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Bi-directional Mean and Volatility Spillover among Equity Markets

by

Nayyab Gulfraz

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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.

CERTIFICATE OF APPROVAL

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Abstract

The objective of this study is to explore bi-directional mean and volatility spillover among equity markets by using methodology of Diebold and Yilmaz (2009,2012). The sample is five emerging and seven frontier markets, while the time span is from 1- January-2003 to 31-December-2019. This study uses extended static approach and as well as dynamic rolling window that examine return and volatility spillover in TO and From context. This study has three main objectives that are (i) to capture mean spillover across emerging and frontier markets (ii) to capture volatility spillover across emerging and frontier markets (iii) to identify the opportunities for portfolio risk diversification. The findings of the study indicate that return and volatility spillover among selected equity markets is not constant over time. Return and volatility spillover is high in some periods and lower in other periods. The spillover is high during global financial crisis of 2007- 2008 which affect whole economy of world. Result also indicate high static and dynamic connectedness among these markets. The results show the positive and significant correlation among Russia (MOEX SE) and South Africa (South Africa 40), China (shanghai) and South Africa (South Africa 40), South Korea (KOSPI) and Mexico (S&P/BMVIPC), Egypt (EGX 30) and Turkey (BIST100). All markets are net recipient of information in some periods and also disseminate information in other periods, some markets are less connected with each other and some markets are more connected with each other. Risk managers and assets managers have to considers this connectedness during decision making.

Keywords: spillover index, Volatility, spillovers, Equity markets, stock returns, vector autoregression, connectedness.

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Abbreviations

ARMA-GARCH	Autoregressive Moving Averages GARCH
BSE	Bombay Stock Exchange
DCC	Dynamic Conditional Correlations
DYCI	Diebold Yilmaz Connectedness Index
EGX	Egyptian Stock Exchange
GARCH	Generalized Autoregressive Conditional Heteroscedasticity
MOEX	Moscow Exchange
US	United State
VAR	Vector Auto-Regression

Chapter 1

Introduction

The financial economics literature has been extremely successful at modeling, measuring and estimating time-varying return volatility, supporting asset pricing mechanism, risk management, and portfolio management. The strength of spillovers might, vary over time, and this difference is of possibly excessive interest. Study admit this statement in an investigation of a wide-ranging set of universal equity returns and volatilities from the early 1990s to the present-day, and see that spillover are essential, spillover strength is time changing, and nature of the time-alternative is extremely changed for returns verses volatilities (Diebold and Yilmaz, 2008).

Transmission mechanism among the return and volatilities of diverse stocks are essential for numerous reasons. Transmission proem explain many things about market behavior. In effect market it should not be possible to use the lagged returns of one stock to estimate the returns of another stock, and in the absence of time-varying risk premier, it may be useful for portfolio management, where information of return spillover effects may be valuable for asset allocation (Harris and Pisedtasalasai, 2006).

To measure the return and volatility spillover in world, researchers used different techniques like ARMA- GARCH Models, Co-integration and Dynamic Conditional Correlation GARCH Model. The technique, used in this study is variance decomposition, which is introduced in 2009 and improvised in bidirectional context

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in period of 2012 and 2014. Those investors who invest in emerging and frontier equity markets they prefer cross border investment in the same markets so it is necessary to examine the possibility of diversification in context of emerging and frontier equity markets.

To explain the connectedness, the study use methodology of Diebold and Yilmaz to quantity the connectedness of dierent stock markets. Second contribution in this study is that, it not only observes on the return spillovers but also examine volatility spillovers to measure the connectedness. In this study, focus is to examine emerging and frontier equity markets connectedness.

Volatility spillover investigation based on forecast error variance decompositions from vector auto-regressions can be used to examine the spillover in return through asset markets, individual assets and assets portfolio etc, both inward and outward countries (Diebold and Yilmaz, 2009).

1.1 Theoretical Background

Market efficiency theory deals with flow of information it finds that when information is arrived then all the assets respond according to available information and prices become adjusted according to information, returns increase with the arrival of good news and market discount with the arrival of bad news. Assets prices reflect all presented information a direct consequence is that it is probable to beat the market always on a risk adopted basis meanwhile market prices should only respond to new information.

With the passage of time all the markets of the world become interdependent with each other due to globalization, cross border investment, exports and imports and economic integration in the world. Markets are not much isolated in the world, so flow of information occurs among different market places.

As emerging markets grow day by day it conveys to develop markets. Emerging economies classically feature a stock market, stable currency, and banking system and are in the process of industrializing. Due to rapid growth, emerging

economies offer high return to investors but due to its category, emerging markets also offer high risk.

In emerging economies, investors face different type of risk like political instability, currency volatility, domestic infrastructure problems and illiquid equity, as mostly large companies may still be private or state run and in emerging economies native stock exchange doesn't offer liquid market to external investors. Emerging markets has some common characteristics like high rate of economic growth, market volatility, income per capita, investment and growth potential.

To determining the connectedness, I have different purposes. First, we used methodology of Diebold and Yilmaz to quantity the connectedness of different stock markets. Second, my contribution in this study, will not only observing on the return spillovers but also using volatility spillovers to measure the connectedness. In this study our focus is to measure emerging and frontier equity markets connectedness.

Investors who want to invest in frontier markets face different type of risk, four main type of risk that investors face in many type of investment such as political and social risk, liquidity risk, investment risk, currency risk. In frontier market everything is present, combined market value of frontier markets is about \$510 billion, stock worth of emerging markets is about \$20 trillion. Mostly local investors must invest in these types of markets so financial links are limited to the outside world that make frontier markets less correlated with international markets.

This study is on emerging and frontier markets and discuss about both markets i.e. emerging and frontier markets. Frontier countries are non-developed then the less developed countries but less established then the emerging countries. The frontier markets are generally small and in these markets large risk is present, in frontier equity markets investors look for high return potential as well as little correlations with other markets.

Globalization wave of 1990s, particularly in the emerging countries economies financial market disasters have become a more often experiential phenomenon. Throughout these crises, stock returns moved into the adverse region so volatility

in financial markets has increased suddenly. As the early shocks of each of these crises are not confined to the inventor country but spread to further countries as well, throughout nancial crises it is essential to examine return and volatility spillover in crosswise countries (Yilmaz, 2010).

The economic and financial instability during 2008-2009 develop interest in understanding the nature of information spread on and between financial markets. There is a strong connection among markets economic entities are connected more and more with each other especially international markets are more interconnected and their connectedness are increasing day by day new approaches are still being develop to quantify and measure the interconnectedness with in the markets. Due to the Eurozone crisis of 2012-13 and global nancial crisis of 2007-08, in policy discussions and academics stock markets volatility has gained significant attention.

The financial market systemic risk attracts both financial industry and academic concern after the current financial crisis, international monetary fund report (2009) tells that how financial systematic risk effect on financial assets prices, maximum countries have considered financial systemic risk anticipation as the essential regulatory purposes. Due to the financial crisis systematic risk occurred and at the same time financial assets prices are dropped, Financial Assets prices dropped due to correlation between financial assets when a price of one financial assets decline it will effect on other financial assets due to spillover effect.

Duncan and Kabundi (2013) study the structures of foreign and domestic sources of transmission volatility in South Africa. Their result show that estimated spillover levels are dynamic and lean towards to increase during foreign and domestic extreme moments.

A recent study tells us that market connectedness between stock markets increase when an unpredicted event occurs in one market, it may not affect only returns, but also cause unpredictability in other markets. Due to the increasing connectedness in international financial markets, stock market shocks spread around the world. The studies make it clear that stock market performances and real economic conditions are connected, the stock markets performance vary based on global factors. Market performances not perfectly connected across countries.

This study emphasizes on conventional equity markets by using conventional indices of selected emerging and frontier markets, this study use the vector Auto-regression model and variance decomposition approach proposed by Diebold and Yilmaz. This approach reveals whether one emerging equity market is connected with other emerging equity markets and one frontier equity market is connected with other frontier equity markets if they are connected then it means that mean spillover and volatility spillover exist among markets. This study does provide insight about Pakistani equity market and find the influence in Pakistan equity market if any change occurs in other markets.

1.2 Gap Analysis

In financial economics, Mean and volatility across markets is one of the most essential topic. These studies generally use ARMA GARCH, BEKK GARCH, DCC GARCH and cointegration analysis to capture spillover and long-term relationships. However, little work is found that explores the financial connectedness using variance decomposition approach that not only examines mean and volatility spillover but also considers the spillover direction. Few studies that discuss return and volatility spillover employ method suggested by (Diebold and Yilmaz, 2009, 2012).

Diebold and Yilmaz (2009) focus on developed countries equity markets. Yilmaz (2010) study on equity markets of east Asia. Mohammadi and Tan (2015) study on Equity Markets of China and the United States. This study focuses on equity markets of emerging and frontier countries as these regions are generally ignored. This study uses the variance decomposition approach in a static and dynamic context and thus provides insight about financial connectedness through spillover indices for returns and volatility.

1.3 Research Questions

Keeping in view research gap following questions are raised and answered:

Research Question 1

Is there a mean spillover across emerging and frontier markets?

Research Question 2

Is there volatility spillover across emerging and frontier markets?

Research Question 3

What is the direction of spillover across the market?

Research Question 4

Do dynamic models perform better than a static model?

Research Question 5

Is it better to give or receive information across the market?

1.4   Objectives of the Study

Objectives of the study are as follows:

Research objective 1

To identify the presence of mean spillover across emerging and frontier markets.

Research objective 2

To provide insight about volatility spillover across emerging and frontier markets.

Research objective 3

To identify the opportunities for portfolio risk diversification.

1.5   Significance of the Study

Several studies are there which study return and volatility spillover but this study focus on conventional equity markets of emerging and frontier countries, In this study variance and mean spillover technique is used, this study explores by directional causality which means a change in one country equity market influence in

other country equity market. The number of studies focuses on different countries but this study focus on five emerging and top ten frontier countries which is before less considered.

The information does not stop at one place it flows in different markets because investors invest across the border because of globalization every company is multi-national, Parent company exists in our country and subsidiaries exist in different countries. Nothing is independent with each other any change in one country affect other countries this study is important for portfolio manager risk manager regulator and investor, our outcomes are essential to practitioners, such as investors of stock markets, and policymakers to increase their understanding of financial markets interconnectedness.

Investors want to get more information about emerging and frontier equity markets especially in the context of return and volatility spillover. Regulators markets are interdependent so there should be careful regulations while revising the policies in context of risk management that safe the investors from external contereous effect. This study is very beneficial for investors to invest in the emerging and frontier equity markets by providing a detailed analysis of return and volatility spillover.

When volatility in one market due to volatility in other markets, then abnormality of volatility spillovers arises. For investors this is beneficial for worldwide portfolio diversification, due to recent technological developments the accessibility of overseas information for national investors have increased and speeded up information flows. Between stock markets, examination of return and volatility spillovers within several geographical areas contributes to our information about international financial inter-connectedness.

The strong linkage is observe between risk and return in equity market as greater the risk, greater the return, so risk manager use risk management strategy in the equity markets as stock prices fluctuates with the arrival of information, so he create portfolio through investment in different asset classes to diversify risk.

The equity markets are consider as an important component of free market economy, so all kind of investor use it for trading and exchange of capital. Investors

also use equity markets for the discovery of efficient prices as well as for efficient dealing in market.

Regulators regulates stock markets to save investors, discover the fair prices and orderly, and efficient markets, and facilitate capital formation i.e Securities and Exchange Commission (SEC) in USA.

1.6   Plan of the Study

Introduction, Theoretical Background, Gap Analysis, Research Questions, Objective and Significance of the study are covered in chapter 1. Chapter 2 include brief literature review regarding past studies in context of spillover among various equity markets across the world. Data description and VAR approach of Diebold and Yilmaz that employ in this study is presented in chapter 3. Data Analysis and interpretation are briefly discussed in chapter 4. Chapter 5 covers conclusion and recommendations of the study.

Chapter 2

Literature Review

2.1 Mean and Volatilty Spillover among Different Financial Markets across the world

Number of studies discuss return and volatility spillovers. These studies employ GARCH based techniques to investigate return and volatility spillover across markets and time horizons.

Harris and Pisedtasalasai (2006) find that return and volatility transmission among small and large stocks is asymmetric in UK the study investigate daily stock return from 1-1-1986 to 31-12- 2002 using the multivariate GARCH framework. These results reveal that there is substantial spillover in returns and volatility from the smaller stocks to the larger stocks.

Mulyadi et al. (2009) investigate the stock market volatility spillover among Indonesia, Japan, and the US using daily data from January 2004 to December 2008. It finds that volatility spillovers uni-directionally run from the US to Indonesia while there is a bi-directional link between Japan and Indonesia. Diebold and Yilmaz,(2008) examine the link between asset return volatility and macroeconomic essentials by studying a broad set of world stock markets covering almost 40 countries for the period 1960 and onward. The study discovers a strong connection among macroeconomic essentials and stock market volatilities, indicating that unstable macroeconomic variables translate into unstable markets of stocks.

Maghyereh and Awartani (2012)) use daily stock returns from the 7 January 2005 to 17 February 2010 to examines return and volatility spillover between ADSE and DFM. The study employs two methodologies, first is introduced by Kroner and Ng (1998) which is a simple asymmetric (VAR-BEKK) and other is proposed by Engle (2002) which is an asymmetric version of the (DCC) model, the result provide that return and volatility transmission between the Abu Dhabi Stock Exchange and Dubai Financial Market are asymmetric. There is substantial spillover in returns and volatility from the DFM to ADSE. These results indicate that firstly information is integrated in the Dubai Financial Market and then impounded in the Abu Dhabi Stock Exchange.

Diebold and Yilmaz (2009) use the data of 19 international equity markets from the first 1990s to 2008 to examine financial assets return and volatility spillover under a new theoretical framework, this framework facilitates the investigating of crisis and non-crisis episodes, including bursts and trends in spillovers. This study finds evidence of diverse behavior in the changes of return spillovers and volatility spillovers, volatility spillover shows clear bursts but no trend, whereas return spillovers display no bursts but a slightly increasing movement.

Yilmaz (2010) uses the forecast error variance decomposition from a vector auto-regression framework to examines return and volatility spillover between the east Asian markets and compares continuing crisis with previous episodes by using data from January 1, 1992 to April 30, 2009. The study observes a large change in the behavior of the volatility and return over the period. However, the spillover index returns find huge integration between the East Asian markets. During market crises, the spillover index volatility exhibits significant bursts, and evidence from crisis of East Asian markets.

Diebold and Yılmaz (2014) propose some connectedness procedures based on variance decompositions, then deliberate that these measures provide a better understanding of connectedness. It displays that variance decompositions describe weighted and directed networks, and these connectedness measures are closely related to measures of connectedness used in network writings. Based on these understandings, the study followed day-to-day time-varying connectedness of large

United States financial institutions return of stock volatilities with a focus on the financial crisis of 2007-2008 and provide evidence of the existence of mean and volatility spillover across institutions.

Zhang and Wang (2014) observe return and volatility spillover among world oil markets and chinese market from December 27, 2001, to December 24, 2013, using method proposed by Diebold and Yilmazs (2012). The study finds that volatility and return spillovers between world oil market and Chinese markets is asymmetric and bi-directional. World oil markets extremely affect the China market and the spillover is higher during the crisis of 2008.

The study of Diebold and Yilmaz (2012) focus on US commodities markets, stock market, bond market and forex market to determine the daily volatility spillovers across these markets by using the data for time span of 1999 to 2010 and employ generalized vector auto-regressive methodology. The result of the study reports that significant volatility spillover is present in all markets which varies during the global financial crisis period, whereas partial volatility spillover is observed across the markets.

Focusing on CIVETS countries Korkmaz et al. (2012) analyze return and volatility spillovers by using weekly data from the period of 2002 to 2010 and employ causality in mean and variance. The findings of the study document the low contemporaneous spillover effects. However, co-movement in the CIVETS stock markets is high. Moreover, this causal relationship structure also confirms the existence of intra-regional and inter-regional return and volatility interdependence.

Using the sample of stock markets of fifteen countries i.e. China, Malaysia, Korea, Indonesia, United Kingdom, India, Hong Kong, Pakistan, Canada, Japan, Singapore, Germany, united states, France, Taiwan, a study conducted by Singh et al. (2010) examine the return and volatility spillover among these countries. The authors use daily data from 2000 to 2008 and employ VAR and AR GARCH model with exogenous variables. The result of the study report that a specific index is frequently influenced by those indices that opens or closes just before it. Moreover, the result confirms a greater regional influence among the stock markets of Asia and Europe.

Maghyereh et al. (2016) use data from 2008 to 2015 and employ the set of directional technique proposed by Diebold and Yilmaz (2012, 2014, 2015) to explore the directional linkage among oil and eleven equity markets. The findings of the study reveal that bi-directional information spillovers between oil and equity market build a linkage between these markets. However, result also confirms that linkage is mostly lead by the spillover from oil to equity markets. In addition, result also concludes that the level of spillover among oil and equity markets is changing during an overall sample period, but this relationship is more pronounced from mid of 2009 to mid of 2012.

A study based on major five stock markets of Europe i.e. FTSE100 (UK), DAX (Germany), IBEX (Spain), CAC40 (France), PSI 20 (Portugal); is conducted by Nishimura and Sun (2018). This study employ Intraday Volatility Spillover Index (IVSI) technique to examine (a) intraday volatility of the stock markets (b) volatility spillover between the stock markets. The empirical result of the study indicates no apparent variation in the linkage of these stock markets during the sample period (after the 3 month of Brexit vote). However, after the one month of Brexit vote it is observed that the volatility spillovers rise with a transformed spillover mechanism. In addition, dynamic studies also report that volatility spillover rise instantly after Brexit vote and then decrease with the passage of time.

Choosing a time period of 1987 to 1989, a study conducted by Susmel and Engle (1994) investigate the mean and volatility spillovers between the equity markets of London and New York by employing ARCH model. The analysis of the study provides an evidence of minimal volatility spillover between London and New York stock markets. Further result concludes that at the opening of New York equity market, the variation of share prices is significantly affected but these results are not consistent.

Yarovaya et al. (2016) using the data from the period of 2005 to 2014 provide experimental evidence on the patterns of intra- and inter-regional spread of information across ten developed markets and eleven emerging markets in Asia. The analysis of return spillover and spillovers volatility around the most current crises

is based on the Generalized vector auto-regressive (VAR) framework. Results provide that markets are more expressed to region-specific and domestic volatility shocks than to inter-regional contagion. This study determines that more effective channels of information transmission provide futures data because the magnitude of return spillover and spillovers volatility across futures is greater than across indices.

Koutmos (2018) using the sample period from August 2015 to July 2018 measures interdependencies in 18 most important cryptocurrencies, through the analysis of forecast error variance decompositions, vector auto-regression methods. This study finds that Bitcoin is prominent contributor to return spillover and volatility spillovers between all the selected crypto currencies. Return spillover and spillovers volatility have increased gradually over the period, there are 'spikes' in spillovers for the duration of key news occasions about cryptocurrencies. These findings suggest increasing interdependence amongst cryptocurrencies and, by adding, an advanced degree of contagion risk.

Roni et al. (2018) examine the interdependencies across stock markets of Asian emerging countries (e.g., China, Bangladesh, India, Philippine, Malaysia, and South Korea) and then measure the level of the Asian emerging stock market fluctuation, by using daily data of stock markets of emerging countries using data of January 2002 to December 2016. It further divides the whole data in three periods; crisis, pre-crisis, post crisis. During this data period these markets experienced key upheaval and fast growth and provide possibly rich information about market connectedness. The volatility and return spillovers are modeled through the Granger causality tests, GARCH, and the forecast error variance decomposition in a generalized VAR (vector auto- regression) models.

The result shows that during the crisis, pre-crisis, and post crisis periods volatility and return spillovers behave very differently over period. Essentially, before the global financial crisis period Asian emerging stock markets interaction is less. During the global financial crisis of 2007 to 2008, the volatility and return spillover indices touch their relevant historical peaks; however, in 2009-2010 markets of Bangladesh faces this condition (Roni et al., 2018).

Fedorova and Saleem (2009) uses weekly stock returns to examine the linkage between Russia and Eastern European emerging stock markets, secondly explore the relationship among the currency markets of Russia, Hungry, Poland and Czech Republic. Moreover, examine the interdependence among Russian and Emerging Eastern European currency and equity markets. They uses bivariate GARCH-BEKK model and find the indication of direct linkage among the currency markets as well as equity markets, both in regards of volatility and returns. While examining the relationship between stock and currency markets the study finds unidirectional spillovers volatility from currency to stock markets. Result shows the clear indication of Eastern European emerging markets integration inside the countries as well with Russia.

Wang et al. (2002) uses daily data from October 1996 to July 2000 to investigates the types of stock volatility and return behavior that are traded in more than one country. Specially, observe the pricing information spread for Hong Kong based stocks traded on the London Stock Exchange and Stock Exchange of Hong Kong. By using GJR-GARCH model the study provide empirical evidence that volatility and returns are bidirectional.

The study of volatility spillovers provides useful insights into how information is transmitted from stock market to foreign exchange market and vice versa. Mishra et al. (2007) explores volatility spillovers between the foreign exchange and Indian stock markets by using GARCH model EGARCH model. The results show that there occurs a bi-directional volatility spillover between the foreign exchange market and Indian stock market with the exception of S&P CNX 500 and S&P CNX NIFT. The result of this study suggest that foreign exchange market and the Indian stock market move in tandem with each other and there is a long run relationship between these markets. The results suggest that these markets are connected with each other and there is an information transmission between these two markets.

Shahzad et al. (2017) examining volatility and return spillovers across the international Islamic stock market, three main conventional state stock markets (the Japan, UK and US) and a number of significant financial and macroeconomic

variables over the period 1996 to 2016. Used VAR-based spillover index approach based on the generalized VAR framework developed by Diebold and Yilmaz (2012) is applied.

The result, show strong interactions among the global Islamic stock market return and volatility, the set of major risk factors and conventional stock markets are considered. This outcome means that the Islamic equity world does not organize a viable substitute for investors who desire to hedge their investments against the vagaries of stock markets, but it exposed to the same risks and global factors hitting the conventional financial system. Then, this indication leads to the refusal of the decoupling hypothesis from conventional stock markets to Islamic stock market, which has substantial implications for faith-based policy makers and investors in terms of hedging strategies, contagion risk portfolio and diversification (Shahzad et al., 2017).

Singh et al. (2010) explain interdependence of fifteen indices of the world as well as an Indian market index in terms of volatility and return spillover. These markets are China, Indonesia, France, Korea, Germany, Canada, Hong-Kong, Japan, Malaysia, , Singapore, Pakistan, Taiwan, United States and United Kingdom. To estimate the conditional return spillover among these indices, Vector auto-regressive model is used. Spillover Volatility is estimated through AR-GARCH. Volatility and Return spillover between other markets and Indian markets are modeled through multivariate GARCH (BEKK) model and bivariate VAR and respectively.

Result found that there is greater regional impact among Asian markets in volatility and return than with European and United States. European markets and United States affects maximum markets of Asian. In addition, among European indices namely CAC, FTSE and DAX high degree of correlation is observed. However, between Indian markets and most of the other markets short run interdependence is found. Indian and other markets like Japan, US, Canada, and Korea positively affect each others. Indian market also has significant effect on Singapore, Pakistan and Malaysia return (Singh et al., 2010).

Kumar (2014) explores the dynamic nature of volatility, return and correlation

transmission between exchange rates of Indian relative to Britain pound, US dollar, Japanese yen and euro. This study uses of the vector auto-regressive, dynamic conditional correlation and multivariate generalized auto-regressive conditional heteroskedasticity model. Result shows a significant uni-directional return spillover from Japanese yen and euro to USD and bi-directional return spillover between Japanese yen and GBP. This study also finds evidence of significant spillover volatility effect from United State dollar to Britain pound, Japanese Yen and euro and from Britain pound and Euro to United State Dollar. Moreover, result indicate that during the period of global financial crisis the time-varying conditional correlations among exchange rate vagaries dynamically over time and are broadly distributed with higher volatility for all United State Dollar and other exchange rate pairs.

Bajo-Rubio et al. (2017) observe return and volatility spillovers among the Turkish stock market with exchange rate, international stock and commodity markets. Focus of this research is to examine behavior of spillover with markets of emerging countries and also investigate cross asset spillovers deal two periods of financial market crisis, the liquidity-induced financial crisis and dotcom crash. This study uses the spillover index methodology and result indicate that, between the same asset class spillovers are largely over the dotcom period, notably two international stock markets series and two exchange rate series. However, in the period of financial crisis, both spillovers increase and cross asset types and exhibit a greater degree of market interdependence.

Mensi et al. (2017) explores the time-varying risk spillovers among precious metals (silver, gold, platinum, and palladium) and most important stock markets (Japan, Asia, USA and Europe) by applying the spillover index proposed by Diebold and Yilmaz (2012). For examine asset allocations, hedging strategies, and hedge ratios. The results of the study show evidence of spillovers volatility between stock markets and precious metal. Further result of the study shows except for Japanese market all of the stock markets are a source of spillovers volatility and the markets of four precious metals are net receipt of spillovers volatility during the European Sovereign Debt Crisis and Global Financial Crisis.

Moon and Yu (2010) explore the short-run spillover effects of daily stock returns and volatilities between the Shanghai Stock Exchange index in China and the Standard & Poors 500 stock index in the United State. It find that a structural break happened in December 2005 in the Shanghai Stock Exchange (SSE) stock return mean by examining modified (general auto-regressive conditional heteroscedasticity), GARCH(1,1)-M models. Moreover, it finds indication of an asymmetric and symmetric spillover volatility effect from the United State to the stock market of China in the post-break period.

Finally, in the post-break period it observes the symmetric spillover volatility effect from China to the United State, by using data of stock market from 5-1-1999 to 12-6- 2007. The result of this study indicate that in the post-break period stock returns mean is much higher than the stock returns mean is in the pre-break period. Using the asymmetric and symmetric GARCH spillover models, the study shows only for the post-break period, unpredicted volatility in the Standard & Poors 500 stock return has both asymmetric and symmetric effects of spillover on the volatility of Chinas Shanghai Stock Exchange composite returns (Moon and Yu, 2010).

Miyakoshi (2003) observe the magnitude of volatility and return spillovers from United State and the Japan to seven Asian stock markets. Ng (2000) contracts with a world and a regional shock as exogenous variables in the univariate GARCH model for the markets of Asia. However, this study deals only with a global shock of the United State as exogenous variable in a bivariate EGARCH model for each of the Asian countries (Taiwan, Korea, Thailand, Malaysia, Hong Kong, Indonesia and Singapore) and japan. First, this study focus only the effect of the United State is essential for returns of Asian market; there is no effect from Japan. Second, the volatility of the markets of Asia is influenced more by the market of Japanese than by United State. Third, from the Asian market to the Japanese market there occurs an adverse influence of volatility.

Kang and Lee (2019) uses daily price data from 1- 1-2002 to 19-7- 2018 for twelve stock market index futures (Brazil, Hong Kong, France, Australia, Germany, India, Korea, Japan, Spain, Singapore, United Kingdom, and United State)

and two commodity futures markets, gold and WTI crude oil futures contracts. To observe the dynamic spillovers volatility and connectedness of network between commodity futures markets and stock index by applying the spillover index method presented by Diebold and Yilmaz (2014) and the multivariate DECOFI-GARCH model. Moreover, estimate a positive equi-correlation between the commodity futures markets and stock index and find the top level of index spillover during the global financial crises of 2008-2009 and European sovereign debt crisis of 2010-2012.

Additional, adopt both dynamic and static approaches of spillover to identify the net spillover receiver or transmitter across worldwide futures markets. Across global futures, markets measure the directional spillover and assess the net pairwise spillover. Finally, in different sub-periods network connectedness provides information on the intensity of connectedness and net pairwise connectedness (Kang and Lee, 2019).

Using a sample period of 1985 to 2015 a study done by Abbas et al. (2019) that examine the linkage between return and volatility of the equity markets and macroeconomic variables for the G7 countries by employing generalized VAR technique. The result shows return and volatility linkage among equity markets and macroeconomic variables including exchange rates, oil prices, money supply, interest rates, ination and industrial production. Further, the transmission of mean and volatility spillover among equity markets and macroeconomic variables show different response after the financial crisis 2008. The result of the study provides useful direction and guidance to market players with unpredicted variations in G-7 equity markets.

In Credit default swap (CDS) markets of Korean, Australian, Japanese, and Hong Kong, a study conducted by Da Fonseca and Gottschalk (2020) explore the determinants of CDS spread. The study employs regression analysis as well as VAR approach and time span from September 2007 to December 2010 including weekly observations. The finding of the study indicates that at rm level stock returns leads the other variables. However, at index level realized volatility and CDS spreads are also important. In addition, analysis of the study reveal that

realized volatility is the key donor to the volatility spillover effects among the three asset classes. The findings show the significance of realized volatility to recognize the market action in a comprehensive way.

The study of Diebold and Yilmaz (2013) analyze the business cycle connectedness by using seasonally adjusted monthly data of Industrial Production (IP) of G-7 from 1958 to 2011 and apply connectedness-measurement technology. The analysis of the study reveals that universal connectedness is substantial as well as time-varying with the change of business cycle. The result also indicates that connection consistent to transmissions to others from the US and Japan is disproportionately significant.

Chen and Wu (2016) study the co-movement and relationship of commodity futures in past two decades by employing two techniques (a) Dynamic Conditional Correlation (DCC) to observe the time varying correlation among commodity futures (b) Vector auto-regression (VAR) models to measure the direction and magnitude of volatility spillover. The result of the study shows that both models DCC and VAR produce consistent results. However, time varying correlation and linkage of commodity markets is dramatically more pronounced during the market decline period (2007 to 2009) and after that it return to normal position as observe during pre-crisis period. Further the findings indicate that variation (downward movement) in commodity prices does not necessarily shows stronger linkage between commodity.

Using high frequency data of Chinese CSI-300 industry indices for the period of 2012 to 2016, a study conducted by He et al. (2018) explore the intraday return and volatility spillovers by employing generalized variance decomposition and VEC-DCC-GARCH methodology. The result of the study reveals high correlation among the CSI 300 industry indices. Further findings conclude that systematic risk is strongly influenced by the dynamic characteristics of mean and volatility spillover, particularly the spillover from real estate and finance industry.

To explore the dynamics of volatility spillover among the currencies of Central European and euro/dollar exchange rate, a study done by Bubák et al. (2011) choose a sample period from the January 2003 to June 2009 with a 5-minute spot

exchange rate and employ two techniques (a) spillover technique of Diebold and Yilmaz (b) parsimonious parametric model. The result of the study shows intra-regional volatility spillover between Central European and foreign forex markets. However, no spillover is observed from euro/dollar to the Central European foreign forex market. Further analysis conclude that volatility spillovers rises in stages categorized by market risk.

To describe the impact of March 2014 and June 2017 crises on dependency of equity market and volatility spillover between Qatar and GCC countries i.e. Bahrain, Kuwait, UAE, Oman and Saudi Arabia a research done by Charfeddine and Al Refai (2019) use data from 2011 to 2018 and employ two techniques: (a) static and dynamic volatility spillovers proposed by Diebold and Yilmaz to observe volatility spillover and connectivity among the markets; (b) DCC model with ADCC extension to capture time varying correlations and asymmetric effect on these correlation. The analysis of the study shows that the crisis of June 2017 substantially effects the dependency of the stock market as well as volatility spillover among Qatar and GCC countries excluding Bahrain, which show no response. In addition, the result provides the evidence of almost zero net spillover for the Qatar, while it is observed negative for the Saudi Arabia after the 2017 GCC crisis.

Sumner et al. (2010) use weekly data and chose time span from 1970 to 2009 and employ spillover index approach proposed by Diebold and Yilmaz (2009) to explore interdependency among gold, bond and stock market. The result of the study provides no evidence of return spillover. Whereas, some evidence of volatility spillovers is found of which much is similar to a spillover from variation in stocks to the volatility of bond return. Further, higher mean Spillovers is found during the early 1980s and mid-1990s and also during the most recent financial crisis. The much higher volatility spillover is observed during the recent market decline period as well as late 1970s and early 1990s.

For a G7 countries i.e. Canada, UK, USA, Japan, Italy, Germany and France, a study done by Liow (2015) investigate the conditional volatility spillover between currency, bond, stock, money and public real estate markets domestically as well

as internationally. The authors use sample period of 1997 to 2013 and employ the spillover technique of Diebold and Yilmaz (2012). The result of the study reveals that level of volatility spillovers among all assets classes is low. However, persistence of volatility is found dominant in domestic markets for all assets. Moreover, result also confirms that general equity portfolio is the main contributor to the overall volatility spillovers.

Diebold and Yilmaz (2009) use weekly stock market return (Friday close) of South American countries i.e. Merval (Argentina), IGPA (chile) Bovespa (Brazil) and IPC (Mexico) from 1992 to 2008 to explore the effect of shocks of one stock market on the forecast-error variance of return and volatilities of other stock markets by utilizing spillover technique. The result of the study shows that there exists volatility spillover that is influenced by the economic events. However, no return spillover is observed, indicating no impact of economic shocks on the return of the stock markets.

Employing spillover technique of Diebold-Yilmaz (2009), a study conducted by Allen et al. (2017) analyze the volatility spillover from Nikkei225 index, Kospi index, Hang-Seng, Shanghai composite and S&P500 index on the markets of Australia. The analysis reveals that Hang-Seng index and S&P500 index have the extreme influence on the Australian markets.

To measure the return and volatility spillover in equity and currencies markets, a study done by Suwanpong (2011) use data of stock markets of twelve countries and forex rate of eleven countries from the period of 1998 to 2010 and apply Variance Decomposition (VD) and spillover technique of Diebold-Yilmaz (2009). The result of the study indicates that return and volatility spillover from equity markets creates forecast-error-variance of about 45% to 55%, whereas it shows 30% for the forex markets correspondingly. In addition, by investigating forex market it is observed that mean and volatility spillover is generated from United State dollar (USD), Hong Kong dollar (HKD), Australian dollar (AUD) and Indonesian rupiah (IDR). The result conclude that mean and volatility spillover among the markets is more pronounced during the decline period.

Another study done by Gamba-Santamaria et al. (2017) to find the volatility

spillover between the returns of the stock market of US, Colombia, Mexico Brazil, and Chile. Their study uses daily data of stock market indices from 2003 to 2016 and employ DCC model to observe time varying correlation among co-variance matrix. Their results conclude that stock market of Brazil is the main source of volatility spillover, while US, Colombia, Mexico and chile are the receiver of volatility spillover.

Fernández-Rodríguez et al. (2015) use daily data from 1999 to 2014 of sovereign bond markets of eleven EMU countries including both peripheral and central countries to examine a volatility spillover. Firstly, study explores the unconditional pattern by employing spillover technique of Diebold and Yilmaz (2012. Secondly, measure the net directional volatility spillovers, dynamic analysis is applied. Thirdly panel analysis is used to examine determinants of net directional volatility spillovers. Result of study reveals that during recent crisis, transmission of shocks from the cross-border is quick and dominant in the EMU, while also strong financial and trade, inter-linkages are found and assurance effects indicates its importance for the transmission mechanism. Further it is observe that during financial crisis period the sentiments of market players suddenly change and they focus on macroeconomic imbalances in few peripheral countries.

Employing two methodologies (a) spillover (b) entropy; a study done by Erkol (2015) use weekly data of stock markets of five countries for the time span from 1997 to 2013 to explore how stock markets are connected with each other. The finding of the study provides the evidence that return and volatility spillovers act in same way and correlation between them is found positive. However, it is also observed that return and volatility spillover behave differently at specific time intervals. The result of the study concludes that in last five years spillover is increased.

The study of Chevallier and Ielpo (2013) use broad data of currencies, equities, interest rates and commodities for the time period 1995 to 2012 to investigate (a) volatility spillover among the commodities (b) volatility spillover among standard assets and commodities (c) volatility spillover among commodities and currencies, by employing the methodology of Diebold and Yilmaz (2012). The result show

weaker volatility spillover for commodities in comparison to the other asset classes, but spillover is rising over the time. Further result indicate that agricultural commodities display low spillover, while precious metals and energy product are the main contributor to the net spillover. The study concludes that diversified portfolio, including commodities (especially agricultural products) reduce the overall spillover.

A study based on South Africa (SA) equities, bonds, currencies is conducted by Duncan and Kabundi (2011) this study use data from 1996 to 2010 to examine the volatility spillover among the domestic asset classes of South Africa by applying generalized vector auto-regressive (GVAR) model. The result show that volatility spillover changes over the time, as volatility spillover move upward during the period of market decline. The analysis of study provides confirms strong volatility spillover from equity markets to bond and currencies market. However, during the period of currency crisis, volatility spillover is temporarily dominated by the currencies market. Further results document that bonds are constantly the receiver of volatility spillover.

For the equity markets of China, Hong Kong, and U.S a research conducted by Mohammadi and Tan (2015) use daily data from 2001 to 2013 and explore daily dynamics of returns and volatility in four equity markets by employing VAR model, Multivariate GARCH Models including (a) MGARCH-BEKK (b) MGARCH-CCC (c) MGARCH-DCC). The uni-directional return spillovers as well as influence of ARCH and GARCH is found from U.S. equity market to other equity markets; but no spillover is detected among Hong Kong, and China.

Furthermore, the level of correlations varies among the returns of markets, as highest correlation is found among Shanghai and Shenzhen, while the correlation is observed among mainland China (Shanghai and Shenzhen) and Hong Kong equity markets and low correlations is found among U.S. and mainland China (Shanghai and Shenzhen) stock markets respectively. The result of DCC model also confirms that correlation among the Chinese and other equity markets increase during the market decline period (2007-2009) (Mohammadi and Tan, 2015).

Another study done by Rao (2008) use a time series data from the period of

2003 to 2006 and uses two methodologies (a) VAR model (b) MGARCH model; to analyze cointegration and persistence of volatility between six emerging AGCC stock markets and developed markets. The result indicates that cross as well as own spillover is created by the AGCC markets, while volatility spillover and persistence of volatility is also innovated in these markets. Further result show that inside the domestic market, emerging AGCC markets originate comparatively more of their innovations and persistence of volatility.

Using several sets of daily data taken at different time of the day a work done by Apergis and Rezitis (2001) employ generalized auto-regressive conditional heteroscedasticity to study the influence of volatility spillover across London and New York forex markets and stock markets. The empirical result of the study shows significant influence of volatility spillover from the forex markets in New York and London to the stock markets in London and New York respectively. However, in contrast, there is no volatility spillover observe from stock markets to the forex markets of London and New York.

A research focusing on major cryptocurrency is conducted by Fasanya et al. (2020) use daily data by choosing time span from 2015 to 2018 and employ the spillover technique of Dielbold and Yilmaz (2012) and rolling sample investegation to explore (a) mean and volatility spillovers between cryptocurrency (b) essential materialistic and recurring movements in the cryptocurrency. The result document that over the time, large difference is noticed among nature of return of portfolio of cryptocurrencies and volatility spillover indices. The finding indicates the interdependency between portfolio of cryptocurrency specified the spillover indices. Moreover the result also confirms that mean spillover index increase linkage among the currency portfolios, while during financial crisis period the volatility spillover index experiences substantial bursts. Further, mean and volatility spillovers show both trends and bursts correspondingly.

El Ghini and Saidi (2017) use daily data for the period of 2002 to 2012 and employ bivariate VAR-BEKK GARCH model to analyze the return and volatility connection among the equity market of Moroccan (MASI) and four other markets i.e. Germany (DAX), USA (NASDAQ), France (CAC), and UK (FTSE). The

result of the study show changing level of interdependency and influence of spillover between Moroccan equity market and other equity markets before as well as after the market decline period.

Employing the spillover index technique of Diebold and Yilmaz (2009) a study conducted by Kumar (2011) investigate the nature of interdependency, and mean and volatility spillovers, for three Indian forex rates (a) US dollar (b) British Pound (c) Euro. The result reveal significant contemporaneous linkage among the return series of US dollar, British Pound, Euro and the series of conditional volatility. The result of spillover indicates significant return and volatility spillover from Euro to British Pound. However, this relationship is found insignificant for the USD rates as it is not influenced by the variations in the other forex rates (British Pound, Euro). Further findings of spillover index confirm that variation in return and volatility of the index is the reflection of a shocks in the economy.

This study fills gap by taking evidence from return spillover and volatility spillover between 5 emerging markets of equity and 7 frontier markets of equity. This literature is based on the Market Efficiency Theory that deals with market prices, which reflect all relevant information.

Chapter 3

Research Methodology

3.1 Data Description

3.1.1 Population and Sample of the Study

The population of this study is the conventional equity markets. The sample is five emerging equity markets and seven frontier equity markets, taken from the list of N-11 2019. Daily data obtained from the equity markets of emerging and frontier countries for the period of 1-January-2003- 31-December-2019 is used.

3.2 Description of Variables

The return of equity markets are calculated by dividing current day closing prices by previous day closing prices and taking their natural log. The formula is as follow:

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

Where

Rt = return of Stock Market Index

ln = Natural log

P_t = Current day closing prices

P_{t-1} = Previous day closing prices

3.3 Econometric Model

This study employ the methodology proposed by Diebold and Yilmaz (2009, 2012). Diebold and Yilmaz (2009) present a spillover index approach to capture the return and volatility spillover across the equity market. This study uses the spillover index approach proposed by Diebold and Yilmaz (2009) for capturing the return and volatility spillover among selected conventional Indices. Diebold-Yilmaz Connectedness Index (DYCI) methodology is based on generalized variance decompositions (with 10-day forecast horizon) obtained from a VAR model of range volatilities. The VAR model is estimated using the elastic net shrinking and selection procedure, which combines Lasso and Ridge estimators.

As an N Variable Vector Autoregression (VAR) equity market return and volatilities are modeled. Shares of forecasted error variance are added for each conventional equity markets including emerging and frontier because of shocks in conventional market d i. Then aggregate examine the spillover index. In short, spillover is the aggregate of all cross-sectional elements among the forecasted error variance matrix. Now we will define how to measure the spillover index in a brief. Covariance stationary kth order of N-variable VAR will be considered upfront,

$$Z_p = \sum_{i=1}^{r} \phi_i Z_{p-1} + \varepsilon_p \tag{3.2}$$

where $Z_p = (Z_{1,p}.....Z_{N,P})'$ ϕ is an NxN constant matrix and there is zero mean and matrix of covariance of the vector of error terms. In the model, Z is a vector of conventional index return volatilities or vector of conventional indices. Suppose there is a covariance stationary in VAR system and its average moving depiction exist and is presented as

$$Z_p = \sum_{i=0}^{\infty} C_i \varepsilon_{p-i} \tag{3.3}$$

where the NxN coefficient of matrices follow the periodic of $C_i = \phi_1 C_{i-1} + \phi_2 C_{i-2} + \dots + \phi_q C_{i-q}$ with C_0 being an unit matrix NxN and $C_i = 0$ for i < 0.

Cholesky Decomposition is used for the covariance matrix of ε_p RR where singular lower triangular Cholesky factor of $\sum$ is R, so equation no2 can be written as

$$Z_p = \sum_{i=0}^{\infty}(C_i R)(R^{-1}\varepsilon_{p-1}) = \sum_{i=1}^{\infty}(C_i R)(\tilde{\varepsilon}_{p-1}) = \sum_{i=0}^{\infty}\tilde{C}\tilde{\varepsilon}_{p-1} \qquad (3.4)$$

such that $\tilde{\varepsilon}_p = R^{-1}\varepsilon_p$ having zero mean are equilateral and ones of covariance matrix in the oblige and zero elsewhere.

Predicted error variances of each variable are separated through variance decomposition into parts which result in the number of system shocks.

Now shares of own variance are determined which are the part of D step onward error variance in predicting X_i due to collapse 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 collapse to X_j, for i ≠ j. The number of achievable spillovers is equal to N in case of N model variable and the number of spillovers is two when a simple case of two-variable VAR, is considered, predicted error variance of X_{2p} that is affected by the collapse of X_{1p} and X_{2p} that affect the predicted error variance of X_{1p}.

Firstly, Covariance Matrix of D- a step along predicted error variance are decomposed with the help of the above definition

$$\theta_{ik}(G) = \frac{\sum_{g=0}^{G-1}(\tilde{\varepsilon}_i C_g R_e k)}{\sum_{g=0}^{G-1}(\acute{e}_i C_g \sum \acute{c}_g e_i)} = \frac{\sum_{g=0}^{G-1}(\acute{e}_i \tilde{C}_g e_k)^2}{\sum_{g=0}^{G-1}(\acute{e}_i \tilde{C}_g \tilde{C}_g e_i)} \qquad (3.5)$$

where e_i is an Nx1 angle with one as its ith factor and zeros somewhere else. $\theta_{ik}(G)$ is the addition of a one-standard-deviation collapse to z_k to the variance of the G step along with the predicted error of z_i?

By composition

$$\sum_{k=1}^{N}\theta_{ik}(G) = 1 \; and \; \sum_{i,k=1}^{N}\theta_{ik}(G) = N \qquad (3.6)$$

Once the spillover measure is obtained from variable i to k, the spillover index can be determined as a total spillover measure in terms of percentage for all I, k.

The Sum of the off- transversal components is equal to the spillover index of the matrix results from a standard variance decomposition discharge in any VAR structure related to the various variable. The number of variables related to the sum of transversal elements, and also is a degree of how much-predicted error variance are determined by their shocks. The abstraction of our spillover measure is useful often and we venture it in our consecutive experimental analysis of return and volatility spillover among the conventional equity market.

The study measure log returns weekly, using underlying stock index levels at the Tuesday close and the weekly returns are used as annualized percentages, which is calculated as $r_i k = 52 \times 100(\Delta \ ln \ P_i k)$ for market i.

Following Garman and Klass (1980), we estimate weekly return volatilities using weekly high, low, opening and closing prices obtained from underlying daily high, low, open and close data, from the Wednesday open to the Tuesday close:

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

where H is the Wednesday Tuesday high, L is the Wednesday Tuesday low, O is the Wednesday open and C is the Tuesday 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 $\tilde{\sigma}_{ik} = 100\sqrt{52} \ \tilde{\sigma}_{i^2k}$.

Chapter 4

Data Analysis and Discussion

4.1 Descriptive Statistics of Daily Stock Market Return

Table 4.1 and 4.2 present summary statistics of daily return including average return, average risk, maximum return. It further explains auto-correlation in data. Start from Chinese market, Average loss in Chinese market is 0.10% average risk of Chinese market is 1.41%, maximum return earned in a day is 9.53% and maximum loss faced by the investors in one day is 7.86%. Data is leptokurtic and skewness is observed in Q(20) and Q2(20) both test shows that auto-correlation is exist.

Average return in Indian market is 0.65% average risk of India market is 0.71% maximum return earned in a day is 6.05% and in Indian market investors face 0% maximum loss in one day. Average loss in brazil market is 0.07% average risk of Brazilian market is 1.65%, maximum return earned in a day is 12.09% and maximum loss faced by the investors in one day is 13.68%, average loss in Russian market is 0.032% per day average risk of Russian market is 1.911%, maximum return earned in a day is 20.66% and maximum loss faced by the investors in one day is 25.23%.

Average loss in south Africa market is 0.028% per day average risk of south Africa market is 1.21%, maximum return earned in a day is 7.96% and maximum loss faced by the investors in one day is -7.71%. In south Korean market average

TABLE 4.1: Descriptive Statistics of Daily Stock Market Return

	china	India	Brazil	Russia	South Africa	South Korea
Mean	-0.1005	0.6542	-0.0707	-0.0316	-0.0283	0.0456
Standard Deviation	1.4062	0.7149	1.6454	1.9114	1.2149	1.0028
Kurtosis	3.8074	8.9474	4.6647	24.6095	4.2095	11.8019
Skewness	0.2576	2.4564	0.0951	0.1571	0.0854	0.5195
Minimum	-7.8628	0.0000	-13.6797	-25.2261	-7.7088	-8.5971
Maximum	9.5265	6.0523	12.0914	20.6571	7.9585	11.3500
JB	3389.766***	23940.476***	5005.125***	139153.746***	4075.856***	32243.291***
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Q(20)	231.308***	14615.768***	246.055***	363.091***	422.214***	326.012***
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Q2(20)	232.330***	6374.370***	1571.744***	1247.410***	703.958***	1935.742***
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LM	149.211***	546.195***	623.003***	500.821***	261.078***	443.251***
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Table 4.2: Descriptive Statistics of Daily Stock Market Return

	Mexico	Egypt	Indonesia	Iran	Pakistan	Turkey
Mean	-0.0303	-0.0648	-0.0614	-0.0205	-0.0058	0.0332
Standard Deviation	1.1345	1.5266	1.1030	1.6173	1.1587	1.5602
Kurtosis	6.1288	13.9399	6.1183	1256.2695	2.6850	4.5365
Skewness	0.0291	0.7651	0.4071	25.4054	0.2969	0.4783
Minimum	-9.9527	-18.3692	-7.1041	-5.8937	-5.2531	-10.9615
Maximum	7.0846	17.9916	9.2577	82.5227	5.2123	13.3408
JB	8627.589***	45176.657***	8749.903***	363188166.076***	1736.154***	4936.501***
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Q(20)	363.478***	627.030***	338.538***	228.690***	342.627***	285.410***
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Q2(20)	721.111***	545.741***	275.871***	0.0020	1128.191***	614.657***
	0.0000	0.0000	0.0000	-1.0000	0.0000	0.0000
LM	398.323***	29.460***	100.653***	0.0320	257.509***	182.598***
	0.0000	0.0000	0.0000	-1.0000	0.0000	0.0000

return is .05% per day average risk in this market is 1.003%, maximum return earned in a day is 11.35% and maximum loss faced by the investors in one day is 8.597%. Average loss in Mexican market is 0.030% per day average risk of Mexico market is 1.13%, maximum return earned in a day is 7.08% and maximum loss faced by the investors in one day is 9.95%.

Average loss in Egyptian market is 0.06% per day average risk of Egyptian market is 1.53%, maximum return is earned in a day is 17.99% and maximum loss faced by the investors in one day is 18.37%. In Indonesian market average loss is 0.061% per day average risk in this market is 1.10%, maximum return earned in a day is 9.26% and maximum loss investors faced in one day is 7.10%. Average loss in Iranian market is 0.02% per day average risk in Iranian market is 1.62%, maximum return earned in a day is 82.52% and in Iran market investors face maximum loss of 5.89% in one day.

In Pakistani market average loss is 0.006% per day average risk in this market is 1.16%, maximum return earned in a day is 5.212% and maximum loss that investors faced in one day is 5.25%. Average return in turkey market is 0.03% per day average risk of turkey market is 1.56%, maximum return earned in a day is 13.34% and investors faced maximum loss of 10.96% in one day. All returns are leptokurtic in all markets except Pakistan. Return of Pakistani market are platokurtic. Skewness is observed positive in all markets, whereas auto-correlation is existing in all return series except Iran, Q (20) test shows that auto-correlation exists in Iran but Q2(20) test shows there is no auto-correlationin Iranian markets.

4.1.1   The Return of each Market are Graphically Present as Fig 4.1

The graphical behavior of different countries, also show contradiction in different countries and spillover of daily return among different countries. The graph indicates periods of high return and low return periods and highly volatile periods. The behavior of iranian market is completely different from other markets. The pakistani region is highly volatile from rest of the world. Volatility clustering

is appears in markets of Russia, south korea and brazil significantly. Pakistan market exhibit a broad range of return.Where is egyptian market appear to the narrow range bound. South korea and indian markets are also affected by global financial crisis uncertainty is high, but average return is reported.
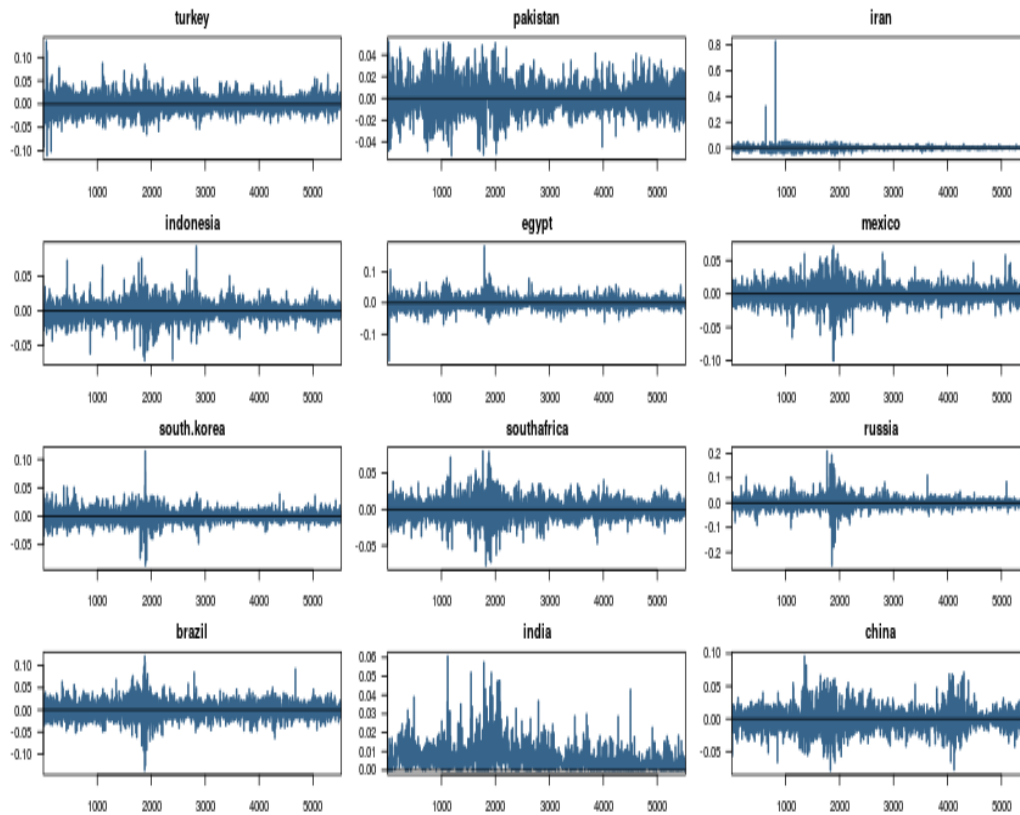
FIGURE 4.1: Graphical Representation of Return

4.1.2 Correlation Analysis of Daily Return

Table 4.3 shows Chinese market has no significant correlation with other markets, Indian market also has no significant correlation with any market. However, Brazilian market has significant correlation with markets of Russia, south Africa, Mexico. Russia has significant correlation with south Africa and Mexico. South African market has significant correlation with markets of Mexico. Markets of South Korea, Egypt, Indonesia, Iran, Pakistan and turkey has no significant correlation with any market.

TABLE 4.3: Correlation Analysis of Daily Return

	China	India	Brazil	Russia	South Africa	South Korea	Mexico	Egypt	Indonesia	Iran	Pakistan	Turkey
China	1											
India	0.0016	1										
Brazil	0.1242	-0.0005	1									
Russia	0.0725	0.0074	0.3419	1								
South Africa	0.0893	-0.0285	0.3668	0.4677	1							
South Korea	0.1994	0.0242	0.2187	0.2021	0.1942	1						
Mexico	0.1235	0.0038	0.5903	0.3383	0.3998	0.2317	1					
Egypt	0.0194	0.0213	0.0940	0.1201	0.1057	0.0631	0.0982	1				
Indonesia	0.1269	-0.0075	0.1941	0.1694	0.2189	0.2660	0.1977	0.0929	1			
Iran	0.0041	0.0069	0.0073	0.0438	0.0294	0.0403	0.0070	0.0482	0.0241	1		
Pakistan	0.0262	0.0217	0.0390	0.0175	0.0524	0.0308	0.0382	0.0678	0.0740	0.0064	1	
Turkey	0.0059	0.0203	0.2277	0.2611	0.2530	0.1036	0.2494	0.0620	0.0964	0.0026	0.0227	1

4.1.3 Static Connectedness of Daily Return

This study uses the cholesky factorization based variance decomposition to calculate the spillover. Table 4.4 and 4.5 report the details of Static connectedness of daily return. China contribution to its own market is 90.3% china contribution to India is 0.02% Brazil is 0.91%, Russia is 0.36%, South Africa is 0.47%, South Korea is 3.03%, Mexico is 0.87%, Egypt is 0.05%, Indonesia is 1.35%, Iran is 0.001%, Pakistan is 0.05% and Turkey is 0% china market has some influence on all other markets except turkey. There is no contribution of china stock market to turkey stock markets. There is an insignificant relationship between these two stock markets. China total contributions to other markets is 7.151% and china contribution to its own market is 90.373%, While other countries contribution is only 9.627% to China's market.

India is presented as second ordered country, Where India contribution to its own market is 99.4%, India's stock market contribution to china is 0.05%, Brazil 0.01%, Russia 0.001%, South Africa 0.1%, South Korea 0.05%, Mexico 0.01%, Egypt 0.10%, Indonesia 0.06%, Iran 0.03%, Pakistan 0.03% and Turkey 0.04%. India total contributions to other markets is 0.52% and India contribution to its own market is 99.4% India contribution including own is 99.9%, While other countries contribution is only 0.56% to India's market.

Brazil contribution to its own market is 57.02% Brazil stock market contribution to china is 1.42%, India 0.06%, Russia 7.6%, South Africa 8.3%, South Korea 3.40%, Mexico 19.62%, Egypt 1.28%, Indonesia 3.10%, Iran 0.01%, Pakistan 0.37% and Turkey 4.21% Brazil total contributions to other markets is 49.47% and Brazil contribution to its own market is 57.02% Brazil contribution including own is 106.5%, While other countries contribution is 42.97% to Brazil market. Russia contribution to its own market is 61.8% Russia's stock market contribution to china is 0.45%, India 0.11%, Brazil 6.18%, South Africa 12.61%, South Korea 3.22%, Mexico 5.90%, Egypt 1.43%, Indonesia 2.24%, Iran 0.20%, Pakistan 0.3% and Turkey 5.46%. Russia total contributions to other markets is 38.15% and Russia contribution to its own market is 61.85% Russia contribution including own is 100.0%, While other countries contribution is 38.11% to Russia market.

TABLE 4.4: Static Connectedness of Daily Return

	China	India	Brazil	Russia	South Africa	South Korea
China	90.373	0.054	1.421	0.454	0.778	3.766
India	0.027	99.431	0.064	0.113	0.096	0.031
Brazil	0.914	0.011	57.028	6.189	7.306	2.940
Russia	0.362	0.001	7.630	61.890	13.428	2.545
South Africa	0.473	0.100	8.330	12.617	58.967	2.246
South Korea	3.031	0.051	3.403	3.226	3.137	76.690
Mexico	0.877	0.018	19.628	5.903	8.165	3.248
Egypt	0.055	0.109	1.289	1.435	1.311	0.532
Indonesia	1.351	0.064	3.106	2.247	3.879	5.559
Iran	0.001	0.039	0.015	0.206	0.201	0.111
Pakistan	0.059	0.033	0.378	0.300	0.542	0.110
Turkey	0.000	0.044	4.210	5.466	4.964	0.863
Contribution to others	7.151	0.524	49.474	38.156	43.808	21.952
Contribution including own	97.523	99.955	106.502	100.046	102.775	98.642
Net spillovers	-2.477	-0.045	6.502	0.046	2.775	-1.358

TABLE 4.5: Static Connectedness of Daily Return

	Mexico	Egypt	Indonesia	Iran	Pakistan	Turkey	From
China	1.351	0.070	1.577	0.002	0.070	0.083	9.627
India	0.089	0.005	0.027	0.010	0.051	0.056	0.569
Brazil	20.171	0.397	1.946	0.026	0.053	3.019	42.972
Russia	7.393	0.687	1.574	0.122	0.001	4.367	38.110
South Africa	10.114	0.476	2.489	0.023	0.083	4.083	41.033
South Korea	3.852	0.223	5.268	0.174	0.062	0.882	23.310
Mexico	56.280	0.384	1.988	0.008	0.043	3.458	43.720
Egypt	1.315	91.858	0.988	0.198	0.207	0.703	8.142
Indonesia	3.131	0.482	78.987	0.031	0.322	0.841	21.013
Iran	0.096	0.189	0.067	99.058	0.012	0.005	0.942
Pakistan	0.311	0.554	0.559	0.014	97.011	0.129	2.989
Turkey	4.796	0.251	0.701	0.008	0.022	78.674	21.326
Contribution to others	52.620	3.719	17.184	0.616	0.925	17.624	253.754
Contribution including own	108.900	95.577	96.172	99.674	97.936	96.298	TCI
Net spillovers	8.900	-4.423	-3.828	-0.326	-2.064	-3.702	21.146

South Africa's contribution to its own market is 58.96% South Africa's stock market contribution to china is 0.77%, India 0.09%, Brazil 7.30%, Russia 13.42%, South Korea 3.13%, Mexico 8.16%, Egypt 1.31%, Indonesia 3.87%, Iran 0.20%, Pakistan 0.54% and Turkey 4.96% South Africa's total contributions to other markets is 43.80% and South Africa's contribution to its own market is 58.96% South Africa's contribution including own is 102.77%, While other countries contribution is 41.03% to South Africa's market.

South Korea's contribution to its own market is 76.69%, South Korea's stock market contribution to china is 3.77%, India 3.03%, Brazil 2.94%, Russia 2.55%, South Africa 2.25%, Mexico 3.25%, Egypt 0.53%, Indonesia 5.56%, Iran 0.11%, Pakistan 0.11% and Turkey 0.86% South Korea's total contributions to other markets is 21.95% and South Korea's contribution to its own market is 76.7% South Korea's contribution including own is 98.64%, While other countries contribution is 23.3% to South Korea's market.

Mexico's contribution to its own market is 56.28%, Mexico's stock market contribution to china is 1.35%, India 0.09%, Brazil 20.17%, Russia 7.39%, South Africa 10.11%, South Korea 3.85%, Egypt 1.32%, Indonesia 3.13%, Iran 0.09%, Pakistan 0.31% and Turkey 4.79% Mexico's total contributions to other markets is 52.62% and Mexico's contribution to its own market is 56.28% Mexico's contribution including own is 108.9%, While other countries contribution is 43.72% to Mexico's market.

Egypt's contribution to its own market is 91.86%, Egypt's stock market contribution to china is 0.07%, India 0.005%, Brazil 0.39% Russia 0.69%, South Africa 0.48% South Korea 0.22%, Mexico 0.38%, Indonesia 0.48%, Iran 0.19%, Pakistan 0.55% and Turkey 0.25% Egypt's total contributions to other markets is 3.72% and Egypt's contribution to its own market is 91.86% Egypt's contribution including own is 95.58%, While other countries contribution is 8.14% to Egypt's market.

Indonesia's contribution to its own market is 78.99% Indonesia's stock market contribution to china is 1.58%, India 0.03%, Brazil 1.95%, Russia 1.57%, South Africa 2.49%, South Korea 5.27%, Mexico 1.99%, Egypt 0.99%, Iran 0.07%, Pakistan 0.56% and Turkey 0.71% Indonesia's total contributions to other markets is

17.18% and Indonesia's contribution to its own market is 78.99% Indonesia's contribution including own is 96.17%, While other countries contribution is 21.01% to Indonesia's market.

Iran's contribution to its own market is 99.06%, Iran stock market contribution to china is 0.002%, India 0.01%, Brazil 0.026%, Russia 0.122%, South Africa 0.023%, South Korea 0.17%, Mexico 0.008%, Egypt 0.19%, Indonesia 0.031%, Pakistan 0.014% and Turkey 0.008% Iran's total contributions to other markets is 0.62% and Iran contribution to its own market is 99.06%, Iran's contribution including own is 99.67%, While other countries contribution is 0.94% to Iran market.

Pakistan's contribution to its own market is 97.01%, Pakistan stock market contribution to china is 0.07%, India 0.05%, Brazil 0.05%, Russia 0.001%, South Africa 0.08%, South Korea 0.06%, Mexico 0.04%, Egypt 0.21%, Indonesia 0.32%, Iran 0.01% and Turkey 0.02%, Pakistan's total contributions to other markets is 0.93% and Pakistan's contribution to its own market is 97.01% Pakistan's contribution including own is 97.94%, While other countries contribution is 2.99% to Pakistan's market.

Turkey's contribution to its own market is 78.67%, Turkey's stock market contribution to china is 0.08%, India 0.06%, Brazil 3.02%, Russia 4.37%, South Africa 4.08%, South Korea 0.88%, Mexico 3.46%, Egypt 0.70%, Indonesia 0.84%, Iran 0.005% and Pakistan 0.13%, Turkey's total contributions to other markets is 17.62% and Turkey's contribution to its own market is 78.67% Turkey's contribution including own is 96.29%, While other countries contribution 21.33% to Turkey's market. China contribution to other markets is up to 7.151% and China's stock market is affected up to 90.37% by including its own shocks. China's stock markets shocks do not affect other markets in high range as compare to other markets. Mexico affect other markets in high range up to 52.6% as compared to other countries secondly brazil affect other markets in high range up to 49.4%. Adding the entries in the contributions from others column or for that matter contribution to others rows we obtain the spillover index 21.15% of the total 1200 points of forecast error variance for all 12 countries is explained by spillovers across

markets. The remaining 78.6% of the total forecast error variance is explained by its own shocks rather than spillovers of shocks across markets.

4.1.4 The Contribution of each Market to all other Markets is Present Graphically as Fig 4.2
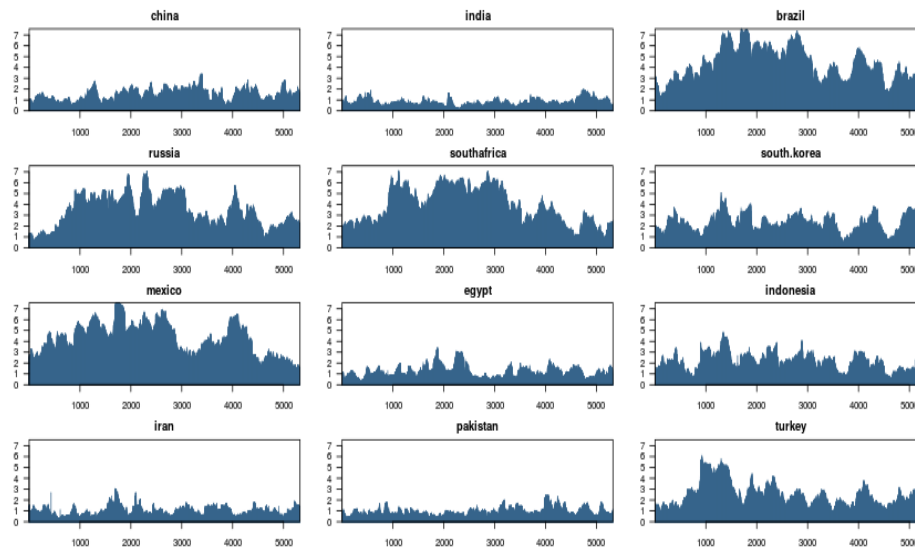
FIGURE 4.2: Contribution of each Market to all other Markets

China contribution to other markets is 7.151%, India contribution to other markets is 0.524%, brazil contribution to other markets is 49.474%, Russia contribution to other markets is 38.156% south Africa contribution to other markets is 43.808%, south Korea contribution to other markets is 21.952%, Mexico contribution to other markets is 52.62%, Egypt contribution to other markets is 3.719%, Indonesia contribution to other markets is 17.184%, Iran contribution to other markets is 0.616%, Pakistan contribution to other markets is 0.925%, turkey contribution to other markets is 17.624%. Large amount of contribution from Mexico to other markets and small amount of contribution from India to other markets in term of daily return spillover is observed. Above graph 4.2 further provide that contribution of market of brazil, Russia, Mexico and South Africa to return of other markets is in higher end, but this spillover is not constant over time. The spillover is high in certain period and lower in other period. The spillover for Pakistan, Iran, and India is generally lower.

4.1.5 The Contribution of the Returns from other Markets to each Markets in Percentage Terms is Provided Graphically in Fig 4.3
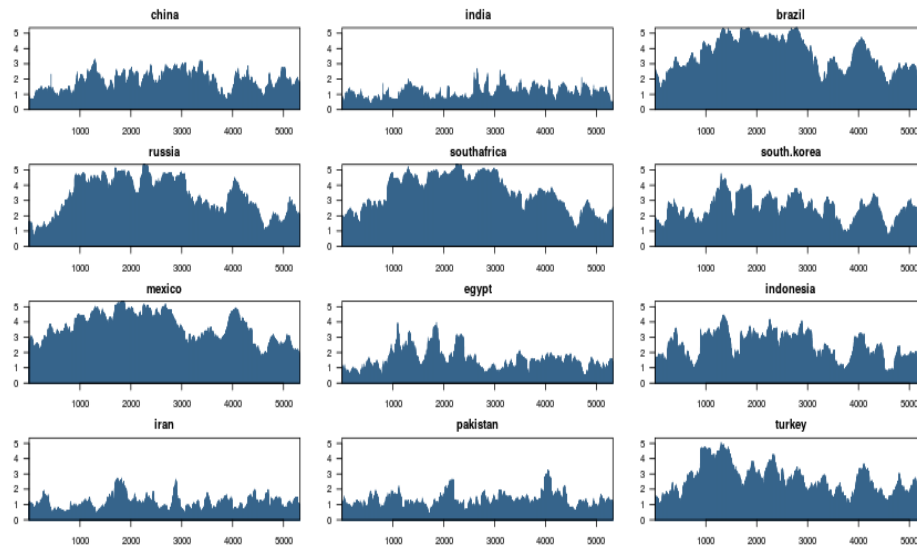
FIGURE 4.3: Contribution of the Returns from other Markets to each Markets in Percentage terms

Other countries contribution to china is 9.627% India 0.569% brazil 42.972% Russia 38.11% south Africa 41.033% south Korea 23.31% Mexico 43.72% Egypt 8.142% Indonesia 21.013% Iran 0.942% Pakistan 2.989% turkey 21.326%. Higher contribution from other countries to Mexico is reported and lower contribution from other countries to India is reported. Generally, brazil, Russia, South Africa and Mexico are more connection with other markets. India, Pakistan and Iran are less connected with other markets. The mean spillover is not constant. The spillover is higher during financial crisis period i.e. 2007-2009.

4.1.6 Contribution from a Specific Market to other Markets and from other Market to a Specific Market is Netted off and Expressed Graphically in Fig 4.4

Net spillover of china is -2.477%, net spillover of India is -0.045%, brazil is 6.502%, Russia is 0.046%, south Africa is 2.775%, south Korea is -1.358%, Mexico

is 8.9%, Egypt is -4.423%, Indonesia is -3.828%, Iran is -0.326%, Pakistan is -2.064%, turkey is -3.702%. if the value of net spillover is negative it means that country is net receiver (other countries information affect country stock market). If the value of net spillover is positive, it means that country is net giver (country information affect other countries stock market). The graph clearly provide that Russian market is recipient of return spillover in some periods and dissemination of return spillover in other periods. China market is generally recipient of information and brazil market is dissemination of information to other markets.
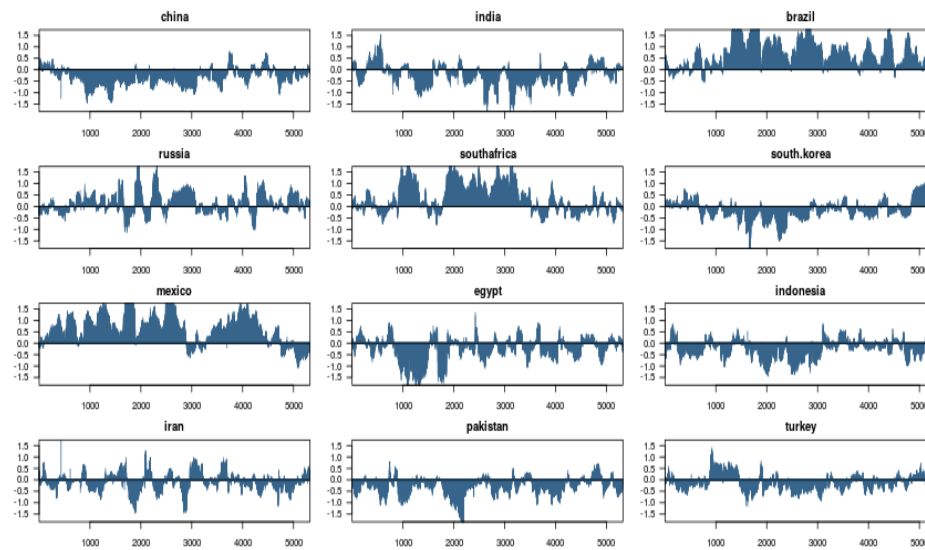
FIGURE 4.4: Contribution from a Specific Market to other Markets and from other Market to a Specific Market is Netted off

4.1.7 Dynamic Model

Over the period of the time economic conditions are not same. New information is in in the market and out from the market, dynamics of returns are changed due to cross border investments, national news etc. so we should not go for single average return and single average volatility we should consider this time varying effect, for this purpose we calculate average rate of return and re-estimate the modes through 200 days rolling window.

The study uses the cholesky factorization based variance decompositions to calculated the variance decompositions used in dynamic connectedness table 4.6.

This model exposes the order dependence of the variance decompositions. China contribution to its own market is 78.3%, contribution of china to India is 0.71% Likewise, 1.55% is the contribution of china to Brazil market, china contribution to Russia is 1.47%, South Africa is 1.64%, South Korea is 4.20%, Mexico is 1.68%, Egypt is 1.064%, Indonesia is 2.019%, Iran is 0.99% Pakistan is 1.35% and turkey is 0.99%. China total contributions to other markets is 17.7%, While other countries contribute only 21.69% to China's market, china contribution including own is 96.007%.

India's contribution to its own market is 87.32%, India contribution to china market is 0.86%, Brazil 0.74%, Russia 0.61%, South Africa 0.72%, South Korea 0.92%, Mexico 0.94%, Egypt 0.90%, Indonesia 0.75%, Iran 1.31%, Pakistan 0.95% and Turkey 0.81%. India total contributions to other markets is 9.55% While other countries contribute only 12.67% to India's market, India contribution including own is 96.8%.

Brazil contribution to its own market is 57.94%. brazil contribution to china is 2.33%, India 1.30%, Russia 6.53%, South Africa 6.92%, South Korea 3.51%, Mexico 16.25%, Egypt 1.94%, Indonesia 3.55%, Iran 1.39%, Pakistan 1.63% and Turkey 4.84%. brazil total contributions to other markets is 50.22% While other countries contribute 42.05% to brazil market, brazil contribution including own is 108.17%.

Russia contribution to its own market is 61.56%. Russia contribution to china market is 1.82%, India 1.43%, Brazil 5.50%, South Africa 9.81%, South Korea 2.65%, Mexico 5.06%, Egypt 2.10%, Indonesia 2.86%, Iran 1.17%, Pakistan 1.24% and Turkey 6.57%. Russia total contributions to other markets is 40.24% While other countries contribute 38.43% to Russia market, Russia contribution including own is 101.81%.

South Africa's contribution to its own market is 58.94%. South Africa's contribution to china market is 2.15%, India 1.20%, Brazil 6.18%, Russia 10.43%, South Korea 3.49%, Mexico 7.32%, Egypt 1.83%, Indonesia 4.14%, Iran 1.43%, Pakistan 1.82% and Turkey 5.52%. South Africa's total contributions to the other markets is 45.55%, While other countries contribute 41.05% to South Africa's market, the

TABLE 4.6: Dynamic Connectedness of Daily return

	China	India	Brazil	Russia	South Africa	South Korea
China	78.308	0.867	2.337	1.823	2.155	4.763
India	0.711	87.324	1.303	1.438	1.207	0.817
Brazil	1.554	0.744	57.945	5.502	6.18	2.9
Russia	1.477	0.615	6.531	61.569	10.432	2.26
South Africa	1.64	0.723	6.921	9.812	58.947	2.76
South Korea	4.209	0.925	3.512	2.651	3.497	71.189
Mexico	1.683	0.943	16.251	5.067	7.328	3.034
Egypt	1.064	0.908	1.944	2.107	1.838	1.466
Indonesia	2.019	0.752	3.556	2.867	4.143	4.882
Iran	0.993	1.313	1.391	1.17	1.43	1.073
Pakistan	1.357	0.954	1.634	1.24	1.82	1.384
Turkey	0.993	0.812	4.846	6.57	5.52	1.642
Contribution to others	17.7	9.556	50.226	40.248	45.55	26.981
Contribution including own	96.007	96.88	108.172	101.817	104.497	98.171
Net spillovers	-3.993	-3.12	8.172	1.817	4.497	-1.829

South Africa contribution including own is 104.49%.

South Korea's contribution to its own market is 71.18%. South Korea contribution to china market is 4.76%, India 0.81%, Brazil 2.9%, Russia 2.26%, South Africa 2.76%, Mexico 3.03%, Egypt 1.46%, Indonesia 4.88%, Iran 1.07%, Pakistan 1.38% and Turkey 1.64%. South Korea total contributions to other markets is 26.98% While other countries contribute to South Korea market is 28.81%, South Korea contribution including own is 98.17%.

Mexico's contribution to its own market is 56.79%. Mexico contribution to china market is 2.35%, India 1.19%, Brazil 16.31%, Russia 5.86%, South Africa 8.51%, South Korea 3.51%, Egypt 2.08%, Indonesia 3.52%, Iran 1.03%, Pakistan 1.54% and Turkey 4.64%. Mexico's total contributions to other markets is 50.60% While other countries contribute 43.20% to Mexico's market, Mexico's contribution including own is 107.39%.

Egypt's contribution to its own market is 82.37%. Egypt's contribution to china market is 1.10%, India 0.99%, Brazil 1.15% Russia 1.43%, South Africa 1.15% South Korea 1.74%, Mexico 0.97%, Indonesia 1.59%, Iran 1.37%, Pakistan 1.15% and Turkey 1.44%. Egypt's total contributions to other markets is 14.13% While other countries contribute only 17.62%to Egypt's market, Egypt's contribution including own is 96.51%.

Indonesia's contribution to its own market is 72.03% Indonesia's contribution to china market is 2.39%, India 1.20%, Brazil 2.14%, Russia 2.24%, South Africa 2.93%, South Korea 4.71%, Mexico 2.49%, Egypt 2.00%, Iran 1.00%, Pakistan 1.61% and Turkey 2.03%. Indonesia's total contributions to other markets is 24.80% While other countries contribute 27.96% to Indonesia market, Indonesia's contribution including own is 96.84%.

Iran's contribution to its own market is 87.006%. Iran's contribution to china market is 1.34%, India 1.23%, Brazil 1.001%, Russia 0.9%, South Africa 0.96%, South Korea 1.09%, Mexico 0.83%, Egypt 1.38%, Indonesia 0.91%, Pakistan 1.002% and Turkey 1.14%. Iran's total contributions to other markets is 11.85% While other countries contribute only 12.99% to Iran's market, Iran's contribution including own is 98.85%.

Pakistan's contribution to its own market is 85.13%. Pakistan contribution to china market is 1.34%, India 1.18%, Brazil 0.85%, Russia 0.91%, South Africa 0.83%, South Korea 1.20%, Mexico 0.85%, Egypt 0.97%, Indonesia 1.33%, Iran 0.79% and Turkey 0.85%. Pakistan total contributions to other markets is 11.10% While other countries contribute only 14.87% to Pakistan's market, Pakistan contribution including own is 96.23%.

Turkey's contribution to its own market is 69.50%. Turkey's contribution to china market is 1.22%, India 1.38%, Brazil 3.72%, Russia 5.72%, South Africa 4.79%, South Korea 1.75%, Mexico 3.74%, Egypt 1.87%, Indonesia 2.37%, Iran 1.41% and Pakistan 1.16%. Turkey's total contributions to other markets is 29.12% While other countries contribute 30.49% to Turkey's market, Turkey's contribution including own is 98.62%.

China contribution to other markets is up to 17.7% and China's stock market is affected up to 78.31% by including its own shocks. China's stock markets shocks do not affect other markets in high range as compare to other markets. The interference of other markets shocks is up to 50.6%. Adding the entries in the contributions from others column or for that matter contribution to others row% we obtain the spillover index 27.7 of the total 1200 points of forecast error variance for all 12 countries is explained by spillovers across markets. The remaining 72.3 of the total forecast error variance is explained by its own shocks rather than spillovers of shocks across markets.

4.1.8 The Graphical Behavior of Dynamic Total Connectedness is Present in Fig 4.5

Total contribution of China is 96.007% (country contribution to its own market and country contribution to other markets is equal to total contribution). Total contribution of India is 96.88%, brazil is 108.172%, Russia is 101.817%, south Africa is 104.497%, south Korea is 98.171%, Mexico is 107.399%, Egypt is 96.512%, Indonesia is 96.845%, Iran is 98.852%, Pakistan is 96.229%, turkey is 98.62%. Dynamic net spillover is 27.656% and static net spillovers is 21.146% of

daily return.
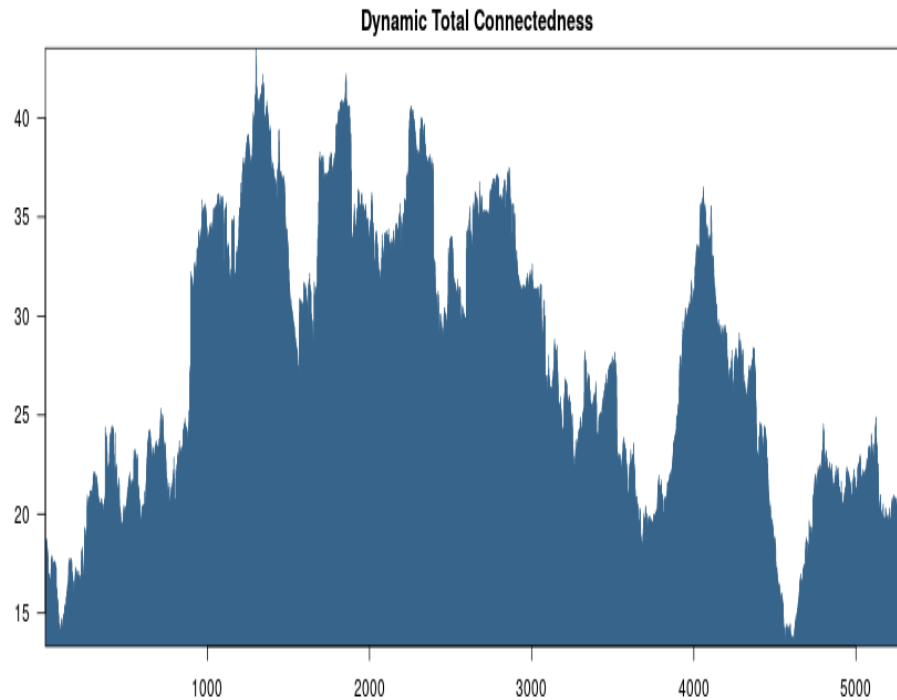
FIGURE 4.5: Graphical Behavior of Dynamic Total
Connectedness

4.2 Descriptive Statistics of Weekly return

Table 4.7 and 4.8 present summary statistics of weekly return including average return, average risk maximum return, maximum risk. It further explains the auto-correlation in data.

Start from Chinese market average return in Chinese market is 0.42% average risk of china market is 7.87% maximum return observed in a week is 87.32% and maximum loss see by investors in one week is -53.40%. Data is leptokurtic positive skewness is observed. Q(20) and Q2(20) both test shows that auto-correlation is exist. Average return in India market is 0.23%, average risk of India market is 1.37%, maximum return is see in a week is 15.53% and in Indian market investors observed maximum loss in one week is -7.36%.

Average loss in brazil market is 0.084%, average risk of brazil market is 5.89%,

TABLE 4.7: Descriptive Statistics of Weekly return

	China	India	Brazil	Russia	South Africa	South Korea
Mean	0.4185	0.2320	-0.0837	0.2545	0.2090	0.2001
Standard Deviation	7.8686	1.3686	5.8855	8.1102	4.0531	4.5355
Kurtosis	51.3532	22.2890	20.4990	59.0228	19.7105	28.3144
Skewness	3.6421	1.6911	0.0253	2.9487	0.7847	1.4875
Minimum	-53.4036	-7.3649	-42.9356	-59.6376	-24.9177	-33.9480
Maximum	87.3238	15.5321	56.8559	105.4990	39.4189	48.5863
JB	97626.965***	18438.056***	15240.837***	127678.493***	14180.480***	29406.431***
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Q(20)	32.865***	84.220***	32.651***	43.644***	27.856***	24.756***
	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0020
Q2(20)	45.414***	0.1110	0.4030	4.1190	0.2390	0.2990
	0.0000	-1.0000	-1.0000	-0.9830	-1.0000	-1.0000
LM(20)	48.467***	16.125*	14.6680	46.897***	15.695*	20.645**
	0.0000	-0.0800	-0.1340	0.0000	-0.0930	-0.0130

TABLE 4.8: Descriptive Statistics of Weekly return

	Mexico	Egypt	Indonesia	Iran	Pakistan	Turkey
Mean	0.0760	-0.0986	0.0479	-0.0122	-0.0595	0.1452
Standard Deviation	4.2059	9.3535	5.8385	7.0614	5.8652	6.5012
Kurtosis	18.4377	24.1145	52.8232	64.8987	19.7196	15.8082
Skewness	-0.0101	-0.4681	0.9186	-2.9514	-0.6765	-0.1832
Minimum	-28.3948	-66.6655	-48.5328	-90.0612	-49.5295	-35.6671
Maximum	37.7072	92.6025	79.0736	68.1168	44.1419	56.6088
JB	12328.788***	21125.054***	101366.703***	154104.879***	14170.350***	9066.760***
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Q(20)	26.244***	44.258***	30.028***	77.935***	19.692**	21.884***
	-0.0010	0.0000	0.0000	0.0000	-0.0200	-0.0080
Q2(20)	0.4030	1.2120	0.0800	133.338***	9.7510	0.6250
	-1.0000	-1.0000	-1.0000	0.0000	-0.5320	-1.0000
LM(20)	18.386**	25.054***	6.2400	193.801***	21.961***	22.102***
	-0.0330	-0.0020	-0.8820	0.0000	-0.0070	-0.0070

maximum return observed in a week is 56.86% and maximum loss see by the investors in a one week is -42.94%. Average return in Russian market is 0.25%, while average risk of Russian market is 8.11%, maximum return is see in a week is 105.49% and maximum loss observed by the investors in one week is -59.64%, Average return in south Africa market is 0.209%, average risk of south Africa market is 4.05%, maximum return observed in a week is 39.42% and maximum loss observed by the investors in one week is -24.92%.

In south Korean market average return is 0.2001% average risk in this market is 4.54%, maximum return that is observed in a week is 48.59% and maximum loss that investors see in one week is -33.95%. Average return in Mexico market is .076% average risk of Mexico market is 4.21%, maximum return observed in a week is 37.71% and maximum loss observed by the investors in one week is -28.39%. Average loss in Egyptian market is 0.099% average risk of Egyptian market is 9.354%, maximum return is see in a week is 92.60% and maximum loss observed by the investors in one week is -66.67%. In Indonesian market average return is 0.05% average risk in this market is 5.84%, maximum return that observed in a week is 79.07% and maximum loss that investors observed in one week is -48.53%.

Average loss in Iran market is 0.012% average risk in Iran market is 7.06%, maximum return earned in a week is 68.12% and in Iran market investors see maximum loss in one week 90.06%. In Pakistan market average loss is 0.06% average risk in this market is 5.87%, maximum return earned in a week is 44.14% and maximum loss investors faced in one week is -49.53%.

Average return in turkey market is 0.145% average risk of turkey market is 6.50%, maximum return earned in a week is 56.61% and in turkey market investors face maximum loss in one week is -35.67%. All returns are leptokurtic, skewness is observed positive in markets of china, India, Brazil, Russia, Indonesia, south Africa and south Korea and skewness is observed negative in Mexico, Egypt, Iran, Pakistan and turkey. Q(20) test shows that auto-correlation is existing in all series and Q2(20) test shows that auto-correlation does not exist in markets of India, Brazil, Russia, south Africa, south Korea, Mexico, Egypt, Indonesia, Pakistan and turkey. Auto-correlation exist in markets of china and Iran.

4.2.1 The Return of each Market are Present Graphically in Fig 4.6
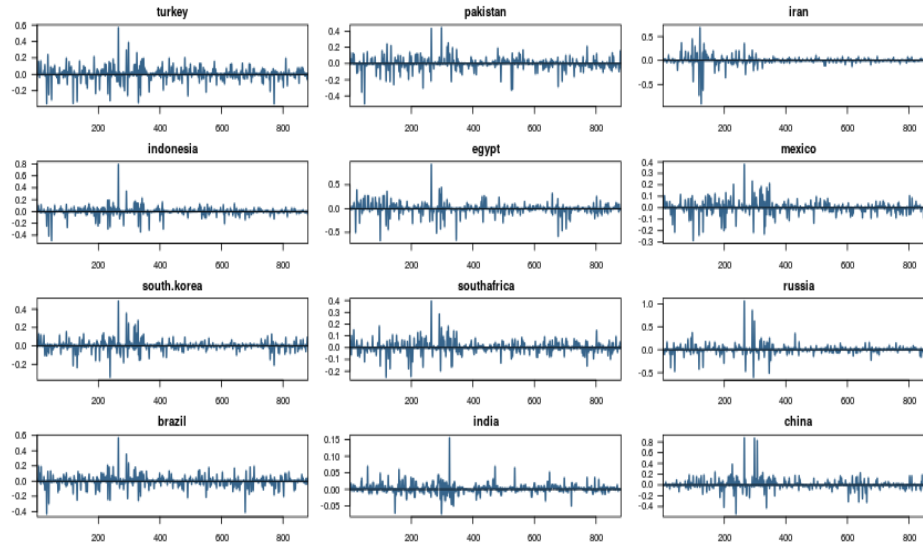
FIGURE 4.6: Return of each Market

The graph 4.6 indicates periods of high return and low return and highly volatile periods. The behavior of Iranian and south Korean markets is completely different from other markets. Volatility clustering is appearing in markets of south Africa, India, turkey, brazil is significant.

4.2.2 Correlation Analysis of Weekly Return

In case of china significant correlation with markets of brazil, Russia, south Africa, south Korea, Indonesia, turkey exist. Indian market has no significant correlation with any market. However, brazil has significant correlation with markets of Russia, south Africa, south Korea, Mexico, Egypt, Indonesia, Pakistan and turkey. Russia has significant correlation with markets of south Africa, south Korea, Mexico, Egypt, Indonesia, Iran, Pakistan and turkey. South Africa has significant correlation with markets of south Korea, Mexico, Egypt, Indonesia, Iran, Pakistan and turkey.

South Korea has a significant correlation with markets of Mexico, Egypt, Indonesia, Pakistan and turkey. Mexico has a significant correlation with markets

TABLE 4.9: Correlation Analysis of Weekly Return

	China	India	Brazil	Russia	South Africa	South Korea	Mexico	Egypt	Indonesia	Iran	Pakistan	Turkey
China	1											
India	-0.0357	1										
Brazil	0.4125	-0.0455	1									
Russia	0.3514	-0.0200	0.6007	1								
South Africa	0.3544	-0.0633	0.5369	0.5795	1							
South Korea	0.4771	-0.0405	0.6018	0.5580	0.6870	1						
Mexico	0.2995	-0.0429	0.6565	0.5825	0.7315	0.6373	1					
Egypt	0.2405	-0.0634	0.4428	0.4805	0.4197	0.4368	0.4416	1				
Indonesia	0.3900	0.0025	0.6138	0.4794	0.5334	0.6417	0.6412	0.4204	1			
Iran	-0.0165	-0.0442	0.1998	0.3105	0.3679	0.2975	0.2975	0.4155	0.2011	1		
Pakistan	0.2923	-0.0587	0.3735	0.3804	0.4031	0.4458	0.4766	0.3907	0.4986	0.2322	1	
Turkey	0.3746	-0.0323	0.6633	0.5109	0.5816	0.7256	0.6366	0.3936	0.6721	0.2743	0.4516	1

of Egypt, Indonesia, Pakistan and turkey. Egypt has significant correlation with markets of Indonesia, Iran, Pakistan and turkey. Indonesia has significant correlation with markets of Pakistan and turkey. Pakistan has significant correlation with equity market turkey.

4.2.3 Static Connectedness of Weekly Return

Table 4.10 and 4.11 report the detail of Static connectedness of weekly return. China contribution to its own market is 45.94% china contribution India is 0.28% Brazil is 4.50%, Russia is 3.56%, South Africa is 3.16%, South Korea is 5.38%, Mexico is 2.16%, Egypt is 2.09%, Indonesia is 3.9%, Iran is 0.01% Pakistan is 3.29% and Turkey is 3.47% china market has some influence on all markets, China total contributions to other markets is 31.901% and china contribution to its own market is 45.94% china contribution including own is 77.84%, While other countries contribution is 54.06% to China's market.

India contribution to its own market is 95.81% India's stock market contribution to china is 0.33%, Brazil 0.21%, Russia 0.06%, South Africa 0.57%, South Korea 0.27%, Mexico 0.27%, Egypt 0.24%, Indonesia 0.01%, Iran 0.106%, Pakistan 0.23% and Turkey 0.26% India total contributions to other markets is 2.55% and India contribution to its own market is 95.81% India contribution including own is 98.36%, While other countries contribution is only 4.191% to India's market.

Brazil contribution to its own market is 26.25% Brazil stock market contribution to china is 7.88%, India 0.39%, Russia 10.51%, South Africa 7.44%, South Korea 8.57%, Mexico 10.41%, Egypt 7.09%, Indonesia 9.95%, Iran 2.16%, Pakistan 5.24% and Turkey 10.93% Brazil total contributions to other markets is 80.57% and Brazil contribution to its own market is 26.25% Brazil contribution including own is 106.82%, While other countries contribution 73.75% to Brazil market.

Russia contribution to its own market is 29.08% Russia's stock market contribution to china is 5.67%, India 0.08% Brazil 9.49%, South Africa 8.67%, South Korea 7.39%, Mexico 8.17%, Egypt 8.46%, Indonesia 6%, Iran 5.51%, Pakistan 5.54% and Turkey 6.50% Russia total contributions to the other markets is 71.48%

TABLE 4.10: Static Connectedness of Weekly Return

	China	India	Brazil	Russia	South Africa	South Korea
China	45.937	0.328	7.879	5.673	5.669	10.411
India	0.283	95.809	0.394	0.079	0.892	0.372
Brazil	4.503	0.207	26.247	9.486	7.56	9.451
Russia	3.564	0.055	10.506	29.08	9.792	9.043
South Africa	3.165	0.573	7.436	8.666	25.829	12.105
South Korea	5.384	0.266	8.568	7.398	11.166	23.774
Mexico	2.16	0.268	10.414	8.169	12.756	9.74
Egypt	2.098	0.243	7.098	8.463	6.593	6.922
Indonesia	3.97	0.008	9.949	6	7.55	10.867
Iran	0.012	0.106	2.158	5.51	7.891	5.071
Pakistan	3.288	0.231	5.243	5.538	6.14	7.435
Turkey	3.473	0.26	10.925	6.501	8.408	13.117
Contribution to others	31.901	2.545	80.57	71.48	84.418	94.535
Contribution including own	77.838	98.355	106.817	100.6	110.247	118.309
Net spillovers	-22.16	-1.645	6.817	0.559	10.247	18.309

TABLE 4.11: Static Connectedness of Weekly Return

	Mexico	Egypt	Indonesia	Iran	Pakistan	Turkey	From
China	4.091	2.59	6.92	0.038	4.039	6.425	54.063
India	0.566	0.443	0.18	0.163	0.515	0.302	4.191
Brazil	11.332	5.131	9.914	1.025	3.623	11.522	73.753
Russia	9.858	6.763	6.621	2.88	4.246	7.595	70.923
South Africa	13.656	4.678	7.388	3.655	4.156	8.692	74.171
South Korea	9.625	4.581	9.809	2.192	4.708	12.529	76.226
Mexico	24.107	4.934	9.991	2.236	5.493	9.731	75.893
Egypt	7.284	36.91	6.421	6.286	5.912	5.766	63.087
Indonesia	10.948	4.658	26.379	1.083	6.611	11.977	73.621
Iran	5.049	9.48	2.267	55.13	3.033	4.29	44.867
Pakistan	8.683	5.822	9.474	2.104	38.218	7.822	61.782
Turkey	10.098	3.946	11.305	1.943	5.108	24.915	75.085
Contribution to others	91.19	53.03	80.292	23.61	47.443	86.651	747.661
Contribution including own	115.298	89.94	106.671	78.74	85.661	111.57	TCI
Net spillovers	15.298	-10.06	6.671	-21.26	-14.339	11.566	62.305

and Russia contribution to its own market is 29.08% Russia contribution including own is 100.56%, While other countries contribution is 70.92% to Russia market.

South Africa's contribution to its own market is 25.83% South Africa's stock market contribution to china is 5.67%, India 0.89%, Brazil 7.56%, Russia 9.79%, South Korea 11.17%, Mexico 12.76%, Egypt 6.59%, Indonesia 7.55%, Iran 7.89%, Pakistan 6.14% and Turkey 8.41% South Africa's total contributions to other markets is 84.42% and South Africa's contribution to its own market is 25.83% South Africa's contribution including own is 110.25%, While other countries contribution is 74.17% to South Africa's market.

South Korea's contribution to its own market is 23.77% South Korea's stock market contribution to china is 10.41%, India 0.37%, Brazil 9.45%, Russia 9.04%, South Africa 12.11%, Mexico 9.74%, Egypt 6.92%, Indonesia 10.87%, Iran 5.07%, Pakistan 7.44% and Turkey 13.12% South Korea's total contributions to other markets is 94.54% and South Korea's contribution to its own market is 23.77% South Korea's contribution including own is 118.31%, While other countries contribution is 76.23% to South Korea's market.

Mexico's contribution to its own market is 24.107%, Mexico's stock market contribution to china is 4.09%, India 0.57%, Brazil 11.33%, Russia 9.86%, South Africa 13.66%, South Korea 9.63%, Egypt 7.28%, Indonesia 10.95%, Iran 5.05%, Pakistan 8.68% and Turkey 10.098% Mexico's total contributions to other markets is 91.19% and Mexico's contribution to its own market is 24.11% Mexico's contribution including own is 115.29%, While other countries contribution is 75.89% to Mexico's market.

Egypt's contribution to its own market is 36.91%, Egypt's stock market contribution to china is 2.59%, India 0.443%, Brazil 5.131% Russia 6.76%, South Africa 4.68% South Korea 4.58%, Mexico 4.93%, Indonesia 4.66%, Iran 9.48%, Pakistan 5.82% and Turkey 3.95% Egypt's total contributions to other markets is 53.03% and Egypt's contribution to its own market is 36.92% Egypt's contribution including own is 89.94%, While other countries contribution is 63.087% to Egypt's market.

Indonesia's contribution to its own market is 26.38%, Indonesia's stock market

contribution to china is 6.92%, India 0.18%, Brazil 9.91%, Russia 6.62%, South Africa 7.39%, South Korea 9.81%, Mexico 9.99%, Egypt 6.42%, Iran 2.27%, Pakistan 9.47% and Turkey 11.31% Indonesia's total contributions to other markets is 80.29% and Indonesia's contribution to its own market is 26.38% Indonesia's contribution including own is 106.67%, While other countries contribution is 73.62% to Indonesia's market.

Iran's contribution to its own market is 55.13%, Iran stock market contribution to china is 0.04%, India 0.163%, Brazil 1.03%, Russia 2.88%, South Africa 3.65%, South Korea 2.19%, Mexico 2.24%, Egypt 6.29%, Indonesia 1.08%, Pakistan 2.104% and Turkey 1.94% Iran's total contributions to other markets is 23.61% and Iran contribution to its own market is 55.13% Iran's contribution including own is 78.74%, While other countries contribution is 44.87% to Iran market.

Pakistan's contribution to its own market is 38.22%, Pakistan stock market contribution to china is 4.04%, India 0.52%, Brazil 3.62%, Russia 4.25%, South Africa 4.16%, South Korea 4.71%, Mexico 5.49%, Egypt 5.91%, Indonesia 6.61%, Iran 3.03% and Turkey 5.11%, Pakistan's total contributions to other markets is 47.44% and Pakistan's contribution to its own market is 38.22% Pakistan's contribution including own is 85.66%, While other countries contribution is 61.78% to Pakistan's market.

Turkey's contribution to its own market is 24.92%, Turkey's stock market contribution to china is 6.43%, India 0.30%, Brazil 11.52%, Russia 7.59%, South Africa 8.69%, South Korea 12.53%, Mexico 9.73%, Egypt 5.77%, Indonesia 11.98%, Iran 4.29% and Pakistan 7.82%, Turkey's total contributions to other markets is 86.65% and Turkey's contribution to its own market is 24.92% Turkey's contribution including own is 111.57%, While other countries contribution is 75.09% to Turkey's market.

China contribution to other markets is up to 31.90%, while China's stock market is affected up to 45.94% by including its own shocks. China's stock markets shocks do not affect other markets in high range as compare to other markets. south Korea affect other markets in high range up to 94.5% as compared to other

countries secondly Mexico affect other markets in high range up to 91.1%, south
Africa affect other markets in high range up to 84.4% turkey affect other markets
in high range up to 86.6%, all these countries affect in high range as compared
to others. Adding the entries in the contributions from others column or for that
matter contribution to others row. We obtain the spillover index 62.3% of the
total 1200 points of forecast error variance for all 12 countries is explained by
spillovers across markets. The remaining 37.7% of the total forecast error variance
is explained by its own shocks rather than spillovers of shocks across markets.

4.2.4   The Contribution of each Market to all other Markets is Present Graphically in Fig 4.7
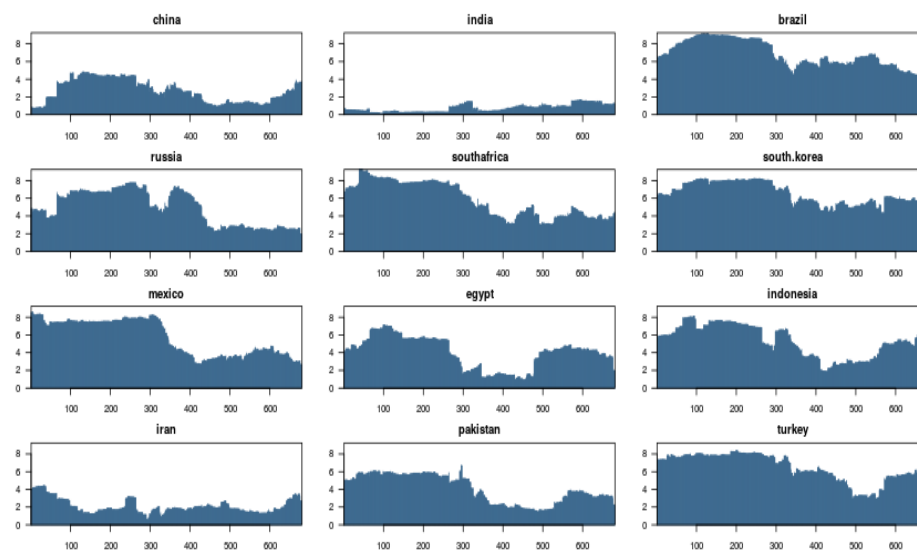
FIGURE 4.7: Contribution of each Market to all other Markets

China contribution to other markets is 31.901%, India contribution to other
markets is 2.545%, brazil contribution to other markets is 80.57%, Russia contri-
bution to other markets is 71.482% south Africa contribution to other markets is
84.481%, south Korea contribution to other markets is 94.535%, Mexico contribu-
tion to other markets is 91.19%, Egypt contribution to other markets is 53.028%,
Indonesia contribution to other markets is 80.292%, Iran contribution to other
markets is 23.606%, Pakistan contribution to other markets is 47.443%, turkey
contribution to other markets is 86.651%.

In static connectedness table of daily return, large amount of contribution from Mexico 52.62% to other markets is reported but in static connectedness table of weekly return large amount of contribution from south Korea 94.535% to other markets is reported. and small amount of contribution from India to other markets is reported in term of daily return spillover and weekly return spillover. Above graph further provide that contribution of markets of Brazil, south Africa and south Korea to return of other markets is in higher end but this spillover is not constant over time. The spillover is high in the certain periods and lower in other period. The spillover for India and Iran is generally low.

4.2.5 The Contribution of the Returns from other Markets to each Markets in Percentage Terms is Provided Graphically in Fig 4.8
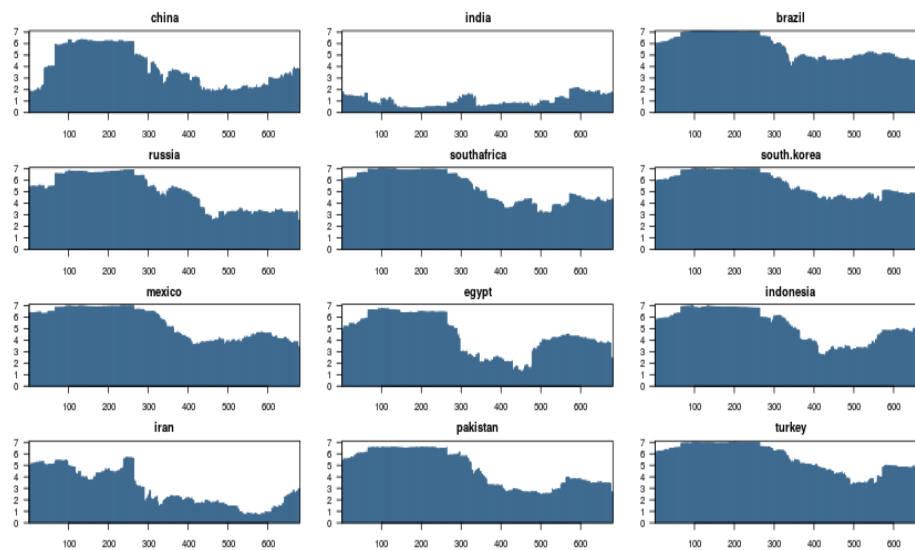
FIGURE 4.8: Contribution of the Returns from other Markets to each Markets in Percentage Terms

Other countries contribute china 54.063% India 4.191% brazil 73.753% Russia 70.923% south Africa 74.171% south Korea 76.226% Mexico 75.893% Egypt 63.087% Indonesia 73.621% Iran 44.867% Pakistan 61.782% turkey 75.085%, large amount of contribution from other countries to Mexico is reported in the daily return table of static connectedness and in this graph large amount of contribution from other

countries to south Korea is reported, and small amount of contribution from other countries to India is reported in daily return and weekly return of static connectedness tables Generally brazil, south Africa, Mexico, Russia and south Korea are more connection with other markets. India and Iran are less connected with other markets. The mean spillover is not constant. It is higher during crisis period.

4.2.6 Contribution from a Specific Market to other Markets and from other Market to a Specific Market is Netted off and Expressed Graphically in Fig 4.9
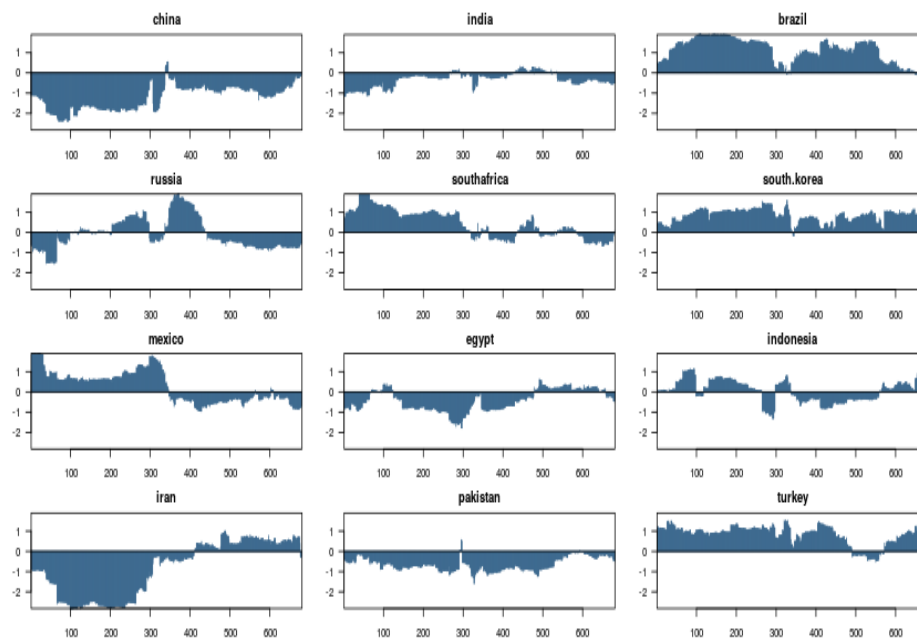
FIGURE 4.9: Contribution from a Specific Market to other Markets and from other Market to a Specific market is Netted off

Net spillover of china is -22.162, net spillover of India is -1.645, brazil is 6.817, Russia is 0.559, south Africa is 10.247, south Korea is 18.309, Mexico is 15.298, Egypt is -10.06, Indonesia is 6.671, Iran is -21.261, Pakistan is -14.339, Turkey is -11.566. net spillover index of south Korea and Indonesia is positive in this graph and these countries net spillover is negative in daily return graph which means that in this graph south Korea and Indonesia is information giver (it means that both countries effect on the other countries stock markets) and in the graph of a

daily return south Korea and Indonesia is information receiver (it means that other countries effect on both countries stock markets). The graph clearly provide that Brazilian and south Korean markets are dissemination of information to other markets. Pakistan and china market is recipient of return spillover. Markets of Indonesia, Mexico and Iran is recipient of return spillover in some periods and dissemination of return spillover in other periods.

4.2.7 Dynamic Connectedness of Weekly Stock Markets Returns

Table 4.12 and 4.13 present the dynamic connectedness of weekly return. Start from china, China contribution to its own market is 53.32%, contribution of china to India is 0.83% Likewise, 4.67% is the contribution of china to Brazil market, china contribution to Russia is 3.36%, South Africa is 2.28%, South Korea is 4.71%, Mexico is 2.03%, Egypt is 2.58%, Indonesia is 3.65%, Iran is 2.35% Pakistan is 2.74% and turkey is 3.01%. China total contributions to other markets is 32.20% While other countries contribute 46.68% to China's market, china contribution including own is 85.52%.

India's contribution to its own market is 87.39%, India contribution to china market is 0.65%, Brazil 0.61%, Russia 0.43%, South Africa 1.75%, South Korea 1.34%, Mexico 1.32%, Egypt 0.43%, Indonesia 0.44%, Iran 0.94%, Pakistan 0.35% and Turkey 0.66%. India total contributions to other markets is 8.91% While other countries contribute only 12.61% to India's market, India contribution including own is 96.30%.

Brazil contribution to its own market is 31.19%. Brazil contribution to china is 7.96%, India 0.82%, Russia 10.04%, South Africa 7.17%, South Korea 9.073%, Mexico 11.93%, Egypt 7.09%, Indonesia 8.97%, Iran 2.76%, Pakistan 6.73% and Turkey 9.50%. brazil total contributions to other markets is 82.03% While other countries contribute 68.80% to brazil market, brazil contribution including own is 113.23%.

Russia contribution to its own market is 40.34%. Russia contribution to china

TABLE 4.12: Dynamic Connectedness of Weekly Stock Markets Returns

	China	India	Brazil	Russia	South Africa	South Korea
China	53.315	0.654	7.957	5.03	3.668	7.427
India	0.823	87.387	0.821	0.69	1.665	1.901
Brazil	4.673	0.612	31.198	8.254	6.61	8.796
Russia	3.355	0.427	10.034	40.336	7.105	6.538
South Africa	2.283	1.745	7.17	6.302	35.165	12.267
South Korea	4.712	1.337	9.073	5.768	11.036	31.562
Mexico	2.033	1.319	11.927	5.89	10.274	7.375
Egypt	2.575	0.431	7.085	8.823	4.381	4.007
Indonesia	3.645	0.443	8.974	3.304	5.881	8.785
Iran	2.354	0.939	2.759	4.035	4.876	3.168
Pakistan	2.736	0.346	6.726	4.814	7.403	6.052
Turkey	3.011	0.66	9.504	5.825	7.154	12.063
Contribution TO others	32.202	8.914	82.03	58.734	70.052	78.379
Contribution including own	85.517	96.301	113.229	99.07	105.217	109.941
Net spillovers	-14.483	-3.699	13.229	-0.93	5.217	9.941

TABLE 4.13: Dynamic Connectedness of Weekly Stock Markets Return

	Mexico	Egypt	Indonesia	Iran	Pakistan	Turkey	From
China	2.966	2.814	5.328	2.538	3.504	4.797	46.685
India	1.966	0.974	1.207	0.987	0.73	0.851	12.613
Brazil	10.453	5.524	7.959	1.776	4.772	9.373	68.802
Russia	6.428	8.036	3.419	2.922	4.668	6.732	59.664
South Africa	10.4	2.982	5.253	2.947	5.651	7.835	64.835
South Korea	7.067	3.196	7.893	1.811	4.619	11.927	68.438
Mexico	34.568	3.313	7.921	1.999	4.262	9.117	65.432
Egypt	4.04	46.643	5.21	4.12	8.073	4.611	53.357
Indonesia	8.46	4.786	36.759	2.095	4.743	12.126	63.241
Iran	2.598	5.359	3.645	64.317	2.905	3.045	35.683
Pakistan	5.539	8.038	5.4	2.616	43.581	6.749	56.419
Turkey	8.711	3.333	10.629	1.641	4.81	32.659	67.341
Contribution TO others	68.628	48.355	63.864	25.452	48.737	77.164	662.51
Contribution including own	103.196	94.998	100.623	89.768	92.318	109.823	TCI
Net spillovers	3.196	-5.002	0.623	-10.232	-7.682	9.823	55.209

market is 5.03%, India 0.69%, Brazil 8.25%, South Africa 6.30%, South Korea 5.77%, Mexico 5.89%, Egypt 8.82%, Indonesia 3.30%, Iran 4.04%, Pakistan 4.81% and Turkey 5.83%. Russia total contributions to other markets is 58.73% While other countries contribute 59.66% to Russia market, Russia contribution including own is 99.07%.

South Africa's contribution to its own market is 35.17%. South Africa's contribution to china market is 3.67%, India 1.67%, Brazil 6.61%, Russia 7.12%, South Korea 11.04%, Mexico 10.28%, Egypt 4.38%, Indonesia 5.88%, Iran 4.88%, Pakistan 7.40% and Turkey 7.15%. South Africa's total contributions to other markets is 70.05% While other countries contribute 64.84% to South Africa's market, South Africa contribution including own is 105.22%.

South Korea's contribution to its own market is 31.56%. South Korea contribution to china market is 7.43%, India 1.90%, Brazil 8.79%, Russia 6.54%, South Africa 12.27%, Mexico 7.38%, Egypt 4.007%, Indonesia 8.79%, Iran 3.17%, Pakistan 6.05% and Turkey 12.06%. South Korea total contributions to other markets is 78.38% While other countries contribute to South Korea market is 68.44%, South Korea contribution including own is 109.94%.

Mexico's contribution to its own market is 34.57%. Mexico contribution to china market is 2.97%, India 1.97%, Brazil 10.45%, Russia 6.43%, South Africa 10.4%, South Korea 7.07%, Egypt 4.04%, Indonesia 8.5%, Iran 2.59%, Pakistan 5.54% and Turkey 8.71%. Mexico's total contributions to other markets is 68.63% While other countries contribute 65.43% to Mexico's market, Mexico's contribution including own is 103.19%.

Egypt's contribution to its own market is 46.64%. Egypt's contribution to china market is 2.81%, India 0.97%, Brazil 5.52% Russia 8.04%, South Africa 2.98% South Korea 3.19%, Mexico 3.31%, Indonesia 4.79%, Iran 5.36%, Pakistan 8.04% and Turkey 3.33%. Egypt's total contributions to other markets is 48.36% While other countries contribute 53.36% to Egypt's market, Egypt's contribution including own is 94.99%.

Indonesia's contribution to its own market is 36.76% Indonesia's contribution to china market is 5.33%, India 1.21%, Brazil 7.96%, Russia 3.42%, South Africa

5.25%, South Korea 7.89%, Mexico 7.92%, Egypt 5.21%, Iran 3.65%, Pakistan 5.4% and Turkey 10.63%. Indonesia's total contributions to other markets is 63.86% While other countries contribute 63.24% to Indonesia market, Indonesia's contribution including own is 100.62%.

Iran's contribution to its own market is 64.32%. Iran's contribution to china market is 2.54%, India 0.99%, Brazil 1.78%, Russia 2.92%, South Africa 2.95%, South Korea 1.81%, Mexico 1.99%, Egypt 4.12%, Indonesia 2.09%, Pakistan 2.62% and Turkey 1.64%. Iran's total contributions to other markets is 25.45% While other countries contribute 35.68% to Iran's market, Iran's contribution including own is 89.77%.

Pakistan's contribution to its own market is 43.58%. Pakistan contribution to china market is 3.50%, India 0.73%, Brazil 4.772%, Russia 4.67%, South Africa 5.651%, South Korea 4.62%, Mexico 4.26%, Egypt 8.07%, Indonesia 4.74%, Iran 2.91% and Turkey 4.81%. Pakistan total contributions to other markets is 48.74% While other countries contribute 56.42% to Pakistan's market, Pakistan contribution including own is 92.32%.

Turkey's contribution to its own market is 32.66%. Turkey's contribution to china market is 4.79%, India 0.85%, Brazil 9.37%, Russia 6.73%, South Africa 7.84%, South Korea 11.93%, Mexico 9.12%, Egypt 4.61%, Indonesia 12.13%, Iran 3.05% and Pakistan 6.75%. Turkey's total contributions to other markets is 77.16% While other countries contribute 67.34% to Turkey's market, Turkey's contribution including own is 109.82%.

China contribution to other markets is up to 32.20% and China's stock market is affected up to 53.32% by including its own shocks. China's stock markets shocks do not affect other markets in high range as compare to other markets. The interference of other markets shocks is up to 82.03%. Adding the entries in the contributions from others column or for that matter contribution to others row. We obtain the spillover index 55.2% of the total 1200 points of forecast error variance for all 12 countries is explained by spillovers across markets. The remaining 44.8% of the total forecast error variance is explained by its own shocks rather than spillovers of shocks across markets.

4.2.8 The Graphical Behavior of Dynamic Total Connectedness is Present in Fig 4.10
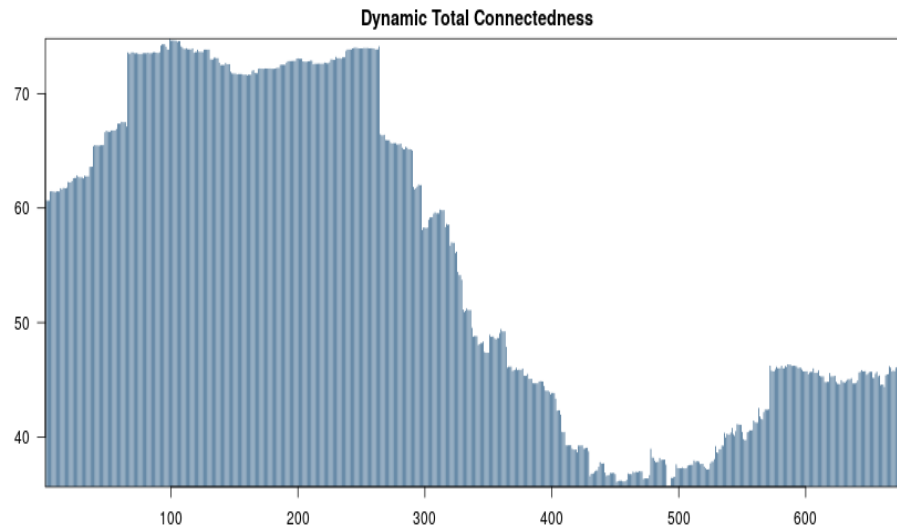
FIGURE 4.10: The Graphical Behavior of Dynamic Total Connectedness

Total contribution of China is 85.517%, India is 96.301%, brazil is 113.229%, Russia is 99.07%, south Africa is 105.217%, south Korea is 109.941%, Mexico is 103.196%, Egypt is 94.998%, Indonesia is 100.623%, Iran is 89.768%, Pakistan is 92.318%, turkey is 109.823%. Dynamic net spillover is 55.209% and static net spillovers is 62.305% of weekly return.

4.3 Descriptive Statistics of Daily Volatility

In second plan, table 4.14 and 4.15 present summary statistics of daily volatility. It tells us about average volatility, average risk, maximum volatility and minimum volatility. Average volatility in china market is 1.08% average volatility of Chinese market is 0.7%. Maximum volatility report in a day is 6.4% and minimum volatility observed in one day is 0.15%. Data is leptokurtic positive skewness is observed in Chinese market Q (20) and Q220 both test shows that auto-correlation is present in daily volatility.

Average volatility in Indian market is 0.46% average variance in volatility of

TABLE 4.14: Descriptive Statistics of Daily Volatility

	China	India	Brazil	Russia	South Africa	South Korea
Mean	1.0820	0.4569	1.2544	1.2843	0.9182	0.7745
Standard Deviation	0.7274	0.4562	0.7271	1.0665	0.5367	0.5498
Kurtosis	7.4927	7.6951	18.7900	34.9332	9.7451	36.0243
Skewness	2.2580	2.3883	3.0312	4.4146	2.4662	4.1974
Minimum	0.1514	0.0189	0.0000	0.0000	0.0000	0.1463
Maximum	6.3943	3.8206	10.0992	16.5445	5.1412	9.5181
JB	17585.818***	18849.502***	89562.192***	298286.251***	27410.249***	314352.187***
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Q(20)	8024.202***	15695.198***	5178.730***	8706.194***	10052.857***	10157.620***
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Q2(20)	1182.479***	4532.063***	790.286***	1660.645***	2694.006***	2912.103***
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LM(20)	249.375***	563.735***	479.827***	457.476***	325.054***	379.164***
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

TABLE 4.15: Descriptive Statistics of Daily Volatility

	Mexico	Egypt	Indonesia	Iran	Pakistan	Turkey
Mean	0.8291	0.8358	0.7834	0.8480	0.8566	1.2254
Standard Deviation	0.5321	0.7221	0.5350	2.4005	0.5689	0.7209
Kurtosis	14.9044	67.4112	11.3413	309.2112	3.7794	11.4015
Skewness	2.9200	5.3627	2.6630	16.6150	1.7520	2.5451
Minimum	0.0000	0.0000	0.0000	0.0000	0.0000	0.1781
Maximum	6.6220	16.3669	5.7222	52.0302	4.6915	8.4199
JB	58875.613***	1070476.470***	36071.874***	22220652.272***	6104.240***	35821.094***
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Q(20)	6627.414***	2638.187***	6279.181***	1667.760***	6151.437***	5451.482***
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Q2(20)	1203.274***	14.0340	460.964***	1452.773***	2637.219***	1136.009***
	0.0000	-0.1680	0.0000	0.0000	0.0000	0.0000
LM(20)	371.733***	15.0700	220.171***	119.150***	247.911***	267.896***
	0.0000	-0.1160	0.0000	0.0000	0.0000	0.0000

Indian market is 0.46% maximum volatility observed in a day is 3.82% and in Indian market exhibit a minimum volatility of 0.02% in one day. Average volatility in brazil market is 1.25%. Average risk of brazil market is 0.73%, maximum volatility see in a day is 10.09% and minimum volatility faced by the investors in one day is 0%. Average volatility in Russian market is 1.28% average variance in volatility of Russian market is 1.07%, maximum volatility observed in a day is 16.54% and minimum volatility is see in one day is 0%.

Average volatility in south Africa market is 0.92% average variance of volatility of south Africa market is 0.54% maximum volatility see in a day is 5.14% and minimum volatility observed in one day is 0%. In south Korean market average volatility is 0.78% average variance in volatility is 0.55%, maximum volatility see in a day is 9.52% and minimum volatility that investors observed in one day is 0.15%. Average volatility in Mexico market is 0.83% average variance of volatility of Mexico market is 0.53%, maximum volatility observed in a day is 6.62% and minimum volatility see by the investors in one day is 0%. Average volatility in Egyptian market is 0.84%, average variance in volatility of Egypt market is 0.72%, maximum volatility is see in a day is 16.4% and minimum volatility observed by the investors in one day is 0%.

In Indonesian market average volatility is 0.79% average variance in volatility is 0.54%, maximum volatility observed in a day is 5.72% and minimum volatility that investors faced in one day is 0%. Average volatility in Iran market is 0.85% average variance in volatility in Iran market is 2.40%, maximum volatility in a day is 52.03% and in Iran market investors face 0% minimum volatility in one day. In Pakistan market average volatility is 0.86% average variance in volatility in this market is 0.57%, maximum volatility observed in a day is 4.69% and minimum volatility that investors faced in a day is 0%.

Average volatility in turkey market is 1.23%, average variance of volatility in turkey market is 0.72%, maximum volatility is see in a day is 8.42% and in turkey market investors face minimum volatility of 0.18% in one day. Volatility series of all markets is leptokurtic; positive skewness is observed in all markets; auto-correlation is present in all volatility series except Egypt. Q (20) test shows

that auto-correlation is exist in Egypt but Q2(20) test shows that there is no auto-correlation exist in Egypt.

4.3.1 The Volatility of each Market is Present Graphically in Fig 4.11
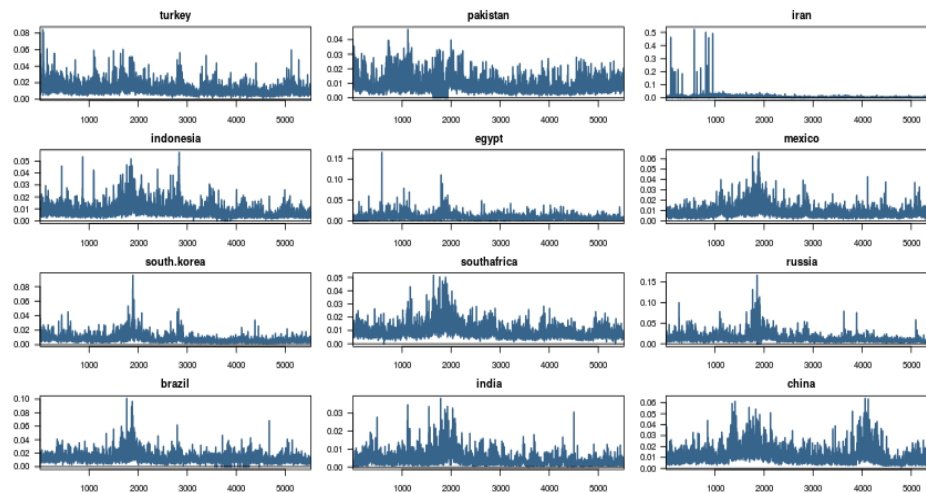
FIGURE 4.11: Graphical Representation of Volatility

The graphical behaviour of volatility series of different countries given in above figure. The financial crisis of 2007 and 2008 also called global financial crisis was severe world wide financial crisis. It was among the five worst financial crises that the world experienced and led to a loss of more than \$2 trillion from the global economy. Global financial crisis has large effect on turkey, Pakistan, Indonesia, Mexico, South Korea, South Africa, Russia, Brazil, India and china. Graph shows that in Pakistan uncertainty increased as compared to other countries, the reason of risk is different economic crisis of Pakistan (including political instability, de-value of currency of pakistan and the misuse of resources). The graphical behavior of Iran is different from other markets.

4.3.2 Correlation Analysis of Daily Volatility

The Stock market of India, Egypt, Iran, Pakistan and turkey have no significant correlation with other markets. However, Brazilian market has a significant

TABLE 4.16: Correlation Analysis of Daily Volatility

	China	India	Brazil	Russia	South Africa	South Korea	Mexico	Egypt	Indonesia	Iran	Pakistan	Turkey
China	1											
India	0.1539	1										
Brazil	0.2280	0.1706	1									
Russia	0.2400	0.1974	0.5010	1								
South Africa	0.2872	0.2170	0.5443	0.5875	1							
South Korea	0.2717	0.2149	0.4434	0.4554	0.5200	1						
Mexico	0.2613	0.2132	0.6328	0.5180	0.5885	0.4573	1					
Egypt	0.1372	0.1091	0.2708	0.3470	0.2699	0.2444	0.2772	1				
Indonesia	0.2338	0.2011	0.3975	0.4418	0.4428	0.4457	0.4271	0.2371	1			
Iran	0.0514	0.0522	0.0579	0.0640	0.0509	0.0726	0.0386	0.0414	0.0538	1		
Pakistan	0.0365	0.0753	0.0399	0.0804	0.1186	0.1040	0.1080	0.0359	0.0705	0.0658	1	
Turkey	0.1657	0.1326	0.3300	0.3883	0.3954	0.3381	0.3362	0.1824	0.3447	0.0646	0.1349	1

correlation with Russia, South Africa, South Korea, Mexico, Indonesia and Turkey. Russia has significant relationship with south Africa, south Korea, Mexico, Egypt, Indonesia and turkey. south Africa has significant correlation with south Korea, Mexico, Mexico has significant correlation with Indonesia and turkey. Indonesia has significant correlation with turkey. Iran and Pakistan has no significant correlation with any market.

4.3.3 Static Connectedness Table of Daily Volatility

Table 4.17 and 4.18 represent the Static connectedness of daily volatility. China contribution to its own market is 79.01% china contribution to India is 0.73% Brazil is 1.34%, Russia is 1.45%, South Africa 2.04%, South Korea 2.06%, Mexico 1.73%, Egypt 0.58%, Indonesia 1.5%, Iran 0.22%, Pakistan 0.06% and turkey 0.68%. China market has some influence on all markets volatility but in static connectedness table of daily return China stock market has no impact on turkey returns, there is a contribution of China's stock markets to create volatility in Turkey's stock market. There is a significant relationship between these two stock markets. China total contributions to other markets is 12.35% and china contribution to its own market is 79.01% china contribution including own is 91.36% While other countries contribution is only 20.99% to China's market.

India is presented as second ordered country where India contribution to its own market is 86.34% India stock market contribution to china is 1.31%, Brazil 0.67%, Russia 0.85%, South Africa 1.12%, South Korea 1.27%, Mexico 1.01%, Egypt 0.48%, Indonesia 1.08%, Iran 0.11%, Pakistan 0.26% and Turkey 0.51%, India total contributions to other markets is 8.67% and India contribution to its own market is 86.34% India contribution including own is 95.009%, While other countries contribution is only 13.66% to India's market.

Brazil contribution to its own market is 48.31%, Brazil stock market contribution to china is 2.38%, India 1.41%, Russia 10.03%, South Africa 10.66%, South Korea 8.02%, Mexico 15.21%, Egypt 4.77%, Indonesia 6.25%, Iran 0.12%, Pakistan 0.09% and Turkey 4.60%, Brazil total contributions to other markets is

TABLE 4.17: Static Connectedness Table of Daily Volatility

	China	India	Brazil	Russia	South Africa	South Korea
China	79.011	1.310	2.376	2.474	4.459	2.831
India	0.727	86.339	1.406	1.603	2.422	2.388
Brazil	1.344	0.673	48.309	8.043	10.310	5.904
Russia	1.453	0.846	10.028	46.794	11.657	5.863
South Africa	2.041	1.122	10.655	11.000	43.086	7.902
South Korea	2.060	1.267	8.019	7.496	9.938	51.159
Mexico	1.726	1.011	15.208	8.201	11.695	5.981
Egypt	0.576	0.483	4.765	7.325	3.251	1.820
Indonesia	1.470	1.077	6.249	7.431	8.174	7.505
Iran	0.216	0.111	0.117	0.151	0.174	0.407
Pakistan	0.064	0.264	0.098	0.192	0.641	0.553
Turkey	0.675	0.506	4.604	6.816	6.743	4.585
Contribution to others	12.353	8.671	63.525	60.731	69.463	45.739
Contribution including own	91.364	95.009	111.834	107.525	112.549	96.898
Net spillovers	-8.636	-4.991	11.834	7.525	12.549	-3.102

TABLE 4.18: Static Connectedness Table of Daily Volatility

	Mexico	Egypt	Indonesia	Iran	Pakistan	Turkey	From
China	3.324	0.672	2.121	0.069	0.038	1.317	20.989
India	2.459	0.195	1.500	0.118	0.281	0.562	13.661
Brazil	15.913	1.720	4.436	0.071	0.062	3.216	51.691
Russia	10.422	2.780	5.452	0.123	0.229	4.353	53.206
South Africa	12.952	1.596	4.846	0.025	0.453	4.321	56.914
South Korea	8.298	1.945	5.621	0.118	0.268	3.811	48.841
Mexico	46.276	1.675	4.890	0.019	0.337	2.979	53.724
Egypt	4.562	73.418	2.405	0.074	0.052	1.269	26.582
Indonesia	7.491	1.321	55.031	0.043	0.130	4.077	44.969
Iran	0.106	0.075	0.382	97.880	0.169	0.212	2.120
Pakistan	0.559	0.158	0.148	0.422	95.441	1.459	4.559
Turkey	5.079	1.048	4.749	0.132	0.625	64.439	35.561
Contribution to others	71.165	13.185	36.550	1.214	2.645	27.577	412.817
Contribution including own	117.441	86.603	91.581	99.094	98.086	92.016	TCI
Net spillovers	17.441	-13.397	-8.419	-0.906	-1.914	-7.984	34.401

63.53% and Brazil contribution to its own market is 48.31% Brazil contribution including own is 111.83%, While other countries contribution is 51.69% to Brazil market.

Russia contribution to its own market is 46.79%, Russia stock market contribution to china is 2.47%, India 1.60%, Brazil 8.04%, South Africa 11%, South Korea 7.49%, Mexico 8.20%, Egypt 7.33%, Indonesia 7.43%, Iran 0.15%, Pakistan 0.19% and Turkey 6.82%, Russia total contributions to other markets is 60.73% and Russia contribution to its own market is 46.79% Russia contribution including own is 107.53%, While other countries contribution is 53.21% to Russia market.

South Africa's contribution to its own market is 43.09%, South Africa's stock market contribution to china market is 4.46%, India 2.42%, Brazil 10.31%, Russia 11.66%, South Korea 9.94%, Mexico 11.69%, Egypt 3.25%, Indonesia 8.17%, Iran 0.17%, Pakistan 0.64% and Turkey 6.74%, South Africa's total contributions to other markets is 69.46% and South Africa's contribution to its own market is 43.09% South Africa's contribution including own is 112.55%, While other countries contribution is 56.91% to South Africa's market.

South Korea contribution to its own market is 51.16%, South Korea stock market contribution to china is 2.83%, India 2.39%, Brazil 5.90%, Russia 5.86%, South Africa 7.90%, Mexico 5.98%, Egypt 1.82%, Indonesia 7.51%, Iran 0.41%, Pakistan 0.55% and Turkey 4.59%, South Korea's total contributions to other markets is 45.74% and South Korea's contribution to its own market is 51.16% South Korea's contribution including own is 96.89%, While other countries contribution is 48.84% to South Korea's market.

Mexico's contribution to its own market is 46.28%, Mexico stock market contribution to china is 3.32%, India 2.46%, Brazil 15.91%, Russia 10.42%, South Africa 12.95%, South Korea 8.29%, Egypt 4.56%, Indonesia 7.49%, Iran 0.11%, Pakistan 0.56% and Turkey 5.08%, Mexico's total contributions to other markets is 71.17% and Mexico's contribution to its own market is 46.28% Mexico's contribution including own is 117.44%, While other countries contribution is 53.72% to Mexico's market.

Egypt's contribution to its own market is 73.42%, whereas Egypt stock market

contribution to china is 0.67%, India 0.19%, Brazil 1.72% Russia 2.78%, South Africa 1.59% South Korea 1.95%, Mexico 1.68%, Indonesia 1.32%, Iran 0.08%, Pakistan 0.16% and Turkey 1.05%, Egypt's total contributions to other markets is 13.19% and Egypt's contribution to its own market is 73.42% Egypt's contribution including own is 86.60%, While other countries contribution is 26.58% to Egypt's market.

Indonesia's contribution to its own market 55.03%, Indonesia's stock market contribution to china is 2.12%, India 1.5%, Brazil 4.44%, Russia 5.45%, South Africa 4.85%, South Korea 5.62%, Mexico 4.89%, Egypt 2.41%, Iran 0.38%, Pakistan 0.15% and Turkey 4.75%, Indonesia's total contributions to other markets is 36.55% and Indonesia's contribution to its own market is 55.03% Indonesia's contribution including own is 91.58%, While other countries contribution is 44.97% to Indonesia's market.

Iran's stock market contribution to its own market 97.88%, Iran stock market contribution to china is 0.07%, India 0.12%, Brazil 0.07%, Russia 0.12%, South Africa 0.03%, South Korea 0.118%, Mexico 0.019%, Egypt 0.07%, Indonesia 0.04%, Pakistan 0.42% and Turkey 0.13%, Iran's total contributions to other markets is 1.214% and Iran contribution to its own market is 97.88% Iran's contribution including own is 99.09%, While other countries contribution is 2.12% to Iran market.

Pakistan's stock market contribution to its own market 95.44%, Pakistan stock market contribution to china is 0.04%, India 0.28%, Brazil 0.06%, Russia 0.23%, South Africa 0.45%, South Korea 0.27%, Mexico 0.34%, Egypt 0.05%, Indonesia 0.13%, Iran 0.17% and Turkey 0.63%, Pakistan's total contributions to other markets is 2.65% and Pakistan's contribution to its own market is 95.44% Pakistan's contribution including own is 98.09%, While other countries contribution is 4.56% to Pakistan's market.

Turkey's stock market contribution to its own market 64.44%, turkey stock market contribution to china is 1.32%, India 0.56%, Brazil 3.22%, Russia 4.35%, South Africa 4.32%, South Korea 3.81%, Mexico 2.98%, Egypt 1.27%, Indonesia 4.07%, Iran 0.21% and Pakistan 1.46%, Turkey's total contributions to other markets is 27.58% and Turkey's contribution to its own market is 64.44% Turkey's

contribution including own is 92.02%, While other countries contribution is 35.56% to Turkey's market.

China contribution to other markets is up to 12.35% and China's stock market is affected up to 79.01% by including its own shocks. China's stock markets shocks do not affect other markets in high range as compare to other markets. The interference of Mexico market shocks is up to 71.1% to other markets, secondly south Africa stock market shocks contribution is up to 69.46% to other markets. Adding the entries in the contributions from others column or for that matter contribution to others row. We obtain the spillover index 34.4% of the total 1200 points of forecast error variance for all 12 countries is explained by spillovers across markets. The remaining 65.6% of the total forecast error variance is explained by its own shocks rather than spillovers of shocks across markets.

4.3.4 Contribution from Individual Market to other Market is Presented Graphically in Fig 4.12
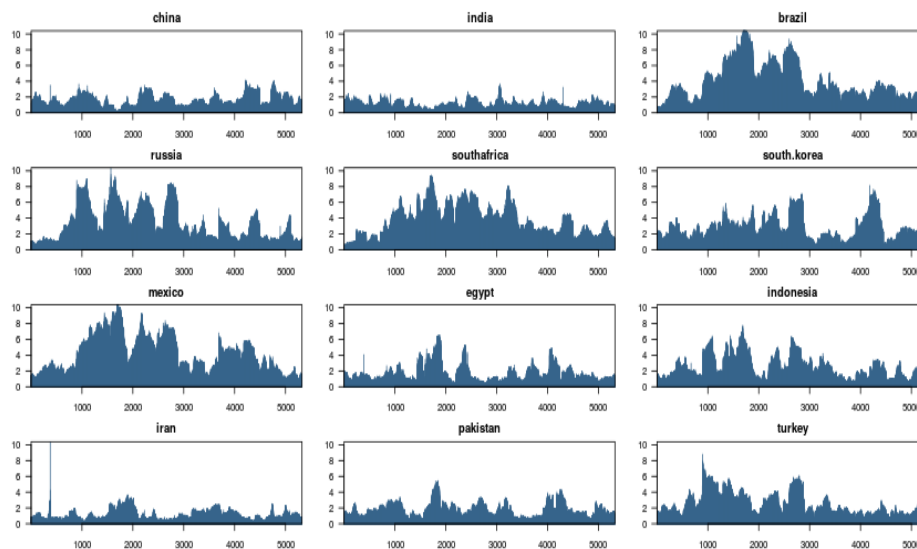
FIGURE 4.12: Contribution from Individual Market to other Market

China contribution to other markets in term of daily volatility is 12.353%, India contribution to other markets is 8.671%, brazil contribution to other markets is 63.525%, Russia contribution to other markets is 60.731% south Africa contribution to other markets is 69.463%, south Korea contribution to other markets is

45.739%, Mexico contribution to other markets is 71.165%, Egypt contribution to other markets is 13.185%, Indonesia contribution to other markets is 36.55%, Iran contribution to other markets is 1.214%, Pakistan contribution to other markets is 2.645%, turkey contribution to other markets is 27.577%. large contribution from south Africa to other markets and small contribution from Iran to other markets in term of daily volatility spillover is observed. Volatility spillover is higher in crisis. Iran contribution to other markets is less than other countries because Iran is disconnected from other countries.

4.3.5 The Contribution from all Markets to an Individual Market Present Graphically in Fig 4.13
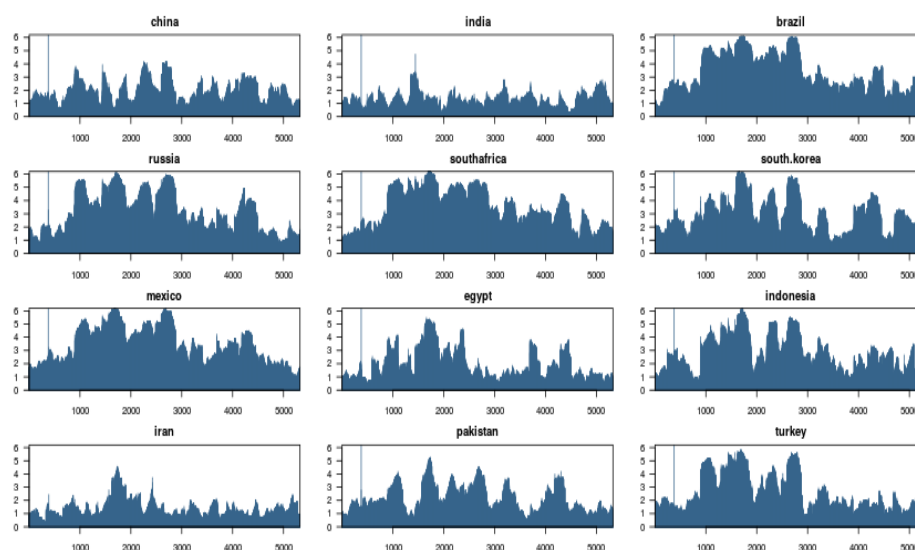
FIGURE 4.13: Contribution from all Markets to an Individual Market

The volatility of china market is 20.989% India 13.661% brazil 51.691% Russia 53.206% south Africa 56.914% south Korea 48.841% Mexico 53.724% Egypt 26.582% Indonesia 44.969% Iran 2.12% Pakistan 4.559% turkey 35.561%, higher contribution from other countries to south Africa is reported and smallest contribution from other countries to Iran is reported. Other countries contribution is high in term of volatility spillover including that risk transmitted from one country to other countries. Spillover is not consistent over time. It varies over time. It is generally higher during crisis period. Above graph clearly provide that these

markets are reciprocal volatility spillover effect as well as transmission of volatility. That is to identify net recipient or transmission of volatility information net spillover effect is expressed as graph below.

4.3.6 Net Spillover Effect is Expressed in Fig 4.14

Net spillover of china is -8.636%, net spillover of India is -4.991%, brazil is 11.834%, Russia is 7.525%, south Africa is 12.549%, south Korea is -3.102%, Mexico is 17.441%, Egypt is -13.397%, Indonesia is -8.419%, Iran is -0.906%, Pakistan is -1.914%, turkey is -7.984%. There is no large difference present in the net spillover value of Iran and Pakistan, it means that if any crisis or instability occur in Pakistan and Iran then other countries are not highly affected. The difference between two indices reveals that volatility spread across other countries stock markets compared returns spillover. It is also consistent behavior exist regarding direction on time these are periods of dissemination of volatility and these are periods of recipient of volatility shocks.
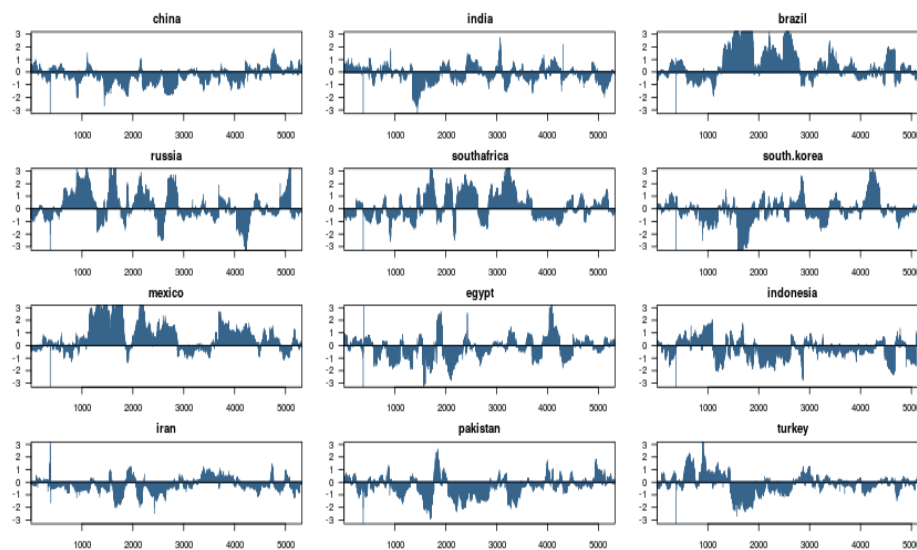
FIGURE 4.14: Net Spillover Effect

4.3.7 Dynamic Connectedness of Daily Volatility

Table 4.19 and 4.20 expressed Dynamic connectedness of daily volatility. The

TABLE 4.19: Dynamic Connectedness of Daily Volatility

	China	India	Brazil	Russia	South Africa	South Korea
China	77.105	1.208	2.383	2.247	2.378	3.792
India	1.443	84.629	1.165	1.217	1.744	1.564
Brazil	1.760	0.837	60.355	4.592	6.365	3.245
Russia	1.903	1.358	5.568	62.726	6.940	2.848
South Africa	1.858	1.404	7.020	6.573	58.589	4.923
South Korea	3.544	1.189	4.178	3.548	5.240	65.533
Mexico	1.685	0.810	11.293	4.865	6.505	4.186
Egypt	1.290	1.094	2.498	3.535	1.882	2.113
Indonesia	1.716	1.059	4.827	4.337	4.226	4.337
Iran	1.433	1.476	1.512	1.377	1.615	1.175
Pakistan	1.412	1.779	2.657	2.145	2.831	2.507
Turkey	1.242	1.252	4.043	5.157	4.580	2.135
Contribution to others	19.287	13.467	47.145	39.592	44.306	32.826
Contribution including own	96.392	98.095	107.500	102.318	102.895	98.359
Net spillovers	-3.608	-1.905	7.500	2.318	2.895	-1.641

TABLE 4.20: Dynamic Connectedness of Daily Volatility

	Mexico	Egypt	Indonesia	Iran	Pakistan	Turkey	From
China	2.429	1.101	2.469	1.611	1.552	1.725	22.895
India	1.285	1.321	1.377	1.498	1.581	1.177	15.371
Brazil	11.226	1.759	3.233	1.146	2.062	3.421	39.645
Russia	5.938	2.662	3.128	0.976	1.581	4.371	37.274
South Africa	7.501	1.548	3.236	1.192	2.011	4.146	41.411
South Korea	4.963	2.286	3.791	1.028	2.437	2.263	34.467
Mexico	58.917	1.879	3.263	1.066	2.207	3.324	41.083
Egypt	2.816	77.277	2.146	1.509	1.745	2.094	22.723
Indonesia	4.363	2.010	66.744	1.007	2.235	3.140	33.256
Iran	1.608	1.880	1.490	83.625	1.501	1.308	16.375
Pakistan	3.537	1.945	2.473	1.526	74.790	2.398	25.210
Turkey	4.319	1.923	2.977	1.203	2.015	69.154	30.846
Contribution to others	49.985	20.313	29.582	13.760	20.926	29.367	360.558
Contribution including own	108.901	97.590	96.326	97.385	95.715	98.522	TCI
Net spillovers	8.901	-2.410	-3.674	-2.615	-4.285	-1.478	30.046

China contribution to its own market is 77.11%. china contribution to India market is 1.44% Likewise, Brazil 1.76% Russia's 1.90%, South Africa 1.86%, South Korea 3.54%, Mexico 1.69%, Egypt 1.29%, Indonesia 1.72%, Iran 1.43%, Pakistan 1.41% and turkey 1.24%. China total contributions to other markets is 19.29% While other countries contribute only 22.89% to China's market, china contribution including own is 96.39%.

India is presented as second ordered country where, India contribution to its own market is 84.63. India contribution to china is 1.21%, Brazil 0.84%, Russia 1.36%, South Africa 1.40%, South Korea 1.19%, Mexico 0.81%, Egypt 1.09%, Indonesia 1.06%, Iran 1.47%, Pakistan 1.78% and Turkey 1.25%. India total contributions to other markets is 13.47% While other countries contribute only 15.37% to India's market, India contribution including own is 98.09%.

Brazil contribution to its own market is 60.36%. brazil contribution to China's stock market is 2.38%, India 1.17%, Russia 5.57%, South Africa 7.02%, South Korea 4.18%, Mexico 11.29%, Egypt 2.49%, Indonesia 4.83%, Iran 1.52%, Pakistan 2.66% and Turkey 4.04%. brazil total contributions to other markets is 47.15% While other countries contribute 39.65% to brazil market, brazil contribution including own is 107.5%.

Russia contribution to its own market is 62.73%. Russia contribution to China's stock market is 2.25%, India 1.22%, Brazil 4.59%, South Africa 6.57%, South Korea 3.55%, Mexico 4.87%, Egypt 3.54%, Indonesia 4.34%, Iran 1.38%, Pakistan 2.15% and Turkey 5.16%. Russia total contributions to other markets is 39.59% While other countries contribute 37.27% to Russia market, Russia contribution including own is 102.32%.

South Africa's contribution to its own market is 58.59%. south Africa contribution to China's stock market is 2.38%, India 1.74%, Brazil 6.37%, Russia 6.94%, South Korea 5.24%, Mexico 6.51%, Egypt 1.88%, Indonesia 4.23%, Iran 1.62%, Pakistan 2.83% and Turkey 4.58%. South Africa's total contributions to other markets is 44.31% While other countries contribute 41.41% to South Africa's market, South Africa contribution including own is 102.89%.

South Korea's contribution to its own market is 65.53%, whereas South Korea

contribution to China's stock market is 3.79%, India 1.56%, Brazil 3.25%, Russia 2.85%, South Africa 4.93%, Mexico 4.17%, Egypt 2.12%, Indonesia 4.34%, Iran 1.18%, Pakistan 2.51% and Turkey 2.14%. South Korea total contributions to other markets is 32.83% While other countries contribute to South Korea market is 34.47%, South Korea contribution including own is 98.36%.

Mexico's contribution to its own market is 58.92% Mexico's contribution to China's stock market is 2.43%, India 1.29%, Brazil 11.23%, Russia 5.94%, South Africa 7.501%, South Korea 4.96%, Egypt 2.82%, Indonesia 4.36%, Iran 1.61%, Pakistan 3.54% and Turkey 4.32%. Mexico's total contributions to other markets is 49.99% While other countries contribute 41.08% to Mexico's market, Mexico's contribution including own is 108.90%.

Egypt's contribution to its own market is 77.285%. Egypt's contribution to China's stock market is 1.10%, India 1.32%, Brazil 1.76% Russia 2.66%, South Africa 1.55% South Korea 2.29%, Mexico 1.88%, Indonesia 2.01%, Iran 1.88%, Pakistan 1.95% and Turkey 1.92%. Egypt's total contributions to other markets is 20.31% While other countries contribute only 22.72% to Egypt's market, Egypt's contribution including own is 97.59%.

Indonesia's contribution to its own market is 66.74%. Indonesia contribution to China's stock market is 2.47%, India 1.38%, Brazil 3.23%, Russia 3.13%, South Africa 3.24%, South Korea 3.79%, Mexico 3.26%, Egypt 2.15%, Iran 1.49%, Pakistan 2.47% and Turkey 2.98%. Indonesia's total contributions to other markets is 29.58% While other countries contribute 33.26% to Indonesia market, Indonesia's contribution including own is 96.33%.

Iran's contribution to its own market is 83.63%. Iran's contribution to China's stock market is 1.61%, India 1.49%, Brazil 1.15%, Russia 0.98%, South Africa 1.19%, South Korea 1.09%, Mexico 1.07%, Egypt 1.509%, Indonesia 1.007%, Pakistan 1.53% and Turkey 1.20%. Iran's total contributions to other markets is 13.8% While other countries contribute 16.37% to Iran's market, Iran's contribution including own is 97.39%.

Pakistan's contribution to its own market is 74.8%. Pakistan contribution to China's stock market is 1.55%, India 1.58%, Brazil 2.06%, Russia 1.58%, South

Africa 2.01%, South Korea 2.44%, Mexico 2.21%, Egypt 1.75%, Indonesia 2.24%, Iran 1.50% and Turkey 2.02%. Pakistan total contributions to other markets is 20.93% While other countries contribute 25.21% to Pakistan's market, Pakistan contribution including own is 95.72%.

Turkey's contribution to its own market is 69.15%. Turkey's contribution to China's stock market is 1.73%, India 1.18%, Brazil 3.42%, Russia 4.37%, South Africa 4.15%, South Korea 2.26%, Mexico 3.32%, Egypt 2.09%, Indonesia 3.14%, Iran 1.308% and Pakistan 2.39%. Turkey's total contributions to other markets is 29.37% While other countries contribute 30.85% to Turkey's market, Turkey's contribution including own is 98.52%. China contribution to other markets is up to 19.28% and China's stock market is affected up to 77.11% by including its own shocks. China's stock markets shocks do not affect other markets in high range as compare to other markets. The interference of other markets shocks is up to 49.9%. Adding the entries in the contributions from others column or for that matter contribution to others row. We obtain the spillover index 30.04% of the total 1200 points of forecast error variance for all 12 countries is explained by spillovers across markets. The remaining 69.96% of the total forecast error variance is explained by its own shocks rather than spillovers of shocks across markets.

4.3.8   Dynamic Total Connectedness is Present in Fig 4.15

Total contribution of China is 96.392%. Total contribution of India is 98.095%, brazil is 107.5%, Russia is 102.318%, south Africa is 102.895%, south Korea is 98.359%, Mexico is 108.901%, Egypt is 97.59%, Indonesia is 96.326%, Iran is 97.385%, Pakistan is 95.715%, turkey is 98.522%.

Dynamic net spillover is 30.046% and static net spillovers is 34.401% of daily volatility. Dynamic return spillover index is 27.656% and dynamic volatility spillover is 30.046% in term of daily data, which shows that there is difference between return spillover and volatility spillover it means that volatility spillover between markets is high as compare to mean spillover.
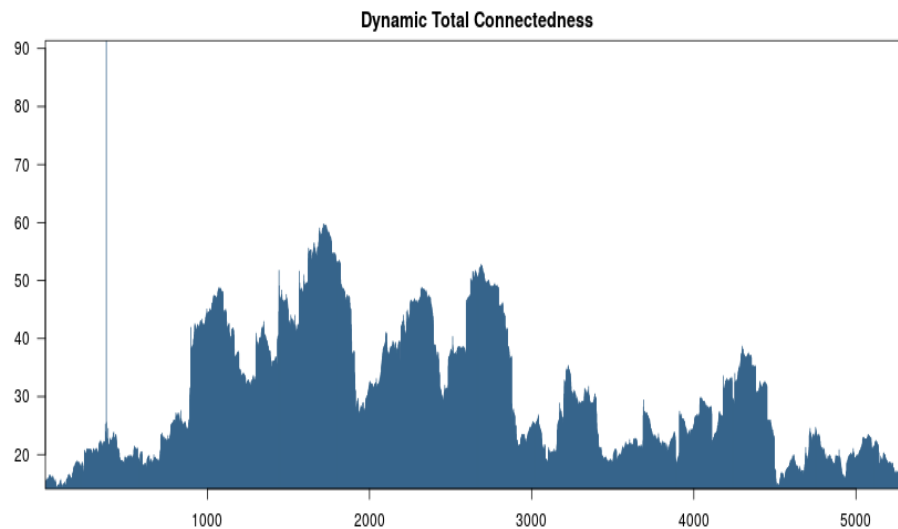
FIGURE 4.15: Dynamic Total Connectednes

4.4 Descriptive Statistics of Weekly Volatility

Table 4.21 and 4.22 present summary statistics of weekly volatility. It tells us about average volatility, average risk, maximum volatility and minimum volatility. Average volatility in china market is 7.15% per week, average volatility of Chinese market is 8.02%. Maximum volatility report in a week is 59.51% and minimum volatility observed in a week is -26.56%. Data is leptokurtic positive skewness is observed in Chinese market Q(20) and Q2(20) both test shows that auto-correlation is present in weekly volatility. Average volatility in Indian market is 1.57% average variance in volatility of Indian market is 1.43%, maximum volatility observed in a week is 12.91% and in Indian market exhibit a minimum volatility of 0.21% in a week.

Average volatility in brazil market is 7.054%. Average risk of brazil market is 6.599%, maximum volatility see in a week is 37.682% and minimum volatility faced by the investors in one week is -10.009%. Average volatility in Russian market is 6.96% average variance in volatility of Russian market is 8.94%, maximum volatility observed in a week is 65.32% and minimum volatility is see in one week is -40.04%. Average volatility in south Africa market is 4.79% average variance of volatility of south Africa market is 4.30% maximum volatility see in a week is 28.84% and minimum volatility observed in one week is -3.23%.

TABLE 4.21: Descriptive Statistics of Weekly Volatility

	China	India	Brazil	Russia	South Africa	South Korea
Mean	7.1492	1.5706	7.05399	6.9550	4.7908	4.9563
Standard Deviation	8.0175	1.4260	6.598773	8.9420	4.3035	5.2146
Kurtosis	7.1774	11.3181	4.1819	13.9759	6.7599	5.2109
Skewness	2.2325	2.6928	1.8456	2.9041	2.1400	2.0803
Minimum	-26.5614	0.2104	-10.0087	-40.0383	-3.2289	-6.1902
Maximum	59.5062	12.9063	37.6820	65.3154	28.8409	35.2724
JB	2547.848***	5599.926***	1142.357***	8163.564***	2282.631***	1579.876***
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Q(20)	924.241***	595.144***	7716.450***	734.577***	974.908***	7442.654***
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Q2(20)	225.720***	20.642**	4473.067***	447.369***	564.318***	2241.368***
	0.0000	-0.0130	0.0000	0.0000	0.0000	0.0000
LM(20)	368.086***	131.137***	7.6820	472.098***	432.025***	31.786***
	0.0000	0.0000	0.7530	0.0000	0.0000	0.0000

TABLE 4.22: Descriptive Statistics of Weekly Volatility

	Mexico	Egypt	Indonesia	Iran	Pakistan	Turkey
Mean	4.9274	8.3209	5.9705	5.5573	6.3251	7.3404
Standard Deviation	4.9942	9.1108	7.0347	9.2495	6.1111	6.8784
Kurtosis	4.9161	4.1585	6.1523	17.4544	2.1485	3.7766
Skewness	2.0773	1.7119	2.1777	3.6608	1.5227	1.7512
Minimum	-3.9477	-29.4346	-21.8193	-16.9322	-4.4289	-7.9164
Maximum	28.6984	54.1356	44.7202	78.6063	29.0860	39.5276
JB	1478.530***	1035.087***	2026.793***	12770.571***	496.490***	946.862***
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Q(20)	977.282***	596.972***	964.913***	1158.628***	797.895***	801.961***
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Q2(20)	457.747***	427.363***	405.337***	180.235***	580.291***	425.339***
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LM(20)	398.154***	369.935***	443.982***	260.422***	369.142***	365.501***
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

In south Korean market average volatility is 4.9564% average variance in volatility is 5.2146%, maximum volatility see in a week is 35.272% and minimum volatility that investors observed in one week is -6.190%. Average volatility in Mexico market is 4.93% average variance of volatility of Mexico market is 4.99%, maximum volatility observed in a week is 28.69% and minimum volatility see by the investors in one week is -3.95%. Average volatility in Egyptian market is 8.32%, average variance in volatility of Egypt market is 9.11%, maximum volatility is see in a week is 54.14% and minimum volatility observed by the investors in one week is -29.43%. In Indonesian market average volatility is 5.97% average variance in volatility is 7.035%, maximum volatility observed in a week is 44.72% and minimum volatility that investors faced in one week is -21.82%.

Average volatility in Iran market is 5.56% average variance of volatility in Iran market is 9.23%, maximum volatility in a week is 78.61% and in Iran market investors face -16.93% minimum volatility in one week. In Pakistan market average volatility is 6.33% average variance of volatility in this market is 6.11%, maximum volatility observed in a week is 29.09% and minimum volatility that investors faced in a week is -4.43%. Average volatility in turkey market is 7.34%, average variance of volatility in turkey market is 6.88%, maximum volatility is see in a week is 39.53% and in turkey market investors face minimum volatility of -7.92% in one week. Volatility series of all markets is leptokurtic except Pakistan; positive skewness is observed in all markets. Auto-correlations present in all volatility series.

4.4.1 The Volatility of each Market is Present Graphically in Fig 4.16

The graphical behavior of different countries, also show contradiction in different countries and spillover of weekly volatility among different countries. The graph indicates high volatility and low volatility periods. The behavior of South Korean and Brazilian market is completely different from other markets. The Pakistan is highly volatile from rest of the markets. Volatility clustering is appears in

markets of Russia, Egypt, South Africa, Mexico significantly. India and Pakistani markets are also affected by global financial crisis high volatility is observed.
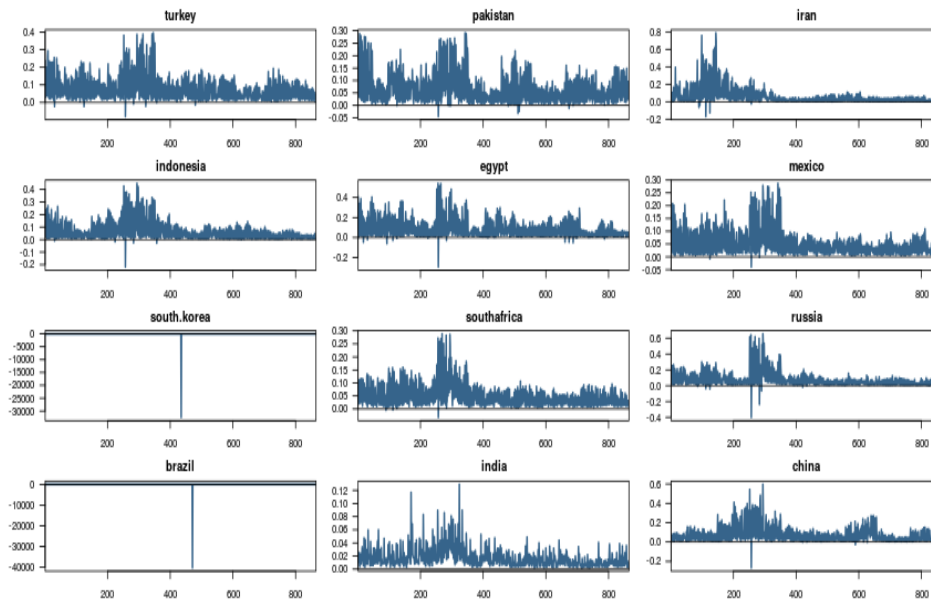

FIGURE 4.16: The volatility of each Market

4.4.2 Correlation Analysis of Weekly Volatility

China has significant correlation with markets of Russia, south Africa, Mexico, Egypt, Indonesia, Iran, Pakistan and turkey. Indian market has significant correlation with markets of Russia, south Africa, Mexico, Egypt, Indonesia, Pakistan and turkey. However, brazil has no significant correlation with any market. Russia has significant correlation with markets of south Africa, Mexico, Egypt, Indonesia, Iran, Pakistan and turkey. South Africa has significant correlation with markets of Mexico, Egypt, Indonesia, Iran, Pakistan and turkey.

South Korea has no significant correlation with any market. Mexico has significant correlation with markets of Egypt, Indonesia, Iran, Pakistan and turkey. Egypt has significant correlation with markets of Indonesia, Iran, Pakistan and turkey. Indonesia has significant correlation with markets of Iran, Pakistan and turkey. Iran has significant correlation with markets of Pakistan and turkey. Pakistan has significant correlation with turkey. In case of volatility almost all countries have significant correlation with each other except brazil and south Korea.

TABLE 4.23: Correlation Analysis of Weekly Volatility

	China	India	Brazil	Russia	South Africa	South Korea	Mexico	Egypt	Indonesia	Iran	Pakistan	Turkey
China	1											
India	0.4879	1										
Brazil	-0.0118	0.0150	1									
Russia	0.5882	0.4198	0.0121	1								
South Africa	0.6647	0.4519	-0.0164	0.8425	1							
South Korea	0.0193	0.0202	-0.0012	0.0208	0.0282	1						
Mexico	0.6145	0.4655	-0.0013	0.8351	0.8763	0.0276	1					
Egypt	0.5134	0.4258	-0.0023	0.7504	0.7183	0.0276	0.7423	1				
Indonesia	0.7089	0.4881	0.0202	0.7884	0.8135	0.0221	0.8448	0.7170	1			
Iran	0.3101	0.2973	0.0136	0.4209	0.5077	0.0189	0.4391	0.4998	0.3138	1		
Pakistan	0.5189	0.4211	-0.0232	0.6572	0.6919	0.0307	0.7190	0.6506	0.6740	0.3775	1	
Turkey	0.6295	0.4699	-0.0217	0.7415	0.7819	0.0212	0.8307	0.7016	0.8240	0.3906	0.7291	1

4.4.3 Static Connectedness of Weekly Volatility

Table 4.24 and 4.25 present Static connectedness weekly volatility. China contribution to its own market is 28.42% china contribution to India is 8.13% Brazil is 0.03%, Russia is 6.33%, South Africa 7.80%, South Korea 0.099%, Mexico 6.45%, Egypt 5.202%, Indonesia 9.26%, Iran 3.396%, Pakistan 5.92% and turkey 7.37%. China total contributions to other markets is 59.98% and china contribution including own is 88.39% While other countries contribution is 71.58% to China's market.

India is presented as second ordered country where India contribution to its own market is 43.44% India stock market contribution to china is 8.95%, Brazil 0.023%, Russia 6.19%, South Africa 6.94%, South Korea 0.096%, Mexico 7.08%, Egypt 5.57%, Indonesia 7.42%, Iran 5.002%, Pakistan 5.97% and Turkey 6.298%. India total contributions to other markets is 59.53% and India contribution including own is 102.97%, While other countries contribution is only 56.56% to India's market.

Brazil contribution to its own market is 99.64%, Brazil stock market contribution to china is 0.03%, India, Russia 0.011%, South Africa 0.029%, South Korea 0%, Mexico 0.01%, Egypt 0.01%, Indonesia 0.023%, Iran 0.024%, Pakistan 0.038% and Turkey 0.031%, Brazil total contributions to other markets is 0.234% and Brazil contribution including own is 99.88%, While other countries contribution is 0.36% to Brazil market.

Russia contribution to its own market is 19.612%, Russia stock market contribution to china is 7.541%, India 5.194%, Brazil 0.021%, South Africa 11.729%, South Korea 0.072%, Mexico 11.387%, Egypt 11.398%, Indonesia 10.392%, Iran 6.127%, Pakistan 8.881% and Turkey 9.545%, Russia total contributions to other markets is 82.285% and Russia contribution including own is 101.898%, While other countries contribution is 80.388% to Russia market.

South Africa's contribution to its own market is 17.613%, South Africa's stock market contribution to china market is 9.921%, India 6.338%, Brazil 0.044%, Russia 12.967%, South Korea 0.118%, Mexico 12.682%, Egypt is 10.578%, Indonesia

TABLE 4.24: Static Connectedness of Weekly Volatility

	China	India	Brazil	Russia	South Africa	South Korea
China	28.418	8.948	0.025	7.541	9.921	0.033
India	8.129	43.442	0.033	5.194	6.338	0.024
Brazil	0.030	0.023	99.643	0.021	0.044	0.000
Russia	6.328	6.190	0.011	19.612	12.967	0.011
South Africa	7.802	6.937	0.029	11.729	17.613	0.009
South Korea	0.099	0.096	0.000	0.072	0.118	99.003
Mexico	6.448	7.081	0.010	11.387	12.682	0.009
Egypt	5.202	5.567	0.010	11.398	10.578	0.036
Indonesia	9.260	7.417	0.023	10.392	11.228	0.014
Iran	3.396	5.002	0.024	6.127	9.455	0.026
Pakistan	5.915	5.970	0.038	8.881	10.225	0.035
Turkey	7.373	6.298	0.031	9.545	10.953	0.014
Contribution to others	59.982	59.530	0.234	82.285	94.509	0.211
Contribution including own	88.399	102.972	99.876	101.898	112.123	99.214
Net spillovers	-11.601	2.972	-0.124	1.898	12.123	-0.786

TABLE 4.25: Static Connectedness of Weekly Volatility

	Mexico	Egypt	Indonesia	Iran	Pakistan	Turkey	From
China	8.660	5.971	12.007	2.266	6.407	9.804	71.582
India	6.836	6.031	7.566	3.228	6.003	7.176	56.558
Brazil	0.003	0.010	0.052	0.021	0.082	0.072	0.357
Russia	12.709	10.248	11.200	3.332	7.731	9.661	80.388
South Africa	12.914	8.645	11.074	4.746	8.171	10.331	82.387
South Korea	0.092	0.129	0.068	0.058	0.145	0.120	0.997
Mexico	17.690	9.086	12.052	3.398	8.608	11.549	82.310
Egypt	11.239	21.941	10.431	5.522	8.448	9.629	78.059
Indonesia	12.546	8.721	18.947	1.666	7.829	11.956	81.053
Iran	6.705	10.184	3.482	44.895	5.305	5.399	55.105
Pakistan	11.190	8.857	9.694	3.146	24.491	11.558	75.509
Turkey	12.650	8.586	12.698	2.772	9.637	19.443	80.557
Contribution to others	95.545	76.470	90.323	30.154	68.365	87.254	744.862
Contribution including own	113.234	98.411	109.270	75.049	92.856	106.697	TCI
Net spillovers	13.234	-1.589	9.270	-24.951	-7.144	6.697	62.072

11.228%, Iran 9.455%, Pakistan 10.225% and Turkey 10.953%, South Africa's total contributions to other markets is 94.509% and South Africa's contribution including own is 112.123%, While other countries contribution 82.387% to South Africa's market.

South Korea contribution to its own market is 99.003%, South Korea stock market contribution to china is 0.033%, India 0.024%, Brazil 0%, Russia 0.011%, South Africa 0.009%, Mexico 0.009%, Egypt 0.036%, Indonesia 0.014%, Iran 0.026%, Pakistan 0.035% and Turkey 0.014%, South Korea's total contributions to other markets is 0.211% and South Korea's contribution including own is 99.214%, While other countries contribution is 0.997% to South Korea's market.

Mexico's contribution to its own market is 17.69%, Mexico stock market contribution to china is 8.66%, India 6.836%, Brazil 0.003%, Russia 12.71%, South Africa 12.914%, South Korea 0.092%, Egypt 11.24%, Indonesia 12.55%, Iran 6.71%, Pakistan 11.19% and Turkey 12.65%, Mexico's total contributions to other markets is 95.55% and Mexico's contribution including own is 113.234%, While other countries contribution is 82.31% to Mexico's market.

Egypt's contribution to its own market is 21.941%, Egypt stock market contribution to china is 5.98%, India 6.031%, Brazil 0.01%, Russia 10.25%, South Africa 8.65% South Korea 0.13%, Mexico 9.09%, Indonesia 8.721%, Iran 10.184%, Pakistan 8.857% and Turkey 8.586%, Egypt's total contributions to other markets is 76.47% and Egypt's contribution including own is 98.411%, While other countries contribution is 78.06% to Egypt's market.

Indonesia's contribution to its own market is 18.947% , Indonesia's stock market contribution to china is 12.007%, India 7.57%, Brazil 0.052%, Russia 11.2%, South Africa 11.074%, South Korea 0.068%, Mexico 12.052%, Egypt 10.431%, Iran 3.482%, Pakistan 9.694% and Turkey 12.698%, Indonesia's total contributions to other markets is 90.323% and Indonesia's contribution including own is 109.27%, While other countries contribution is 81.053% to Indonesia's market. .   Iran's stock market contribution to its own market 44.895%, Iran stock market contribution to china is 2.27%, India 3.23%, Brazil 0.021%, Russia 3.332%, South Africa 4.746%, South Korea 0.058%, Mexico 3.398%, Egypt 5.522%, Indonesia 1.67%,

Pakistan 3.15% and Turkey 2.772%, Iran's total contributions to other markets is 30.15% and Iran's contribution including own is 75.05%, While other countries contribution is 55.105% to Iran market.

Pakistan's stock market contribution to its own market 24.491%, Pakistan stock market contribution to china is 6.41%, India 6.003%, Brazil 0.082%, Russia 7.731%, South Africa 8.171%, South Korea 0.145%, Mexico 8.61%, Egypt 8.45%, Indonesia 7.83%, Iran 5.31% and Turkey 9.64%, Pakistan's total contributions to other markets is 68.37% and Pakistan's contribution including own is 92.86%, While other countries contribution is 75.509% to Pakistan's market.

Turkey's stock market contribution to its own market 19.443%, turkey stock market contribution to china is 9.804%, India 7.18%, Brazil 0.072%, Russia 9.661%, South Africa 10.331%, South Korea 0.12%, Mexico 11.549%, Egypt 9.629% Indonesia 11.96%, Iran 5.399% and Pakistan 11.56%, Turkey's total contributions to other markets is 87.254% and Turkey's contribution including own is 106.697%, While other countries contribution is 80.557% to Turkey's market. Brazil and south Korean stock markets are highly effected by its own shocks, but other countries effected by spillovers of shocks across markets. Adding the entries in the contributions from others column (or for that matter contribution to others row) we obtain the spillover index 62.07% of the total 1200 points of forecast error variance for all 12 countries is explained by spillovers across markets. The remaining 37.93% of the total forecast error variance is explained by its own shocks rather than spillovers of shocks across markets.

4.4.4 Contribution from Individual Market to other Market is Presented Graphically in Fig 4.17

China contribution to other markets in term of weekly volatility is 59.982%, India contribution to other markets is 59.53%, Brazil contribution to other markets is 0.234%, Russia contribution to other markets is 82.285% south Africa contribution to other markets is 94.509%, south Korea contribution to other markets is 0.211%, Mexico contribution to other markets is 95.545%, Egypt contribution to

other markets is 76.47%, Indonesia contribution to other markets is 90.323% Iran contribution to other markets is 30.154%, Pakistan contribution to other markets is 68.365%, turkey contribution to other markets is 87.254%. Higher contribution from Mexico to other markets and smaller contribution from south Korea to other markets in term of weekly volatility spillover is reported. weekly results show that Return spillover and volatility spillover between markets is almost same. Spillover is not consistent over time; it varies over time. It is generally higher during crisis period.
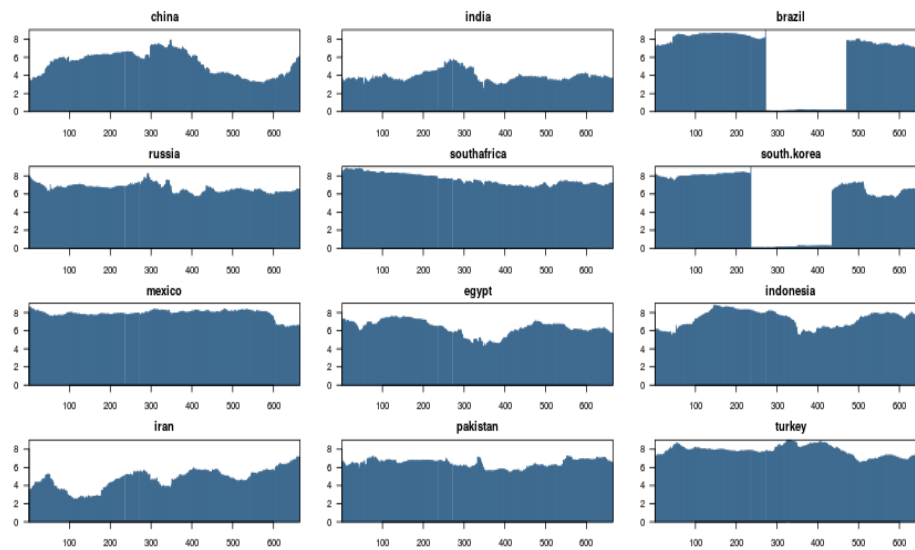

FIGURE 4.17: Contribution from Individual Market to other Market

4.4.5 The contribution from all Markets to an Individual Market Present Graphically in Fig 4.18

Other countries contribute china 71.582% India 56.558%, brazil 0.357%, Russia 80.388%, South Africa 82.387%, South Korea 0.997%, Mexico 82.31%, Egypt 78.059%, Indonesia 81.053%, Iran 55.105%, Pakistan 75.509%,Turkey 80.557%, smaller contribution from other countries to Brazil is reported and higher contribution from other countries to south Africa and Mexico is reported. The behavior of Brazil and south Korean markets are totally different from other markets. The contribution of other markets in Iran is low because of disconnection of Iran to other markets.
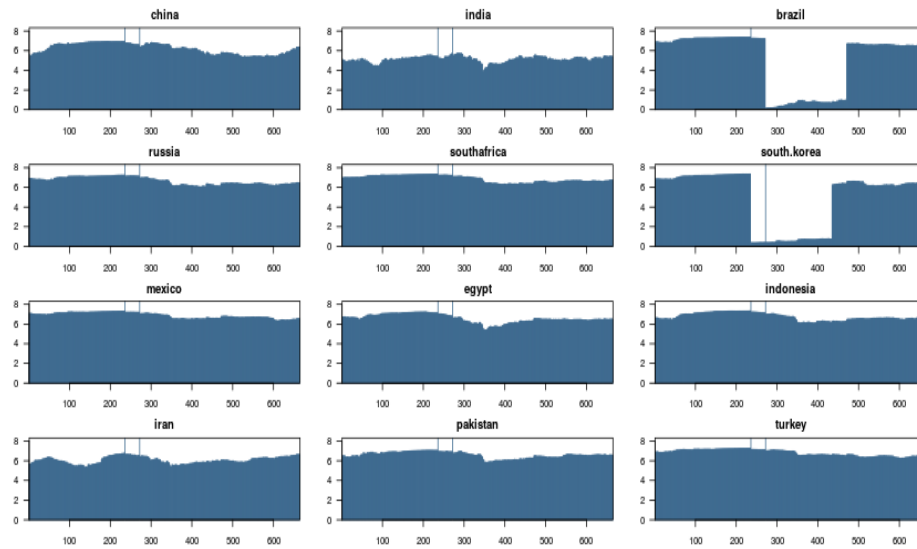
FIGURE 4.18: Contribution for all Markets to an Individual Market

4.4.6 Net Spillover Effect is expressed in Fig 4.19
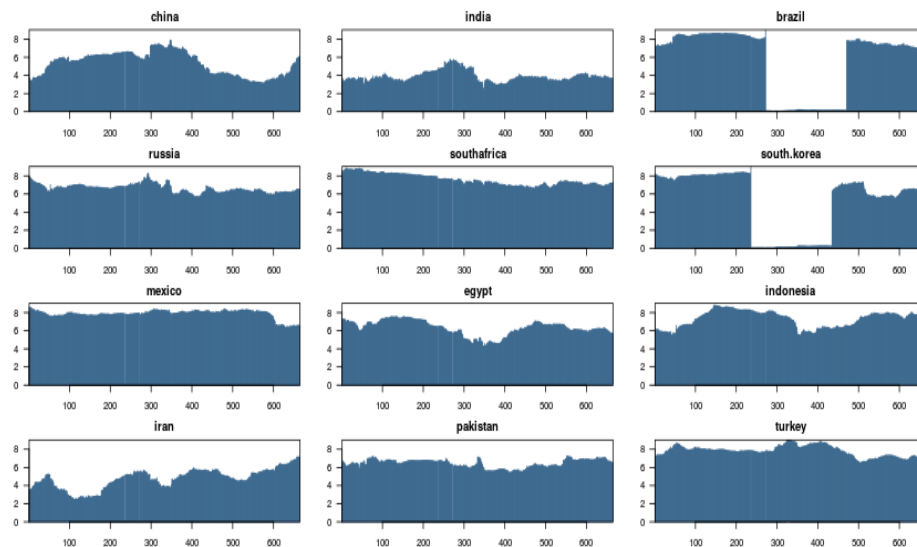
FIGURE 4.19: Net Spillover Effect

Net spillover of china is -11.601%, net spillover of India is 2.972%, brazil is -0.124%, Russia is 1.898%, south Africa is 12.123%, south Korea is -0.786%, Mexico is 13.234%, Egypt is -1.589%, Indonesia is 9.27%, Iran is -24.951%, Pakistan is -7.144%, turkey is 6.697%. china, brazil, south Korea, Egypt, Iran, Pakistan are information receiver countries. However, India, Russia, south Africa, Mexico, Indonesia and turkey are information giver countries. The graph clearly provide that

china market is recipient of volatility spillover in mostly periods and dissemination of volatility spillover in few periods, and Iranian market is generally recipient of information to other markets.

4.4.7 Dynamic Connectedness of Weekly Volatility

Table 4.26 and 4.27 present Dynamic connectedness of weekly volatility. China contribution to its own market is 25.357%. China contribution to India market is 6.926% Likewise, Brazil 4.061%, Russia's 5.919%, South Africa 5.913%, South Korea 4.584%, Mexico 6.011%, Egypt 5.34%, Indonesia 7.803%, Iran 5.213%, Pakistan 5.837%, and Turkey 6.069%. China total contributions to other markets is 63.676% While other countries contribute only 74.643% to China's market, china contribution including own is 89.033%.

India is presented as second ordered country where, India contribution to its own market is 38.127%. India contribution to china is 6.053%, Brazil 2.8, Russia 4.568%, South Africa 4.002%, South Korea 2.594%, Mexico 4.639%, Egypt 4.789%, Indonesia 4.924%, Iran 4.129%, Pakistan 3.961% and Turkey 3.995%. India total contributions to other markets is 46.455% While other countries contribute only 61.873% to India's market, India contribution including own is 84.581%

Brazil contribution to its own market is 39.173%. brazil contribution to China's stock market is 5.611% India 4.21%, Russia 6.887%, South Africa 6.241%, South Korea 5.865%, Mexico 7.348%, Egypt 7.445%, Indonesia 7.01%, Iran 4.422%, Pakistan 7.574% and Turkey 5.901%. brazil total contributions to other markets is 68.512% While other countries contribute 60.827% to brazil market, brazil contribution including own is 107.685%.

Russia contribution to its own market is 19.936%, Russia stock market contribution to china is 17.07%, India 5.54%, Brazil 6.09%, South Africa 8.524%, South Korea 6.14%, Mexico 9.181%, Egypt 8,77%, Indonesia 7.18%, Iran 6.46%, Pakistan 6.88% and Turkey 7.524%, Russia total contributions to other markets is 79.35% and Russia contribution including own is 99.29%, While other countries contribution is 80.064% to Russia market.

TABLE 4.26: Dynamic Connectedness of Weekly Volatility

	China	India	Brazil	Russia	South Africa	South Korea
China	25.357	6.053	5.611	7.067	7.331	6.211
India	6.926	38.127	4.210	5.538	5.228	3.828
Brazil	4.061	2.800	39.173	6.088	6.276	5.676
Russia	5.919	4.568	6.887	19.936	9.406	6.517
South Africa	5.913	4.002	6.241	8.524	17.553	6.986
South Korea	4.584	2.594	5.865	6.136	7.383	40.978
Mexico	6.011	4.639	7.348	9.181	10.430	6.036
Egypt	5.340	4.789	7.445	8.767	7.828	4.964
Indonesia	7.803	4.924	7.010	7.183	9.289	5.609
Iran	5.213	4.129	4.422	6.457	9.018	4.669
Pakistan	5.837	3.961	7.574	6.884	8.917	5.488
Turkey	6.069	3.995	5.901	7.524	9.550	7.077
Contribution to others	63.676	46.455	68.512	79.349	90.657	63.061
Contribution including own	89.033	84.581	107.685	99.285	108.210	104.039
Net spillovers	-10.967	-15.419	7.685	-0.715	8.210	4.039

TABLE 4.27: Dynamic Connectedness of Weekly Volatility

	Mexico	Egypt	Indonesia	Iran	Pakistan	Turkey	From
China	7.909	5.907	10.074	4.435	6.190	7.856	74.643
India	6.291	6.022	6.613	5.255	5.489	6.472	61.873
Brazil	7.377	6.228	6.647	3.204	6.877	5.594	60.827
Russia	10.549	8.492	7.713	4.926	6.730	8.358	80.064
South Africa	10.813	6.693	8.996	6.399	8.026	9.854	82.447
South Korea	6.420	4.624	5.552	3.458	5.065	7.341	59.022
Mexico	17.391	7.046	8.865	4.809	8.254	9.990	82.609
Egypt	8.440	21.046	8.863	6.985	7.608	7.925	78.954
Indonesia	9.423	7.778	18.968	4.998	6.842	10.174	81.032
Iran	7.094	8.582	6.525	27.072	7.289	9.529	72.928
Pakistan	9.700	7.370	7.540	5.701	20.853	10.176	79.147
Turkey	10.036	6.677	9.736	6.698	8.622	18.115	81.885
Contribution to others	94.052	75.419	87.123	56.870	76.990	93.269	895.432
Contribution including own	111.443	96.466	106.091	83.942	97.842	111.383	TCI
Net spillovers	11.443	-3.534	6.091	-16.058	-2.158	11.383	74.619

South Africa's contribution to its own market is 17.55%, South Africa's stock market contribution to china market is 7.331%, India 5.23%, Brazil 6.28%, Russia 9.41%, South Korea 7.38%, Mexico 10.43%, Egypt 7.83% Indonesia 9.29%, Iran 9.02%, Pakistan 8.92% and Turkey 9.55%, South Africa's total contributions to other markets is 90.66% and South Africa's contribution including own is 108.21%, While other countries contribution 82.45% to South Africa's market.

South Korea's contribution to its own market is 40.978%. south Korea contribution to China's stock market is 6.211%, India 3.828%, Brazil 5.676%, Russia 6.517%, South Africa 6.986%, Mexico 6.036%, Egypt 4.964%, Indonesia 5.609%, Iran 4.669%, Pakistan 5.488% and Turkey 7.077%. South Korea total contributions to other markets is 63.061% While other countries contribute to South Korea market is 59.022%, South Korea contribution including own is 104.039%.

Mexico's contribution to its own market is 17.391% Mexico's contribution to China's stock market is 7.909%, India 6.291%, Brazil 7.377%, Russia 10.549%, South Africa 10.813%, South Korea 6.42%, Egypt 8.44%, Indonesia 9.423%, Iran 7.094%, Pakistan 9.7% and Turkey 10.036%. Mexico's total contributions to other markets is 94.052% While other countries contribute 82.609% to Mexico's market, Mexico's contribution including own is 111.443%.

Egypt's contribution to its own market is 21.046%. Egypt's contribution to China's stock market is 5.907%, India 6.022%, Brazil 6.228% Russia 8.492%, South Africa 6.693% South Korea 4.624%, Mexico 7.046%, Indonesia 7.778%, Iran 8.582%, Pakistan 7.37% and Turkey 6.677%. Egypt's total contributions to other markets is 75.419% While other countries contribute 78.954% to Egypt's market, Egypt's contribution including own is 96.466%.

Indonesia's contribution to its own market is 18.968%. Indonesia contribution to China's stock market is 10.074%, India 6.613%, Brazil 6.647%, Russia 7.713%, South Africa 8.996%, South Korea 5.552%, Mexico 8.865%, Egypt 8.863%, Iran 6.525%, Pakistan 7.54% and Turkey 9.736%. Indonesia's total contributions to other markets is 87.123% While other countries contribute 81.032% to Indonesia market, Indonesia's contribution including own is 106.091%.

Iran's contributions to its own market is 27.072%. Iran's contribution to the

China's stock market is 4.435%, India 5.255%, Brazil 3.204%, Russia 4.926%, South Africa 6.399%, South Korea 3.458%, Mexico 4.809%, Egypt 6.985%, Indonesia 4.998%, Pakistan 5.701% and Turkey 6.698%. Iran's total contributions to other markets is 56.87% While other countries contribute 72.928% to Iran's market, Iran's contribution including own is 83.942%.

Pakistan's contribution to its own market is 20.853%. Pakistan contribution to China's stock market is 6.19%, India 5.489%, Brazil 6.877%, Russia 6.73%, South Africa 8.026%, South Korea 5.065%, Mexico 8.254%, Egypt 7.608%, Indonesia 6.842%, Iran 7.289% and Turkey 8.622%. Pakistan total contributions to other markets is 76.99% While other countries contribute 79.147% to Pakistan's market, Pakistan contribution including own is 97.842%.

Turkey's contribution to its own market is 18.115%. Turkey's contribution to China's stock market is 7.856%, India 6.472%, Brazil 5.594%, Russia 8.358%, South Africa 9.854%, South Korea 7.341%, Mexico 9.99%, Egypt 7.925%, Indonesia 10.174%, Iran 9.529% and Pakistan 10.176%. Turkey's total contributions to other markets is 93.269% While other countries contribute 81.885% to Turkey's market, Turkey's contribution including own is 111.383%. Almost in every country, there is small effect capture due to country own shocks and large effect capture due to others countries shocks it means that one country risk affect others countries stock market. Adding the entries in the contributions from others column (or for that matter contribution to others row). We obtain the spillover index 74.619% of the total 1200 points of forecast error variance for all 12 countries is explained by spillovers across markets. The remaining 25.381% of the total forecast error variance is explained by its own shocks rather than spillovers of shocks across markets.

4.4.8 Dynamic Total Connectedness is Expressed in Fig 4.20

Total contribution of China is 89.033%. Total contribution of India is 84.581%, Brazil is 107.685%, Russia is 99.285%, South Africa is 108.21%, South Korea is

104.039%, Mexico is 111.443%, Egypt is 96.466%, Indonesia is 106.091%, Iran is 83.942%, Pakistan is 97.842%, turkey is 111.383%.
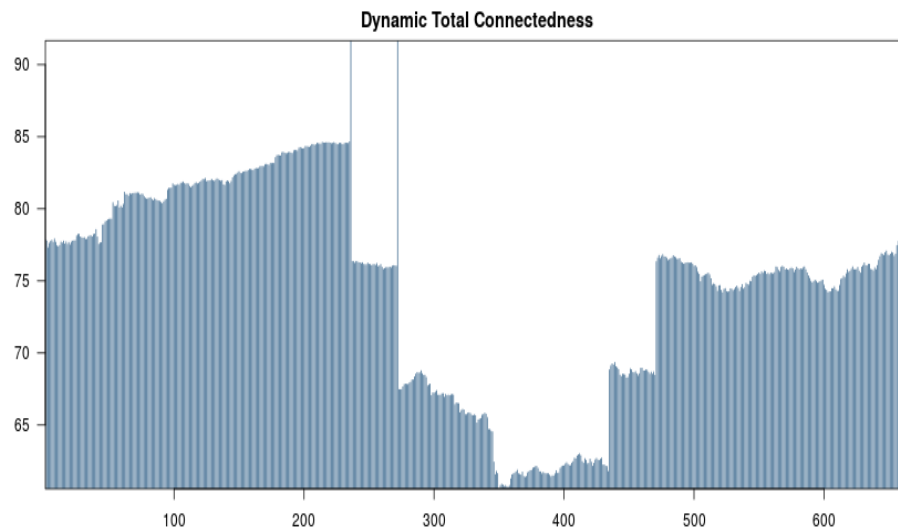

FIGURE 4.20: Dynamic Total Connectedness

Dynamic net spillover is 74.619% and static net spillovers is 62.072% of weekly volatility. There is difference between both values. Dynamic net spillover index of daily volatility is 30.046% and Dynamic net spillover index of weekly volatility is 74.619% is reported.

Chapter 5

Conclusion and Recommendations

5.1   Conclusion

The main focus of this study is to measure the bidirectional mean and volatility spillover among equity markets of selected countries. This study includes twelve conventional equity markets from different part of the world i.e. china, India, brazil, Russia, south Africa, south Korea, Mexico, Egypt, Indonesia, Iran, Pakistan and turkey.

This study employ the methodology proposed by Diebold and Yilmaz (2009, 2012). Who presented a spillover index approach to capture the return and volatility spillover across the equity market. Diebold-Yilmaz Connectedness Index (DYCI) methodology is based on generalized variance decompositions obtained from a VAR model of range volatilities. The VAR model is estimated using the elastic net shrinking and selection procedure, which combines Lasso and Ridge estimators. Daily and weekly data is used from the equity markets of emerging and frontier countries. This study uses sample period of 1-January-2003- 31-December-2019.

In case of daily return, daily return of India is high and daily risk of India is low. In case of weekly return, average return of china is high and average risk of

India is low. On daily basis lowest risk of India is observed and in weekly basis lowest risk of India is observed. In case of daily volatility, average volatility of Russia is high and average variance in volatility of India is low. In case of weekly volatility, average volatility of Egypt is high and average variance in volatility of India is low. In case of daily return, return is generally leptokurtic except Pakistan and returns are positively skewed, auto correlation exists in all series.

In case of weekly return, returns are leptokurtic and negative skewness is observed in Mexico, Egypt, Iran, Pakistan and turkey. In case of daily volatility all volatility series are leptokurtic and positive skewness are observed in all volatility series, auto correlation exists in markets of china, brazil, Russia, Mexico, Egypt, Indonesia, Iran, Pakistan and turkey. In case of weekly volatility all volatility series are leptokurtic except Pakistan and possitive skewness are observed in all volatility series and auto correlation exists in all series.

In case of daily return significant correlation is exist in markets of brazil, Russia, south Africa, Mexico. In case of weekly return there is significant correlation with markets of china, brazil, Russia, south Africa, south Korea, Indonesia and turkey. Russia has significant correlation with markets of south Africa, south Korea, Mexico, Egypt, Indonesia, Iran, Pakistan and turkey. In case of daily volatility significant correlation is exist in markets of brazil, Russia, south Africa, south Korea, Mexico, Indonesia and turkey. Russia has significant relationship with south Africa, south Korea, Mexico, Egypt, Indonesia and turkey.

In case of weekly volatility there is significant correlation with markets of china, Russia, south Africa, Mexico, Egypt and Indonesia, Iran, Pakistan and turkey. South Africa has significant correlation with markets of Mexico, Egypt, Indonesia, Iran, Pakistan and turkey. brazil has no significant correlation with any market.

In case of static connectedness of daily return highest contribution of Mexico to other countries and smallest contribution of India to other countries is reported, contribution of other countries to Mexico is high and contribution of other countries to India is low. Net spillover is 21.146%. In case of static connectedness of weekly return highest contribution of south Korea to other countries and smallest

contribution of India to other countries is observed, contribution of other countries to the South Korea is high and contribution of other countries to India is low. Net spillover is 62.305%.

In case of static connectedness of daily volatility highest contribution of Mexico to other countries and smallest contribution of Iran to other countries is observed, contribution of other countries to south Africa is high and contribution of other countries to Iran is low. Net spillover is 34.401%. In case of static connectedness of weekly volatility highest contribution of Mexico to other countries and smallest contribution of south Korea to other countries is seen. Contribution of other countries to south Africa is high and contribution of other countries to brazil is low. Net spillover is 62.072%.

Over the period of the time economic conditions are not same. New information moves in the market, returns are changed due to cross border investments, national news etc. So time varying effect has also re-estimate through 200 days rolling window. In case of dynamic connectedness of daily return highest contribution of Mexico to other countries and smallest contribution of India to other countries is observed. Contribution of other countries to Mexico is high and contribution of other countries to India is low. Net spillover is 27.656%.

In case of dynamic connectedness of weekly return, highest contribution of brazil to other countries and smallest contribution of India to other countries is observed, contribution of other countries to brazil is high and contribution of other countries to India is low. Net spillover is 55.209%. In case of dynamic connectedness of daily volatility spillover highest contribution of Mexico to other countries and smallest contribution of Iran to other countries is observed.

Contribution of other countries to south Africa is high and contribution of other countries to India is low. Net spillover is 30.046%. In case of dynamic connectedness of weekly volatility spillover highest contribution of Mexico to other countries and smallest contribution of India to other countries is reported, contribution of other countries to Mexico is high and contribution of other countries to south Korea is low. Net spillover is 74.619%.

5.2   Recommendations

The basic objective of this study is to explore bi-directional mean and volatility spillover among equity markets. So connection between these markets contain an important role for the construction of a portfolio, as the benefit of diversification comes from the addition of shocks that arise in one market and reflect in another market with relatively low level of correlation. The overall findings of this study recommend to investors, portfolio managers and risk managers. In case of daily and weekly return diversification benefit exist where markets are less connected and risk professional needs to be careful where markets are more connected. In case of daily and weekly volatility those countries which are more connected high risk is present and in this case those countries which are less connected diversification benefit is present for portfolio manager.

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