatility spillover across these markets and find significant volatility fluctuations from 1999 to 2010 by using forecast-error decomposition technique of generalized vector auto-regressive.

Duncan and Kabundi (2011) studies daily volatility spillover indices related to currencies, equities and bonds of south Africa by using variance decomposition from Generalized VAR model. The study finds a time varying nature in volatility from Oct 1996 to June 2010. It further find that equities as a main source which lead volatility spillover to other asset classes and currencies regulate volatility transmission temporarily and bonds are net recipients of volatility spillover.

Fernández-Rodríguez et al. (2015) examine volatility spillover in EMU SB (Sovereign Bond) markets by taking the sample of eleven countries from 1999 to 2014. The study examines the data of 10 years using methodology of Diebold and Yilmaz (2012) to check the unconditional patterns of spillover. It further performs dynamic analysis to check the directional volatility spillover and finally they uses Panel analysis to evaluate the determinants of directional spillover. The results of the study propose a fundamental change in their mechanism of intensity and in direction by analyzing pairwise directional spillover. Finally, the study further finds that the key elements in the central and bordering countries are not in uniform pattern.

Wang et al. (2016) uses spillover index approach which is presented by Diebold and Yilmaz (2009; 2012) to measure the volatility spillover by taking the sample of four assets including stock, bond, foreign exchange and commodity futures of China from 2005 to 2015. The results show that these markets are weekly integrated and largest net sender is stock market and rest of all are net recipients of volatility spillover. The results also demonstrate that time varying volatility-spillovers express that the current GFC (Global Financial Crisis) and the ESDC (European Sovereign Debt Crisis) greatly influenced Chinas financial markets of China.

Tiwari et al. (2018) uses the methodology of Diebold and Yilmaz (2012) to estimate the connectedness index to measure volatility spillover between four global asset classes which are Credit Default Swap, Sovereign bonds, Stock and Currencies in the time period of 2009 to 2016. According to results, Credit Default Swap (CDS) and stock markets are net transmitter of volatility and currencies and bond markets are net recipients of spillover.

Maghyereh et al. (2016) uses the technique presented by Diebold and Yilmaz (2012; 2014; 2015) to measure the directional connectedness between equities and oil through volatility indices by taking eleven main stock exchanges in time period of 2008-2015. The study finds the uniform results across all the stock exchanges of countries which shows the bidirectional connectedness and spillover between equities and oil. The mechanism of transmissions is fluctuating over the sample time period. Most of the connections among oil and equities are recognized from the middle of 2009 to the middle of 2012 that is a phase that perceived the start of global repossession.

Chevallier and Ielpo (2013) measure the volatility spillover among commodity markets with the help of Diebold and Yilmaz (2012) technique by taking the daily data of equities, commodities, interest rate and currencies according to the VAR model in the time period of 1995 to 2012. The study intends to identify the volatility spillover among commodities, among commodities and asset classes and among currencies and commodities. The results show that commodities reveal weaker volatility spillover as compare to other asset classes and they also find

some currencies give more response to commodity volatility spillover than other. The results also show that total spillover index can be decreased with the help of agricultural products.

Nishimura and Sun (2018) propose a new approach in this study which is known as Intra-day Volatility Spillover Index that is the extended form of spillover index of Diebold and Yilmaz (2012; 2014). The study checks the impact of Brexit vote on volatility spillover across five main European stock markets. The results show no changes in connectedness among these markets in a period of three months but when one month is reduced in period, volatility spillover is increased in the initial month and fall in the second month of period after the vote.

Liow (2015) uses generalized spillover model of Diebold and Yilmaz (2012) to check the conditional volatility spillover among stock, bond, public real estate, money and currency markets on domestic and international level in G-7 countries in the period of 1997 to 2013. The results show there is low volatility spillovers in context of cross assets with in each G-7 country and the main source of total volatility is generalized stock portfolio and volatility constancy is dominant in all domestic asset markets. This study also shows that return and volatility spillover between financial asset classes cycle and domestic business cycle fluctuations are correlated.

Koutmos (2018) select a sample of 18 major Cryptocurrencies on the basis of market capitalization and using daily data from 2015 to 2018 to check the return and volatility spillover in context of interdependencies, spikes and time varying nature of spillover by using the variance decomposition techniques of Diebold and Yilmaz (2009) and Yilmaz (2010). The results indicate more growing interdependencies and increasing integration and time varying nature shows the uncertainty of digital currencies in future. It also shows that Bitcoin is a main source of return and volatility spillover among all the sampled cryptocurrencies.

Diebold and Yilmaz (2015) work on the daily data of stock return volatilities of thirty-five major financial institutions, eighteen institution of Europe and seventeen institutions of United State from the time period 2004 to 2014. This study measure the stock return volatility of the financial institutions of America

and Europe by using the variance decomposition framework of Diebold and Yilmaz (2014). The study find unidirectional connectedness from America to Europe during 2007-2008 but they also find bi-directional connectedness at the end of 2008. The study also finds the main institutions which are the major source of generating connectedness during the crises of United State and Europe.

Sugimoto et al. (2014) uses an econometric approach of Diebold and Yilmaz (2012) to investigate the inter- market transmission of global and regional financial markets by using the daily data from 2004 to 2013 in emerging countries specifically when European Sovereign Debt and US financial crises arisen. The study examines regional, global, commodity and nominal exchange rate to individual countries of Africa during these crises. The results show that the spillover of global, commodity and exchange rate markets severally affected the African countries and regional spillovers are smaller than global in African countries.

Demirer et al. (2018) uses the variance decomposition approach of Diebold and Yilmaz (2009, 2012, and 2014) to estimate the network connectedness of global banks. The study uses a sample of ninety-six banks from twenty-nine developed and developing economies by taking the daily high, low, opening and closing prices of stocks as required in the methodology of Diebold and Yilmaz (2009, 2012, 2014) in the time duration of 2003 to 2014. The results show that there is a great equity connectedness in the networking of global banks as compared to sovereign bonds connectedness by analyzing the static and dynamic network connectedness.

Diebold and Yilmaz (2010) measure a connectedness among financial firms by using the generalized variance decomposition technique from auto-regressive framework presented by Diebold and Yilmaz (2009). The study monitors the return volatilities among financial institutions of United State during the financial crises of 2007 to 2008. They address the daily-time varying and average stock return volatilities of the major financial institutions in United State during the years of financial crises of America and Europe in the time period of 2007 to 2008.

Gamba-Santamaria et al. (2017) extend the technique of Diebold and Yilmaz (2009) and Diebold and Yilmaz (2012) by using the Dynamic Conditional Correlation Model to measure the direct volatility spillover index among the series of

asset returns and capture time varying nature among co-variance matrix. This approach clearly identifies the moves of financial returns inside volatility spillover. The study uses sample stock indices of US and four countries of Latin America which are Brazil, Colombia, Mexico and Chile by covering the daily data of stock market indices from 2003 to 2016. The results show that Brazil is a major source of volatility transmission in the sample and rest of all are volatility recipients.

Charfeddine and Al Refai (2019) analyze that the volatility spillover and stock market dependence of Qatar and other countries like UAE, Saud Arabia, Bahrain, Oman and Kuwait is affected due to recent political and economic crises of March, 2014 and June, 2017. The study test these structural breaks and create two dummy variables that reflect these crises to check the impact on DCC of stock market obtained through ADCC, DCC and CADCC-GARCH models. The study also used Dynamic and Static volatility spillover technique of Diebold and Yilmaz (2012, 2014) to measure the volatility spillover and connectedness among various equity markets. They cover the data period from 2011 to 2018 and their results show only the significant effect of June, 2017 crises on the volatility spillover and equity market dependence among Qatar and other countries except Bahrain.

Klößner and Wagner (2014) use the spillover index for measuring the connection between IFMs (International financial markets) which is developed by Diebold and Yilmaz. According to VAR model, index is based on the ordering of variables and they check strength by totaling the index for a small figure of randomly selected versions, they acquire divide and conquer strategy to explore the large amount of remunerations by using the data of weekly stock markets index returns and volatilities of nineteen countries. The study compute minimum and maximum spillover index of all randomly selected remunerations by using algorithm and find actual limit of spillover is three times larger as calculated by Diebold and Yilmaz.

Abbas et al. (2019) examine the bond between the return and volatility of macroeconomic factors and the stock markets by taking the series of monthly data of G-7 countries from 1985 to 2015 by using the approach of spillover index consists on generalized auto-regressive framework which is presented by Diebold and

Yilmaz (2012; 2014). The analysis shows strong relations between the returns and volatilities of the stock markets the G-7 countries and the measured set of consistent macroeconomic essentials including oil prices industrial production, exchange rates, money supply, interest rates (IR), inflation, and MS (money supply). Global financial crisis of 2008 lead to change in the relationships dynamics of return and volatility spillover transmission among stock markets and macroeconomics essentials of G-7 countries.

Choi and Hyung (2011) uses Extended Constant Conditional Correlation GARCH model to analyze the volatility spillover presented by Diebold and Yilmaz (2009) instead of using VAR model to check volatility spillover of indices of industrial production on monthly basis among Germany, France, Japan, Italy, United Kingdom and United State in the time period of 1958 to 2009.

Fonseca and Gottschalk (2012) studies the credit default swap (CDS) markets of Australia, Japan, Korea and Hong Kong and do a regression analysis to understand the factors of the CDSS (Credit Default Swap Spread) by using weekly data from 2007 to 2010. The study analyzes the relationship at the individual and the market level. It mainly focus on lead-lag relationships among Credit Default Swap spreads, realized stock returns and volatility and also estimate volatility spillover among these variables by using the volatility spillover technique from GVAR model developed by Diebold and Yilmaz (2011). The results suggest that realized volatility plays a main role in the volatility spillover among the three asset classes and the results emphasize the status of realized volatility to understand market movements in a comprehensive way.

Bubák et al. (2011) studies the dynamics of volatility reception among currencies of Central Europe and foreign exchange euro/dollar with the help of model free estimation of regular exchange rate volatility constructed on intra-day data for the time period from 30/05/2007 to 30/06/ 2009. The study find statistically substantial evidence of intraregional volatility spillovers between the Central European foreign exchange markets of Central Europe by using volatility and return spillover approach of Diebold &Yilmaz. The study selects EUR/CZK (Czech koruna), EUR/HUF (Hungarian forint) and EUR/PLN (Polish zloty) as sample

currencies. The analysis is done on the mid-quotes of five-minute spot exchange rate. The results show no significant spillovers consecutively from euro/dollar to the foreign exchange markets of Central Europe except the Czech currency.

Sumner et al. (2010) examine the interdependence among gold, stocks and bonds and presenting new technique by extending the spillover approach of Diebold-Yilmaz (2009) to observe whether returns and volatilities of gold can forecast the movements of stock and bond market of United State or vice versa. The study uses weekly data from different sources due to unavailability of daily data and return spillovers seem as muted during the sample period from 1970 to 2009. Though, there is some indication of volatility spillovers from stocks to the return volatility of bond. Spillovers in context of returns are high during the beginning of 1980s, mid of 1990s and the most recent financial crisis 2007-2008. By analyzing the sample, the study concludes that nature of spillover is dynamic.

Chen and Wu (2016) analyzes the co-movements and connectedness of commodity prospects by using sample period from 1995-2015 and 1996-2016 for past two decades with the help of dynamic conditional correlation framework to construct the time varying dependence structure of various commodities across diverse sectors. The study measure commodity markets connectedness by using framework of Diebold-Yilmaz (2014) that indicates the direction and degree of volatility spillover using GVD (generalized generalized) forecast error from vector auto regression (VAR) models. The study find consistent results of both models by expressing that co-movements and connectedness of commodity markets have intensely increased during financial distress of 2007-2009. The study also finds that recent downfall of commodity prices does not essentially specify the stronger linking between commodity markets.

He et al. (2018) studies the intra-day return and volatility spillovers of CSI 300 (China Stock Index) industry indices of China in the time duration of 2012 to 2016 and calculate spillover indicators by using GVD (Generalized Variance Decomposition)technique with intra-day return and volatility, correspondingly. The Dynamic Correlation among the industries is computed with VECDCC-GARCH framework. The results demonstrate that the correlations among the China Stock

Index 300 industry indices are high. The time window rolling approach is used to estimate the return and volatility spillover index that is developed as connectedness by Diebold and Yilmaz to determine the dynamic features of China Stock Index 300 return and volatility spillover of industries. They sum up that the dynamic features of return and volatility spillover have great consequence on systematic risk, finance and real-estate industries.

Allen et al. (2017) investigate volatility spillover from Korea, Japan, China, and the US which are the Australia's major trading partners in the time duration of 2004-2014. The study finds the impact of the GFC (Global Financial Crisis). It use, some major conventional indices such as Kospi index, Shanghai composite, S&P500 index, Hang-seng and the Nikkei225 index to represent these markets and construct return and volatility spillover on the basis of Diebold-Yilmaz (2009) technique of assessing spillovers from markets. The analysis reveals that the Hong Kong and United State markets have the extreme influence on the markets of Australia. The study further analyzes conditional correlations of Chinese and United State markets by using TVC-GARCH framework.

Suwanpong (2011) measures return and volatility spillovers in GFMs (global financial markets),currencies and equity markets with the help of (variance decomposition) of a generalized vector auto regression (GVAR) and measuring into spillover indices from 1998 to 2010 that is the approach of Diebold-Yilmaz (2009). The study use sample stock market indices of twelve countries and foreign-exchange rates of eleven countries and their results show that nearly 45% and 55% of forecast-error-variance originates from returns and volatilities spillovers of equity market, although the return and volatility spillovers in currency market are around 30%, correspondingly. By analyzing currency market, it is found that the return and volatility spillovers originate from HKD (Hong Kong dollar), IDR (Indonesian rupiah), AUD (Australian dollar) and USD (United State dollar). The study also finds the return and volatility burst among markets in the duration of GFC (Global Financial Crises).

Xiao and Huang (2018) investigates the international crude oil prices connectedness and discovers its time varying features constructed on a measurement

framework of connectedness by using daily prices of international crude oil from 02/ 01/2003 to 17/ 08/2018 with the help of connectedness measurement technique of Diebold-Yilmaz (2016). The study investigates international crude oil prices connectedness with three standpoints: total oil prices connectedness, total oil prices directional connectedness and pairwise oil prices directional connectedness. The study finds that the total and pairwise directional crude oil prices connectedness is very high and Brent and West Texas Intermediate (WTI) crude oil prices highly affect the oil prices of Dubai, Tapes, Minas and Daqing. The study expresses affected countries as price adopters and Brent and West Texas Intermediate (WTI) as price creators.

Balcilar et al. (2021) examines the Monthly realized return and volatility spillover effects among the S&P 500, gold, and , crude oil by using the spillover index of Diebold and Yilmaz (2012) covering the period from 1986 to 2018 for both daily and monthly frequency. The findings indicate a bidirectional return and volatility spillover among these variables. The study finds that return spillover is much higher than average shocks with positive and negative shocks, while volatility spillover is higher only in case of positive large shocks than average shocks. The study calculates the total pairwise spillover in order to acquire the input strength between two assets. The study uses the data of monthly frequency for both return and volatility chain as data at daily frequency to calculate Volatility as the realized volatility.

Bhar and Nikolova (2007) analyses the point of integration on a regional and universal basis of the BRIC countries, attained by using daily data of equity index level from 1995 to 2004 by employing the two-stage GARCH-in-mean approach, as specified by Liu and Pan (1997). The research concludes that a high grade of integration occurs between the BRIC countries and their corresponding regions and to a slighter extent to rest of the world. Regional tendencies are found to have a much bigger impact than world tendencies upon the stock return process of the BRIC countries.

The Results show that world index returns and the returns of US equity market have a significant impact on the variance of returns across Brazil, Russia

and India. China is the only country where there exists a adverse relationship among volatility spillover effects on a regional and universal basis. This proposes presence of diversification opportunities for investment managers. This research use daily closing equity market index prices for working days only and weekends are excluded from the data sample (Bhar and Nikolova, 2007).

Baruník et al. (2016) conduct its research on two concepts, description of measure of volatility and description of how to measure volatility spillover. So, they examine how to enumerate volatility spillovers asymmetries that develop due to good and bad volatility by using Diebold and Yilmaz (2009) technique which is based on forecast error variance decompositions from vector auto regressions. This study use sample that cover twenty one liquid stocks of US in seven sectors to provide sufficient indication of the asymmetric connectedness between stocks at the disaggregate level by covering period from 2004 to 2011. Additionally, the spillovers of bad and good volatility are transmitted at different levels that generously vary with time in different sectors. The study finds the connectedness of intra-markets stocks in US increased significantly during the recent financial crisis.

Gallagher and Twomey (1998) employs a MV-VAR-GARCH analysis developed by Engle (1982) to identify the source of mean and volatility spillovers from one financial series to another by examining the role of the UK stock market in the price behavior of the ten largest Irish stocks. The study use daily closing prices from time period of 1988 to 1996. The study concludes that there is significant relationship between UK stock market and Irish Stock market which indicates significant and persistent return and volatility spillover exist form UK stock market to Irish Stock market.

Hirayama (2012) analyze return and volatility spillovers during overlying trading hours between China stock market and Japan stock market using intra-day high frequency data by applying two step method established by Cheung and Ng (1996). The study estimates suitable volatility model for each uni-variate time series to find their standardized residuals in first section. In Second step it uses CCF of standardized residuals and squared standardized residuals to identify mean

causality and variance -causality among Japanese and Chinese stock markets. The results of this study indicate a uni-directional impact from China to Japan both in case of return and volatility. Additionally, volatility spillover arises with some interruption after a return spillover.

Above litreture focus on common research methodologies like ARMA-GARCH, DCC-GARCH, Co-integretion etc and create linkage among different financial markets of world , whereas Shariah Compliant Equity market is an ignored area and research method of Diebold and Yilmaz to capture spillover is not much focus in earlier studies. so, this study bridges this gap by employing TVP-VAR method of Diebold and Yilmaz and this study is supported by EMH, which deals with flow of information availible in the market.

## 2.2 Hypothesis of the Study

Hypothesis of the study are as follows:

**Hypothesis 1**

There exists return spillover across Islamic markets.

**Hypothesis 2**

There exists volatility spillover across Islamic markets.

**Hypothesis 3**

There exists directional spillover across Islamic markets.

# Chapter 3

# Research Methodology

## 3.1 Data Description

### 3.1.1 Population and Sample of Study

The population of the study is Shariah Compliant Equity Markets of the world and the sample is 10 Shariah Compliant Indices of the world. Daily and weekly data is used in analysis and data is taken from Investing.com.

## 3.2 Description of Variables

The study uses returns of the market indices calculated under the assumption of compounded continuously by using the formula as under

$$R_t = ln(\frac{P_t}{P_{t-1}}) \tag{3.1}$$

Where

Rt = Return of shariah complaint equity index

ln = Natural log

$P_t$ = Current day closing prices

$P_{t-1}$ = Previous day closing prices

TABLE 3.1: Shariah Complaint Equity Markets

| Sr.No | Shriah Indices | Country |
|---|---|---|
| 1 | FTSE NASDAQ DUBAI 10 SHARIAH | Dubai |
| 2 | FTSE SET Shariah Index | Thailand |
| 3 | FTSE SHARIAH INDIA | India |
| 4 | FTSE SHARIAH USA | USA |
| 5 | FTSEBM EMAS SHARIAH | Malaysia |
| 6 | MSCI World Islamic Index | England |
| 7 | Jakarta IslamicShariah Index | Indonesia |
| 8 | Karachi Meezan 30 | Pakistan |
| 9 | QE Al Rayan Islamic | Qatar |
| 10 | S&P-TSX 60 | Canada |

*This table provides the information about the selected Shariah Complaint equity markets.*

## 3.3 Econometric Model

This study uses the spillover index approach proposed by Diebold and Yilmaz (2009) for capturing the return and volatility spillover among selected Islamic Indices. Diebold-Yilmaz Connectedness Index (DYCI) methodology is applied to daily stock market index return volatilities. The results are based on generalized variance decompositions (with 10-day forecast horizon) obtained from a VAR model of daily range volatilities. The VAR model is estimated using the elastic net shrinking and selection procedure, which combines Lasso and Ridge estimators.

Dynamic connectedness measures are obtained from the estimation of the VAR model over 150-day rolling windows. "Index" is the total connectedness index. "To," "From" and "Net" are the "to," "from," and "net" directional connectedness measures calculated for each variable in the analysis.

Diebold and Yilmaz (2009; 2012) compute of "spillover" indexes by examining the decomposition of variance in 2009 and a "generalized" decomposition of variance in 2012 for a VAR on a large set of series and aggregating them into "to" and "from" measures for the flow of variance. Diebold and Yilmaz (2009) use a

standard Cholesky factorization that is sensitive to order, while Diebold and Yilmaz (2012) base the calculation on "generalized" impulse responses rather than an actual factorization. While the latter is not sensitive to order, it produces a decomposition of a quantity that has no real economic interpretation, while the Cholesky factorization is decomposing the actual forecast error variances of the series.

The Diebold and Yilmaz methodology is important to understand as the Diebold and Yilmaz (2009) repackage standard decompositions of variance for a set of similar series. For a more modest-sized structural model, the standard FEVD's directly aggregating into "from" and "to" doesnt even make sense when the shocks don't correspond one-to-one with the variables. For a more structured model of the contemporaneous interaction, shocks are typically interpreted as factors, which don't have any obvious direct relationship with the series and which neither have nor need any aggregation across groupings of shocks.

Returns or volatilities of the selected Islamic index are modeled as a vector auto regression (VAR) N-variable. Predicted error variance for each Islamic index is added because of a breakdown in another Islamic index market U, for all U $\neq$ i. Then across all, i = 1 is added, and N is used to get the spillover index. The sum of all non-diagonal elements must be equal to the spillover index in the expected error variance matrix. Firstly, Covariance stationary qth-order with N-variable VAR is considered to get the spillover index.

$$Y_k = \sum_{i=1}^{a} \phi_i Y_{k-1} + \varepsilon_k \tag{3.2}$$

where $Y_k = (Y_{1,k}.....Y_{N,K})'$ $\phi$ is a representation of the NxN parameter model and the direction of error terms $\varepsilon$ has zero mean and Matrix of covariance. In this study, Y will also be a vector of Islamic index return volatilities or vector of Islamic index. The study assumes that the VAR system is stationary in covariance and its average moving illustration exists and is presented as

$$Y_k = \sum_{i=0}^{\infty} B_i \varepsilon_{k-i} \tag{3.3}$$

where the coefficient matrices $B_i$ of NxN follow the periodic of $B_i = \phi_1 B_{i-1} + \phi_2 B_{i-2} + .... + \phi_q B_{i-q}$ with $B_0$ being an unit matrix NxN and $B_i = 0$ for i $< 0$.

The study further uses the Cholesky decomposition of the covariance matrix of $\varepsilon_k$ $Q\acute{Q}$ where Q is the exclusive lower-triangular Cholesky factor of $\varepsilon$, Now equation can be written as

$$Y_k = \sum_{i=0}^{\infty}(B_i Q)(Q^{-1}\varepsilon_{k-1}) = \sum_{i=1}^{\infty}(B_i Q)(\tilde{\varepsilon}_{k-1}) = \sum_{i=0}^{\infty}\tilde{A}\tilde{\varepsilon}_{k-1} \tag{3.4}$$

such that $\tilde{\varepsilon}_k = Q^{-1}\varepsilon_k$ with zero mean are quadratic and a covariance matrix of those in the transversal and zeros somewhere else.

Due to the number of system shocks, variance decomposition allows us to divide the predicted error variances of each variable into parts. The study further defines the shares of own variance which are the proportion of the D step along with error variance in predicting $X_i$ due to distress to $X_i$, for i = 1,2,....., N and shares of cross variance or spillovers, to be the part of the D-step along with error variances in Predicting $x_i$ due to distress to $X_j$, for i $\neq$ j. The number of potential spillovers is equal to N if the model is N variable and the number of spillovers is two if we consider the simple case of two-variable VAR, predicted error variance of $X_{2k}$ that is affected by any change in $X_{1k}$ and $X_{2k}$ distress that affect the forecast error variance of $X_{1k}$.

The covariance matrix of the D-step along predicted error will be decomposed by using the above definition

$$\theta_{il}(D) = \frac{\sum_{d=0}^{D-1}(\tilde{\varepsilon}B_d Q_e j)}{\sum_{d=0}^{d-1}(\acute{e}_i B_d \varepsilon \acute{B}_d e_i)} = \frac{\sum_{d=0}^{d-1}(\acute{e}_i \tilde{B}_d e_l)^2}{\sum_{d=0}^{D-1}(\acute{e}_i \tilde{B}_d \tilde{B}_d e_i)} \tag{3.5}$$

Where $e_i$ is an Nx1 trajectory with one as its ith component and zeros somewhere else. $\theta_{il}$ (D) is the influence of one-standard-deviation distress to $Y_l$ to the variance of the D -a step along with the predicted error of $Y_i$

By formation

$$\sum_{l=1}^{N} \theta_{il}(D) = 1 \; and \sum_{i,l=1}^{N} \theta_{il}(H) = N \tag{3.6}$$

when we get the spillover computation from variable i to l, for all i, l, now total spillover can be measured in term of percentage through spillover index,

Spillover index is the sum of the off- transversal component of the matrix found from an average variance decomposition act in any VAR approach comparative to the numerous variables. The summation of transversal components related to the numerous variables; on the other side it is a degree of how much predicted error variances are described by their shocks. The simplification of our spillover measure is frequently useful, and we enterprise it in our successive practical examination of return and volatility spillover in selected Islamic countries index.

This study measure log-returns daily using underlying stock index levels at the Monday open to Friday close.

Following Garman and Klass (1980), this study estimate week return volatilities using daily high, low, opening and closing prices obtained from underlying daily high, low, open and close data, from the Monday open to Friday close:

$$\tilde{\sigma}_2 = 0.511(H_{ik}-L_{ik})-0.019[(C_{ik}-O_{ik})(H_{ik}+L_{ik}-2O_{ik})-2(H_{ik}-O_{ik})(L_{ik}-O_{ik})] - 0.383(C_{ik}-O_{ik})^2 \tag{3.7}$$

where H is the Monday - Friday high, L is the Monday - Friday low, O is the Monday open, and C is the Friday close (all in natural logarithms). Given the weekly variance estimator $\tilde{\sigma}_{i^2k}$ The corresponding estimate of the annualized weekly percent standard deviation (volatility) is $\tilde{\sigma}_{ik} = 100\sqrt{52}\ \tilde{\sigma}_{i^2k}$ .

For daily volatilities following formula is used as proposed by Parkinson (1980)

$$\tilde{\sigma}_2 = 0.361 * ((ln(H_t) - (ln(L_t)))) \tag{3.8}$$

# Chapter 4

# Data Analysis and Discussion

Table 4.1 reports the descriptive statistics of daily return. It covers measurement of central tendency i.e. means, measure of dispersion i.e., standard deviation, maximum and minimum and finally measure of location i.e. skewness and kurtosis.

## 4.1 Descriptive Statistics of Daily Returns

Average return of Indian market is -0.02%, likewise average return of USA market is -0.03%, Malaysia market is -0.02%, British market is 0.06%, Indonesian market is 0.01%, Pakistani market is 0.01%, Qatar market is -0.07%, Canadian market is 0.01%, Dubai market is -0.03% and average return of last sample country Thailand is -0.02%.

Table 4.1 also shows the average risk of all sample countries. We can see in above table that average risk of Indian market is 1.18%, USA Market is 0.79%, Malaysian market is 0.63%, England market is 0.60%, Indonesian market is 1.18%, Pakistani market is 1.18%, Qatar market is 0.91%, Canadian market is 0.72%, Dubai market is 1.191% and average risk of Thailand is 1.11%. In above table the values of kurtosis are greater than 3 which indicates that data is leptokurtic which means data is not normally distributed and distribution of data is too peaked. Higher values of kurtosis of sample countries indicate that data is less peaked for

Table 4.1: Descriptive Statistics of Daily Returns

| | INDIA | USA | MALAYSIA | ENGLAND | INDONESIA |
|---|---|---|---|---|---|
| Mean | -0.0241 | -0.0315 | -0.0233 | 0.0659 | 0.0188 |
| Standard Deviation | 1.1848 | 0.7998 | 0.6300 | 0.6051 | 1.1823 |
| Kurtosis | 11.7718 | 3.3760 | 10.4639 | 35.9902 | 7.9182 |
| Skewness | 0.5107 | 0.3354 | -0.5818 | -1.5950 | -0.3740 |
| Minimum | -9.0000 | -5.0000 | -6.0000 | -10.0000 | -12.0000 |
| Maximum | 13.0000 | 4.0000 | 4.0000 | 3.0000 | 7.0000 |
| JB | 14154.226*** | 1199.951*** | 11237.096*** | 132382.598*** | 6411.601*** |
| Q(20) | 69.984*** | 105.766*** | 167.051*** | 88.126*** | 119.896*** |
| Q2(20) | 131.710*** | 294.548*** | 630.977*** | 2.8240 | 175.502*** |
| LM(20) | 389.297*** | 117.933*** | 171.663*** | 141.113*** | 426.414*** |

Table 4.1: continued ....

| | PAKISTAN | QATAR | CANADA | DUBAI | THAILAND |
|---|---|---|---|---|---|
| Mean | 0.0192 | -0.0728 | 0.0110 | -0.0348 | -0.0221 |
| Standard Deviation | 1.1898 | 0.9104 | 0.7269 | 1.1918 | 1.1164 |
| Kurtosis | 4.4765 | 4.1569 | 16.7568 | 7.9180 | 13.4058 |
| Skewness | 0.2592 | 0.1278 | 0.6808 | -0.1333 | 0.1796 |
| Minimum | -6.0000 | -6.0000 | -6.0000 | -12.0000 | -10.0000 |
| Maximum | 8.0000 | 6.0000 | 9.0000 | 8.0000 | 11.0000 |
| JB | 2057.374*** | 1757.006*** | 28657.203*** | 6361.536*** | 18232.682*** |
| Q(20) | 181.167*** | 249.009*** | 53.015*** | 376.807*** | 77.447*** |
| Q2(20) | 988.237*** | 82.395*** | 175.617*** | 1.3310 | 836.812*** |
| LM(20) | 401.279*** | 167.514*** | 323.029*** | 51.024*** | 274.390*** |

USA, Pakistan and Qatar as are not too much higher in comparison to rest of the countries.

Return series of Malaysia, England, Indonesia and Dubai are negatively skewed and rests of sample countries are positively skewed. Table 4.1 and 4.2 highlights that maximum return of Indian stock market in a day is 13% whereas maximum loss in a day is 9%. Likewise, maximum gain of USA stock market is 4% and loss 5%. Malaysian market reports a maximum return of 4% and maximum of loss 6%, England stock market maximum return of 3% and maximum loss of 10%, Indonesian stock market maximum return of 7% and maximum loss of 12%, Pakistani market maximum return of 8% and maximum loss of 6%.

Qatari market maximum gain and loss is 6%, Canadian stock market maximum return of 9% and report maximum loss of 6%, Dubai stock market earn maximum return of 8% and maximum loss of 12% and Maximum return of Thailand is of 10% and maximum loss is of 11% in a day. The p value of JB shows that data is not normal. There exists auto-correlation in return series of all sample countries at Q (20) whereas England and Dubai markets show no auto-correlation in their return series at Q2 (20) and negatives skewness is observed in these markets and their data is also leptokurtic which means these are not normally distributed. LM (20) shows also auto-correlation in all sample counties.

A review of description provides that Qatar has highest mean value and India, Indonesian and Qatar market has highest average risk in sample countries whereas England market is highly leptokurtic as compared to other countries and its data is moderately skewed due to which England market maximum return in a day is lowest as compare to other countries.

### 4.1.1 The Return Series are Expressed Graphically as Figure 4.1 below

These graphs show time varying variations in return series of sample countries where England and Canadian stock market returns do not have higher variations. The graph clearly provides that calm periods as well as volatile periods. Returns

are low in some periods and high in other periods. Markets of Qatar, Pakistan and US generally exhibit high dispersion in returns.

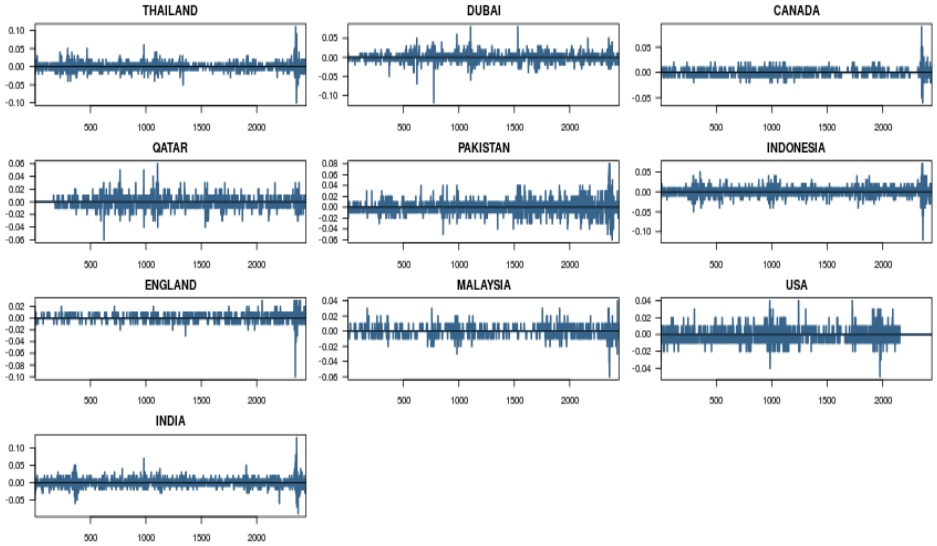


FIGURE 4.1: Variations in Return Series - Daily Returns

### 4.1.2 Correlation Analysis of Daily Returns

Table 4.2 reports the results of correlation analysis characterized between return series. Basically, in an analysis correlation is used to see the connectivity between return series that how strongly sample countries are co-related with each other. According to table 4.2, India which is ordered as first shows no significant correlation with any country except Thailand. Indian stock market is only connected to Thailand stock market which shows spillover in Indian market may cause the spillover in Thailand stock market and vice versa.

USA has only significant relationship with Canadian stock market and it has insignificant relationship with rest of the countries which means that spillover shocks may not cause spillover in other stock markets except Canadian market that is significantly connected to USA stock market. Malaysian market indicates that it has no significant correlation with any other stock market. Other markets cannot interfere in the stock market of Malaysia because of insignificant relationship with all of the sample countries. Due to Insignificant association if return series of Malaysian market increase or decrease, it has no link with a return series of other

Table 4.2: Correlation Analysis - Daily Returns

| | INDIA | USA | MALAYSIA | ENGLAND | INDONESIA | PAKISTAN | QATAR | CANADA | DUBAI | THAILAND |
|---|---|---|---|---|---|---|---|---|---|---|
| INDIA | 1 | | | | | | | | | |
| USA | 0.1586 | 1 | | | | | | | | |
| MALAYSIA | 0.2279 | 0.0773 | 1 | | | | | | | |
| ENGLAND | 0.0005 | 0.1456 | -0.0475 | 1 | | | | | | |
| INDONESIA | 0.2805 | 0.0755 | 0.2600 | -0.0446 | 1 | | | | | |
| PAKISTAN | 0.0967 | 0.0273 | 0.0765 | -0.0438 | 0.1484 | 1 | | | | |
| QATAR | 0.1099 | 0.0772 | 0.0891 | 0.0139 | 0.1161 | 0.0591 | 1 | | | |
| CANADA | 0.1486 | 0.3865 | 0.0158 | 0.1296 | 0.0645 | 0.0362 | 0.0606 | 1 | | |
| DUBAI | 0.1571 | 0.0959 | 0.1112 | 0.0548 | 0.0844 | 0.0752 | 0.5677 | 0.0222 | 1 | |
| THAILAND | 0.4022 | 0.1418 | 0.2449 | -0.0088 | 0.2816 | 0.1559 | 0.1196 | 0.1350 | 0.1640 | 1 |

stock markets and vice versa.

In above table of correlation coefficient indicates that stock market of England is not significantly associated in terms of return series with other stock markets. England stock market returns are not dependent on other stock markets return and vice versa. It has no contribution in return forecast of other sample countries and also other stock markets have no involvement in its return forecast. One of the sample country Pakistan is also showing insignificant relationship with other stock markets. Qatari stock market has strong correlation with stock market of Dubai and Qatar has insignificant association with rest of the countries.

Qatar and Dubai stock markets are strongly integrated with each other so, sentiment in Qatar stock market may spillover to stock market of Dubai. Positive value of correlation indicates that return of Qatar stock market will increase the return of Dubai stock market and decrease in return series of Qatar stock market will decrease the return series of Dubai stock market. Canadian market is not correlated with any stock market whereas only correlated with USA stock market as discussed earlier. Dubai stock market has no significant relationship with other stock markets, it is only associated with Qatar stock market. Thailand shows no significant association with any other sample stock market however only Indian stock market shows significant relationship with stock market of Thailand.

### 4.1.3 Spillover among Shariah Compliant Equity Markets

The study uses, first order VARs (p=1) with 10 steps ahead forecasts (h=10) and N = 10 countries. The idea of time variation in spillover is explained by estimation of VAR using a daily data of 17 years after checking the stationarity of data. Table 4.3 reports the results of static connectedness of daily returns.

### 4.1.4 Static Connectedness of Daily Returns

In order to provide better understanding of index spillover, this study calculates return spillover through variance decomposition as show in table 4.3 . India's returns explained by other markets are 28.5% whereas India's contribution to other

markets is 26.51%. India's market shocks have only 1.482% impact on USA return. Likewise, India's own contribution to return of Malaysia is 4.04%, England 0.02%, Indonesia 6.01%, Pakistan 1.09%, Qatar 0.59%, Canada 1.56%, Dubai 1.12% and Thailand's return is 10.56% explained by India's market shocks.

USA market contributes 25.1% to rest of the sample countries where as other sample countries contribute17.6% in explaining USA return. USA market contribute in the return forecast error variance of Malaysia 0.68%, England 2.07%, Indonesia 0.43%, Pakistan 0.28%, Qatar 0.94%, Canada 12.69%, Dubai 2.30% and Thailand 2.92%.

Results for Malaysia is presented on order third where we can see that 81.77% of its return forecast error variances is explained by its own market shocks and 18.22% return is due to other markets shocks. The findings of the study reveal that 0.28% of England's return, 5.19% of Indonesia, 0.76% of Pakistan, 0.53% of Qatar, 0.11% of Canada, 0.82% of Dubai and 4.06% of Thailand's return forecast is explained by Malaysia.

England's 95.04% return forecast error variance are explained by itself where as other markets inference is only 4.92%. The contribution of England's market shocks in Indonesia is 0.22%, Pakistan 0.18%, Qatar 0.10%, Canada 1.30%, Dubai 0.54% and in Thailand 0.77%. Indonesia's 78.34% returns are explained by its own shocks and 21.65% of its forecast error variances are explained by other markets. Indonesia is 2.52% return to Pakistan, 1.08% to Qatar, 0.356% to Canada, 0.615% to Dubai and 5.434% to Thailand.

Pakistan is second country where high returns are explained by its own shocks. Other markets contribute only 7.99% in explaining return spillover shocks where as its own contribution is 92% in total return spillover. Pakistan contributes 0.81% to India, 0.03% to USA, 0.81% to Malaysia, 0.28% to England, 1.41% to Indonesia, 0.22% to Qatar, 0.13% to Canada, 0.39% to Dubai and 1.57% to Thailand in explaining the return spillover.

Qatar contributes in explaining the 0.83% return forecast of india,0.34% of USA, 0.64% of Malaysia, 0.05% of England, 1.01% of Indonesia, 0.26% of Pakistan, 0.31% of Canada, 26.71% of Dubai, and 0.79% of Thailand whereas the 75.02% of

Table 4.3: Static Connectedness - Daily Returns

| | INDIA | USA | MALAYSIA | ENGLAND | INDONESIA |
|---|---|---|---|---|---|
| INDIA | 71.497 | 2.733 | 3.683 | 0.243 | 5.436 |
| USA | 1.482 | 82.391 | 0.397 | 1.694 | 0.477 |
| MALAYSIA | 4.049 | 0.686 | 81.775 | 0.203 | 5.804 |
| ENGLAND | 0.029 | 2.072 | 0.289 | 95.048 | 0.254 |
| INDONESIA | 6.018 | 0.435 | 5.192 | 0.221 | 78.341 |
| PAKISTAN | 1.096 | 0.280 | 0.762 | 0.188 | 2.529 |
| QATAR | 0.590 | 0.948 | 0.535 | 0.108 | 1.084 |
| CANADA | 1.562 | 12.691 | 0.113 | 1.306 | 0.356 |
| DUBAI | 1.121 | 2.307 | 0.825 | 0.459 | 0.615 |
| THAILAND | 10.562 | 2.924 | 4.068 | 0.775 | 5.434 |
| Contribution to others | 26.510 | 25.075 | 15.863 | 5.195 | 21.989 |
| Contribution including own | 98.008 | 107.466 | 97.638 | 100.243 | 100.329 |
| Net spillovers | -1.992 | 7.466 | -2.362 | 0.243 | 0.329 |

Table 4.3: continued ....

| | PAKISTAN | QATAR | CANADA | DUBAI | THAILAND | FROM |
|---|---|---|---|---|---|---|
| INDIA | 0.812 | 0.839 | 2.687 | 1.296 | 10.773 | 28.503 |
| USA | 0.032 | 0.347 | 11.563 | 0.444 | 1.174 | 17.609 |
| MALAYSIA | 0.818 | 0.644 | 0.151 | 1.040 | 4.829 | 18.225 |
| ENGLAND | 0.285 | 0.057 | 1.593 | 0.168 | 0.205 | 4.952 |
| INDONESIA | 1.415 | 1.011 | 0.778 | 0.507 | 6.084 | 21.659 |
| PAKISTAN | 92.003 | 0.268 | 0.273 | 0.388 | 2.213 | 7.997 |
| QATAR | 0.224 | 75.024 | 0.550 | 20.167 | 0.773 | 24.976 |
| CANADA | 0.135 | 0.312 | 81.804 | 0.080 | 1.641 | 18.196 |
| DUBAI | 0.395 | 26.719 | 1.213 | 64.757 | 1.591 | 35.243 |
| THAILAND | 1.574 | 0.791 | 2.797 | 1.323 | 69.752 | 30.248 |
| Contribution to others | 5.689 | 30.988 | 21.604 | 25.412 | 29.282 | 207.607 |
| Contribution including own | 97.692 | 106.012 | 103.409 | 90.169 | 99.034 | TCI |
| Net spillovers | -2.308 | 6.012 | 3.409 | -9.831 | -0.966 | 20.761 |

return spillover is due to its own market shocks. Qatar contributes more in creating return spillover of Dubai as compared to other sample countries.

Canada explain 2.687% return forecast of India, 11.56% of USA, 0.15% of Malaysia, 1.59% of England, 0.77% of Indonesia, 0.27% of Pakistan, 0.55% of Qatar, 1.21% of Dubai and 2.79% of Thailand whereas 81.80% Canada's return forecast is explaining by its own market spillover. Dubai explain 1.29% return spillover of India, 0.44% of USA, 1.04% of Malaysia, 0.16% of England, 0.50% of Indonesia, 0.38% of Pakistan, 20.16% of Qatar, 0.08% of Canada and 1.32% of Qatar whereas 64.75% of its return spillovers is created by its own circumstances.

Thailand is presented at last order which reveals that its contribution in return spillover is 10.77% to India, 1.17% to USA, 4.82% to Malaysia, 0.20% to England, 6.08% to Indonesia, 2.21% to Pakistan, 0.77% to Qatar, 1.64% to Canada, 1.59% to Dubai and its own 69.75% return is created by its markets up and down. Total calculated index is 20.76S% in static connectedness which shows the market inter-connectedness.

### 4.1.5 The Contribution of each Market to other Markets is Presented Graphically as Fig 4.2

The Contribution of market to other markets and contribution of other markets to a specific market is also expressed graphically below.

As we already discussed in research gap that this technique is very catchy because it captures to-and-from context. Above graph 4.2 show the contribution of each sample country to other countries. India is contributing 26.51% return spillover in static connectedness to the stock markets. Likewise, USA contributing 25.07% to other markets, Malaysia contributes 15.86% to other markets, England contributes 5.19%, Indonesia contributes 21.88% and Pakistan contributes 5.68% to other markets. Qatar contributes 30.08%, Canada contributes 21.60%, Dubai contributes 25.41% and Thailand is contributing 29.28% return to other sample stock markets of countries.

The result shows that Qatar is highest contributor of return spillover to other

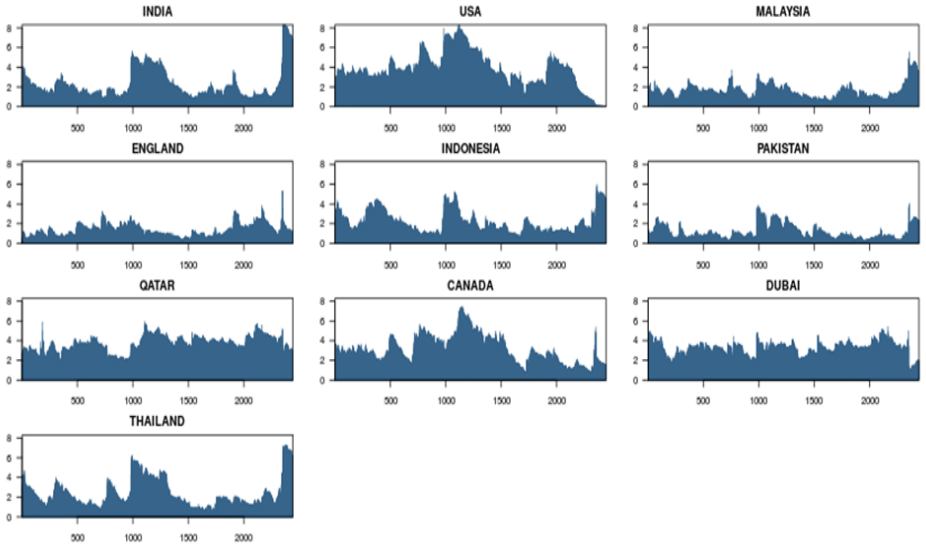


FIGURE 4.2: Contribution of each Market to other Markets-Daily Returns

countries where as where Thailand is the second largest contributor and India is a third largest contributor in static connectedness to other stock markets. Graphs indicate that Pakistan is a lowest contributor of return spillover, England is a second lowest contributor and India is on third number which has lowest contribution in explaining return forecast of other countries. The graphs further reveal that spillover is not constant overtime. The spillover is high in certain periods and spillover is lower in other periods.

### 4.1.6 The Mean Spillover from other Markets to a Specific Market is Expressed Graphically in Fig 4.3

Every sample stock market has some portion of return forecast which is explained by other market sentiments. India receives 28.50% static return spillover from other countries whereas USA receives 17.60% spillover, Malaysia receives 18.22%, England receives 4.95% return spillover, Indonesia receives 21.65% return spillover, Pakistan receives 7.99% return spillover, Qatar receives 24.97% return spillover, Canada receives 18.19% return spillover, Dubai receives 35.24% return spillover and Thailand receives 30.24% contribution in explaining their return forecast.

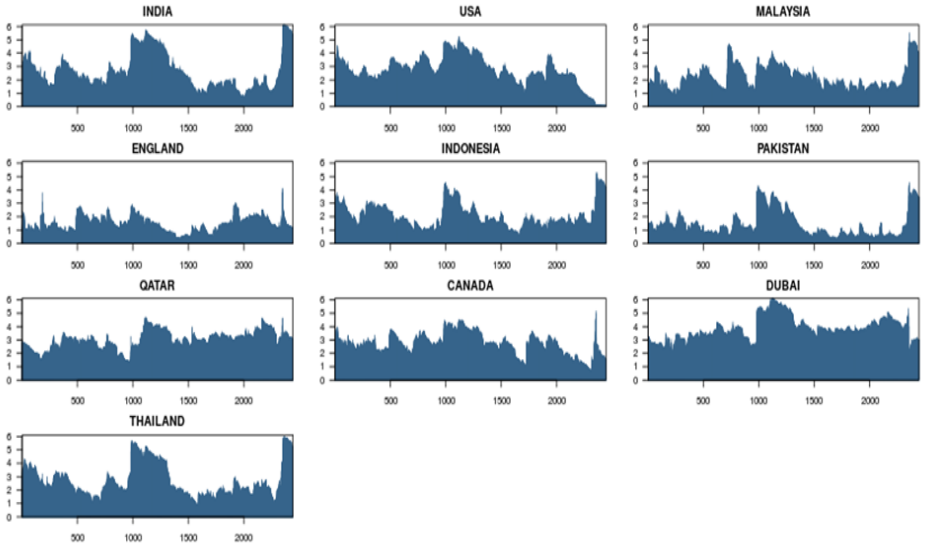


FIGURE 4.3: Contribution from other Markets to a Specific Market - Daily Returns

Graphical representation of FROM context indicate that Dubai is a largest receiver of return spillover from other countries, Thailand is a second largest receiver and India is third largest receiver of return spillover from other countries (as well as giver country) in static connectedness. Graphical vibes of India show that is a lowest receiver of return spillover from other countries, Pakistan is a second lowest receiver country and USA is third lowest receiver of return spillover from other countries. The spillover is not constant over time. There is low spillover found as well as high spillover proceeds. The spillover is generally high during crises period.

### 4.1.7 The Spillover from a Specific Market to other Specific Markets and from all Sample Markets to a Specific Market is Netted off as Expressed in Fig 4.4

The spillover from a specific market to other specific markets and from all sample markets to a specific market is netted off. The results of net spillover are expressed graphically as under as Fig 4.4. Net return spillover of India is-1.99% statically. Likewise, net spillover of USA is 7.48%, Malaysia is -2.36%, England is 0.24%, Indonesia is 0.32%, Pakistan is -2.30%, Qatar is 6.01%, Canada

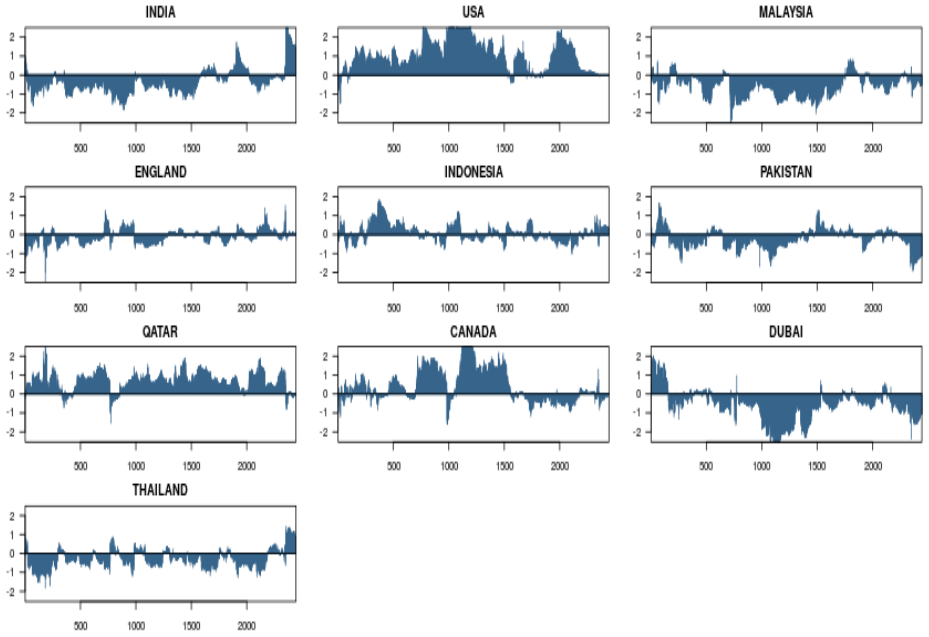


FIGURE 4.4: Net Spillover of each Market - Daily Returns

is 3.40%, Dubai is -9.83% and net spillover of Thailand is -0.96% in static connectedness. USA has highest net return spillover whereas Malaysia has lowest net return spillover. The US is net giver and Malaysia is net recipient of spillover. The positive figures indicate that country disseminates information and negative figure indicate that country is recipient of information, Indonesia disseminate information in some period and receives in other periods.

### 4.1.8 Dynamic Connectedness of Daily Return Series

Table 4.4 reports the results of dynamic connectedness of daily returns. Over the period of time economic conditions change so investors should have knowledge of dynamic conditions of market return where they want to invest. For that purpose, this study calculates dynamic connectedness of all sample countries.

The results exhibit that 73.64% returns of Indian stock market are explained by its own market shocks whereas its contribution in explaining return forecast of USA is 2.26%, Malaysia 2.63%, England 1.17%, Indonesia 3.95%, Pakistan 2.09%, Qatar 1.16%, Canadian stock market 1.60%, Dubai 1.52% and contribution to Thailand stock market returns forecast is 6.45%. India's highest contribution in

return forecast of other stock markets is 6.47% to Thailand's returns forecast error variance because India and Thailand stock markets returns are strong positively correlated.

USA's 72.96% returns are explained by its own shocks whereas USA is contributing 4.41% returns of India, 2.21% of Malaysia, 3.79% OF England, 1.41% of Indonesia, 1.48% of Pakistan, 1.61% of Qatar, 15.09% of Canada, 2.72% of Dubai and contributing in explaining 4.53% returns forecast of Thailand stock market. Its highest contribution is 15.09% to Canadian stock market returns that are significantly correlated.

Malaysia is contributing 77.89% to its own return forecast and on the other side its contribution to India's return is 2.25%, USA's returns 1.06%, England's returns 0.77%, Indonesia's return 4.40%, Pakistan's returns 1.25%, Qatar's returns 1.03%, Canada's returns 1.27%, Dubai's returns 1.29% and its contribution to Thailand's market return forecast is 2.66%. The results indicate that Malaysia is not contributing much in return forecast of other countries and its maximum contribution is 4.40% to Indonesia's returns which are partly correlated.

England's 85.36% returns are described by its own market spillover whereas its contribution to India's market returns is 1.43%, 3.37% USA's returns, 1.27% Malaysia returns, 0.08% Indonesia's return, 0.74% Pakistan's returns, 0.83% Qatar returns, 2.83% Canada's returns, 0.83% Dubai's returns and also explain 1.328% returns forecast of Thailand stock market. England is ordered as second one which has lowest contribution to other countries in terms of return series in dynamic connectedness.

About 79% returns of Indonesian stock market are captured by its own market spillover and rest of the portion is captured by other stock markets spillover. Indonesia contributes to explain 4.27% India's return, 1.23% USA's returns, 5.18% Malaysia's returns, 1% England's returns, 1.79% Pakistan's returns, 1.53% Qatar's returns, 1.41% Canada's returns, 1.33% Dubai's returns and it contributes 3.77% to describe returns of Thailand stock market. Lowest contribution of Indonesian stock market sentiments is 1% in England and its markets sentiments may highly spillover to Malaysian market returns.

Table 4.4: Dynamic Connectedness Table - Daily Returns

| | INDIA | USA | MALAYSIA | ENGLAND | INDONESIA |
|---|---|---|---|---|---|
| INDIA | 73.640 | 4.414 | 2.254 | 1.431 | 4.272 |
| USA | 2.261 | 72.964 | 1.064 | 3.375 | 1.232 |
| MALAYSIA | 2.639 | 2.218 | 77.892 | 1.270 | 5.184 |
| ENGLAND | 1.178 | 3.792 | 0.777 | 85.361 | 1.000 |
| INDONESIA | 3.950 | 1.416 | 4.404 | 0.983 | 79.474 |
| PAKISTAN | 2.098 | 1.486 | 1.250 | 0.747 | 1.795 |
| QATAR | 1.168 | 1.615 | 1.038 | 0.838 | 1.532 |
| CANADA | 1.603 | 15.096 | 1.271 | 2.831 | 1.415 |
| DUBAI | 1.527 | 2.723 | 1.291 | 0.834 | 1.336 |
| THAILAND | 6.457 | 4.531 | 2.666 | 1.328 | 3.775 |
| Contribution to others | 22.882 | 37.292 | 16.015 | 13.638 | 21.541 |
| Contribution including own | 96.522 | 110.256 | 93.906 | 98.999 | 101.015 |
| Net spillovers | -3.478 | 10.256 | -6.094 | -1.001 | 1.015 |

Table 4.4: continued ....

| | PAKISTAN | QATAR | CANADA | DUBAI | THAILAND | FROM |
|---|---|---|---|---|---|---|
| INDIA | 1.475 | 1.609 | 2.700 | 1.901 | 6.303 | 26.360 |
| USA | 1.289 | 0.893 | 13.804 | 0.875 | 2.244 | 27.036 |
| MALAYSIA | 1.255 | 1.627 | 2.911 | 1.929 | 3.075 | 22.108 |
| ENGLAND | 0.697 | 1.446 | 3.602 | 0.970 | 1.176 | 14.639 |
| INDONESIA | 1.817 | 1.605 | 1.147 | 1.453 | 3.750 | 20.526 |
| PAKISTAN | 86.020 | 1.462 | 1.260 | 1.900 | 1.981 | 13.980 |
| QATAR | 1.042 | 69.856 | 1.266 | 20.269 | 1.376 | 30.144 |
| CANADA | 0.985 | 1.265 | 72.946 | 0.992 | 1.597 | 27.054 |
| DUBAI | 1.285 | 25.182 | 1.855 | 61.648 | 2.319 | 38.352 |
| THAILAND | 1.648 | 1.731 | 2.703 | 2.019 | 73.142 | 26.858 |
| Contribution to others | 11.493 | 36.819 | 31.248 | 32.309 | 23.821 | 247.057 |
| Contribution including own | 97.513 | 106.675 | 104.194 | 93.957 | 96.962 | TCI |
| Net spillovers | -2.487 | 6.675 | 4.194 | -6.043 | -3.038 | 24.706 |

Pakistan is contributing 86.02% to its own return forecast error variance and on the other side its contribution to India's return is 1.47%, USA's returns 1.28%, Malaysia's returns 1.25%, England's returns 0.69%, Indonesia's return 1.81%, Qatar's returns 1.04%, Canada's returns 0.98%, Dubai's returns 1.28% and its contribution to Thailand's market return forecast is 1.64%. Pakistan is one of the top sample countries where stock market is very volatile. Only Its 13.08% returns are illuminated by other markets and its contribution to other market is also very low which means that Pakistani market sentiments are not much transfer to other markets returns.

About 69.85% returns of Qatar stock market is captured by its own market spillover and rest of the portion is dependent on other stock markets spillover. Qatar stock market sentiments contribute to explain 1.60% India's return, 0.89% USA's returns, 1.62% Malaysia's returns, 1.44% England's returns, 1.60% Indonesia's 1.46% Pakistan's returns, 1.26% Canada's returns, 26.18% Dubai's returns and it explains 1.73% returns of Thailand stock market. Qatar highly contributes in explaining return of Dubai stock market because Dubai and Qatar stock market returns are strongly significantly correlated which means Qatar sentiments highly spillover to Dubai stock market returns and vice versa.

Canada's 72.49% returns are explained by its own shocks whereas Canada is contributing 2.7% returns of India, 13.80% of USA, 2.91% of Malaysia, 3.60% of England, 1.14% of Indonesia, 1.26% of Pakistan, 1.26% of Qatar, 1.85% of Dubai and contributing in explaining 2.70% returns forecast of Thailand stock market.

Dubai is contributing 61.64% to its own return forecast which is lowest percentage as compared to other sample countries and on the other side its contribution to India's return is 1.901%, USA's returns 0.875%, Malaysias returns 1.929, England's returns 0.97%, Indonesia's return 1.453%, Pakistan's returns 1.9%, Qatar's returns 20.279%, Canada's returns 0.992%, Dubai's returns and its contribution to Thailand's market return forecast error variance is 2.019%.

Thailand is contributing 73.14% to its own return forecast error variance and on the other side its contribution to India's return is 6.30%, USA's returns 2.24%, Malaysia's returns 3.07%, England's returns is 1.17%, Indonesia's return is 3.75%,

Pakistanis returns 1.98%, Qatar's returns 1.37%, Canada's returns 1.59% and its contribution to Dubai stock market return forecast error variance is 2.31%.

### 4.1.9 The Graphical Behavior of Dynamic Total Connectedness of Daily Return Series is Presented as Fig 4.5

Graph 4.5 is showing dynamic total connectedness among all sample countries which is also reflected in table 4.4. By using 500 rolling window, total connectedness of all stock markets is calculated. Using rolling window of first 500 values total connectedness seems normal where as in third and fourth rolling window total connectedness in on the peak which show high return spillover. There is not much difference in static and dynamic connectedness.

Total contribution of India including its own contribution in dynamic connectedness is 96.52%. Likewise, total dynamic contribution is 110.25%, Malaysia 93.90%, England 98.99%, Indonesia 98.99%, Pakistan 97.51%, Qatar 106.67%, Canada 104.19%, Dubai 93.95% and Thailand has 96.96% total return spillover in dynamic connectedness. USA has highest total return spillover; Qatar has second highest total return spillover and Canadian stock market is on third number that have highest total return spillover in dynamic connectedness. Dubai has lowest total return spillover, India has second lowest total return spillover and Thailand is on number third which has lowest contribution including its own contribution of return spillover in dynamic connectedness.

The highest connectedness of markets and the initial stage of last period show not very high connectedness but at the end of the time frame connectedness between markets is very high due to high economic integration. Total calculated index is 24.604% in dynamic connectedness which shows the inter-connectedness between markets. The spillover is not constant over time. There is low spillover found in some period and also high spillover in other periods. The spillover is generally high during crises period in Syria when civil war started in June 2014 and whole economy of world was under crisis.

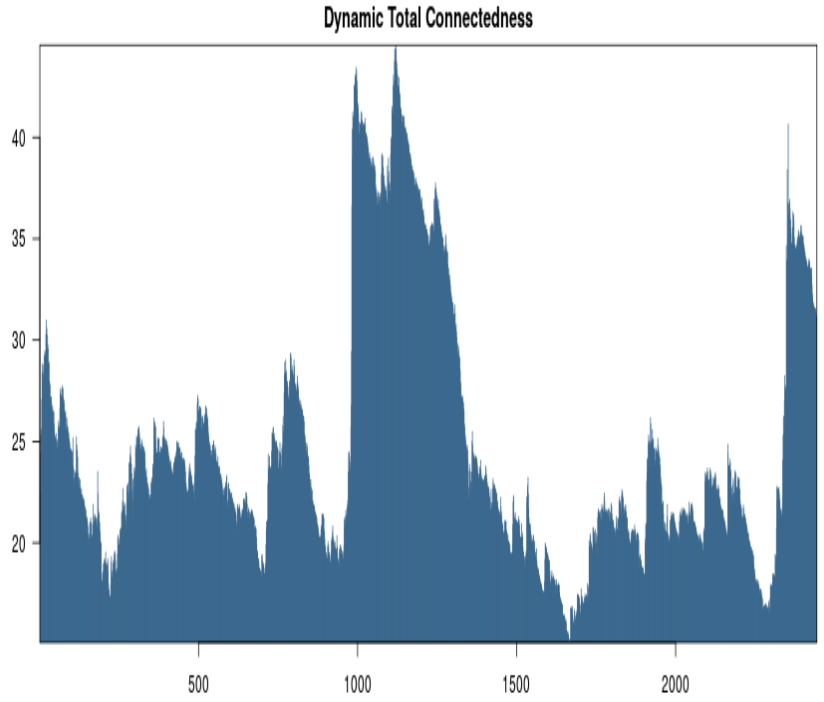


FIGURE 4.5: Dynamic Total Connectedness - Daily Returns

## 4.2 Descriptive Statistics of Daily Volatility Series

Table 4.5 reports the statistical behavior of volatility series. Average volatility of Indian market is 0.86%, likewise average volatility of USA market is 0.46%, Malaysia market is 0.22%, UK market is 0.13%, Indonesian market is 0.89%, Pakistani market is 0.91%, Qatar market is 0.59%, Canadian market is 0.46%, Dubai market is 0.85% and average volatility of Thailand is 0.84%. It also shows the average variations in volatility of sample countries.

As we can see that average variations in volatility of Indian market are 0.72%, USA Market is 0.55%, Malaysian market is 0.22%, UK market is 0.41%, Indonesian market is 0.68%, Pakistani market is 0.66%, Qatar market is 0.61%, Canadian market is 0.60%, Dubai market is 0.70% and average variations in volatility of Thailand is 0.69%.

The kurtosis is greater than 3 which indicate that data is leptokurtic which means data is not normally distributed and distribution of data is peaked. Higher

Table 4.5: Descriptive Statistics - Daily Volatility

| | INDIA | USA | MALAYSIA | ENGLAND | INDONESIA |
|---|---|---|---|---|---|
| Mean | 0.8623 | 0.4631 | 0.2255 | 0.1309 | 0.8953 |
| Standard Deviation | 0.7234 | 0.5575 | 0.4541 | 0.4193 | 0.6850 |
| Kurtosis | 28.9256 | -0.1741 | 4.1103 | 44.0378 | 18.9242 |
| Skewness | 3.1668 | 0.7390 | 1.9612 | 5.0090 | 2.4618 |
| Minimum | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Maximum | 10.0000 | 3.0000 | 3.0000 | 7.0000 | 8.0000 |
| Q(20) | 2083.699*** | 3662.318*** | 2094.178*** | 5700.823*** | 4139.863*** |
| Q2(20) | 781.260*** | 1256.255*** | 1675.617*** | 76.756*** | 1903.719*** |
| LM(20) | 245.196*** | 192.213*** | 221.346*** | 536.511*** | 407.849*** |

Table 4.5: continued ....

| | PAKISTAN | QATAR | CANADA | DUBAI | THAILAND |
|---|---|---|---|---|---|
| Mean | 0.9110 | 0.5916 | 0.4607 | 0.8534 | 0.8433 |
| Standard Deviation | 0.6601 | 0.6160 | 0.6045 | 0.7036 | 0.6948 |
| Kurtosis | 4.1529 | 1.7322 | 9.8000 | 8.3746 | 61.2483 |
| Skewness | 1.0313 | 0.8746 | 1.9636 | 1.5817 | 4.5781 |
| Minimum | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Maximum | 5.0000 | 4.0000 | 5.0000 | 7.0000 | 12.0000 |
| Q(20) | 4003.400*** | 2862.763*** | 4585.552*** | 2608.861*** | 3667.675*** |
| Q2(20) | 3220.473*** | 598.892*** | 5950.829*** | 63.978*** | 834.510*** |
| LM(20) | 281.087*** | 89.203*** | 426.204*** | 121.810*** | 383.792*** |

kurtosis values of India, England, Indonesia and Thailand indicate that data is not normal and positive skewness is observed in volatility series of the sample countries. The maximum volatility of Indian stock market in a day is 10%.

Likewise, maximum volatility of USA stock market is 3%, Malaysian market is 3%, England stock market is 7%, Indonesian stock market maximum volatility is 8%, Pakistani market has maximum volatility of 5%, Qatari market has maximum volatility of 4%, Canadian stock market has maximum volatility of 5%, Dubai stock market has maximum volatility of 7% and Maximum volatility of Thailand is 12% in a day. The p, Q (20), Q2 (20) test and LM test indicate the presence of auto correlation in volatility series of sample countries. Pakistan has highest and England has lowest volatility sample countries.

### 4.2.1 The Variations in Volatility Series are Expressed Graphically as Fig 4.6 below

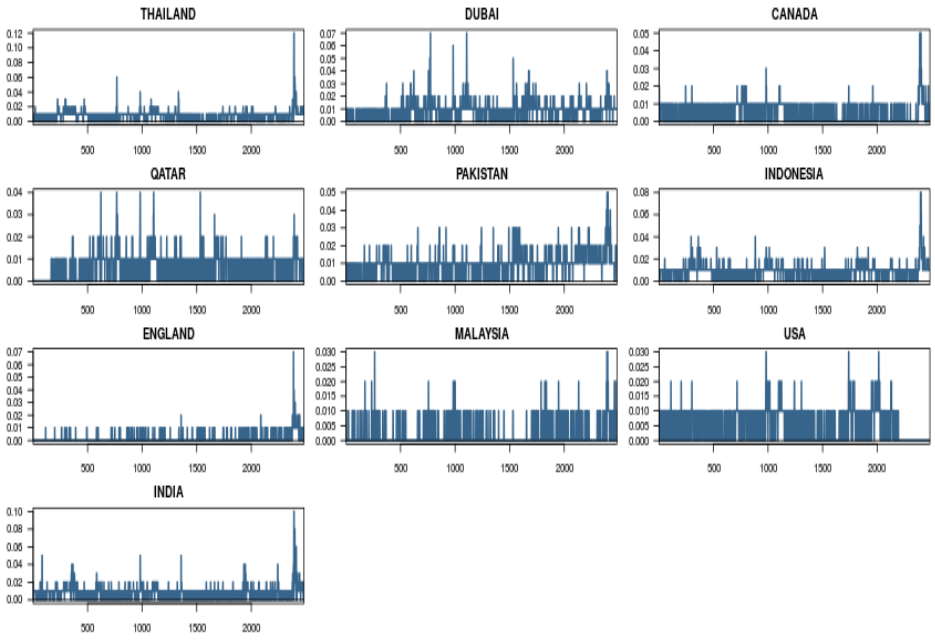


FIGURE 4.6: Variations in each Market - Daily Volatility Series

The Volatility series of spillover contribution is expressed graphically as Fig 4.6. There are many variations seems in India, Indonesia, Pakistan, Qatar, Dubai and Thailand whereas highest variations observed in Pakistani stock market. Malaysia

is less volatile and England contains least variations in its daily volatility streams.

### 4.2.2 Correlation Analysis of Daily Volatility

Table 4.6 reports the results of correlation coefficient of daily volatility series of sample markets. Relationship between volatility of sample stock markets has been exhibit by employing correlation test. In above table, India which is ordered as first shows significant correlation with England, Indonesia, Canadian and Thailand and England have also significant relationship with these countries and Pakistan in term of volatility. It means that any news in Indian market may spillover to all its correlated markets.

USA is not significantly associated with any stock market volatility and it has insignificant relationship with all of the countries which means that USA market volatility sentiments cannot spillover to other sample stock markets. On order third Malaysian market is significantly correlated with a England, Indonesia and Thailand. Indonesia has positive significant relationship with Canada and Thailand. So, volatility is dependent on any other stock market volatility because other markets shocks do interfere in the stock markets due to significant correlation with the sample countries. Volatility series of these markets increase or decrease with the change in volatility series of other stock markets.

In above correlation table 4.6, correlation coefficient of Pakistani stock market indicates that stock market of Pakistan is significantly associated with only England stock market in terms of volatility series whereas rests of the sample stock markets are insignificantly correlated with Pakistan. Significant and positive association shows that Pakistani stock market volatility increase and decrease with the change in England stock market volatility and rest of the stock market volatility has no impact on Pakistani stock market volatility.

Qatari stock market has strong positive correlation with the Dubai stock market in terms of Volatility and as well as in terms of return series. By comparing the return and volatility link, we can say that Qatar's return and volatility sentiments may spillover to only a Dubai market returns and volatility. Qatar's market is not

Table 4.6: Correlation Analysis-Daily Volatility

| | INDIA | USA | MALAYSIA | ENGLAND | INDONESIA | PAKISTAN | QATAR | CANADA | DUBAI | THAILAND |
|---|---|---|---|---|---|---|---|---|---|---|
| INDIA | 1 | | | | | | | | | |
| USA | 0.0603 | 1 | | | | | | | | |
| MALAYSIA | 0.2332 | 0.0981 | 1 | | | | | | | |
| ENGLAND | 0.3609 | -0.0854 | 0.3189 | 1 | | | | | | |
| INDONESIA | 0.3603 | 0.0426 | 0.3311 | 0.3689 | 1 | | | | | |
| PAKISTAN | 0.2300 | -0.0456 | 0.2001 | 0.3245 | 0.2137 | 1 | | | | |
| QATAR | 0.1070 | 0.0559 | 0.1652 | 0.1243 | 0.0523 | 0.1900 | 1 | | | |
| CANADA | 0.3663 | 0.2800 | 0.2980 | 0.3803 | 0.3520 | 0.1977 | 0.1863 | 1 | | |
| DUBAI | 0.1606 | 0.0417 | 0.1742 | 0.1470 | 0.1102 | 0.2261 | 0.5822 | 0.1693 | 1 | |
| THAILAND | 0.4565 | 0.1063 | 0.3202 | 0.3387 | 0.4243 | 0.1883 | 0.1451 | 0.4031 | 0.2135 | 1 |

correlated with any stock market whereas only correlated with Dubai stock market as discussed earlier.

### 4.2.3 Static Connectedness of Daily Volatility

The Spillover between volatility series is extended by using static connectedness approach by Diebold and Yilmaz (2009) and results are represented as Table 4.7.

In order to provide better understanding of spillover, volatility spillover for sample is captured through variance decomposition. India's 32.902% volatility forecast is explained by other markets where as India's own contribution its market forecast error variance is 67.09%. India's market shocks have only 0.07% impacts on USA volatility forecast. Likewise, India's own contribution to volatility spillover of Malaysia is 1.93%, England 4.56%, Indonesia 5.49%, Pakistan 2.14%, Qatar 0.33%, Canada 4.72%, Dubai's 0.995% and Thailand's 7.31% volatility forecast is Canada 4.72%, Dubai 0.995% and Thailand's 7.31% volatility forecast is explained by India's market shocks.

USA's 89.34% market volatility is due its own market shocks and. USA market shocks contribute in the volatility forecast error variance of India 0.20%, Malaysia 0.85%, England 0.91%, Indonesia 0.16%, Pakistan 034%, Qatar 0.48%, Canada 4.85%, Dubai 0.18% and Thailand 0.65%.

Malaysian stock market 73.01% volatility forecast error variance is explained by its own volatility sentiments and results further reveal the contribution of Malaysian sentiments in volatility spillover is 1.80% to Indian stock market, 0.44% to USA stock market, 2.97% to England stock market, 4.24% to Indonesian market , 1.59% to Pakistani market, 4.46% to Qatari stock market, 2.7% to Canadian stock market, 0.48% to Dubai stock market and 3.01% Volatility spillover of Thailand stock market is due to Malaysian volatility forecast.

England's 69.5% volatility forecast is explained by its own shocks and its contribution in volatility spillover of India is 5.49%, USA 1.13%, Malaysia 5.71%, Indonesia 7.04%, Pakistan 5.80%, Qatar 0.74%, Canada 6.46%, Dubai 1.11% and

Table 4.7: Static Connectedness - Daily Volatility

| | INDIA | USA | MALAYSIA | ENGLAND | INDONESIA |
|---|---|---|---|---|---|
| INDIA | 67.096 | 0.203 | 1.808 | 5.491 | 4.377 |
| USA | 0.071 | 89.345 | 0.442 | 1.130 | 0.148 |
| MALAYSIA | 1.938 | 0.850 | 73.011 | 5.714 | 3.092 |
| ENGLAND | 4.561 | 0.918 | 2.973 | 69.500 | 3.735 |
| INDONESIA | 5.493 | 0.168 | 4.244 | 7.048 | 64.894 |
| PAKISTAN | 2.149 | 0.345 | 1.599 | 5.808 | 0.906 |
| QATAR | 0.338 | 0.480 | 0.468 | 0.743 | 0.104 |
| CANADA | 4.722 | 4.856 | 2.700 | 6.468 | 3.579 |
| DUBAI | 0.995 | 0.183 | 0.488 | 1.116 | 0.184 |
| THAILAND | 7.314 | 0.657 | 3.011 | 5.151 | 5.701 |
| Contribution to others | 27.582 | 8.659 | 17.733 | 38.670 | 21.826 |
| Contribution including own | 94.678 | 98.005 | 90.743 | 108.170 | 86.719 |
| Net spillovers | -5.322 | -1.995 | -9.257 | 8.170 | -13.281 |

Table 4.7: continued ....

| | PAKISTAN | QATAR | CANADA | DUBAI | THAILAND | FROM |
|---|---|---|---|---|---|---|
| INDIA | 2.025 | 0.309 | 6.258 | 1.155 | 11.275 | 32.904 |
| USA | 0.116 | 0.262 | 7.665 | 0.041 | 0.778 | 10.655 |
| MALAYSIA | 2.135 | 1.484 | 4.767 | 1.715 | 5.296 | 26.989 |
| ENGLAND | 4.467 | 0.389 | 6.763 | 0.987 | 5.708 | 30.500 |
| INDONESIA | 2.332 | 0.131 | 6.326 | 0.450 | 8.914 | 35.106 |
| PAKISTAN | 81.700 | 1.519 | 1.436 | 2.605 | 1.934 | 18.300 |
| QATAR | 2.040 | 72.051 | 1.943 | 21.019 | 0.813 | 27.949 |
| CANADA | 1.201 | 1.424 | 66.462 | 1.157 | 7.430 | 33.538 |
| DUBAI | 2.786 | 20.863 | 1.136 | 70.340 | 1.909 | 29.660 |
| THAILAND | 0.966 | 0.839 | 7.829 | 1.963 | 66.569 | 33.431 |
| Contribution to others | 18.069 | 27.220 | 44.123 | 31.092 | 44.058 | 279.031 |
| Contribution including own | 99.769 | 99.271 | 110.586 | 101.432 | 110.627 | TCI |
| Net spillovers | -0.231 | -0.729 | 10.586 | 1.432 | 10.627 | 27.903 |

contribution in Thailand's volatility spillover is 5.15%.

Indonesia's 64.89% volatility are explained by its own shocks and Indonesian market is 4.37% volatility spillover contributor to India, 0.14% to USA stock market, 3.09% to Malaysian market, 0.90% to Pakistani stock market, 0.104% to Qatari market, 3.57% to Canadian market, 0.18% to Dubai stock market and it contributes 5.70% volatility spillover to Thailand stock market.

Pakistan's 81.5% volatility is captured by its own ups and downs. Pakistani stock market sentiments involve in explaining 2.02% volatility spillover shocks of India, 0.11% of USA, 2.13% of Malaysia, 4.46% of England, 2.33% of Indonesia, 2.04% of Qatar, 1.20% of Canada, 2.78% of Dubai and explain 0.96% volatility spillover of Thailand stock market.

Qatar's own shocks explain 72.051% of its own volatility spillover whereas it contributes in explaining the 0.309% volatility forecast of India,0.262% of USA, 1.484% of Malaysia, 0.389% of England, 0.131% of Indonesia, 1.519% of Pakistan, 1.424% of Canada, 20.863% of Dubai, and 0.839% volatility of Thailand stock market.

Canadian 66.462% volatility forecast is followed by its own market sentiments and its volatility sentiments may 6.258% spillover to Indian market, 7.665% to USA, 4.767% to Malaysian market, 6.763% to England stock market, 6.326% to Indonesian market, 1.436% to Pakistan, 1.943% to Qatar, 1.136% to Dubai and 7.829% to Thailand.

Dubai stock market shocks describe 70.34% of its own volatility spillover whereas it contributes 1.155% in volatility of India, 0.041% of USA, 1.715% of Malaysia, 0.987% of England, 0.45% of Indonesia, 2.605% of Pakistan, 21.019% of Qatar, 1.157% of Canada and 1.963% of Thailand stock market.

Thailand is on second highest number in interference of other countries. Its 66.569% volatility is captured by its on shocks and remaining 33.431% volatility is explained by other markets shocks. Thailand's market shocks contribute in explaining 11.275% volatility spillover of India, 0.778% of USA, 5.296% of Malaysia, 5.708% of England, 8.914% of Indonesia, 1.934% of Pakistan, 1.934% of Qatar,

7.43% of Canada, 1.909% volatility spillover of Dubai. Total calculated index of volatility series is 27.903% in static connectedness which is basically reflection of inter-connectedness.

### 4.2.4 The Volatility Spillover from a Specific Market to other Specific Markets is Represented Graphically as under in Fig 4.7

India is contributing 27.58% volatility spillover in to other stock markets. Likewise, USA contributing 8.65%, Malaysia 17.73%, England 38.67%, Indonesia 21.82%, Pakistan 18.06%, Qatar 27.22%, Canada 44.12%, Dubai 31.09% and Thailand is contributing 44.05% volatility spillover to other sample stock markets of countries.

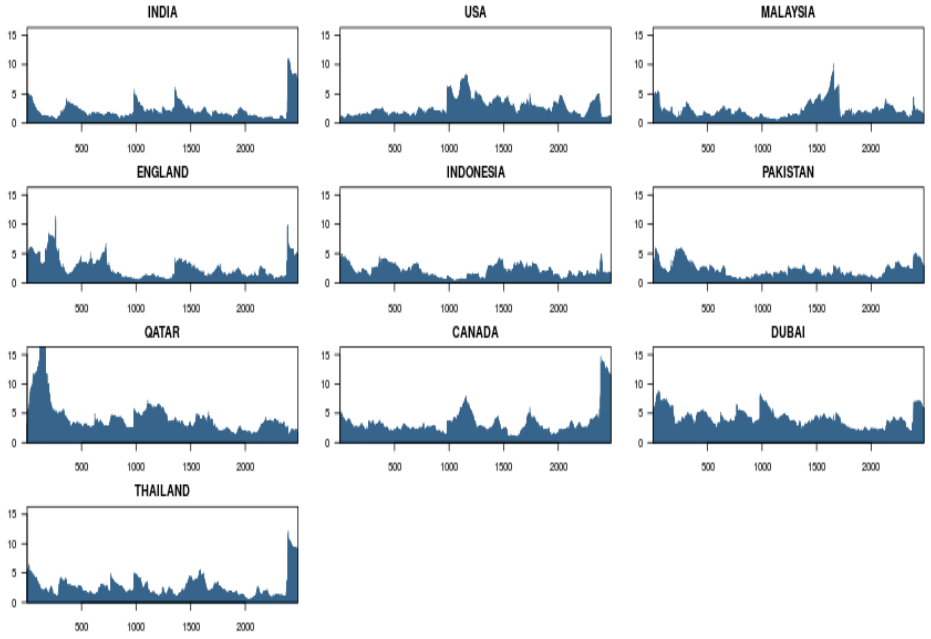


FIGURE 4.7: Contribution from Specific Market to other Specific Markets - Daily Volatility

Canada is largest contributor of volatility spillover to other countries, Thailand is second and India is third largest contributor of volatility spillover to other countries where as USA has lowest contribution, Malaysia is on second and Pakistan is on third ranking which has lowest contribution in explaining volatility

forecast error variance of other countries. The spillover is not constant over time. There is high volatility spillover in certain periods and lower volatility spillover in other periods. The spillover is generally high during crises period in Syria when civil war started in June 2014 and whole economy of world was under crisis.

### 4.2.5 The spillover from all other Markets to a specific Market is Represented as Fig 4.8

Every sample stock market has some portion of volatility forecast which is explained by other market sentiments. India receives 32.90% volatility spillover from other countries whereas USA receives 10.65%, Malaysia receives 26.88%, England receives 30.5%, Indonesia receives 35.10%, Pakistan receives 18.3%, Qatar receives 27.94%, Canada receives 33.53%, Dubai receives 29.66% spillover and Thailand receives 28.622% explaining its volatility forecast.

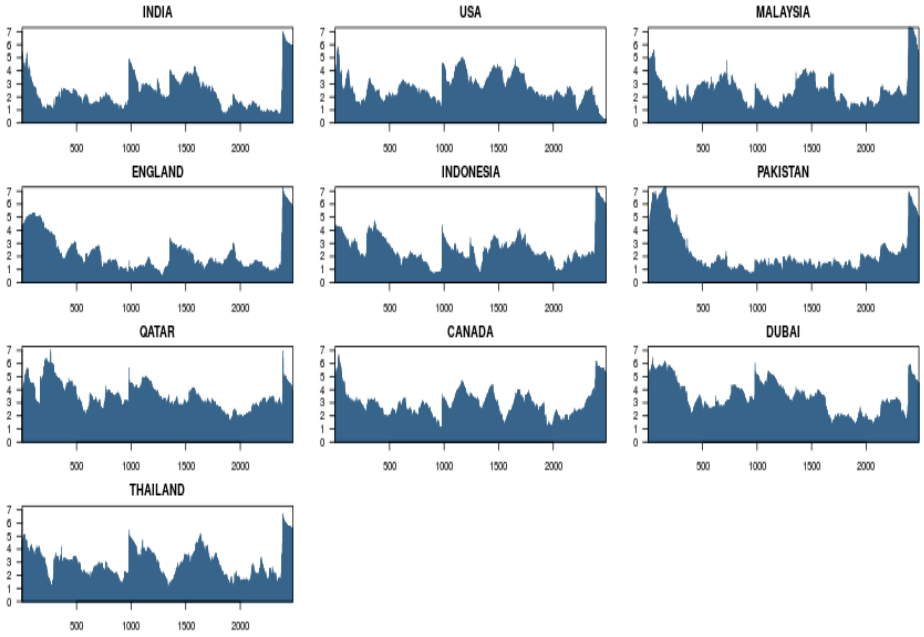


FIGURE 4.8: Contribution from other Markets to a Specific Market - Daily Volatility

Graphs 4.8 indicate that Indonesia is a largest receiver of volatility spillover from other countries, Canada is a second largest receiver and Thailand is third largest receiver of volatility spillover from other countries in static connectedness.

Graphical vibes of USA show that is a lowest receiver of volatility spillover from other countries, Pakistan is a second lowest receiver country and Malaysia is third lowest receiver of volatility spillover from other countries.

### 4.2.6 The Volatility Spillover from a Specific Market to other Specific Markets and from other Markets to a Specific Market is Netted off as Expressed in Fig 4.9

Net volatility spillover of India is -5.322%, USA -1.99%, Malaysia -9.25%, England 8.17%, Indonesia -13.28%, Pakistan -0.23%, Qatar -0.72%, Canada 10.58%, Dubai 1.43% and Thailand has 10.62% net volatility spillover. India, USA, Malaysia, Indonesia, Pakistan and Qatar are net receiver countries of Volatility spillover whereas England, Canada, Dubai and Thailand are net giver countries of volatility spillover in static connectedness.

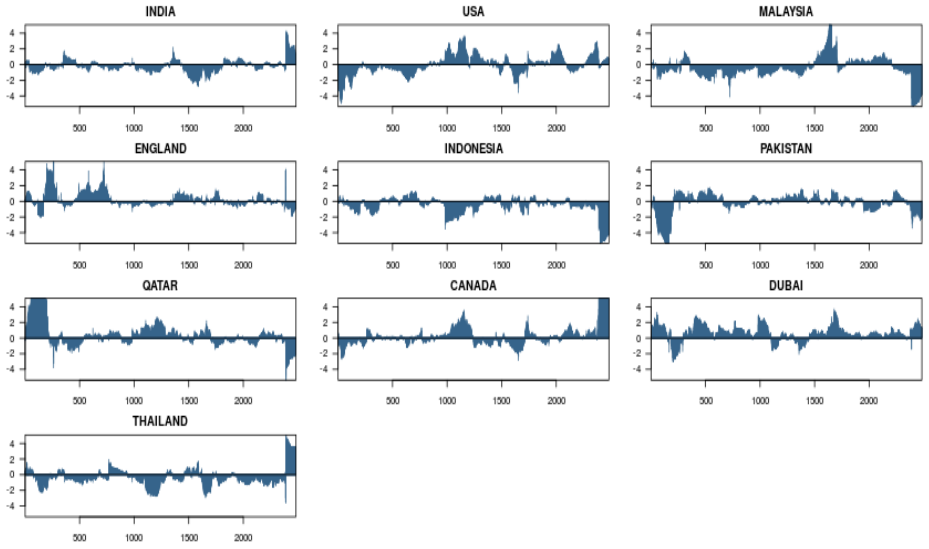


FIGURE 4.9: Net Spillover of each Market - Daily Volatility

Indonesia is a highest net receiver and Pakistan is lowest net receiver of volatility spillover whereas Thailand is a highest net giver and Dubai is lowest net giver of volatility spillover in static connectedness. All markets are net receiver in one period and net giver in other period. Dubai appears to be a net giver in recent part.

### 4.2.7 Dynamic Connectedness of Daily Volatility Series

The results of dynamic connectedness of daily volatility series are represented as Table 4.8. Over the period of time economic conditions change so investors should have knowledge of dynamic conditions of market return where they want to invest. For that purpose, the study calculates dynamic connectedness of all sample countries that provides brief understanding.

Below table 4.8 shows that 77.73% volatility of Indian stock market are explained by its own market shocks whereas its contribution in explaining volatility forecast of USA is 1.38%, Malaysia 1.78%, England 2.83%, Indonesia 3.28%, Pakistan 2.06%, Qatar 1.33%, Canadian stock market 2.25%, Dubai 1.95% and contribution to Thailand stock market forecast is 3.56%. India's highest contribution in volatility forecast of other stock markets is 3.56% to Thailand's volatility forecast because India and Thailand stock markets volatility is positively correlated.

USA's 74.02% volatility are explained by its own shocks whereas USA is contributing 1.84% volatility of India, 3.17% of Malaysia, 1.19% of England, 2.16% of Indonesia, 1.7% of Pakistan, 1.88% of Qatar, 9.62% of Canada, 1.36% of Dubai and contributing in explaining 2.94% volatility variance of Thailand stock market. And its highest contribution is 9.62% to Canadian stock market volatility that are significantly correlated.

Malaysia is contributing 75.21% to its own return forecast and on the other side its contribution to India's volatility is 2.13%, USA volatility 2.65%, England's volatility 2.22%, Indonesia's volatility 3.45%, Pakistan's volatility 1.62%, Qatar's volatility 1.43%, Canada's volatility 2.27%, Dubai's volatility 1.51% and its contribution to Thailand's market volatility forecast is 3.27%. We can see that Malaysia is not contributing much in return forecast of other countries and its maximum contribution is 3.45% to Indonesia's volatility which are partly correlated.

England's 78.33% volatility are described by its own market spillover whereas its contribution to India's market volatility is 2.87%, 1.41% of USA's volatility, 3.93% of Malaysia's volatility, 2.71% of Indonesia's volatility, 3.47% of Pakistan's volatility, 2.77% of Qatar volatility, 3.18% of Canada's volatility, 1.95% of Dubai's

Table 4.8: Dynamic Connectedness-Daily Volatility

| | INDIA | USA | MALAYSIA | ENGLAND | INDONESIA |
|---|---|---|---|---|---|
| INDIA | 77.734 | 1.842 | 2.132 | 2.879 | 2.791 |
| USA | 1.383 | 74.020 | 2.657 | 1.416 | 1.489 |
| MALAYSIA | 1.782 | 3.177 | 75.216 | 3.931 | 2.705 |
| ENGLAND | 2.834 | 1.191 | 2.224 | 78.334 | 2.332 |
| INDONESIA | 3.287 | 2.165 | 3.457 | 2.716 | 75.286 |
| PAKISTAN | 2.066 | 1.700 | 1.628 | 3.478 | 1.330 |
| QATAR | 1.338 | 1.885 | 1.431 | 2.774 | 1.111 |
| CANADA | 2.256 | 9.624 | 2.274 | 3.186 | 1.988 |
| DUBAI | 1.950 | 1.364 | 1.519 | 1.951 | 1.074 |
| THAILAND | 3.569 | 2.940 | 3.276 | 1.815 | 4.486 |
| Contribution to others | 20.465 | 25.889 | 20.599 | 24.145 | 19.305 |
| Contribution including own | 98.199 | 99.909 | 95.815 | 102.479 | 94.591 |
| Net spillovers | -1.801 | -0.091 | -4.185 | 2.479 | -5.409 |

Table 4.8: continued ....

| | PAKISTAN | QATAR | CANADA | DUBAI | THAILAND | FROM |
|---|---|---|---|---|---|---|
| INDIA | 1.774 | 1.585 | 2.633 | 2.401 | 4.229 | 22.266 |
| USA | 1.855 | 2.204 | 10.286 | 1.893 | 2.797 | 25.980 |
| MALAYSIA | 2.051 | 2.748 | 2.601 | 2.895 | 2.894 | 24.784 |
| ENGLAND | 2.768 | 3.084 | 3.203 | 2.231 | 1.800 | 21.666 |
| INDONESIA | 2.243 | 1.598 | 2.991 | 2.035 | 4.222 | 24.714 |
| PAKISTAN | 77.740 | 4.707 | 2.165 | 3.346 | 1.840 | 22.260 |
| QATAR | 3.122 | 65.284 | 3.048 | 18.266 | 1.742 | 34.716 |
| CANADA | 2.596 | 2.535 | 70.983 | 2.131 | 2.426 | 29.017 |
| DUBAI | 2.584 | 18.620 | 1.734 | 66.115 | 3.087 | 33.885 |
| THAILAND | 1.218 | 3.522 | 3.207 | 4.589 | 71.378 | 28.622 |
| Contribution to others | 20.212 | 40.602 | 31.869 | 39.786 | 25.037 | 267.910 |
| Contribution including own | 97.952 | 105.886 | 102.853 | 105.902 | 96.415 | TCI |
| Net spillovers | -2.048 | 5.886 | 2.853 | 5.902 | -3.585 | 26.791 |

volatility and also explain 1.81% of volatility forecast of Thailand stock market. England is ordered as third no which has highest contribution to other countries in terms of volatility series in dynamic evaluation as well as in static connectedness.

About 75.28% volatility of Indonesian stock market are captured by its own market spillover and rest of the portion is captured by other stock markets spillover. Indonesia contributes to explain 2.791% of India's volatility, 1.48% of USA's volatility, 2.70% of Malaysia's volatility, 2.33% of England's volatility, 1.33% of Pakistan's volatility, 1.11% of Qatar's volatility, 1.98% of Canada's volatility, 1.07% of Dubai's volatility and it contributes 4.48% to describe volatility of Thailand stock market which is the highest contribution of Indonesia to other countries.

USA's 74.02% volatility are explained by its own shocks whereas USA is contributing 1.84% volatility of India, 3.17% of Malaysia, 1.19% of England, 2.16% of Indonesia, 1.7% of Pakistan, 1.88% of Qatar, 9.62% of Canada, 1.36% of Dubai and contributing in explaining 2.94% volatility variance of Thailand stock market. And its highest contribution is 9.62% to Canadian stock market volatility that are significantly correlated.

Malaysia is contributing 75.21% to its own return forecast and on the other side its contribution to India volatility is 2.13%, USA's volatility 2.65%, England's volatility 2.22%, Indonesia's volatility 3.45%, Pakistan's volatility 1.62%, Qatar's volatility 1.43%, Canada's volatility 2.27%, Dubai's volatility 1.51% and its contribution to Thailand's market volatility forecast is 3.27%. We can see that Malaysia is not contributing much in return forecast of other countries and its maximum contribution is 3.45% to Indonesia's volatility which are partly correlated.

England's 78.33% volatility are described by its own market spillover whereas its contribution to India's market volatility is 2.87%, 1.41% of USA's volatility, 3.93% of Malaysia's volatility, 2.71% of Indonesia's volatility, 3.47% of Pakistan's volatility, 2.77% of Qatar volatility, 3.18% of Canada's volatility, 1.95% of Dubai's volatility and also explain 1.81% of volatility forecast of Thailand stock market. England is ordered as third no which has highest contribution to other countries in terms of volatility series in dynamic evaluation as well as in static connectedness.

About 75.28% volatility of Indonesian stock market are captured by its own market spillover and rest of the portion is captured by other stock markets spillover. Indonesia contributes to explain 2.791% of India's volatility, 1.48% of USA's volatility, 2.70% of Malaysia's volatility, 2.33% of England's volatility, 1.33% of Pakistan's volatility, 1.11% of Qatar's volatility, 1.98% of Canada's volatility, 1.07% of Dubai's volatility and it contributes 4.48% to describe volatility of Thailand stock market which is the highest contribution of Indonesia to other countries.

### 4.2.8 The Graphical Behavior of Dynamic Total Connectedness of Volatility Series is Presented in Fig 4.10

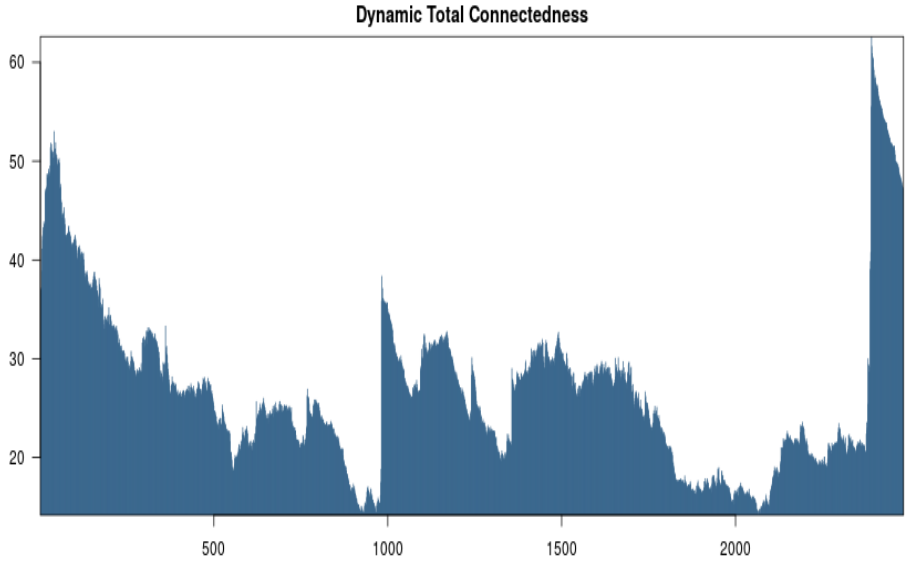


FIGURE 4.10: Dynamic Total Connectedness-Daily Volatility

Graph 4.10 represents the total volatility spillover index of all countries. Above graph shows recession, boom all phenomenon of total volatility spillover Index. Overall, first and last session give signal of high connectedness whereas the second period show there is no high connectedness between sample markets and third and fourth period shows normal connectedness but at last of period fourth connectedness is very low between markets due to macroeconomic changes. Total calculated

index is 26.791% in term of volatility series of static index which indicate inter-connectedness

TCI values of return series are lower than TCI values of volatility which indicates that markets returns are less inter-connected where fluctuation in one market may much spillover to another market as contrast to return series. The spillover is not constant over time. There is low volatility spillover found in some period and also high volatility spillover in other periods. The spillover is generally high during crises period in Syria when civil war started in June 2014 and whole economy of world was under crisis.

## 4.3 Summary Statistics of Weekly Returns

Table 4.9 reports the descriptive statistics of daily return. It coves measurement of central tendency i.e., means, measure of dispersion i.e., standard deviation, maximum and minimum and finally measure of location i.e., skewness and kurtosis.

Average loss of India is 0.021% in a week, USA has 0.012%, Indonesia has 0.0195%, Qatar has 0.04%, Canada has 0.026% and average loss of Dubai is 0.01% where average mean of England is 0.01%, Pakistan has 0.009% and avarage gain of Thailand is 0.002%. Average risk of India is 0.34%, USA has 0.22%, Malaysia has 0.49%, England has 1.18%, Indonesia has 0.70%, Pakistan has 0.35%, Qatar has 0.56%, Canada has 0.65%, Dubai has 0.27% and average risk of Thailand is 0.30%. Kurtosis are greater than 3 which indicates that data is leptokurtic which means data is not normally distributed and distribution of data is too peaked.

Minimum loss of India is 1% in a week, USA market 2%, Malaysian market 4%, England market 16%, Indonesian market 4%, Pakistani market 2%, Qatar market is 6%, Canadian market is 8%, Dubai market is 3% and average loss of Thailand market is 2% in a week whereas Maximum return of India is 1%, USA has market 2%, Malaysian market has 5%, England market has 4%, Indonesian market has 2%, Pakistani market has 1%, Qatar market & Canadian market has 3%, and 2% and Maximum return of Thailand market has 3% in a week.

Table 4.9: Summary Statistics - Weekly Returns

| | INDIA | USA | MALAYSIA | ENGLAND | INDONESIA |
|---|---|---|---|---|---|
| Mean | -0.0220 | -0.0122 | -0.0707 | 0.1000 | -0.0195 |
| Standard Deviation | 0.3454 | 0.2263 | 0.4968 | 1.1815 | 0.7060 |
| Kurtosis | 5.4038 | 50.4457 | 40.6200 | 84.5298 | 4.9819 |
| Skewness | -0.3447 | -2.1705 | -0.0287 | -6.2286 | -1.2713 |
| Minimum | -1.0000 | -2.0000 | -4.0000 | -16.0000 | -4.0000 |
| Maximum | 1.0000 | 2.0000 | 5.0000 | 4.0000 | 2.0000 |
| JB | 492.199*** | 42717.567*** | 27486.328*** | 121706.374*** | 520.939*** |
| ERS | -0.5310 | -6.279*** | -5.411*** | -2.439** | -1.5220 |
| Q(20) | 16.021* | 2.3210 | 23.655*** | 4.8900 | 16.485* |
| Q2(20) | 18.541** | 42.419*** | 0.1030 | 0.0240 | 0.6670 |
| LM(20) | 16.469* | 56.567*** | 2.9870 | 0.6200 | 2.9700 |

Table 4.9: continued ....

| | PAKISTAN | QATAR | CANADA | DUBAI | THAILAND |
|---|---|---|---|---|---|
| Mean | 0.0098 | -0.0415 | -0.0268 | -0.0122 | 0.0024 |
| Standard Deviation | 0.3564 | 0.5601 | 0.6536 | 0.2750 | 0.3008 |
| Kurtosis | 12.4747 | 67.8051 | 71.7494 | 51.6965 | 37.2672 |
| Skewness | -1.1677 | -5.6362 | -6.2040 | -1.8738 | 1.1496 |
| Minimum | -2.0000 | -6.0000 | -8.0000 | -3.0000 | -2.0000 |
| Maximum | 1.0000 | 3.0000 | 3.0000 | 2.0000 | 3.0000 |
| JB | 2680.620*** | 78765.124*** | 88395.377*** | 44765.320*** | 23224.137*** |
| ERS | -7.440*** | -5.467*** | -5.538*** | -5.905*** | -6.639*** |
| Q(20) | 13.6520 | 11.9270 | 40.957*** | 21.766*** | 14.6200 |
| Q2(20) | 0.9030 | 0.6340 | 33.595*** | 0.3730 | 0.1450 |
| LM(20) | 7.3450 | 5.1030 | 63.220*** | 5.8820 | 5.2490 |

The p value of JB shows that data is not normal. All steric values show the existence of auto correlation between series where most of the values in Q2 (20) and LM (20) indicate there is no correlation in that series which have 2 steric. England Pakistan and Thailand has no auto correlation in weekly return series.

### 4.3.1 The Weekly Return Series are Expressed Graphically as Figure 4.11

The graph 4.11 clearly provides that calm periods as well as volatile periods. Returns are low in some periods and high in other periods. India, Indonesia and Pakistan stock markets generally exhibit high dispersion in returns. There are some variations in Thailand, Dubai, Qatar, Malaysia and USA stock market returns where India and Canada stock markets have fewer variations as compared to other markets.

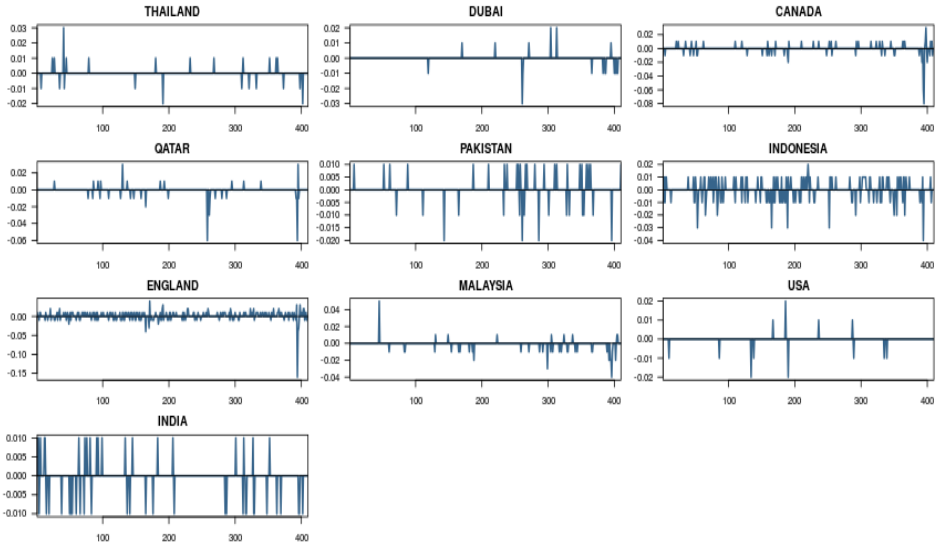


FIGURE 4.11: Variations in Return Series - Weekly Returns

### 4.3.2 Correlation Analysis of Weekly Returns

Table 4.10 reports the results of correlation analysis characterized between weekly return series. Correlation of weekly return series in above table indicate that India and USA markets have no significant correlation with any country where

Table 4.10: Correlation Analysis - Weekly Returns

| | INDIA | USA | MALAYSIA | ENGLAND | INDONESIA | PAKISTAN | QATAR | CANADA | DUBAI | THAILAND |
|---|---|---|---|---|---|---|---|---|---|---|
| INDIA | 1 | | | | | | | | | |
| USA | -0.0973 | 1 | | | | | | | | |
| MALAYSIA | 0.1761 | -0.0947 | 1 | | | | | | | |
| ENGLAND | 0.0833 | -0.0503 | 0.2370 | 1 | | | | | | |
| INDONESIA | 0.1887 | -0.1086 | 0.2261 | 0.3541 | 1 | | | | | |
| PAKISTAN | 0.0017 | 0.0015 | 0.1144 | 0.0615 | 0.0688 | 1 | | | | |
| QATAR | 0.0585 | -0.0619 | 0.1476 | 0.3610 | 0.2020 | 0.0633 | 1 | | | |
| CANADA | -0.0026 | 0.0805 | 0.2351 | 0.5481 | 0.2002 | -0.0094 | 0.1038 | 1 | | |
| DUBAI | 0.0744 | -0.0024 | -0.0779 | -0.0865 | 0.0491 | 0.2007 | 0.2348 | -0.1242 | 1 | |
| THAILAND | 0.0476 | 0.0004 | 0.1321 | -0.0557 | -0.0113 | -0.0002 | 0.0151 | -0.0619 | 0.0595 | 1 |

Malasysian market is significantly correaleted with Enland stock market.

Correlation of weekly return series in above table indicate that India and USA markets have no significant correlation with any country where Malasysian market is significantly correaleted with Enland stock market. Likewise England stock market returns are significantly correlated with Indonesian and Qatar stock market is highly correlated with Canadian market which means that returns news in England market may very spillover to Indonesian, Qatar and Canadian stock market.

### 4.3.3 Static Connectedness of Weekly Returns

Index spillover is captured through variance decomposition as in table 4.11. India's returns forecast is 11.878% explained by other markets where as India's own contribution to its own return forecast is 88.122%. India's market shocks have only 0.9% impact on USA return forecast. Likewise, India's contribution in explaining return spillover of Malaysia is 2.311%, England is 0.556%, Indonesia is 2.7975%, Pakistan is 0.1335%, Qatar is 0.115%, Canada is 0.238%, Dubai is 0.764% and 0.189% of return forecast of Thailand is explained by India's market shocks.

USA market shocks Contribute 94.922% in describing their own return forecast. USA market shocks contribute 0.781% of return forecast to India, 0.797% to Malaysia, 0.254% to England, only 1% to Indonesia, 0.354% to Pakistan, 0.34% to Qatar, 0.373% to Canada, 0.022% to Dubai and 1.975% to Thailand.

Table 4.11 reveals that 68.486% of Malaysia's return forecast is explained by its own market shocks and it contributes in explaining 2.936% India's return, 1.101% USA returns, 2.752% England's return, 4.148% Indonesia's returns, 0.253% Pakistan's returns, 2.928% Qatar's returns, 2.03% Canada's returns, 0.445% Dubai's returns and 1.507% Thailand's return error forecast is explained by Malaysia.

England's 58.561% return forecast is explained by its own shocks where as other markets inference is 41.439% which is very high interference from other countries. The contribution of England's market shocks in India market is 0.895%,

Table 4.11: Static Connectedness - Weekly Returns

| | INDIA | USA | MALAYSIA | ENGLAND | INDONESIA |
|---|---|---|---|---|---|
| INDIA | 88.122 | 0.781 | 2.936 | 0.895 | 3.506 |
| USA | 0.900 | 94.922 | 1.101 | 0.255 | 1.411 |
| MALAYSIA | 2.311 | 0.797 | 68.486 | 8.121 | 4.002 |
| ENGLAND | 0.556 | 0.254 | 2.752 | 58.561 | 7.633 |
| INDONESIA | 2.797 | 1.000 | 4.148 | 9.398 | 74.801 |
| PAKISTAN | 0.133 | 0.354 | 0.253 | 1.364 | 0.997 |
| QATAR | 0.115 | 0.340 | 2.928 | 13.662 | 3.970 |
| CANADA | 0.238 | 0.373 | 2.030 | 25.294 | 4.989 |
| DUBAI | 0.764 | 0.022 | 0.445 | 4.247 | 0.491 |
| THAILAND | 0.189 | 1.975 | 1.507 | 0.859 | 0.276 |
| Contribution to others | 8.003 | 5.896 | 18.099 | 64.096 | 27.276 |
| Contribution including own | 96.125 | 100.819 | 86.585 | 122.657 | 102.078 |
| Net spillovers | -3.875 | 0.819 | -13.415 | 22.657 | 2.078 |

Table 4.11: continued ....

| | PAKISTAN | QATAR | CANADA | DUBAI | THAILAND | FROM |
|---|---|---|---|---|---|---|
| INDIA | 2.215 | 0.283 | 0.514 | 0.617 | 0.130 | 11.878 |
| USA | 0.327 | 0.338 | 0.743 | 0.001 | 0.001 | 5.078 |
| MALAYSIA | 0.093 | 4.228 | 10.715 | 0.193 | 1.055 | 31.514 |
| ENGLAND | 0.069 | 8.675 | 20.723 | 0.540 | 0.236 | 41.439 |
| INDONESIA | 0.282 | 3.048 | 4.128 | 0.306 | 0.090 | 25.199 |
| PAKISTAN | 87.190 | 1.219 | 4.153 | 4.257 | 0.079 | 12.810 |
| QATAR | 1.789 | 70.191 | 4.192 | 2.784 | 0.029 | 29.809 |
| CANADA | 0.266 | 9.946 | 56.329 | 0.340 | 0.195 | 43.671 |
| DUBAI | 4.253 | 3.553 | 1.014 | 84.656 | 0.556 | 15.344 |
| THAILAND | 0.281 | 0.092 | 0.697 | 0.290 | 93.835 | 6.165 |
| Contribution to others | 9.575 | 31.383 | 46.878 | 9.329 | 2.371 | 222.906 |
| Contribution including own | 96.765 | 101.574 | 103.207 | 93.985 | 96.206 | TCI |
| Net spillovers | -3.235 | 1.574 | 3.207 | -6.015 | -3.794 | 22.291 |

USA 0.255%, Malaysia 8.121%, Indonesia 9.398%, Pakistan 1.364%, Qatar 13.662%, Canada 25.294%, Dubai 4.247% and in Thailand 0.859%.

Indonesia's 74.801% returns are explained by its own shocks and 25.199% of its forecast are explained by other markets. Indonesia is 3.506% spillover giver to India, 1.411% to USA, 4.002% to Malaysia, 7.633% to England, 0.997% to Pakistan, 3.97% to Qatar, 4.989% to Canada, 0.491% to Dubai and 0.27% to Thailand stock market.

Pakistan's own contribution is 87.19% in explaining its total return spillover. On other hand, Pakistan contributes 2.215% to India, 0.327% to USA, 0.093% to Malaysia, 0.069% to England, 0.282% to Indonesia, 1.789% to Qatar, 0.266% to Canada, 4.253% to Dubai and 0.281% to Thailand in explaining the return spillover.

Qatar s 70.191% return forecast is dependable on its own market sentiments while Qatar contributes in explaining 0.283% return forecast error variance of india, 0.338% of USA, 4.228% of Malaysia, 8.675% of England, 3.048% of Indonesia, 1.219% of Pakistan, 9.946% of Canada, 3.553% of Dubai, and 0.092% of Thailand.

Canada's 56.329% returns are explained by its own shocks which is lowest percentage in all sample countries in terms of explaining own return spillover and it explains0.514% return forecast of India, 0.743% of USA, 10.715% of Malaysia, 20.723% of England, 4.128% of Indonesia, 4.153% of Pakistan, 4.192% of Qatar, 1.014% of Dubai and 0.697% of Thailand.

Dubai explain 0.617% return spillover of India, 0.001% of USA, 0.193% of Malaysia, 0.54% of England, 0.306% of Indonesia, 4.257% of Pakistan, 2.784% of Qatar, 0.34% of Canada and 0.29% of Thailand whereas 84.656% of its return spillovers is created by its own market sentiments.

Thailand's contribution in return spillover is 0.13% to India, 0.001% to USA, 1.055% to Malaysia, 0.236% to England, 0.09% to Indonesia, 0.079% to Pakistan, 0.029% to Qatar, 0.195% to Canada, 0.556% to Dubai and its own 93.835% return spillover is created by its markets shocks. Total calculated weekly return spillover index is 22.291% in static connectedness which shows market inter-connectedness.

### 4.3.4 The Contribution of each Market to other Markets is Presented Graphically as Fig 4.12

The Contribution of market to other markets and contribution of other markets to a specific market is also expressed graphically below.

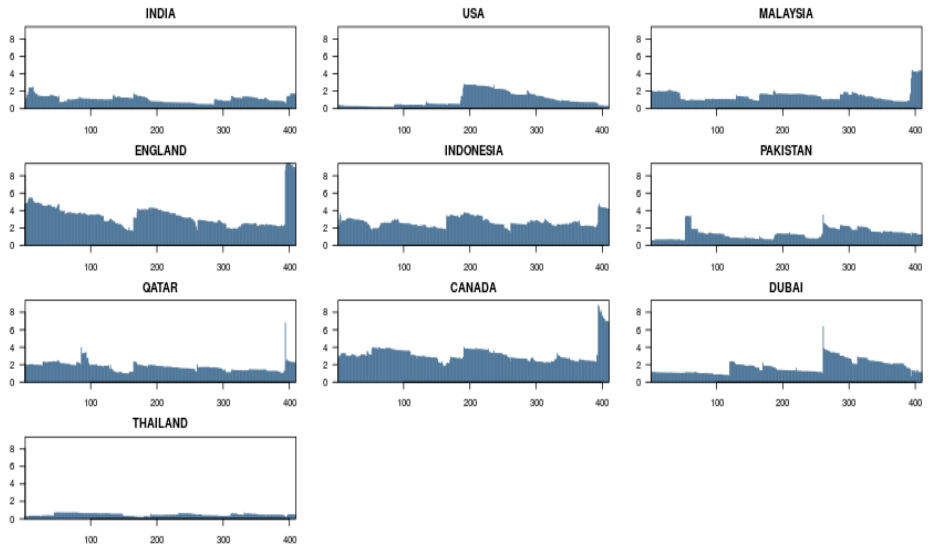


FIGURE 4.12: Contribution of each Market to other Markets - Weekly Returns

The graphs 4.12 reveal that spillover is not constant overtime. The spillover is high in some periods and spillover is lower in other periods. Graphs represent how one stock market contributes to another stock market in terms of weekly return series in both static and dynamic connectedness. Above graphs represent that England, Canada and India has greater contribution to other markets as contrast to other sample markets. India contributes 8.003% to other stock markets. Likewise, USA is contributing 5.896%, Malaysia has 18.099%, England has 64.096%, Indonesia has 27.276%, Pakistan has 9.575%, Qatar has 31.383%, Canada has 46.878%, Dubai has 9.329% and Thailand is contributing 2.371% return spillover to other sample stock markets of countries. England's contribution to other countries is highest in all sample countries however Thailand has lowest contribution in explaining return forecast of other countries. About 64% of England's market sentiments are interfering in return spillover of other countries and Canada is on second number in context of contribution to other markets.

### 4.3.5 The Mean spillover from other Markets to a Specific Market is Expressed Graphically in Fig 4.13

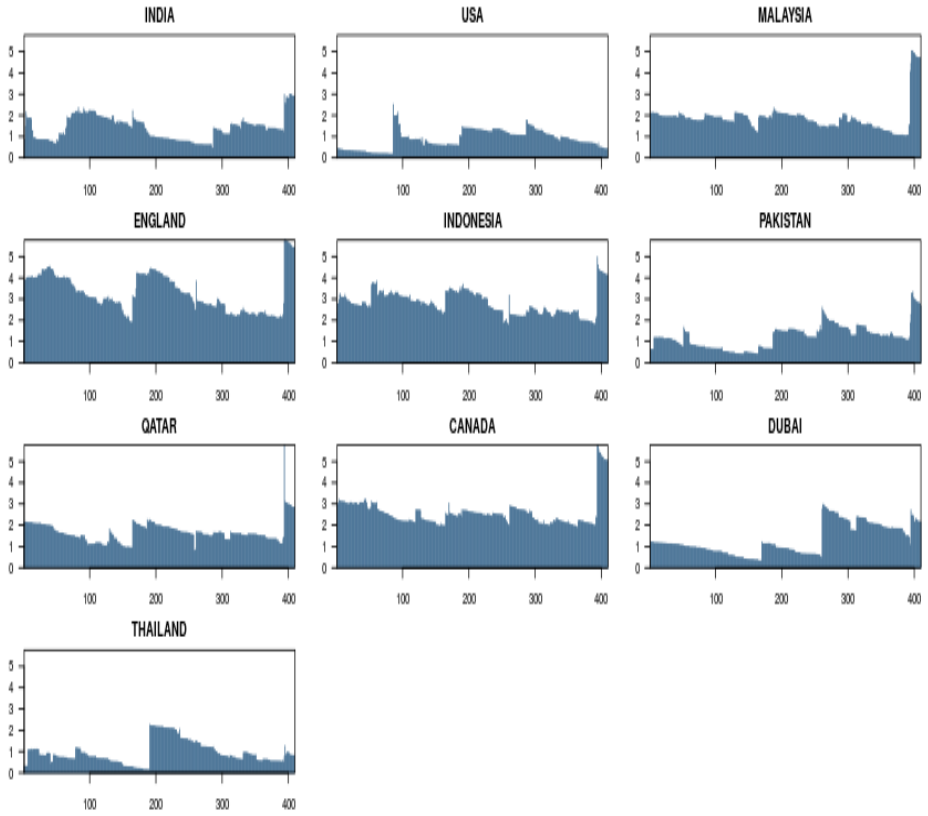


FIGURE 4.13: Contribution from other Markets to a Specific Market - Weekly Returns

The spillover is not constant over time. There is low spillover found as well as high spillover proceeds. The spillover is generally high during crises period of 2014 during civil war in Syria. Graphical representation is a reflection which indicates that how much one country receives spillover shocks from other countries. Graphs 4.13 represent that England, Indonesia and Canada stock markets receive more spillover as compare to other sample countries and relatively rest of the countries are not big receiver of return spillover.

India receives 11.878% return spillover, USA receives 5.078% return spillover, Malaysia receives 31.514% return spillover, England receives 41.439% return spillover, Indonesia receives 25.199% return spillover, Pakistan receives 12.81% return spillover, Qatar receives 29.809% return spillover, Canada receives 43.671% return spillover,

Dubai receives 15.344% return spillover and Thailand receives 6.165% return spillover. Canada receives highest contribution which is 43.671% from other countries.

### 4.3.6 The Spillover from a Specific Market to other Specific Markets and from all Sample Markets to a Specific Market is Netted off as Expressed in Fig 4.14

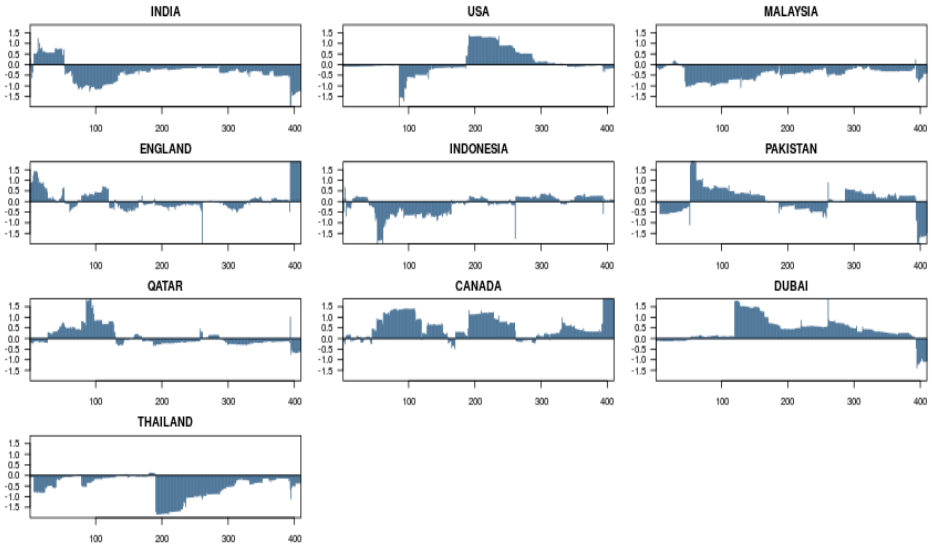


FIGURE 4.14: Net Spillover of each Market - Weekly Returns

Above graphs 4.14 indicate that India, Malaysia, Indonesia and Thailand stock markets are net receiver of return spillover whereas USA, England, Qatar and Canada stock market are net giver of return spillover. Pakistan and Dubai stock markets are net receiver and net giver in some dynamic conditions. Likewise, Indonesia is net giver. Net spillover of India is -3.875%, USA 0.819%, Malaysia -13.415%, England 22.657%, Indonesia 2.078%, Pakistan -3.235%, Qatar 1.574%, Canada 3.207%, Dubai -6.015% and Thailand -3.794%.

All markets are net receiver in one period and net giver in other period. The Thailand and Malaysian markets are net recipient and Canadian market is net giver of spillover. The positive figures indicate that country disseminates information and negative figure indicate that country is recipient of information.

### 4.3.7 Dynamic Connectedness of Weekly Return Series

Table 4.12 reports the results of dynamic connectedness of weekly returns. We calculates weekly dynamic connectedness of all sample countries that provides brief understanding of volatility scenario in dynamic conditions.

Result show 4.386.01% returns of Indian stock market are explained by its own market shocks whereas its contribution in explaining return forecast of USA is 1.163%, Malaysia 1.814%, England 0.765%, Indonesia 4.546%, Pakistan 0.576%, Qatar 0.391%, Canadian stock market 0.387%, Dubai 0.414% and contribution to Thailand stock market returns forecast is 0.46%. India's highest contribution in return forecast of other stock markets is 4.564% to Indonesia's returns forecast because India and Indonesian stock markets returns are strong positively correlated.

USA's 91.515% returns are explained by its own shocks whereas USA is contributing 1.069% returns of India, 1.29% of Malaysia, 0.543% of England, 1.167% of Indonesia, 0.668% of Pakistan, 0.93% of Qatar, 2.029% of Canada, 0.02% of Dubai and contributing in explaining 1.947% returns forecast of Thailand stock market. And its highest contribution is 1.947% to Thailand stock market returns that are significantly correlated.

Malaysia is contributing 81.334% to its own return forecast and on the other side its contribution to India's return is 1.069%, USA's returns 1.332%, England's returns 1.642%, Indonesia's return 3.29%, Pakistan's returns 0.781%, Qatar's returns 2.036%, Canada's returns 1.555%, Dubai's returns 0.51% and its contribution to Thailand's market return forecast is 1.47%. Malaysia is contributing highest in return forecast of Indonesia whichis 3.29%.

England's 67.243% returns are described by its own market spillover whereas its contribution to India's market returns is 1.805%, 0.46% USA's returns, 2.663% Malaysia returns, 8.252% Indonesia's return, 0.956% Pakistan's returns, 3.956% Qatar returns, 13.314% Canada's returns, 1.79% Dubai's returns and also explain 1.201% returns forecast of Thailand stock market. England's highest contribution is 13.314% to Canadian market and its lowest contribution is 0.46% to USA return series.

Table 4.12: Dynamic Connectedness - Weekly Returns Series

| | INDIA | USA | MALAYSIA | ENGLAND | INDONESIA |
|---|---|---|---|---|---|
| INDIA | 86.010 | 1.069 | 1.886 | 1.805 | 5.675 |
| USA | 1.163 | 91.515 | 1.332 | 0.460 | 1.276 |
| MALAYSIA | 1.814 | 1.290 | 81.334 | 2.663 | 3.866 |
| ENGLAND | 0.765 | 0.543 | 1.642 | 67.243 | 7.958 |
| INDONESIA | 4.564 | 1.167 | 3.290 | 8.252 | 72.092 |
| PAKISTAN | 0.576 | 0.668 | 0.781 | 0.956 | 1.357 |
| QATAR | 0.391 | 0.930 | 2.036 | 3.956 | 1.799 |
| CANADA | 0.387 | 2.029 | 1.555 | 13.314 | 3.051 |
| DUBAI | 0.414 | 0.020 | 0.510 | 1.790 | 0.653 |
| THAILAND | 0.460 | 1.947 | 1.470 | 1.201 | 0.766 |
| Contribution to others | 10.535 | 9.663 | 14.502 | 34.398 | 26.401 |
| Contribution including own | 96.545 | 101.178 | 95.836 | 101.641 | 98.493 |
| Net spillovers | -3.455 | 1.178 | -4.164 | 1.641 | -1.507 |

Table 4.12: continued ....

| | PAKISTAN | QATAR | CANADA | DUBAI | THAILAND | FROM |
|---|---|---|---|---|---|---|
| INDIA | 1.444 | 0.513 | 0.912 | 0.449 | 0.238 | 13.990 |
| USA | 0.356 | 1.526 | 2.302 | 0.042 | 0.028 | 8.485 |
| MALAYSIA | 0.941 | 2.499 | 3.730 | 0.652 | 1.211 | 18.666 |
| ENGLAND | 0.631 | 3.754 | 13.834 | 2.873 | 0.757 | 32.757 |
| INDONESIA | 2.703 | 1.489 | 4.610 | 1.406 | 0.426 | 27.908 |
| PAKISTAN | 87.878 | 1.250 | 2.032 | 4.015 | 0.486 | 12.122 |
| QATAR | 1.603 | 83.444 | 0.908 | 4.826 | 0.108 | 16.556 |
| CANADA | 0.878 | 1.125 | 74.307 | 2.427 | 0.927 | 25.693 |
| DUBAI | 3.822 | 4.613 | 1.033 | 86.978 | 0.167 | 13.022 |
| THAILAND | 0.498 | 0.430 | 2.213 | 0.191 | 90.823 | 9.177 |
| Contribution to others | 12.875 | 17.199 | 31.573 | 16.882 | 4.349 | 178.376 |
| Contribution including own | 100.753 | 100.643 | 105.880 | 103.860 | 95.172 | TCI |
| Net spillovers | 0.753 | 0.643 | 5.880 | 3.860 | -4.828 | 17.838 |

About 72.092% returns of Indonesian stock market are captured by its own market spillover and rest of the portion is captured by other stock markets shocks. Indonesia contributes to explain 5.675% India's return, 1.276% USA's returns, 3.866% Malaysia's returns, 7.958% England's returns, 1.357% Pakistan's returns, 1.799% Qatar's returns, 3.051% Canada's returns, 0.653% Dubai's returns and it contributes 0.766% to describe returns of Thailand stock market. Highest contribution of Indonesian stock market sentiments is 7.958% in England and its markets sentiments may highly spillover to England market returns.

Pakistan is contributing 87.878% to its own return forecast and on the other side its contribution to India's return is 1.444%, USA's returns 0.356%, Malaysia's returns 0.941%, England's returns 0.631%, Indonesia's return 2.703%, Qatar's returns 1.603%, Canada's returns 0.878%, Dubai's returns 3.822% and its contribution to Thailand's market return forecast is 0.498%. Only its 12.122% returns are illuminated by other markets as well as in static connectedness.

About 83.444% returns of Qatar stock market are captured by its own market spillover and rest of the portion is dependent on other stock markets spillover. Qatar stock market sentiments contribute to explain 0.513% India's return, 1.526% USA's returns, 2.499% Malaysia's returns, 3.754% England's returns,1.489% Indonesia's 1.25% Pakistan's returns, 1.125% Canada's returns, 4.613% Dubai's returns and it explains 0.43% returns of Thailand stock market. Qatar highly contributes in explaining return of Dubai stock market because Dubai and Qatar stock market returns are strongly significantly correlated which means Qatar sentiments highly spillover to Dubai stock market returns and vice versa.

Canada's 74.307% returns are explained by its own shocks whereas Canada is contributing 0.912% returns of India, 2.302% of USA, 3.373% of Malaysia, 13.834% of England, 4.61% of Indonesia, 2.032% of Pakistan, 0.908% of Qatar, 1.033% of Dubai and contributing in explaining 2.213% returns forecast of Thailand stock market. Canada's highest contribution is 13.8345% to England stock market returns.

Dubai is contributing 86.978% to its own return forecast and on the other side its contribution to India's return is 0.449%, whereas USA's returns is 0.042%,

Malaysia's returns 0.652%, England's returns 2.873%, Indonesia's return 1.406%, Pakistan's returns 4.015%, Qatar's returns 4.826%, Canada's returns 2.427%, and its contribution to Thailand's market return forecast is 0.191%. As we discussed earlier Dubai and Qatar stock market returns are significantly correlated so Dubai is highly contributing in Qatar.

Thailand is contributing 90.823% to its own return forecast and on the other side its contribution to India's return is0.238%, USA's returns 0.028%, Malaysia's returns 1.211%, England's returns 0.757%, Indonesia's return 0.426%, Pakistan's returns 0.486%,, Qatar's returns 0.108%, Canada's returns 0.927% and its contribution to Dubai stock market return forecast is 0.167%. Highest contribution of Thailand is 1.211% to Malaysian market return overall Thailand is top country which returns are highest explained by its own market sentiments.

### 4.3.8 The Graphical Behavior of Dynamic Total Connectedness of Weekly Return Series is Presented as Fig 4.15

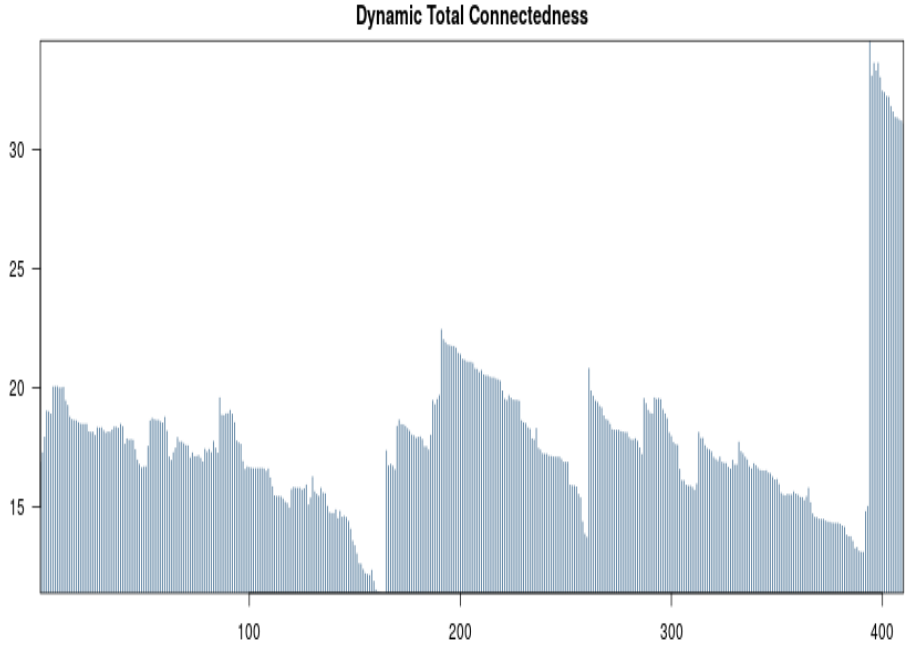


FIGURE 4.15: Dynamic Total Connectedness - Weekly Returns

Above graphs 4.15 shows total connectedness of return series on weekly basis. In first 400 vales total connectedness of series is not much greater relatively after 400 vales. Last periods show the peak (boom) of total connectedness among weekly return series. In second session of values total connectedness is being falling and turns to point zero due to critical situation in Syria when civil war started in June 2014 and whole economy of world was under crisis. Total contribution of India is 96.545%, USA 101.178%, Malaysia 95.836%, England 101.641%, Indonesia 98.493%, Pakistan 100.753%, Qatar 100.643%, Canada 105.88%, Dubai 103.86% and total contribution of Thailand is 95.172% in dynamic evaluation Canada has highest where Thailand have lowest total contribution in dynamic connectedness. Total weekly calculated return spillover index is 17.838% in dynamic connectedness which shows the inter-connectedness between markets.

## 4.4 Summary Statistics of Weekly Volatility Series

Table 4.13 reports the statistical behavior of volatility series. Average volatility of Indian market is 0.86%, likewise average volatility of USA market is 0.46%, Malaysia market is 0.22%, UK market is 0.13%, Indonesian market is 0.89%, Pakistani market is 0.91%, Qatar market is 0.59%, Canadian market is 0.46%, Dubai market is 0.85% and average volatility of Thailand is 0.84%. It also shows the average variations in volatility of sample countries.

As we can see that average variations in volatility of Indian market are 0.72%, USA Market is 0.55%, Malaysian market is 0.22%, UK market is 0.41%, Indonesian market is 0.68%, Pakistani market is 0.66%, Qatar market is 0.61%, Canadian market is 0.60%, Dubai market is 0.70% and average variations in volatility of Thailand is 0.69%.

The kurtosis is greater than 3 which indicate that data is leptokurtic which means data is not normally distributed and distribution of data is peaked. Higher kurtosis values indicate that data is not normal and positive skewness is observed

Table 4.13: Summary Statistics - Weekly Volatility

| | INDIA | USA | MALAYSIA | ENGLAND | INDONESIA |
|---|---|---|---|---|---|
| Mean | 2.1687 | 1.2103 | 1.0891 | 1.2392 | 2.1361 |
| Standard Deviation | 1.2609 | 0.8436 | 0.7492 | 0.9846 | 1.4836 |
| Kurtosis | 16.4036 | 4.7964 | 8.0037 | 38.4460 | 19.1670 |
| Skewness | 3.0705 | 1.6830 | 2.3312 | 4.7801 | 3.4755 |
| Minimum | 0.5785 | 0.1517 | 0.2445 | -0.0003 | 0.5045 |
| Maximum | 12.4012 | 6.1524 | 6.0900 | 11.6613 | 14.2728 |
| JB | 3500.320*** | 296.157*** | 800.195*** | 24363.808*** | 6484.860*** |
| Q(20) | 182.180*** | 32.296*** | 69.849*** | 105.186*** | 271.199*** |
| Q2(20) | 80.673*** | 8.7340 | 85.695*** | 0.0480 | 101.340*** |
| LM(20) | 99.022*** | 16.074* | 57.979*** | 11.0100 | 79.751*** |

Table 4.13: continued ....

| | PAKISTAN | QATAR | CANADA | DUBAI | THAILAND |
|---|---|---|---|---|---|
| Mean | 2.2887 | 1.7238 | 1.3708 | 1.9425 | 1.8043 |
| Standard Deviation | 1.3967 | 1.2742 | 1.1117 | 1.2594 | 1.2988 |
| Kurtosis | 10.0508 | 7.3106 | 35.1395 | 5.3157 | 37.0938 |
| Skewness | 2.4307 | 2.2840 | 4.9288 | 1.9951 | 4.6222 |
| Minimum | 0.3996 | -0.0003 | 0.3245 | 0.3512 | 0.3986 |
| Maximum | 11.7844 | 9.0721 | 11.5349 | 8.1979 | 15.7695 |
| JB | 2179.750*** | 966.095*** | 22560.995*** | 627.761*** | 23945.415*** |
| Q(20) | 103.397*** | 620.595*** | 380.802*** | 1006.207*** | 1721.091*** |
| Q2(20) | 82.155*** | 60.856*** | 80.614*** | 122.694*** | 8.4450 |
| LM(20) | 41.010*** | 39.706*** | 116.766*** | 51.451*** | 29.768*** |

in volatility series of the sample countries. The maximum volatility of Indian stock market in a week is 12.40%. Likewise, maximum volatility of USA stock market is 6.15%, Malaysian market has 6.08%, British stock market has 11.66%, Indonesian stock market maximum volatility is 14.27%, Pakistan stock market has maximum volatility of 11.78%, Qatar market has maximum volatility of 9.07%, Canadian stock market has maximum volatility of 11.53%, Dubai stock market has maximum volatility of 8.19% and Maximum volatility of Thailand is 15.76% in a week. The p, Q (20), Q2 (20) test and LM test indicate the presence of auto correlation in volatility series of sample countries.

### 4.4.1 The Variations in Weekly Volatility Series are Expressed Graphically as Figure 4.16 below

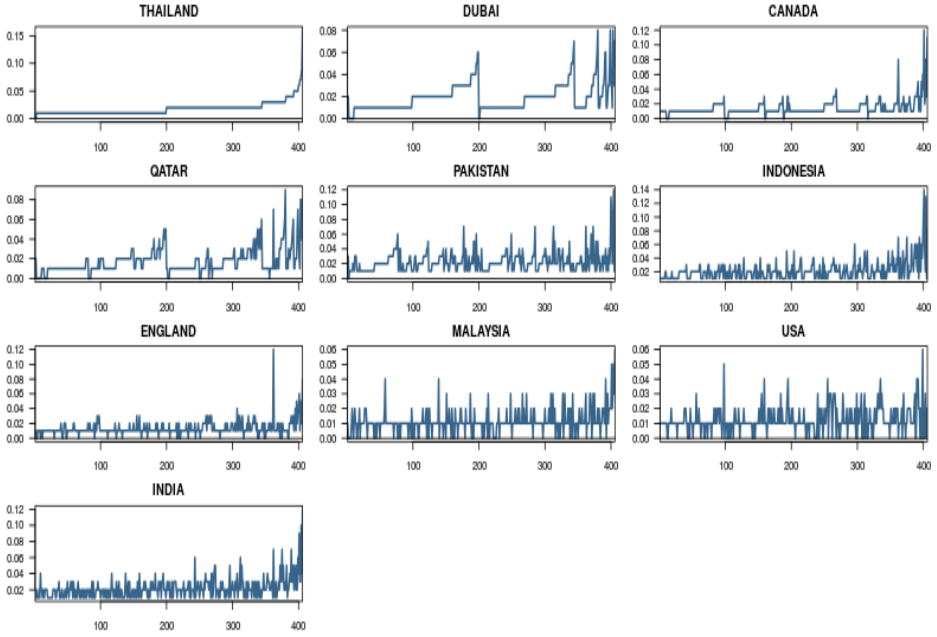


FIGURE 4.16: Variations in each Market - Weekly Volatility Series

The Volatility series of spillover contribution is expressed graphically as Fig 4.16. There are many variations seems in India, Indonesia, Pakistan, Qatar, Dubai and Thailand whereas highest variations observed in Pakistani stock market. Malaysia is less volatile and England contains least variations in its daily volatility streams.

### 4.4.2 Correlation Analysis of Weekly Volatility

Table 4.14 reports the results of correlation analysis. Correlation analysis indicate the significant positive correlation among all market where as only USA market has insignificant relationship with other markets in weekly volatility series.

Table 4.14: Correlation Analysis - Weekly Volatility

| | INDIA | USA | MALAYSIA | ENGLAND | INDONESIA | PAKISTAN | QATAR | CANADA | DUBAI | THAILAND |
|---|---|---|---|---|---|---|---|---|---|---|
| INDIA | 1 | | | | | | | | | |
| USA | 0.1249 | 1 | | | | | | | | |
| MALAYSIA | 0.5457 | 0.1546 | 1 | | | | | | | |
| ENGLAND | 0.5740 | 0.1586 | 0.5569 | 1 | | | | | | |
| INDONESIA | 0.6775 | 0.0771 | 0.5460 | 0.5709 | 1 | | | | | |
| PAKISTAN | 0.4072 | -0.0895 | 0.3529 | 0.4391 | 0.4547 | 1 | | | | |
| QATAR | 0.3035 | 0.2148 | 0.3258 | 0.3408 | 0.2023 | 0.2819 | 1 | | | |
| CANADA | 0.6536 | 0.2558 | 0.6326 | 0.7849 | 0.6467 | 0.4203 | 0.4026 | 1 | | |
| DUBAI | 0.2507 | 0.2222 | 0.2775 | 0.2042 | 0.1297 | 0.2311 | 0.8822 | 0.3195 | 1 | |
| THAILAND | 0.6168 | 0.1226 | 0.5494 | 0.5180 | 0.5782 | 0.3006 | 0.4178 | 0.6512 | 0.3691 | 1 |

### 4.4.3 Static Connectedness of Weekly Volatility

The results of Spillover between volatility series using static connectedness approach are represented as Table 4.15. We have calculated statistic connectedness of weekly volatility. Index spillover is captured through variance decomposition.

India's own contribution to its market forecast is 32.16%. Indian market 0.349% to explain volatility spillover of USA, 4.22% to Malaysia, 6.38% to England, 8.69% to Indonesia, 4.45% to Pakistan, 0.615% to Qatar 5.08% to Canada, 0.49% to Dubai and 1.96% volatility forecast of Thailand market is explained.

USA's 79.72% market volatility is due its own market shocks and USA market shocks contribute in the volatility forecast of India is 0.73%, Malaysia is 0.71%, England is 1.30%, Indonesia is 0.94%, Pakistan is 2.18%, Qatar is 1.18%, Canada is 1.76%, Dubai is 1.48% and Thailand is 1.85%.

Malaysian sentiments contribution in volatility spillover is 4.01% to Indian stock market, 0.26% to USA stock market, 4.71% to England stock market, 4.78% to Indonesian market, 3.89% to Pakistani market, 1.34% to Qatari stock market, 5.23% to Canadian stock market, 1.15% to Dubai stock market and 2.88% Volatility spillover contribution in Thailand stock market where 42.66% of Malaysian volatility forecast is explained by its own shocks.

England s 36.04% volatility forecast is explained by its own shocks and its contribution in volatility spillover of India is 5.66%, USA is 0.77%, Malaysia is 5.19%, Indonesia is 4.86%, Pakistan is 6.25%, Qatar is 1.43%, Canada is 11.42%, Dubai is 0.37% and contribution in Thailand's volatility spillover is 1.77%.

Indonesia's 31.17% volatility are explained by its own shocks and Indonesian market is contributing 10.47% volatility spillover contributor to India, 0.46% to USA stock market, 7.11% to Malaysian market, 6.16% to British stock market, 8.47% to Pakistan stock market, 2.47% to Qatari market, 6.57% to Canadian market, 3.87% to Dubai stock market and it contributes 4.07% volatility spillover to Thailand stock market.

Pakistan's 51.57% volatility is captured by its own ups and downs. Pakistani stock market sentiments involve in explaining 2.63% volatility spillover of a India,

Table 4.15: Static Connectedness - Weekly Volatility

| | INDIA | USA | MALAYSIA | ENGLAND | INDONESIA |
|---|---|---|---|---|---|
| INDIA | 32.169 | 0.732 | 4.017 | 5.669 | 10.472 |
| USA | 0.349 | 79.727 | 0.261 | 0.770 | 0.466 |
| MALAYSIA | 4.225 | 0.713 | 42.667 | 5.194 | 7.116 |
| ENGLAND | 6.381 | 1.303 | 4.710 | 36.047 | 6.167 |
| INDONESIA | 8.691 | 0.947 | 4.789 | 4.868 | 31.177 |
| PAKISTAN | 4.456 | 2.183 | 3.898 | 6.251 | 8.475 |
| QATAR | 0.615 | 1.184 | 1.346 | 1.437 | 2.471 |
| CANADA | 5.080 | 1.763 | 5.233 | 11.427 | 6.579 |
| DUBAI | 0.497 | 1.486 | 1.156 | 0.378 | 3.876 |
| THAILAND | 1.966 | 1.851 | 2.882 | 1.779 | 4.074 |
| Contribution to others | 32.262 | 12.163 | 28.293 | 37.773 | 49.696 |
| Contribution including own | 64.432 | 91.890 | 70.960 | 73.820 | 80.873 |
| Net spillovers | -35.568 | -8.110 | -29.040 | -26.180 | -19.127 |

Table 4.15: continued ....

| | PAKISTAN | QATAR | CANADA | DUBAI | THAILAND | FROM |
|---|---|---|---|---|---|---|
| INDIA | 2.639 | 1.811 | 8.269 | 2.134 | 32.087 | 67.831 |
| USA | 2.521 | 2.383 | 3.858 | 4.401 | 5.263 | 20.273 |
| MALAYSIA | 2.780 | 1.554 | 9.251 | 1.721 | 24.779 | 57.333 |
| ENGLAND | 4.244 | 2.271 | 17.362 | 1.057 | 20.459 | 63.953 |
| INDONESIA | 4.265 | 1.895 | 8.573 | 3.250 | 31.545 | 68.823 |
| PAKISTAN | 51.578 | 2.339 | 5.863 | 4.435 | 10.521 | 48.422 |
| QATAR | 0.165 | 39.819 | 2.149 | 32.858 | 17.955 | 60.181 |
| CANADA | 2.475 | 2.332 | 29.737 | 2.424 | 32.949 | 70.263 |
| DUBAI | 0.500 | 24.115 | 1.644 | 50.652 | 15.697 | 49.348 |
| THAILAND | 0.130 | 2.776 | 6.655 | 3.394 | 74.492 | 25.508 |
| Contribution to others | 19.720 | 41.475 | 63.623 | 55.673 | 191.255 | 531.934 |
| Contribution including own | 71.298 | 81.294 | 93.360 | 106.326 | 265.748 | TCI |
| Net spillovers | -28.702 | -18.706 | -6.640 | 6.326 | 165.748 | 53.193 |

2.52% of USA, 2.78% of Malaysia, 4.24% of England, 4.26% of Indonesia, 0.16% of Qatar, 2.47% of Canada, 0.5% of Dubai and explain 0.13% volatility spillover of Thailand stock market.

Qatar's own shocks explain 39.81% of its own volatility spillover, whereas it contributes in explaining the 1.81% volatility forecast of India, 2.38% of USA, 1.55% of Malaysia, 2.27% of England, 1.89% of Indonesia, 2.34% of Pakistan, 2.33% of Canada, 24.11% of Dubai, and 2.77% volatility of Thailand stock market.

Canadian 29.73% volatility forecast is followed by its own market sentiments and its volatility sentiments may 8.26% spillover to Indian market, 3.85% to USA, 9.25% to Malaysian market, 17.36% to British stock market, 8.57% to Indonesian market, 5.86% to Pakistani market, 2.14% to Qatar, 1.64% to Dubai and 6.65% to Thailand.

Dubai stock market shocks describe 50.65% of its own volatility spillover whereas it contributes 2.13% in volatility of India, 4.40% of USA, 1.72% of Malaysia, 1.05% of England, 3.25% of Indonesia, 4.43% of Pakistani, 32.85% of Qatar, 2.42% of Canada and 3.39% of Thailand stock market.

Thailand 74.49% of volatility forecast is followed by its own market sentiments. Thailand's market shocks contribute in explaining 32.08% volatility spillover of India, 5.26% of USA, 24.77% of Malaysia, 20.45% of England, 31.54% of Indonesia, 10.52% of Pakistan, 17.95% of Qatar, 32.94% of Canada, 15.69% volatility spillover of Dubai. Total calculated index of weekly volatility series is 53.19% in static connectedness which indicate an inter-connectedness of markets.

### 4.4.4 The Volatility Spillover from a Specific Market to other Specific Markets is Represented Graphically as under in Fig 4.17

The spillover is not constant over time. There is high volatility spillover in certain periods and lower volatility spillover in other periods. The spillover is generally high during crises period in Syria when civil war started in June 2014 and whole economy of world was under crisis.

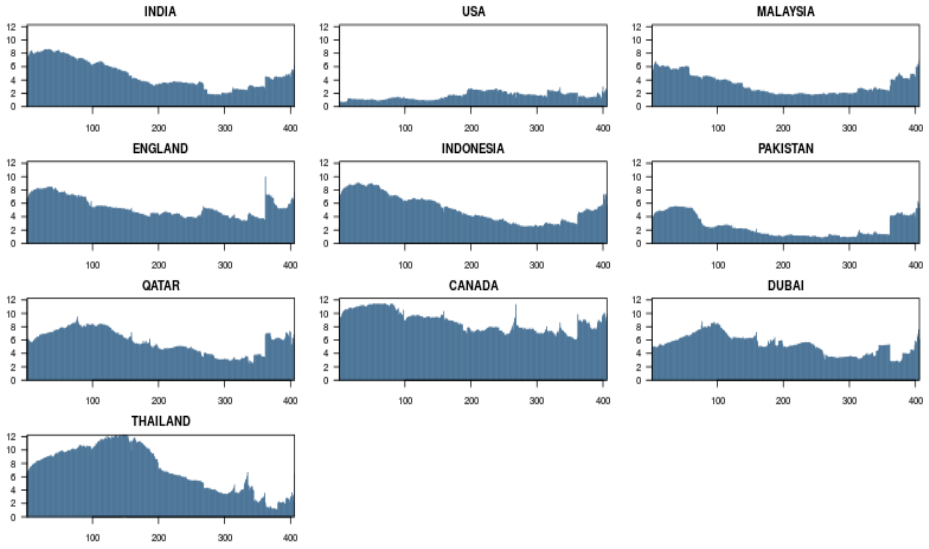


FIGURE 4.17: Contribution from a Specific Market to other Specific Markets - Weekly Volatility

Graphs 4.17 show how much every sample country contribute in volatility spillover of other countries. Graphs reveals that India contributes 32.26% of volatility spillover to other countries.

Similarly, USA is contributing 12.16% of volatility spillover to other markets, Malaysian market contributes 28.29% of volatility spillover, British market contributes 37.77% of volatility spillover and Indonesia contributes 49.69% of volatility spillover to other markets. Pakistan is contributing 19.72% of volatility spillover, Canada is contributing 41.47% of volatility spillover, Dubai is contributing 63.62% and Thailand has 55.67% contribution of volatility spillover to other markets. Graphical representation of TO concept indicates that Thailand market has highest and USA market has lowest contribution in volatility spillover to other sample markets.

### 4.4.5 The Spillover from all other Markets to a Specific Market is Represented as Fig 4.18

High spillover contribution has observed in graphical representation 4.18 from other markets to Indian, England, Indonesian and Canadian market where as other markets have not much received volatility spillover shocks from other markets and

Canada is highest receiver and Dubai is lowest receiver of volatility spillover.

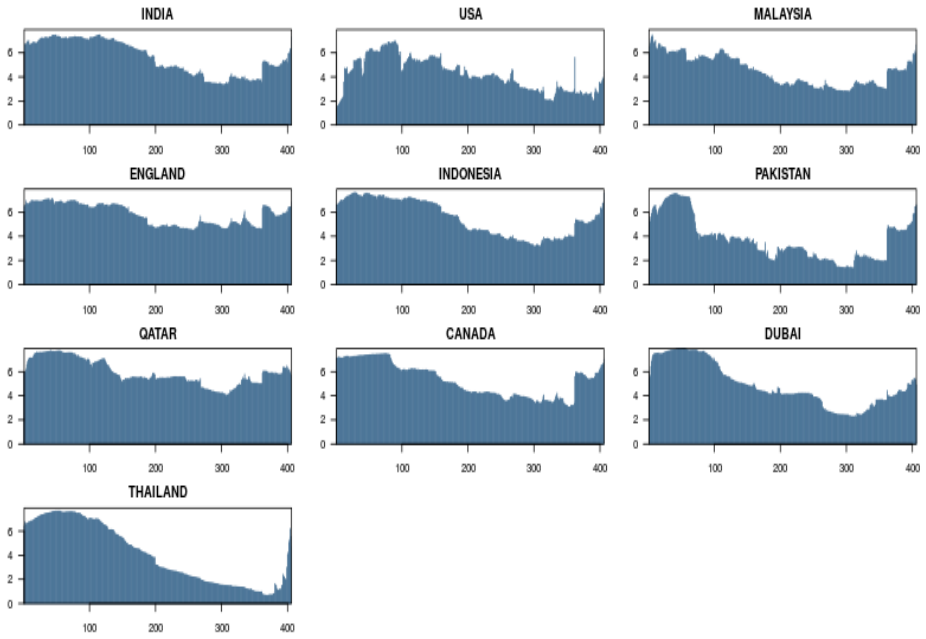


FIGURE 4.18: Contribution from other Markets to a Specific Market - Weekly Volatility

India receives 67.83% volatility spillover, USA receives 20.27% receives, Malaysia receives 57.33, British market receives 63.95% Indonesia receives 68.82%, Pakistan receives 48.42%, Qatar receives 60.18%, Canadian market receives 70.26%, Dubai receives 49.34% and Thailand receives 25.50% of volatility spillover from other markets. In short, Canada receives highest and USA receives lowest volatility spillover contribution from other markets.

### 4.4.6 The Volatility Spillover from Specific Market to other Specific Markets and from other Markets to Specific Market is Netted off as Expressed in Fig 4.19

Net Spillover of India is -35.56%, USA -8.11%, Malaysia -29.04%, England -26.18%, Indonesia -19.12%, Pakistan -28.70%, Qatar -18.70%, Canada -6.64%, Dubai 6.32% and Thailand has 165.74% of net spillover. All markets are net receiver in one period and net giver in other period. USA, Malaysia and Pakistan

appear to be net receiver whereas Canada and Thailand stock markets are net giver.

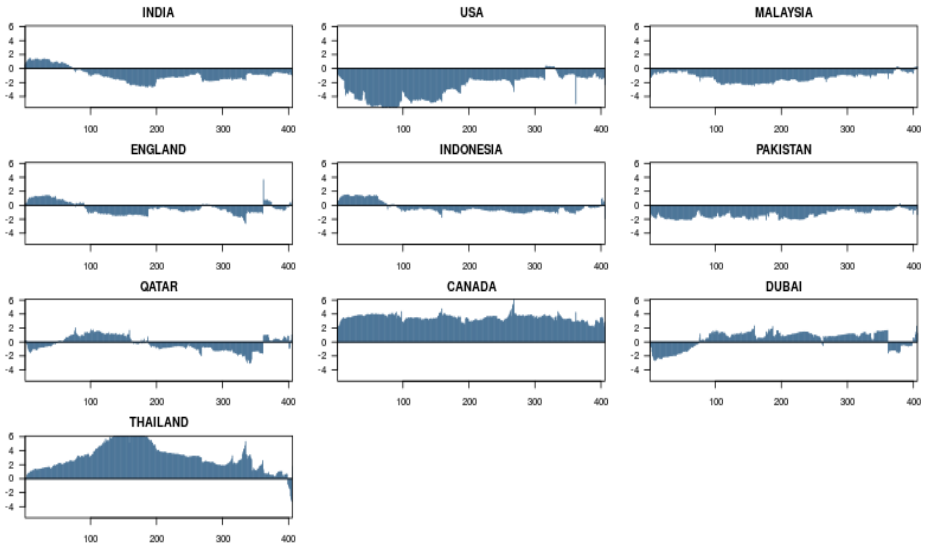


FIGURE 4.19: Net Spillover of each Market - Weekly Volatility

### 4.4.7 Dynamic Connectedness of Weekly Volatility

The results of dynamic connectedness of daily volatility series are represented in Table 4.16. Total 44.04% volatility of Indian stock market are explained by its own market shocks whereas its contribution in explaining 3.38% volatility forecast of USA, 5.23% to Malaysia, 6.25% to England, 10.53% to Indonesia, 4.22% to Pakistan, 3.87% to Qatar, 4.99% to Canadian stock market, 3.10% to Dubai and contribution to Thailand stock market volatility forecast is 6.01%.

USA's 58.12% volatility are explained by its own shocks whereas USA is contributing 0.90% volatility spillover of India, 1.58% of Malaysia, 2.47% of England, 0.96% of Indonesia, 1.99% to Pakistan, 1.07% of Qatar, 4.81% of Canada, 1.54% of Dubai and contributing in explaining 0.34% volatility forecast of Thailand stock market.

Malaysia is contributing 54.97% to its own volatility forecast and its contribution to India's volatility is 2.02%, USA's volatility 4.29%, England's volatility 5.98%, Indonesia's volatility 4.70%, Qatar's volatility 2.73%,Canada's volatility 4.04%, and Dubai's volatility 2.22% and its contribution to the Thailand's market

Table 4.16: Dynamic Connectedness - Weekly Volatility

| | INDIA | USA | MALAYSIA | ENGLAND | INDONESIA |
|---|---|---|---|---|---|
| INDIA | 44.042 | 0.908 | 4.254 | 7.068 | 10.680 |
| USA | 3.382 | 58.129 | 2.022 | 5.573 | 2.825 |
| MALAYSIA | 5.233 | 1.581 | 54.975 | 5.924 | 7.116 |
| ENGLAND | 6.258 | 2.473 | 4.297 | 42.017 | 7.241 |
| INDONESIA | 10.537 | 0.969 | 5.980 | 7.290 | 45.010 |
| PAKISTAN | 4.225 | 1.995 | 4.702 | 4.925 | 5.556 |
| QATAR | 3.873 | 1.075 | 2.730 | 4.147 | 3.281 |
| CANADA | 4.996 | 4.817 | 4.043 | 12.322 | 6.861 |
| DUBAI | 3.102 | 1.540 | 2.226 | 2.500 | 1.968 |
| THAILAND | 6.012 | 0.349 | 2.936 | 4.191 | 6.445 |
| Contribution to others | 47.618 | 15.707 | 33.189 | 53.940 | 51.973 |
| Contribution including own | 91.660 | 73.835 | 88.164 | 95.958 | 96.983 |
| Net spillovers | -8.340 | -26.165 | -11.836 | -4.042 | -3.017 |

Table 4.16: continued ....

| | PAKISTAN | QATAR | CANADA | DUBAI | THAILAND | FROM |
|---|---|---|---|---|---|---|
| INDIA | 3.280 | 4.016 | 9.757 | 3.300 | 12.696 | 55.958 |
| USA | 1.671 | 3.072 | 16.471 | 2.506 | 4.350 | 41.871 |
| MALAYSIA | 2.822 | 3.667 | 9.264 | 2.540 | 6.878 | 45.025 |
| ENGLAND | 3.868 | 4.494 | 19.038 | 1.807 | 8.508 | 57.983 |
| INDONESIA | 3.245 | 2.973 | 9.534 | 2.597 | 11.865 | 54.990 |
| PAKISTAN | 62.679 | 5.150 | 3.681 | 4.016 | 3.071 | 37.321 |
| QATAR | 3.174 | 40.836 | 6.317 | 28.260 | 6.307 | 59.164 |
| CANADA | 2.616 | 3.735 | 46.984 | 2.624 | 11.001 | 53.016 |
| DUBAI | 1.975 | 24.375 | 4.718 | 51.092 | 6.504 | 48.908 |
| THAILAND | 1.945 | 5.352 | 8.664 | 4.987 | 59.121 | 40.879 |
| Contribution to others | 24.595 | 56.832 | 87.444 | 52.636 | 71.180 | 495.114 |
| Contribution including own | 87.274 | 97.669 | 134.428 | 103.729 | 130.300 | TCI |
| Net spillovers | -12.726 | -2.331 | 34.428 | 3.729 | 30.300 | 49.511 |

volatility forecast is 2.93%.

England's 42.01% volatility are described by its own market spillover whereas its contribution to India's market volatility is 7.06%, 5.57% USA's volatility, 5.92% Malaysia volatility, 7.29% Pakistan's volatility, 4.92% Indonesia's volatility, 4.14% Qatar volatility, 12.32% Canada's volatility, 2.5% Dubai's volatility and 4.19% volatility forecast of Thailand stock market.

About 45.01% volatility of Indonesian stock market are captured by its own market spillover and it contributes to explain 10.61% India's volatility 2.82% USA's volatility, 7.11% Malaysia's volatility, 7.24% England's volatility,5.55% Indonesia's volatility, 3.28% Pakistan's volatility, 6.86% Canada's volatility, 1.96% Dubai's volatility and it explains 6.4% volatility of Thailand stock market.

Pakistan's 62.67% volatility is captured by its own ups and downs. Pakistani stock market sentiments involve in explaining 3.28% volatility spillover of India, 1.67% of USA, 2.82% of Malaysia, 3.86% of England, 3.24% of Indonesia, 3.17% of Qatar, 2.61% of Canada, 1.97% of Dubai and explain 1.94% volatility spillover of Thailand stock market.

About 40.83% volatility of Qatar stock market are captured by its own market spillover and rest of the portion is captured by other stock markets sentiments. Qatar stock market sentiments contributes to explain 4.01% India's volatility 3.07% USA's volatility, 3.66% Malaysia's volatility, 4.49% England's volatility,2.97% Indonesia's volatility, 5.15% Pakistan's volatility, 3.73% Canada's volatility, 24.37% Dubai's volatility and it explains 5.35% volatility of Thailand stock market.

Canada's 46.98% volatility is explained by its own shocks whereas Canada is contributing 9.75% volatility of India, 16.47% of USA, 9.26% of Malaysia, 19.03% of England, 9.53% of Indonesia, 3.68% of Pakistan, 6.31% of Qatar, 4.71% of Dubai and contributing 8.66% volatility forecast of Thailand stock market.

Dubai is contributing 51.09% to its own volatility forecast and its contribution to India's volatility is 3.3%, USA's volatility 2.50%, Malaysia's volatility 2.54%, England's volatility 1.80%, Indonesia's volatility 2.59%, Pakistan's volatility is a

4.01%, Qatar's volatility 28.26% which is an its highest contribution, Canada's volatility 2.62% and its contribution to Thailand's market volatility forecast error variance 4.98%.

Thailand is contributing 59.12% to its own volatility and its contribution to India's volatility is 12.69%, USA's volatility 4.35%, Malaysia's volatility 6.87%, England's volatility 8.50%, Indonesia's volatility 11.86%, Pakistan's volatility 3.07%, Qatar's volatility 6.30%, Canada's volatility 11% and its contribution to Dubai stock market volatility forecast is 6.50%.

### 4.4.8 The Graphical Behavior of Dynamic Total Connectedness of Volatility Series is Presented as Fig 4.20

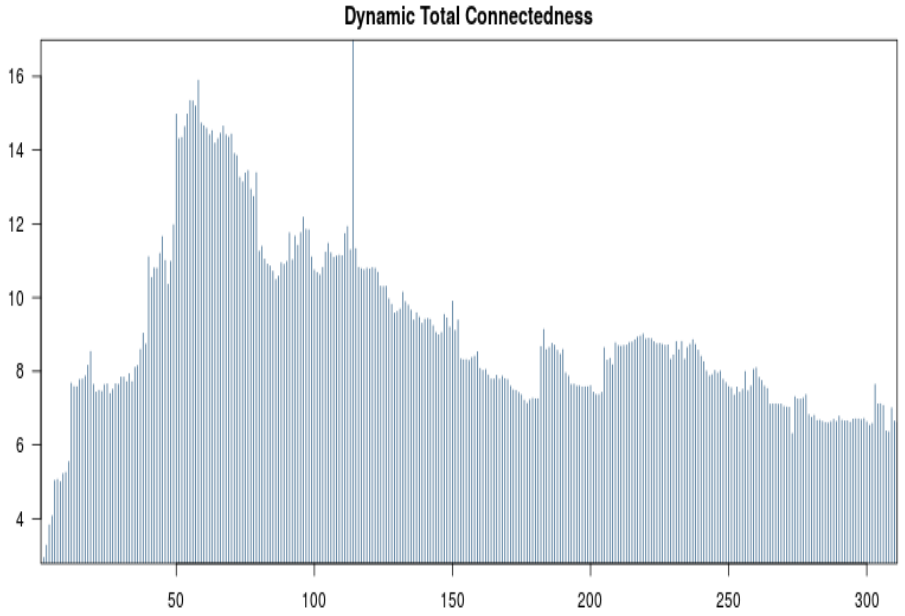


FIGURE 4.20: Graphical Behavior of Dynamic Total Connectedness of Volatility Series

Graph 4.20 shows spillover is not constant over time. There is low volatility spillover found in some period and also high volatility spillover in other periods. First 100 values show high total connectedness because spillover is generally high during crises period in Syria when a civil war started in June 2014 and the whole

economy of world was under crisis. From 150 values to end of the period, there is not much variations in total dynamic spillover connectedness. Total calculated weekly spillover index in dynamic connectedness is 49.51% which indicate interconnectedness.

# Chapter 5

# Discussion and Conclusion

Basically this study has been done to capture the return and volatility spillover among shariah complaint equity markets. This study use ten Islamic indices of world that are FTSE SHARIAH INDIA (India), FTSE SHARIAH USA (USA), FTSEBM EMAS SHARIAH (Malaysia), iShares MSCI World Islamic UCITS (ISWD) from England, Jakarta Islamic Shariah Index (Indonesia), Karachi Meezan 30 (Pakistan), QE Al Rayan Islamic(Qatar), S&P-TSX 60 (Canada), FTSE NASDAQ DUBAI 10 SHARIAH (Dubai) and FTSE SET Shariah Index (Thailand). This study use the spillover index technique of Diebold and Yilmaz to examine daily and weekly spillover among Islamic indices by covering time period from 1 July 2012 to 30 June 2020.This study have three main purpose that are (i) to capture return spillover across Islamic markets (ii) to capture volatility spillover across shariah complaint equity markets (iii) to explore directions of spillover across shariah complaint equity markets.

Results of this study show that England has highest and Qatar has lowest daily returns whereas England has lowest and Pakistan has highest daily volatility in all sample stock markets. Computed results indicate the significant and positive correlation among Indian and Thailand equity market, USA and Canadian equity markets and Qatar and Dubai shariah complaint equity market where as Malaysian market is partly correlated with Indonesian shariah complaint equity markets and rest of equity markets have insignificant relationship in terms of return and volatility series on daily basis .Because of significant positive relationship

India is highly contributing in return and volatility spillover of Thailand equity market, USA is contributing in Canadian equity market, Malaysia is contributing in Indonesian equity market and Qatar returns and volatility sentiments highly spillover to returns and volatility of Dubai equity markets by analyzing statically and as well as dynamically.

Results reveal that USA has highest and Dubai has lowest total return spillover in both static and as well as in dynamic connectedness. USA has highest net return spillover whereas Malaysia has lowest net return spillover in both static and as well as dynamic connectedness. Thailand has highest total volatility spillover in static connectedness and Qatar has highest total volatility spillover in dynamic connectedness whereas Indonesia has lowest total return spillover in both static and dynamic connectedness. By contrasting static and dynamic results there is not much difference in their results. In short TCI values of return series are lower than TCI values of volatility which indicates that markets returns are less interconnected where fluctuation in one market may much spillover to another market as contrast to return series of daily data.

Now come to the weekly series which indicate that England has highest and Qatar has lowest weekly returns .Correlation values show that only England have positive and significant relationship with Indonesia, Qatar and Canada and rest of all stock markets are insignificantly correlated with each other.

England's contribution to other countries is highest in all sample countries however Thailand has lowest contribution in explaining weekly return forecast error variance of other countries in both static and as well as dynamic connectedness. England has highest and Malaysia has lowest total contribution in static connectedness on other side Canada has highest where Malaysia and Thailand has lowest total contribution in dynamic connectedness. Canada receives highest contribution from other countries. All markets are net receiver in one period and net giver in other period. The Thailand and Malaysian markets are net recipient and Canadian market is net giver of weekly return spillover.

By analyzing weekly volatility series, Significant and positive auto correlation has been observed through Q(20), Q2(20) and LM(20) among all markets where

as only USA market has insignificant relationship with other markets in weekly volatility series. TCI values of weekly return are lower than weekly volatility which shows high interconnectedness in volatility shocks of all markets. Thailand market has highest and USA market has lowest contribution in volatility spillover to other sample markets. Canada receives highest and USA receives lowest volatility spillover contribution from other markets. All markets are net receiver in one period and net giver in other period. USA, Malaysia and Pakistan appear to be net receiver whereas Canada and Thailand stock markets are net giver of weekly volatility spillover.

## 5.1 Recommendations

The study recommend all market players including investors, portfolio managers, and risk manager to keep eyes on those markets which are less connected with each other, so they can earn the benefit of diversification from these markets. They should also keep in mind that those markets which are highly correlated with each other there is limited chance of diversification benefit. The result of study shows that India and Thailand, USA and Canada, Qatar and Dubai are highly connected with each others as connectedness between them is not constant and is time varying, so risk professionals should be vigilant and should be careful at time when markets becomes more closer and when it disperse, while in other rest of the countries the diversification benefit exist due to their less connectedness and provide opportunity to the market players to earn more from the diversification in the markets. In highly connected countries portfolio manager has to restructure portfolio again and again, because these countries markets are time varying and overcome the diversification benefit, so there is a limited diversification benefit.

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