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Equity Market Volatility and Portfolio Diversification within and Across Emerging Market and Developed Market

by

Noor-ul-ain

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I want to dedicate this achievement my parents, siblings, teachers and friends who always encourage and support me in every crucial time

CERTIFICATE OF APPROVAL

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Abstract

The objective of this study is to investigate the equity market connectedness and portfolio diversification opportunity within and across emerging and developed markets. The sample is six emerging markets and six developed markets, while the time span is from July 1, 2005 to June 30, 2020. The dynamic conditional correlation model of Engle (2002) and spillover index approach by Diebold and Yilmaz (2009) is used to identify the transmission mechanisms of volatility shocks and the contagion of volatility within and across emerging market and developed market. In emerging countries Pakistan is less connected country while South Africa highly connected country. In developed countries Japan is less connected country while France is highly connected. The spillover is high during global financial crisis of 2007- 2008, 2015 and 2020 which affect whole economy of world. Pakistan show no correlation with any country except India. The finding of the study also indicate low static and dynamic connectedness of China and Pakistan with other markets. China, Pakistan, Japan, and Australia are the countries which are totally receiver of the information and U.K, France, and Germany are disseminator of the information. The study reveals that volatility spillover within and across selected equity markets is not constant over the time. There is an opportunity of portfolio diversification within and across the emerging and developed markets. Effective hedge can be created within various pairs of markets. This study recommended that optimal weights for risk return trade off. This study also provides useful information for investors, fund's managers, risk managers, portfolio managers and policy makers for the construction of portfolio diversification and management of hedge ratio.

Keywords: Equity Markets, Volatility, DCC-GARCH, Vector Autoregression, Connectedness.

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Abbreviations

ADDC	Asymmetric Dynamic Conditional Correlations
ARMA-GARCH	Autoregressive Moving Averages GARCH
Aus	Australia
DCC	Dynamic Conditional Correlations
DYCI	Diebold Yilmaz Connectedness Index
GARCH	Generalized Autoregressive Conditional Heteroscedasticity
Ger	Germany
SA	South Africa
VAR	Vector Autoregressive

Chapter 1

Introduction

The world markets are changing their investment strategies, to manage the risk after the global financial crisis and oil crisis. Investors and fund manager have shifted their investments from emerging to developed markets and vice versa. The main purpose of the study is to understand the volatilities and portfolio diversification within and among emerging markets and developed markets.

1.1 Theoretical Background

Volatility in one market spreads to other markets and continues to persist after one closes, increasing volatility in markets that are geographically distant and open many hours later. The relationship between emerging and mature financial markets has a variety of implications for investment process, but they have become even more important since financial turmoil (Taufiq et al. 2006).

It is obvious that, financial markets provide deep insights in the background of risk management and portfolio diversification. The perception of higher risk arising from large volatilities and their spillovers influences both institutional and individual investment decisions.

Investment portfolios could produce benefits to reduce risk without compromising returns if there exist no volatility spillovers and strong correlation in the equity returns. However, if stock markets move together and there are significant volatility

spillovers then the benefit from spillover is minimum. Portfolio managers would like a greater understanding of how all financial markets work so that they can assess market risk and hedging strategies. Furthermore, unsettle effects of stock market contagion and volatility spillovers are of great interest to economic policy-makers. They are concerned about the smooth functioning of financial markets. As a result, different market players such as policymakers, investors, and customers need a greater understanding of the sources and drivers of volatility across markets.

Stock market volatility and portfolio diversification is one of the most important domain in finance. In recent past that number of studies have been conducted in this domain and it is ongoing debate. The volatility of stock market has always attracted the researcher, academician and analyst. Because all are interested to diversify risk which is one of the prime objectives of portfolio management. Due to globalization in past the link between the markets has strengthen. The news of one market seems to have an effect on other markets, and the uncertainty in one market causes volatility in others. So, things cannot be seen in isolation, therefore, both things get important that countries are interconnected or not, what is the mechanism of transfer of their information and finally what strategies should portfolio manager and risk manager have to adopt to diversify the risk in this situation. Is it possible that only investing in emerging market can diversify the risk or we have to go for broader scale while diversification (emerging and developed market both)? Globally mixed empirical evidence exists. In the financial market there is too much fluctuation. This volatility did not affect only one market of the world. Due to cross broader flours over the period of time markets one connected with each other. In this situation want to manage risk. For this purpose, he goes for investment diversification not only with in the home country also across the country. In this way the investor controls the systematic risk. Investors have transferred some of their investments to countries other than their own, heeding money managers' advice not to place all of eggs in one basket.

Regional patterns are found to have a much greater impact on the BRIC countries' stock return system than global trends. The variation of returns seen across Brazil, Russia, and India is influenced significantly by global index returns, and most

likely by US stock market returns. China is the only country where regional and global volatility spillover effects are negatively correlated. It shows that there is an opportunity of diversification for managers.

The theoretical background of this study is efficient market theory or hypothesis. It refers to the degree to which market prices reflect all available, suitable information. So, investors do not rely in all available information.

There are three forms of efficient market theory which are weak, semi strong and strong form. The weak form says that prices of stocks are predicted on the historical prices, semi strong form says that in the stock prices the publicly available information are reflected already and strong form says that the relevant information while it is public or private is reflected in the stock process.

1.2 Research Gap

The literature on spillovers in international equity markets goes back to the work of (Eun and Shim, 1989), Hamao et al.(1990) and Lin et al.(1994).More recent studies include those of Baur and Jung (2006) and Savva, Osborn, and Gill (2009), among others. Several studies have been performed to determine the mechanism(s) by which stock market changes are transmitting due to the rapid speed of global market integration. The key finding was that, even though stock market correlations have been increasing, investors still have advantage from portfolio diversification by investing in various country equity markets. (Grosvenor & Greenidge, 2010; Kiymaz, 2003; Kumar, 2013; Yavas & Dedi, 2016; Yavas & Rezayat, 2016).

Bhar and Nikolova (2007) analyze volatility spillovers between BRIC stock markets. It indicates that stock market returns in the United States have a significant impact on the variability of returns in India. Brazil, and Russia. China is the only country where there is a negative correlation between regional and global volatility spillover effects.

The investors and fund manager would benefits from portfolio diversification. Therefore, this is the extension of earlier study in which studies are limited only to emerging market or developed while in its countries of emerging market are

exist regionally and globally e.g India, South Africa, Brazil, China, Russia, Pakistan and developed market e.g US, UK, Japan, France, Germany, Australia. This study may be useful for the investors, fund's managers and risk management professionals.

1.3 Research Question

Is there empirical evidence of volatility spillovers within emerging stock markets?

Is there empirical evidence of volatility spillovers within developed stock markets?

Is there empirical evidence of volatility spillovers across emerging and developed stock markets?

What is the magnitude of volatility spillovers across emerging stock markets?

What is the magnitude of volatility spillovers across developed stock markets?

If these markets are interconnected what are choices for portfolio allocation?

How should hedge be created with in these markets?

1.4 Objectives of the Study

- To identify the presence of volatility spillovers within emerging markets.
- To identify the presence of volatility spillovers within Developed markets.
- To identify the presence of volatility spillovers within and across emerging and developed markets.
- To find the magnitude of volatility spillovers across emerging stock markets.
- To find the magnitude of volatility spillovers across developed stock markets.
- To find the choices for portfolio allocation.
- To facilitate resource allocation within and across emerging and developed market through risk optimization.

1.5 Significance of Study

Funds managers are the custodian of others wealth so when investing the funds, they need to create best risk return trade off.

Funds managers have to do resource allocation and portfolio diversification. The investors and fund's managers of emerging markets and developed market consider various factors in making investment decision across the world.

In the market the dissemination of information is continuous. Bad and good news occur in the market as well some unexpected news hit the market. These conditions portfolio managers can do the active portfolio management. They have to do the restructuring of their portfolio therefore it is important to see the impact of markets cycle for restructuring portfolio. Risk manager can also understand how to manage the risk betterly. It helps the investor how they invest and where they have to invest to manage optimize the risk and return trade off.

If the markets are interconnected then to safe the markets the policy makers make instruments and conditions that should be imposed so the market should not influence too much from other markets. The policy maker may introduce the circuit breaker to manage the uncertainty.

1.6 Plan of Study

This thesis comprises of five main chapters. Chapter 1 focuses on primary idea of the topic which includes Introduction, Theoretical Background, Research Gap, Research Questions, Research Objectives and Significance of the study. Chapter 2 reports the findings and outcomes of survey of topic that includes the theoretical and empirical arguments from previous study. Chapter 3 contains the definition of the variables and various methodologies which have been employed for investigation that including DCC GARCH model and spillover index approach. Chapter 4 explains the outcomes from empirical results and explains the finding. Finally chapter 5 summarizes the research outcomes and recommendations are added in this chapter.

Chapter 2

Literature Review

2.1 Emerging Equity Markets with Emerging Equity Markets

A study by Gilmore and McManus (2002) examines long-term and short-term relationships between three markets of Central European and the United States stock market. The study examines weekly closing indices for the United States, Polish, Hungarian, and Czech stock markets, for the time period covering July 1, 1995, through Aug 1, 2001. The study identifies that there is benefit from diversifying into the Czech, Hungarian, and Polish for United States invertor. These markets show no co-integration with the United States market. Central European markets have relatively low correlations of returns with the United States. Both United States and Central Europe are not dependent on the investment perspective. So it gives diversification advantage for the investors in the long-term and short-term both.

Jong and De Roon (2001) examines time-varying market integration and expected returns in thirty developing countries that are grouped into four regions: the Middle East and Africa (6), Latin America (7), Asia and the Far East (10), and Europe (7) by applying the GARCH model for the time period Jan 1988 to May 2000. The findings of the study conclude that no symmetric relation finds in it and the level of segmentation is often significantly relevant to volatility in the

emerging market. There is significant time variance in the betas compared to the world portfolio due to the high degree of segmentation.

Beirne, Caporale, Ghattas, and Spagnolo (2008) uses trivariate GARCH-BEKK models capturing returns in local developing markets, regional developing markets, and developed markets for all of the 41 developing market economies in the sample. The likelihood-ratio test is use to find the presence of spillover. The study investigates volatility spillovers from developed to developing stock markets and tests for changes in the transmission mechanism contagion during turbulences in developed markets. The result shows that the volatility in a mature market influence the volatility in the local emerging stock market. During episodes of turbulence, there are limited conditional correlations between mature and emerging stock markets.

Johansson and Ljungwall, (2009) investigate the connections among the different stock markets in the greater china region (Taiwan, hong kong, and China). A multi-variate general autoregressive conditional heteroscedasticity (MVGARCH) model is applied. The time period for the sample is from January 5, 1994, to December 31, 2005. The result indicates that short-run spillover effects in both returns and volatility in the region. Mean spillover of Taiwan effects both China and Hong Kong. There is an effect of volatility spills over the Hong Kong stock market into the Taiwan stock market. Due to which the affects of volatility turns in the mainland china market. It means that the mainland china market is related to other markets, even though there is limited investments possibility for the outside investor. Within the three markets of the Greater China region, there is significant interdependency.

Beirne, Caporale, Ghattas, and Spagnolo, (2013) examine the period 1993 to 2008, the study looks at volatility spillovers from developed to developing stock markets. During the turbulence in developed markets, it looks for improvements in the transmission process. As well as the implications for conditional correlations between developed and developing market returns. By using Tri-variate GARCH-BEKK models returns in developed, regional emerging, and local emerging markets are estimated for 41 emerging market economies (EMEs) across four geographical regions: asia, emerging europe, south africa, latin america, the middle east, and

north africa. According to the study, the conditional variances of many emerging markets are affected by mature market volatility. The effect of spillover shifts during turbulent periods. In the maximum of the emerging market economies sample, at the same time of these segment, conditional correlations between local and mature markets increase. As well as in local markets conditional variances rise, volatility in developed markets rises more, and in the increase of conditional correlation, this shift is the important factor. During turbulence episodes, conditional beta coefficients between developed and developing markets are usually unchanged or lower with a few exceptions.

The effect of volatility spillover between the stock markets of Asian countries, i.e., pakistan, india, sri lanka, china, japan, and hong kong is investigated by Jebran and Iqbal, (2016). The generalized autoregressive conditional heteroskedasticity (GARCH) model is used and the time period is from 4 Jan 1999 to 1 Jan 2014. The result of the study show evidence that between Japan and China there is a significant bidirectional spillover of return and volatility. There is significant bidirectional Volatility transmitted between the equity markets of sri lanka, and hong kong, sri lanka, and china. Stock market volatility transmitted unidirectionally from Pakistan to Sri Lanka, Sri Lanka to Japan, India to China, and Hong Kong to India and Japan.

A study (Roni, Abbas & Wang, 2018) examines interdependence across the six Asian emerging countries and the extent of contagion. The time period in the study is from Jan 2002 to December 2016 and the GARCH (generalized autoregressive conditional heteroscedasticity) and VAR (vector autoregression) models are used. The results show very different behavior of volatility and return spillovers during different periods, like pre-crisis, and post-crisis periods. Before the global financial crisis period, Asian emerging stock markets show less interaction. Within the global financial crisis 2007-2008, the return and volatility spillover indices reach their highest level, however the Bangladeshi market experience this condition in 2009-2010.

Panda, (2018) examines the spillovers among stock markets for Brazil, Russia, India, China, and South Africa (BRICS). The time period for the study is June 26, 2002, to July 31, 2014, and the exponential generalised autoregressive conditional

heteroskedasticity (EGARCH) model is employed. The findings of the result show that the existence of bidirectional and unidirectional return spillover. The impact of negative news is extra on the volatility of these stock markets. There is no economic value of diversification does from india, russia, and brazil stock markets to the chinese stock market. The result also indicates that the conversion of information from one market to another market help to develop hedge strategies. There are diversification chances and captures the efficiency of the market.

A study (Hung, 2019) investigate the effects of daily returns and volatility spillover in common stock prices between China and four countries in South East Asia are vietnam, thailand, singapore, and malaysia. By using a vector autoregression with a bivariate GARCH BEKK model and the study time period includes the pre-and post-2008 Global Financial Crisis. The results show a significant impact of the volatility of the chinese market on the other markets in the data sample. During and after the global financial crisis, the linkage between china and other markets seems to be exceptional in terms of stock returns. Notably, the findings reveal that the financial markets are more deeply entangled in the crisis.

2.2 Developed Equity Markets with Developed Equity Markets

Oh and Cha, (2000) uses a VAR model with a proper control for heteroscedasticity and investigates the relationships between the two largest equity markets in the world US, and Japan and the four asian emerging equity markets: Taiwan, Singapore, korea, and Hong Kong. The time period of the study is Jan 4, 1980, to Sep 18, 1998. The result shows there is a significant impact on the Singapore and Hong Kong equity markets of the US equity market, though U.S. influence on the korean and the Taiwan equity markets is unchanged. There is not too much impact of the Japanese equity market on the four asian emerging equity markets until the financial crisis of Asia. On the asian emerging equity markets the impact of both developed markets has dramatically increased since the outbreak of the financial crisis.

Another study (Hsin, 2004) investigates the co-movements in stock indices among major Asia-Pacific, European, and American developed markets, by using the aggregate shock model and AR (1)-GARCH (1, 1)-the in-mean model for the daily observations from Jan 1990 to Dec 2002 that cover the 1997 Asian financial crisis. The study finds that among these major world markets there are significant international transmission effects, in terms of both returns and volatility, mostly in a positive direction. The US has the leading market. Therefore it has the most persistent and significant impact on all markets across continents. The US market has a different relationship to European markets. It is not like the relationship of Asian markets to European markets. The UK, France, and Germany have a strong linkage with each other. Other well-connected areas are Australia, Singapore, Hong Kong, and Japan. The United Kingdom, Canada, and the United States are the three markets that continue to have contagion effects on countries outside of their region, and Japanese market volatility became more contagious to other markets during the Asian financial crisis.

A study by Savva, Osborn, and Gill, (2004) investigates the transmission mechanism of price and volatility spillovers across the new york, london, frankfurt, and paris stock markets. The multivariate EGARCH model is employed to study the period of Dec 3, 1990, to Aug 6, 2004. The research shows that for the whole period after the introduction of EURO for London and Frankfurt the behaviour of foreign markets are influenced the domestic stock prices and volatilities. The news on other markets influenced the volatility and respond asymmetrically. The bad news has more impact than the good news. After the launch of EURO the correlations of returns have expended for all markets, Paris and Frankfurt experiencing the largest increase.

Another study (Baele, 2005) investigates at what level globalization and regional integration lead to increasing equity market interdependence by using the regime-switching model for European Union and US market to 13 local european equity markets includes eight european monetary union countries (Spain, belgium, Italy, Ireland, france, germany, the netherlands, and austria), three european union countries that do not participate in the European Monetary Union countries (Sweden, U.K, and Denmark), two countries from outside the European Union

(Switzerland and Norway). The sample time period is from Jan 1980 to Aug 2001, for 1,130 observations. The intensity of shock spillovers from the european union and the U.S increased significantly in the 1980s and 1990s, though the increase is much pronounced for European Union spillovers. In the second half of the 1980s, the intensity of shock spillovers increased most strongly, as well as increased more strongly in the first half of the 1990s. Throughout the periods of the high volatility of world markets, trade integration, stock market growth, and low inflation all lead to an increase in European Union shock spillover intensity and contagion from the United States market to several local European equity markets. In European stock markets, the United States tends to be the dominant power as a proxy for the global economy.

Baur and Jung, (2006) investigate that the contemporaneous correlation and the spillover effects between the German and the United States stock markets around the opening of the two markets like Deutsche Aktienindex and the Dow Jones Industrial average respectively. The popular aggregate-shock model are applied and the study sample period is from Jan 2, 1998, to Dec 29, 2000. The result indicates that there is no evidence of spillovers for both the US and the German market.

Bhar and Nikolova, (2007) examine the degree of integration of the BRIC countries on a regional and global basis, by using daily equity index level data. The study uses a two-stage GARCH-in-mean approach (GARCH-M). The data samples are from the daily closing stock market indices for China, brazil, russia, india, morgan stanley's all countries world index, financial times all countries europe index, financial times all countries asia-pacific index and financial times all countries americas index, for the period between Jan 1995 and Dec 2004. The results show that the world has an influence on the conditional mean returns and the volatility of the BRIC countries. The world has a positive effect of mean spillover on all BRIC countries. The volatility spillover effects are positive for India, Brazil, and Russia. But there is a negative and significant effect of volatility spillover for China. In terms of equity price creation, it suggests that all BRIC countries are regionally integrated. . It is concluded that for all BRIC countries regional trends have larger influence than the world in the equity price generating process.

Another study (Diebold & Yilmaz, 2010) examines the broad stock market returns from Jan 1, 1992, to Oct 10. 2008 in Mexico, Chile, Argentina and Brazil. This study uses Diebold-Yilmaz (2009) spillover index to assess equity return and volatility spillovers in the Americas. The results of this analysis indicate that the dynamics of return spillovers and volatility spillovers diverge dramatically. Return spillovers have slowly changing cycles with no spikes, while volatility spillovers have clear bursts that closely correlate to economic events.

Dedi and Yavas, (2016) investigate that linkages among equity market returns and volatility spillover investigate that linkages among equity market returns and volatility spillovers in the following countries: turkey, germany, U.K, russia and china, and MARMA, GARCH, GARCH-in-mean, and exponential GARCH (EGARCH) are employed in this study and the time period of the study is from Mar 31, 2011, to Mar 11, 2016. The findings of the study are that there are significant co-movements of returns among the countries in the sample. ETF returns in Russia, germany, and the UK affect returns in all of the other sample countries. Russia and Turkey have the highest volatilities are exhibited by Turkey and Russia, while the Chinese and the UK markets have the lowest volatilities.

The return and volatility linkages among the Moroccan stock market and that of the USA and three european countries like the UK, france, and germany, before and during the financial crisis is investigated by Ghini & Saidi,(2017). In this study bivariate VAR-BEKK GARCH model is applied and the sample period is from January 2002 to December 2012. The results of the study show that the return and volatility spillover effects between the moroccan market and the other considered markets. Before and after the global financial crisis, the empirical findings show varying degrees of interdependence and spillover effects between the four main stock markets and the moroccan developing stock market.

Another study by Bheenick, Brooks, Chi, & Do, (2017), examines the stock market volatility spillover between three closely related countries, Australia, the U.S, and China the study time period is from July 2007 to May 2016. The finding of the study is one-way volatility spillover from the United States to China in the utility industry, financial services, discretionary industrials, and consumer. From the australian to chinese stock markets in energy industries, financial services,

and telecommunications there is insignificant volatility spillover. By removing the effect of the global financial crisis, there is a significant bilateral relationship across all of the industries of all three countries.

Aslam, Ferreira, Mughal, & Beenish, (2021) estimates the volatility spillover among twelve european stock markets representing all four regions of europe. The data consists of 10,990 intraday observations from Dec 2, 2019, to May 29, 2020, and the methodology proposed by Diebold and Yilmaz, (2009). According to the findings, spillovers contribute to 77.80% of intraday volatility forecast error variance in twelve european markets. The stock markets of Sweden and the Netherlands have the highest gross directional volatility spillovers, while the stock markets of Poland and Ireland have the lowest spillovers to other stock markets. The net directional volatility spillovers from German and Dutch markets, on the other hand, are the largest. When the entire sample is divide into pre and post-pandemic declaration (11 March 2020), the latter shows more stable spillovers.

2.3 Developed Equity Markets with Emerging Developed Equity Markets

Chaa and Oh, (2000) finds that the links between the developed markets and the Asian developing markets began to increase after the stock market crash in October 1987, and have significantly intensified since the outbreak of the Asian financial crisis in July 1997. In this study, a tri-variate vector autoregression (VAR) model is applied and the sample period is from Jan 4, 1980, to Sep 18, 1998.

A study (Miyakoshi, 2003) examines the magnitude of return and volatility spillovers from the US and Japan to seven Asian equity markets. This study uses the indices of the US, Japan from the developed markets and Hong Kong, Taiwan, Indonesia, Singapore, Thailand, and Malaysia from the emerging equity markets of Asia. The bivariate EGARCH model is employed and the time period of the sample is from Jan 1, 1998, to Apr 30, 2000. The findings show that only the dominance of the United States has an effect on Asian market returns; Japan has no impact. The Japanese market has a larger influence on Asian market volatility

than the US market, and volatility from the Asian market has a negative impact on the Japanese market.

Another study (Bala & Premaratne, 2004) investigate volatility co-movement between the singapore stock market and the markets of Japan, the US, Hong Kong, and the UK. By using daily returns from 1992 to 2002 and Univariate GARCH, and Asymmetric Multivariate GARCH model is used. The findings indicate that there is a high degree of volatility co-movement between the financial markets of Singapore, the United Kingdom, the U.S, Hong Kong, and Japan. The results express that there is a slight but substantial volatility spillover from Singapore into the US Japan, and Hong Kong markets. It's possible that uncertainty from the smaller market will spread to the larger market.

Worthington and Higgs, (2004) investigate the transmission of equity returns and volatility among Asian equity markets and investigates the differences that exist in this regard between the developed and developing markets. Multivariate generalized autoregressive conditional heteroskedasticity (MGARCH) model is employed in the study and the time period of the study is from Jan 15, 1988, to Oct 6, 2000, for three developed markets are Singapore, Japan, and Hong Kong, and six emerging markets are Thailand, Indonesia, Malaysia, Korea, the Philippines, and Taiwan. The study found that all Asian equity markets are highly integrated, and mean spillovers from developed to emerging markets are not uniform, implying that some markets may be more useful in forecasting emerging market equity returns than others. For all markets, but especially for emerging markets, own volatility spillovers are generally higher than cross-volatility spillovers. It suggests that, at least in the Asian context, exchanges in volatility in developed markets are relatively less significant than exchanges in volatility in developing markets.

A study by Vo and Daly, (2005) examine correlation, causality, and cointegration analysis to describe the behaviour of the stock market indices of hong kong, japan, korea, taiwan, indonesia, malaysia, philippines, singapore, thailand, and the advanced stock markets of Australia, Germany, U.K, and the U.S over the period pre and post the 1997 Asian Financial Crises. The results indicate that between 1993 and 1997, a period before the Asian financial crash there is mixed evidence of cointegration ties between the US equity market and Asian markets. Furthermore,

there appears to be no proof of co-integration between Asian, US, and Australian markets during the period 1998-2003.

For the US or Australian investors considering investing in Asian financial markets, the findings have significant consequences for long-term diversification returns. Firstly, the Asian markets do not share a similar stochastic pattern with either the US or Australian stock markets, showing that long-term investors benefit from diversification. This effect is especially strong during the post-Asian financial crisis period. Secondly, the rapid speed of global financial integration suggests that equity return correlations are continuing to rise, implying that this study must be taken into account when making asset allocation decisions in the future.

Another study (Yılmaz, 2009) investigates the return and volatility spillovers among the East Asian equity markets like hong kong, indonesia, japan, S. korea, malaysia, philippines, singapore, taiwan, thailand, and australia from January 1, 1992, through April 30, 2009. The study finds that there is a large difference between the behavior of return and volatility spillover indices of East Asia over time. The return spillover index reveals increased integration among the East Asian equity markets. During market crises, such as the East Asian crisis, the volatility spillover index experiences significant bursts. Both return and volatility spillover indices reached their respective peaks during the global financial crisis of 2008-2009.

Another study (Beirne, Caporale, Ghattas, & Spagnolo, 2009) examines the global and regional spillovers for 41 emerging markets in the Middle East, Asia, Latin America, and Europe. The tri-variate VAR-GARCH-in-mean model is use and the study period from 1 Sep 1993 to 12 Mar 2008. The study reveals that spillovers from regional and global markets are present in most emerging market economies. The nature of cross-market linkages varies across countries and regions. In emerging asia and latin america, mean return spillovers dominate, while variance spillovers tend to be significant in emerging Europe. Cross-market GARCH-in-mean effects are present. Regional and global spillovers have varying degrees of significance. The global spillovers predominating in Asia while regional spillovers predominating in the Middle East and Latin America.

A study (Singh, Kumar, & Pandey, 2009) investigate price and volatility spillovers across Asian, North american, and European stock markets. The VAR and AR-GARCH model is used and the study time period is from Jan 1, 2000, to Feb 22, 2008. The findings indicate that most Asian indices are influenced by lagged returns of US and European indices. Return spillover occurs from the US market to Korean and Japanese markets, to Taiwan and Singapore markets, to Hong Kong markets, to european markets, to the US market, and so on. However, some asian markets, such as Hong Kong, Singapore, Japanese, and Korean markets, have greater influence than others. Hong Kong, Singapore, Japanese, Korean, and United States markets all have a major influence on European markets. There is also a high connection between European countries. Both the Asian and European markets have an effect on the US economy.

A bivariate Weibull CARR (BWCARR) model to investigate the range-based volatility spillover is used by (Lee, 2010). The data set consists of daily high and low price stock market indices for the Hang Seng index, S&P 500 index, Shanghai composite index, Nikkei 225 index, Shenzhen composite index, and Taiwan stock weighted index (hereafter, SP500, NK225, SHC, SZC, HIS, and TWI) and the sample time period is from Jan 1, 1998, to July 31, 2009. The analysis shows that a conditional autoregressive range relationship exists between the Hong Kong, US, mainland China, Japan, and Taiwan stock markets. The US and Japanese stock market range-based volatility has an effect on Taiwan, meaning that there is a range-based global and regional stock market spillover effect on the taiwanese stock market.

A study (Wang & Wang, 2010) examine stock market linkages between Japan and Greater China and the US in terms of volatility and price spillovers. The GJR–BEKK–GARCH model is used and the study time period is from July 15, 1992, to September 28, 2001. The findings show that volatility spillovers between Greater China markets and developed markets in the US and Japan are higher than price spillovers. The transmission of volatility from the United States and Japan is minimal.

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 notice across the markets.

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.

Another study (Abbas, Shah, & Khan Sabeen, 2013) investigates the presence of volatility transmission among regional equity markets of Sri Lanka, Pakistan, India, and China, and developed countries, the stock indices of Japan, USA, Singapore, and the UK are considered. The findings indicate that countries of the common region have a long-run relationship. The volatility transmission between friendly countries in various regions with economic relations is seen in developed and Asian countries. The transference of volatility between countries that are on unfriendly terms as well.

Li and Giles (2013) examine the linkages of stock markets across the U.S., Japan, and six Asian developing countries: Thailand, China, the Philippines, Indonesia, India, and Malaysia. The sample period is from Jan 1, 1993, to Dec 31, 2012. In this study volatility spillover is modeled through an asymmetric multivariate GARCH model. The results show a significant unidirectional shock and volatility spillovers from the U.S. market to the Asian and the Japanese developing markets. The volatility spillovers between the US and asian markets are higher and bidirectional during the Asian financial crisis. The linkages between the Japanese and Asian developing markets have become more evident over the last five years. 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.

Santamaria, Gomez-Gonzalez, Melo-Velandia, & Hurtado-Guarin, (2016) uses a DCC-GARCH framework. To find the multivariate relationships of volatility among assets. The study period is from January 2, 2003, to January 27, 2016. The study indicates that Brazil is a net volatility transmitter, whereas Mexico, Colombia, and Chile are net receivers. Between 2008 and 2012, the total spillover index increased significantly, and shock transmission from the U.S to Latin America increased significantly around the Lehman Brothers episode.

Emerging markets have higher returns, but they also have higher volatility, and the risk-return tradeoff is much higher than in established stock markets. The developed markets have low returns and lower risk-return tradeoffs, as well as a strong positive correlation between them, while the emerging and developed markets have a relatively insignificant correlation. There is significant evidence of ARCH and GARCH effects for all the developed and emerging stock markets (Ahme, Vveinhardt, Streimikiene, Ghauri, & Ashrad, 2017), the methodology used in this study is ARCH and GARCH based model. The time period selected for this study is from January 1, 2000, to June 30, 2016. The data is selected from seven emerging market indices Pakistan., Brazil, Malaysia, China, South Korea, India, and Indonesia. Five developed equity markets are United States, Germany, Japan, and Hong Kong, and have been selected for this research.

Bhowmik and Wang, (2018) examines correlations in stock returns and, especially, volatility linkages between six major emerging Asian (e.g., India, China, Bangladesh, South Korea, Philippines, and Malaysia) stock markets and four mature (e.g., Japan, United Kingdom, United States, and Singapore) stock markets. The Generalized Autoregressive Conditional Heteroskedastic (GARCH) family models and the Vector Autoregressive (VAR) model are used and the sample time period is from Jan 2, 2007, to Dec 30, 2016. The findings indicate that both

the returns and volatility linkages exist between emerging asia and the developed stock markets. From the causality test, it is found that both returns and return variances linkages exist between the emerging Asian and selected developed countries. Nevertheless, the U.S influences the other countries most on both the mean and variance. In addition, the volatilities to unexpected shocks in various markets especially, come from neighboring country markets and more developed country markets.

Uludag and Khurshid, (2019) investigate volatility spillover from the Chinese stock market to E7 and G7stock markets by using the VAR-GARCH model. The sample time period is from Sep 1, 1995, to Mar 3, 2015. The results of the study show that there is a significant volatility spillover from the chinese stock market to E7 and G7 stock markets

A study (Saliba, 2020) examines the level of interdependence across stock market returns, namely, US, EU, and Asia in terms of return and volatility spillover and evaluate the impact of news announcements on their stock market volatility. GARCH model is employed in the study. The results show that news announcements significantly affect stock market returns in the US and Asia and news announcements affect the transmission of volatility between US and Asian stock markets. No volatility spillover is present between the EU and US when news came into the market. There is also significant evidence of bidirectional volatility transmission between US and Asia stock market returns and between EU and Asia stock market returns. In all stock returns, negative shocks have more impact than positive shocks.

Another study (Yousaf, Ali, & Wong, 2020) examines the return-and-volatility spillover between the world top markets of China, and the USA four developing Latin American stock markets over the global financial crisis of 2008 and the crash of the Chinese stock market of 2015. A vector autoregression (VAR) and a multivariate BEKK-GARCH model are use and sample time period Jan 1, 2000, to May 29, 2020. The result shows a unidirectional return transmission from Mexico to the US stock market during the global financial crisis. The return spillover from the US to Brazil, Chile, Mexico, and Peru is found to be unidirectional during the Chinese stock market crash. Furthermore, the findings show an exclusive

return transmission from China to the capital markets of Peru, Brazil, Mexico, and Chile during the global financial crisis and the Chinese stock market crash. The findings show bidirectional volatility transmission between the US and the capital markets of Chile and Mexico during the global financial crisis in terms of volatility spillover. The bidirectional volatility transmission between the US and Mexican stock markets present during the Chinese crash. Moreover, during the global financial crisis, the volatility spillover from China to the Brazilian stock market is unidirectional. The volatility spillover between the Chinese and Brazilian stock markets is bidirectional during the Chinese crash.

Chapter 3

Research Methodology

3.1 Data Description

This study examines time varying correlation and spillover within and across emerging market and developed market to facilitate the investors and fund manager to get insight about the possible benefits from portfolio diversification. The emerging markets are represented by China, Pakistan, Brazil, Russia, South Africa and India. The developed markets are represented by US, UK, Japan, France, Germany and Australia. This study examines the emerging market, developed market and both of them collectively. Table 3.1 presents the names and time periods of indices studied. The time period are selected on the basis of availability of data.

This study has three streams; the first stream is emerging markets with emerging market. The second stream is developed markets with developed market. The third stream is within and across emerging markets and developed market.

The returns are calculated from the indices of emerging market and developed markets. The returns are measured by computing the difference of natural log of the daily closing prices through following equations:

$$R_t = Ln(X_t/x_{t-1}) \tag{3.1}$$

To find the returns of emerging market indices and developed market indices closing prices of indices are used above.

Where R_t is the return of indices of emerging market or developed markets, Ln is natural log, X_t is the markets price of day t and divided it on Xt which is of market price of day 't -1'.

Table 3.1: Details of Sample

S. No	**Countries**	**Symbol**	**Time Period**
1	Brazil	Bovespa (BVSP)	July 1, 2005 to June 30, 2020
2	Russia	MOEX Russia (IMOEX)	July 1, 2005 to June 30, 2020
3	India	BSE Sensex 30 (BSESN)	July 1, 2005 to June 30, 2020
4	China	Shanghai Composite (SSEC)	July 1, 2005 to June 30, 2020
5	South Africa	Top 40 (JTOPI)	July 1, 2005 to June 30, 2020
6	Pakistan	Karachi 100 (KSE)	July 1, 2005 to June 30, 2020
7	U.S	Dow Jones Industrial Average (DJI)	July 1, 2005 to June 30, 2020
8	U.K	FTSE 100 (FTSE)	July 1, 2005 to June 30, 2020
9	Japan	Nikkei 225 (N225)	July 1, 2005 to June 30, 2020
10	France	CAC 40 (FCHI)	July 1, 2005 to June 30, 2020
11	Germany	DAX (GDAXI)	July 1, 2005 to June 30, 2020
12	Australia	ATX (ATX)	July 1, 2005 to June 30, 2020

3.2 Econometric Model

3.2.1 Time-Varying Conditional Correlation - DCC and ADCC

DCC approach is used for time varying Dynamic Conditional Correlation between the volatilities in two steps. The main target of this model is to capture asymmetries in terms of negative (or 'bad news') and positive shocks (or 'good news'). The DCC model is estimated using a two-step procedure. In the first step, the individual conditional variances are specified as univariate GARCH processes and in the second step the standardized residuals from the first step are used to construct the conditional correlation matrix.

To examine the time-varying correlations in the volatilities of each of the equity market of emerging market and developed market, this study employ the DCC model proposed by Engle (2002) which is defined as:

$$r_t = \mu_t(\theta) + e_{\,t,} \;\; where \;\; \varepsilon_t \mid \Omega_{t-1} \sim N(0, U_t) \tag{3.2}$$

$$e \; = U_t \; 1/2 u_{t,} \; where a_t \sim N(0, I) \tag{3.3}$$

$$H_t = D_t R_t D_t \tag{3.4}$$

Where rt = (r_{it},..., r_{Nt})' is a N × 1 vector of volatilities (specifically, the BVSP, IMOEX, BSESN, SSEC, JTOPI, KSE, DJI, FTSE ,N225, FCHI, GDAXI and ATX. $\mu t(\theta)$ = (μyt,..., μNt)' is the conditional 12 × 1 mean vector of rt, Dt = diag($h_{yyt}^{\frac{1}{2}}$,...,($h_{NNt}^{\frac{1}{2}}$)'.

The time-varying conditional correlations defined as:

$$R_t = diag(^{-\frac{1}{2}} q_{yy,t}, ...q_{NN,t}^{-\frac{1}{2}}) Q_t diag(q_{yy,t}^{-\frac{1}{2}}, ...q_{NN,t}^{-\frac{1}{2}}) or \rho_{yz,t} = \frac{qyz,t}{\sqrt{q_{yy.t} q_{zz,t}}} \tag{3.5}$$

Thus Qt = (qyz,t)is a N × N symmetric positive definite matrix given by:

$$Q_t = (1 - \alpha - \beta)\overline{Q} + \alpha\mu_t - 1\acute{a}_{t-1} + \beta Q_{t-1} \tag{3.6}$$

Where ut = (u_{1t},u_{2t}...u_{Nt})0 is the N × 1 vector of standardized residuals, $\bar{Q}$ is the N *times* N unconditional variance matrix of u_t.

$$Q_t = \overline{R} + \sum_{i=1}^{m} \pi_i(\varepsilon_{t-1}\varepsilon_{t-1} - \overline{R}) + \sum_{i-1}^{m} \xi_i(Q_{t-1} - \overline{R}) \tag{3.7}$$

ADCC is defined as.

$$\sigma_t = min(\varepsilon_t, O), \overline{N} = \frac{1}{T}\sum_{t-1}^{T} \sigma_t\acute{\sigma}_t \tag{3.8}$$

1. Asymmetry can be introduced with terms that are zero except when both returns are negative such as:

$$\mu\sigma_i, \sigma_{i,t} \tag{3.9}$$

2. Or more generally (and averaging to zero),

$$G(\sigma_t\acute{\sigma}_t - N) \tag{3.10}$$

3.2.2 Volatility Spillover Index

To study volatility spillovers of equity market of emerging markets and developed markets thus that the generalized version of the spillover index, which is proposed by (Diebold and Yilmaz, 2009). The rolling-window estimation is to find spillover effect of dynamic evolution. The spillover plots is used to illustrated it.

K^{th} order, N variable VAR are used in the start of equation:

$$X_t = \sum_{m=1}^{k} \theta_m X_{t-m} + \varepsilon_t \tag{3.11}$$

Where Xt = (X_{1t}, X_{2t},...,X_{Nt}) is a vector of variables, comprising n = 1, . . . , N (12) observations and θm, m= 1, . . . , M. in which N × N are parameter of matrices. In equation 3.11 $X_t = \sum_{\pi}^{\infty} = 0 A_p \varepsilon_{t-p}$, where the N × N coefficient matrices, in which Ap is defined as: Ap = $\theta 1 A_{p1}$ + θ 2 A_{p-2} +···+$\theta_p A_{pl}, where A_0$ is the N × N identity matrix and $A_p = 0$ for p < 0.

$$\phi_{yz}(U) = \frac{\sigma_{zz}^{-1} \sum_{h=0}^{U-1} (\acute{e}_y A_h \sum_e z)^2}{\sum_{h=0}^{U-1} (\acute{e_y} A_h \sum \acute{A}_{hz}^{e})} \tag{3.12}$$

The own and cross-variable variance contribution shares do not sum to 1 under the generalized decomposition, i.e. $\sum_{z=1}^{N} \Phi_{yz}(U) \neq= 1$ each entry of the variance decomposition matrix is normalized by row sum, such that

$$\phi_{yz}(U) = \frac{\phi_{yz}(U)}{\sum_{z=1}^{U} \phi_{yz}(U)} \tag{3.13}$$

With $\sum_{z=1}^{U} \phi_{yz}(U)$ and by construction $\sum_{z=1}^{U} \tilde{\phi}_{yz}(U) = N$ by construction.

A total spillover index, which is given by the following:

$$TS(U) = \frac{\sum_{y,z=1,y\neq=z}^{N} \tilde{\phi}_{yz}(U)}{\sum_{y,z=1}^{N} \tilde{phi}_{yz}(U)} \times 100 = \frac{\sum_{y,z=1,yz}^{N} \tilde{\phi}_{yz}(U)}{N} \times 100 \tag{3.14}$$

The following are the directional volatility spillovers:

$$DS_{y\leftarrow z}(U) = \frac{\sum_{y,z=1,y\neq=z}^{N} \tilde{\phi}_{yz}(U)}{\sum_{y,z=1}^{N} \tilde{phi}_{yz}(U)} \times 100 = \frac{\sum_{y,z=1,yz}^{N} \tilde{\phi}_{yz}(U)}{N} \times 100 \tag{3.15}$$

Variable y to all other variables z is transmitted by the directional volatility spillovers by as follows:

$$DS_{y\rightarrow z}(U) = \frac{\sum_{y,z=1,y\neq=z}^{N} \tilde{\phi}_{yz}(U)}{\sum_{y,z=1}^{N} \tilde{phi}_{yz}(U)} \times 100 = \frac{\sum_{y,z=1,yz}^{N} \tilde{\phi}_{yz}(U)}{N} \times 100 \tag{3.16}$$

By subtracting equation (3.11) from equation (3.12) the net volatility spillovers from variable y to all other variables z are obtained as follows:

$$NSy(U) = DS_{y\leftarrow z}(U) DS_{y\rightarrow z}(U), \tag{3.17}$$

Finally, the net pairwise volatility spillovers can be calculated as:

$$NPS_{yz}(U) = (\frac{\tilde{\phi}_{yz}(U)}{\sum_{y,r=1}^{N} \tilde{\phi}_{yr}(H)} - \frac{\tilde{\phi}_{yz}(U)}{\sum_{z,r=1}^{N} \tilde{\phi}_{zm}(U)}) \times 100 = (\frac{\tilde{\phi}_{yz}(U) - \tilde{\phi}_{yz}(U)}{N}) \times 100 \tag{3.18}$$

3.2.3 Hedge Ratios and Portfolio Weights

The conditional variance estimates can be used to construct hedge ratios and optimal portfolio weights (Chang et al., 2011; Balcılar et al., 2016; Maghyereh et al., 2017).Specifically, a long position in emerging markets volatilities (denoted as volatility p) can be hedged with a short position in one of the developed markets volatilities (denoted as volatility q). Then, the hedge ratio between emerging markets volatilities p and developed markets volatilities q is:

$$\beta_{pq,t} = h_{pq,t} \setminus h_{pq,t} \tag{3.19}$$

Between p and q the optimal portfolio weights are determined as follows:

$$W_{pq,t} = \frac{hpq,t - h_{pj,t}}{2h_{pp,t} - 2h_{pq,t} + h_{qq,t}} \tag{3.20}$$

$$\begin{cases} 0, \ if \ W_{pq,t} < p \\ W_{pq,t,} \ if \ 0 \leq W_{pq,t} \leq 1 \\ 1, \ if W_{pq,t} > 1 \end{cases} \tag{3.21}$$

Hedging effectiveness is measured as follows:

$$HE = \left[\ \frac{h_{pp,qq} - h_{\beta,w}}{h_{pp,qq}} \ \right] \tag{3.22}$$

Chapter 4

Data Analysis and Discussion

The analysis is done in three sections. First section covers the data characteristics, correlation and spillover with emerging markets. Second section covers developed markets. Finally in section three correlation, spillover and connectedness in static and dynamic setting is conducted within and across emerging and developed markets.

4.1 Spillover between Returns of Emerging Markets

The first step is to examine the behavior of data though descriptive statistics of each return series of the emerging markets and the developed markets. Descriptive statistics includes mean which provide the average of data, median which divide the data set into two equal segments and it is the mid value of data set, standard deviation provides the information that the spread of data from its mean value. Location or portion of data captured by using the skewness and kurtosis produce information about the peakness or flatness of data.

4.1.1 Descriptive Statistics of Emerging Markets Return

Table 4.1 shows the descriptive statistics of Emerging countries which includes Mean, Variance, Skewness Kurtosis and Jarque-Bera. Moreover the spread of data

is also assessed by this Maximum & Minimum.

TABLE 4.1: Descriptive Statistics of Emerging Markets Return

	Brazil	Russia	India	China	South Africa	Pakistan
Mean	0.0003	0.0003	0.0003	0.0002	0.0003	0.0003
Median	0.0000	0.0000	0.0001	0.0001	0.0002	0.0001
Maximum	0.1367	0.2522	0.1633	0.0903	0.0790	0.0825
Minimum	(0.1599)	(0.2065)	(0.139)	(0.0925)	(0.1045)	(0.0710)
Std. Dev.	0.0174	0.0189	0.014	0.0156	0.0132	0.0119
Skewness	(0.4407)	(0.2319)	(0.3152)	(0.6687)	(0.29088)	(0.4758)
Kurtosis	12.8625	27.5932	15.8701	8.187	8.3018	7.0465
Jarque-Bera	15981.76	98622.1	27064.12	4677.233	4636.968	2816.627
Probability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Start from Brazilian market, Average return in Brazilian market is 0.03% maximum return earned in a day is 13.67%, maximum loss in one day is 15.99% and average risk of 1.74%. Skewness is negative and data is leptokurtic because Kurtosis is greater than 3. Finally the Jarque-Bera probability is significant which shows that the data is non normal.

Average return in Russia is 0.03%, maximum return earned in a day is 25.22%, in Russian market investors face 20.65% maximum loss in one day and average risk of Russian market is 1.87%. Average return in Indian market is 0.03%, maximum return earned in a day is 16.33%, maximum loss faced by the investors in one day is 13.90%, and average risk of Indian market is 1.40%. Average return in Chinese market is 0.02% maximum return earned in a day is 9.03%, maximum loss faced by the investors in one day is 9.25% and per day average risk of Chinese market is 1.56%.

Average return in South Africa market is 0.03%, maximum return earned in a day is 7.90%, maximum loss faced by the investors in one day is 10.45% and per day average risk of South Africa market is 1.32%,. In Pakistani market average return

is 0.03%, maximum return earned in a day is 8.25, maximum loss faced by the investors in one day is 7.10%, and average risk in this market is 1.19%.

The indices of all the emerging countries the mean is positive it shows that markets have positive average returns. Highest risk is observed in Russian market .The range of return is also highest in Russian market lays between -20.6% to 25.2%. Skewness of all the emerging countries index is negative. Kurtosis of all variables are greater than 3, that shows presence of peaked and fat tail distribution in the returns of all emerging market index. Finally the Jarque-Bera probability is significant which shows that the data is non normal.

In case of emerging markets, return of Russia is high and risk of Russia is low while Kurtosis is greater than 3 it means returns are leptokurtic and negative skewness is observed. This leads to presence of arbitral opportunities at least in short run.

The returns of each emerging markets are presented graphically in Figure. 4.1 In study, the second step is to see the behavior of data by visualization. Visualization of data helps to check the stationarity and heteroskedasticity of series. Data must be stationary for further spillover analyses.

The graphical behavior of emerging countries, also show mixed pattern in different countries. The graph indicates periods of high return and low return periods as well as highly volatile periods and low volatile periods. Volatility in the returns of Russia is comparatively very low while the Chinese region is highly volatile from rest of emerging countries. Moderate volatility clustering is appears in markets of Brazil, South Africa and Brazil significantly. It also show less volatility in returns of Pakistan. The boom created in Pakistan has been burst at the end of 2008 and the market get freeze. During the period of 2007 -2009 all these emerging countries show high variation it's the time period of credit crises period. Further, in 2020 all these countries show high volatility it's the time period when whole world is facing the pandemic i.e COVID-19. The mean of series above are constant so these are stationary and it shows that heteroskedasticity are present in it. The volatility of these series are not constant, some periods are highly volatile and some are calm periods. When volatility increases or decreases it becomes cluster. So this raw data indicates that GARCH model is applicable in it.

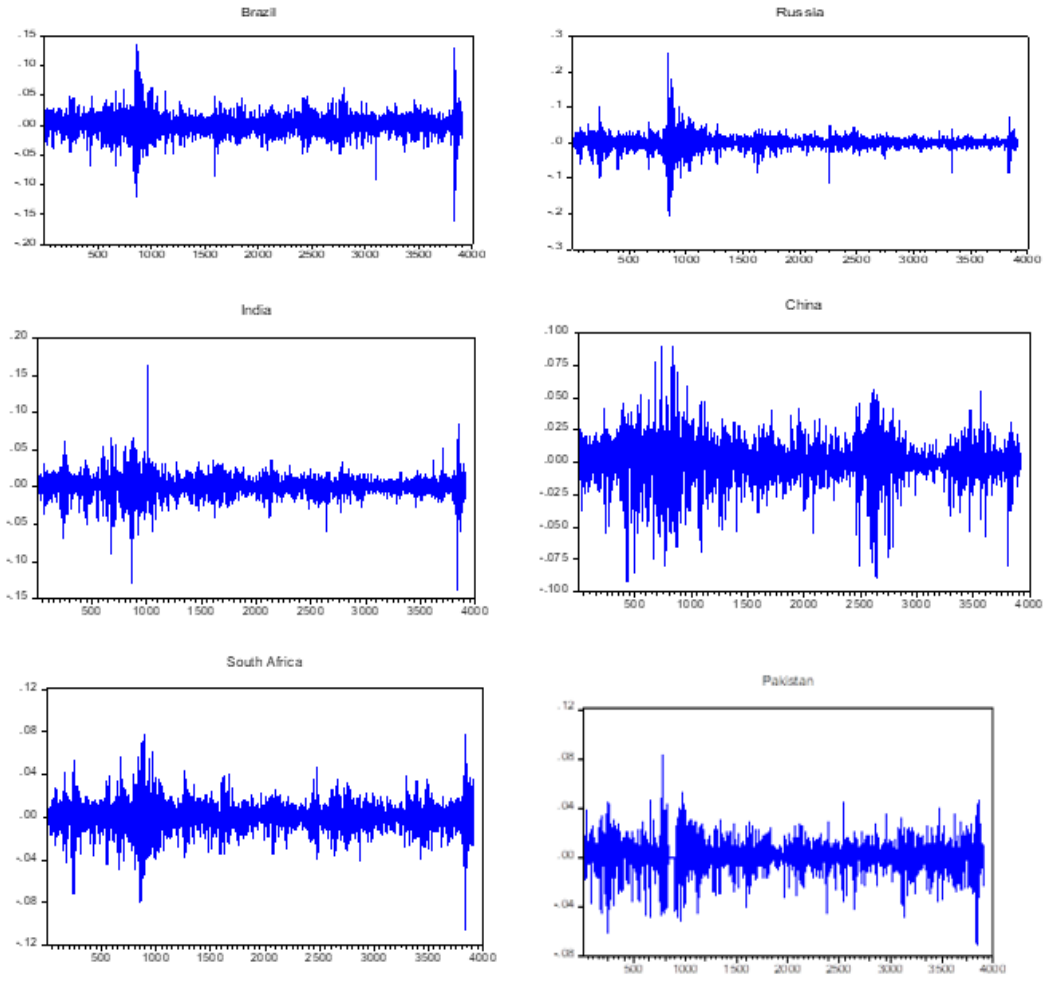

FIGURE 4.1: Graphical Representation of Return series of Emerging Countries

The mean of series above are constant so these are stationary and it shows that heteroskedasticity are present in it. The volatility of these series are not constant, some periods are highly volatile and some are calm periods. When volatility increases or decreases it becomes cluster. So this raw data indicates that GARCH model is applicable in it.

4.1.2 Correlation Analysis of Emerging Markets

Correlation analysis is used to capture the strength of relationship among variables. This tool also deals about the direction of relationship between variables. Correlation analysis among variables may be positive or negative. The ranges of correlation coefficient -1 to +1, in which -1 indicates a perfectly negative correlation also the +1 show a perfect positive correlation and 0 displays no correlation

at all. Low correlation between two variables shows high chances of diversification while high correlations between two variables indicate low chances of diversification.

Table 4.2 exhibits the correlation among sample emerging markets. Brazil has weak significant correlation with Russia, India and China. Brazil has strong significant correlation with South Africa. Russia has weak significant correlation with India and China while strong significant correlation South Africa.India has weak significant correlation with China and Pakistan while strong correlation with South Africa. Pakistan has no significant correlation with any market except India but weak significant correlation.

TABLE 4.2: Correlation Analysis of Emerging Countries

	Brazil	**Russia**	**India**	**China**	**South Africa**	**Pakistan**
Brazil	1					
Russia	0.3724	1				
India	0.3131	0.3549	1			
China	0.1598	0.1559	0.2385	1		
South Africa	0.4421	0.556	0.4489	0.2176	1	
Pakistan	0.0553	0.0293	0.1347	0.0813	0.0918	1

Africa.India has weak significant correlation with China and Pakistan while strong correlation with South Africa. Pakistan has no significant correlation with any market except India but weak significant correlation.

4.1.3 Time-Varying Conditional Correlation – DCC & ADCC

If the correlation is time varying, then Dynamic Condition Correlation DCC model is used in this study. Moreover, the effects of any asymmetry is also captured by

using the extended version of DCC model that is, Asymmetric Dynamic Conditional Correlation ADCC. The first stage of DCC model framework is the fitting of the most appropriate univariate GARCH specifications to each series that best describes the return behavior of the countries. In the table below which contains the chosen specification and parameter values of the best GARCH model for each series based on the Akaike information criterion (AIC). The DCC univariate GARCH models tested include the standard GARCH, GJR-GARCH and the EGARCH.

4.1.4 Time Varying Correlation between Emerging Countries

The parameters measure the impact of past standardized shocks ($\theta 1$) and lagged dynamic conditional correlations ($\theta 2$) respectively on the current dynamic conditional correlations. The table suggests that the conditional correlations all show significant variations over time, as all the bivariate combinations have highly significant $\theta 1$ and $\theta 2$ parameters that are greater than zero.

The necessary condition of $\theta 1 + \theta 2$ ¡1 holds for all country pairs, while the sum of the parameters is close to unity in each case. This suggests that the DCC model is adequate both at measuring time-varying conditional correlations, in that it displays mean reversion along a constant level, and controlling for the high degree of persistence in conditional volatility for all pairs of countries in the study.

$\theta 1$ is significant and $\theta 2$ are significant for the pair of Brazilian equity market with Russian equity market, Brazilian equity market with South African equity market, Russian equity market with Indian equity market, Russian equity market with Chinese equity market, Russia equity market with South Africa equity market, Russia equity market with Pakistani equity market, Indian equity market with South Africa equity market, Indian equity market with Pakistani. Equity market, Chinese equity market with South Africa equity market, South Africa equity market with Pakistani equity market. It shows that past residual shock have present and lagged dynamic condition correlation have also present between these pairs.

Table 4.3: DCC - GARCH Models selection - Emerging Countries

Countries	**Russia Selected Model**	**India Selected Model**	**China Selected Model**	**South Africa Selected Model**	**Pakistan Selected Model**
Brazil	GJR/TARCH	GJR/TARCH	GJR/TARCH	EGARCH	GJR/TARCH
Russia		GJR/TARCH	GJR/TARCH	GJR/TARCH	GJR/TARCH
India			GJR/TARCH	GJR/TARCH	GJR/TARCH
China				GJR/TARCH	GJR/TARCH
South Africa					EGARCH
Pakistan					

This table shows the DCC-GARCH model selected for Emerging Countries on the basis of lowest possible Akaike Information Criteria (AIC).

$\theta 1$ is insignificant and $\theta 2$ is significant for the pair of Brazilian equity market With Indian equity market, Brazilian equity market with Chinese Equity market, Indian equity market with Chinese equity market, Chinese equity market with Pakistani equity market.

TABLE 4.4: Time Varying Correlation between Emerging Countries

Countries	**Russia**		**India**		**China**		**South Africa**		**Pakistan**	
	θ_1	θ_2	θ_1	θ_2	θ_1	θ_2	θ_1	θ_2	θ_1	θ_2
Brazil	0.0328	0.9158	0.0126	0.9245	0.0035	0.8624	0.0068	0.9905	0.0058	0.9734
	(0.0002)	(0.0000)	(0.1032)	(0.0000)	(0.6326)	(0.0001)	(0.0008)	(0.0000)	(0.2277)	(0.0000)
Russia			0.0283	0.9059	0.0181	0.8597	0.0296	0.961	-0.0081	0.7929
			(0.0019)	(0.0000)	(0.0329)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
India					0.0105	0.9645	0.0243	0.9345	0.0278	0.9382
					(0.0703)	(0.0000)	(0.0006)	(0.0000)	(0.0000)	(0.0000)
China							0.0031	0.9952	0.0365	0.7551
							(0.024)	(0.0000)	(0.0688)	(0.0001)
South Africa									0.0076	0.9784
									(0.0212)	(0.0000)
Pakistan										

This table summarizes the estimated coefficients from the DCC-GARCH model in a bivariate framework for all country pairs in the study. The p-values arereported in parenthesis. Theta(1) and Theta(2) are reported above the p-values.

It shows that past residual has no impact on correlation and suggests lagged dynamic condition correlation exists between these pairs.

All the pairs of emerging countries shows mixed behavior. In which pairs of some countries have significant values of both Theta 1 and Theta 2 which means passed residual and lagged dynamic both are find. Some pair of countries have significant values of Theta 1 and insignificant value of Theta 2 which means passed residual are present and lagged dynamic both are not find while some pair of countries have insignificant values of Theta 1 and significant value of Theta 2 which means passed residual are not present and lagged dynamic are present.

4.1.5 ADCC GARCH Model of Emerging Countries with Emerging Countries

Tables 4.5 and 4.6 show the suitable univariate ADCC models and estimates form Emerging countries-to-other Emerging countries. The appropriate model is chosen on the basis of lowest possible Akaike Information Criteria AIC. NA indicates that the dynamic conditional correlation doesn't exists in these specified countries and stability condition is not met. The first two parameters of ADCC GARCH are same as that of DCC GARCH models i.e. the impact of the past residual shocks ($\theta 1$) and lagged dynamic conditional correlation ($\theta 2$). An additional parameter of ($\theta 3$) is used in this model that provides the information about the shocks of positive and negative news on dynamic conditional correlation. Like previous model of DCC, the first condition that is the stability of model is also met in all industries (i.e. $\theta 1 + \theta 2 < 1$). It means, the model is stable. $\theta 3$ is significant and positive that indicates that negative news has significant impact on correlation between Russian and Indian equity market. Russian equity market with South African equity market, Indian equity market with South African equity market. It indicates that correlation has been increased with the effect of negative news. $\theta 3$ is insignificant indicating that no asymmetric effect is present in the Brazilian equity market and Russian equity market, Brazilian equity market and Indian equity market, Brazilian equity market and Chinese equity markets, Brazilian.

Table 4.5: ADCC GARCH Models Between Emerging Countries

Countries	**Russia**	**India**	**China**	**South Africa**	**Pakistan**
	Selected Model	**Selected Model**	**Selected Model**	**Selected Model**	**Selected Model**
Brazil	GJR/TARCH	GJR/TARCH	GJR/TARCH	GJR/TARCH	GJR/TARCH
Russia		GJR/TARCH	GJR/TARCH	GJR/TARCH	GJR/TARCH
India			GJR/TARCH	GJR/TARCH	GJR/TARCH
China				GJR/TARCH	GJR/TARCH
South Africa					EGARCH
Pakistan					

This table shows the ADCC GARCH model selected for Emerging Countries on the basis of lowest AIC. It is interesting to note first that all the series display requiring either GJR-GARCH or EGARCH models to be fitted. Equity market and South African equity market, Brazilian equity market and Pakistani equity market. The series of these pair of countries show no variations with respect to asymmetric effect. In short, any good or bad news arises in market, have some effect on the correlation.

Table 4.6: ADCC - GARCH Estimates Between Emerging Countries

Countries	**Russia**			**India**			**China**			**South Africa**			**Pakistan**		
	θ_l	θ_2	θ_3	θ_l	θ_2	θ_3	θ_l	θ_2	θ_3	θ_l	θ_2	θ_3	θ_l	θ_2	θ_3
Brazil	0.024	0.936	0.005	0.007	0.949	0.006	-0.002	0.949	0.007	0.007	0.090	0.001	0.006	0.973	0.000
	(0.027)	(0.000)	(0.199)	(0.246)	(0.000)	(0.165)	(0.718)	(0.000)	(0.208)	(0.001)	(0.000)	(0.372)	(0.240)	(0.000)	(0.886)
Russia				0.016	0.934	0.007	0.016	0.869	0.002	0.022	0.964	0.006	-0.008	0.783	0.000
				(0.066)	(0.000)	(0.044)	(0.1506)	(0.000)	(0.808)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.986)
India							0.006	0.969	0.006	0.015	0.948	0.007	0.023	0.936	0.008
							(0.081)	(0.000)	(0.071)	(0.008)	(0.000)	(0.009)	(0.001)	(0.000)	(0.165)
China										0.002	0.997	0.001	0.036	0.756	0.000
										(0.074)	(0.000)	(0.193)	(0.115)	(0.000)	(0.981)
South Africa													0.010	0.653	0.026
													(0.449)	(0.002)	(0.116)
Pakistan															

This table summarizes the estimated coefficients from the ADCC-GARCH model in a bivariate framework between Emerging Countries with Emerging Countries. Values in parenthesis are the p-values. Theta (1), Theta (2) and Theta (3) are reported above the p-values.

4.1.6 Static Connectedness of Emerging Countries

To calculate the spillover, the cholesky factorization based variance decomposition is used in this study. **Table 4.7** report the details of Static connectedness of returns of emerging countries. Brazil contribution to its own market is 65.58%, Brazil contribution to Russia is 12.28%, India is 10.04%, China is 4.08%, South Africa is 15.08% and Pakistan is 1.43%. Brazil market has some influence on all other markets. Brazil total contributions to other markets is 42.91% and Brazil contribution including its own market is 108.49%. While other countries contribution is 34.42% to Brazil's market.

Russia contribution to its own market is 61.73%, Russia contribution to Brazil is 10.38%, India is 7.73%, China is 2.59%, South Africa is 16.11% and Pakistan is 1.10%. Russian market has some influence on all other markets. Russia total contributions to other markets is 37.91% and Russia contribution including its own market is 99.64%. While other countries contribution is 38.26% to Russia's market.

India contribution to its own market is 65.87%, India contribution to Brazil is 7.29%, Russia is 7.01%, China is 4.32%, South Africa is 10.08% and Pakistan is 1.67%. Indian market has some influence on all other markets. India total contributions to other markets is 30.38% and India contribution including its own market is 96.25%. While other countries contribution is 34.13% to India's market.

China contribution to its own market is 84.55%, China contribution to Brazil is 1.87%, Russia is 1.19%, India is 3.18%, South Africa is 2.28% and Pakistan is 0.35%. Chinese market has some less influence on all other markets. China total contributions to other markets is 8.88% and China contribution including its own market is 93.43%. While other countries contribution is 15.45% to China's market.

South Africa contribution to its own market is 56.04%, South Africa contribution to Brazil is 14.60%, Russia is 17.75%, India is 12.20%, China is 4.09% and Pakistan is 1.53%. South Africa market has some influence on all other markets. South Africa total contributions to other markets is 50.17% and South Africa contribution including its own market is 106.22%. While other countries contribution is 43.96% to South Africa's market.

TABLE 4.7: Static Connectedness of Emerging Countries

	Brazil	**Russia**	**India**	**China**	**South Africa**	**Pakistan**	**FROM**
Brazil	65.577	10.376	7.291	1.874	14.599	0.283	34.423
Russia	12.284	61.731	7.013	1.194	17.753	0.025	38.269
India	10.043	7.731	65.866	3.181	12.2	0.979	34.134
China	4.079	2.587	4.326	84.547	4.085	0.376	15.453
South Africa	15.075	16.114	10.083	2.282	56.045	0.402	43.955
Pakistan	1.433	1.105	1.668	0.352	1.533	93.908	6.092
Contribution TO others	42.913	37.913	30.382	8.883	50.171	2.065	172.327
Contribution including own	108.49	99.644	96.248	93,429	106.216	95.973	TCI
Net Spillover	8.490	-0.356	-3.752	-6.571	6.216	-4.027	28.721

Pakistan contribution to its own market is 93.91%, Pakistan contribution to Brazil is 0.28%, Russia is 0.025%, India is 0.98%, China is 0.38% and South Africa is 0.40%. Pakistan market has some very low influence on all other markets. Pakistan total contributions to other markets is 2.07% and Pakistan contribution including its own market is 95.97%. While other countries contribution is 6.09% to Pakistan's market From all the above emerging countries contribution to other markets and contribution from other markets of both China and Pakistan are very low. The Contribution of each emerging Market to all other emerging Markets is Presented Graphically as Fig 4.2.

Brazil contribution to other markets is 42.91%, Russia contribution to other markets is 37.91%, India contribution to other markets is 30.38%, China contribution to other markets is 8.88%, South Africa contribution to other markets is 50.17% and Pakistan contribution to other markets is 2.07%. Large amount of contribution from South Africa to other markets while small amount of contribution from China and Pakistan to other markets in term of return spillover is observed. Above graph 4.2 further provide that contribution of market of Brazil, Russia, and India to return of other markets is in higher end, but this spillover is not constant over time. There are periods of high spillover and there are periods of low spillover.

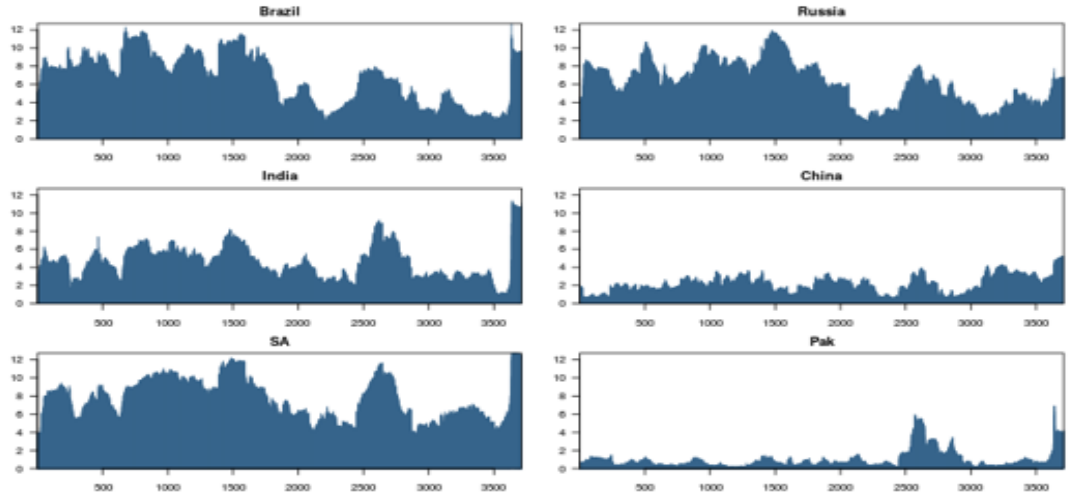

FIGURE 4.2: Contribution of each Emerging Market to all other Emerging Markets

The Contribution of the returns from other emerging markets to each emerging markets is provided graphically in **Fig 4.3**.

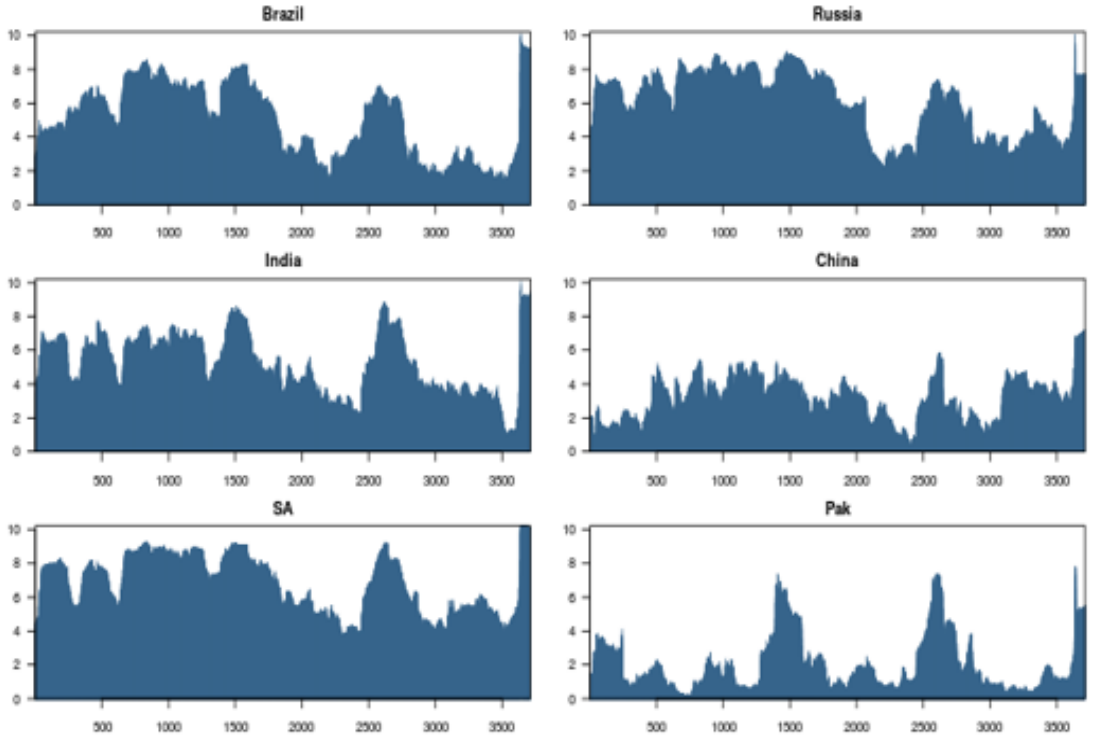

FIGURE 4.3: Contribution of the Returns from other Emerging Markets to each Emerging Markets

Other countries contribution to Brazil is 34.42%, Russia 38.27%, India 34.13%, China 15.45%, South Africa 43.96% and Pakistan 6.09%.Higher contribution from

other countries to South Africa is reported and lower contribution from other countries to China and Pakistan is reported. Generally, Brazil, Russia, South Africa and India are more connection with other markets. Pakistan and China are less connected with other markets. The mean spillover is not constant. The spillover is higher during financial crisis period i.e. 2007-2009, 2015 and 2020.

Contribution from a specific emerging market to other emerging markets and from other emerging market to a specific emerging market is netted off and expressed graphically in **Fig 4.4**.

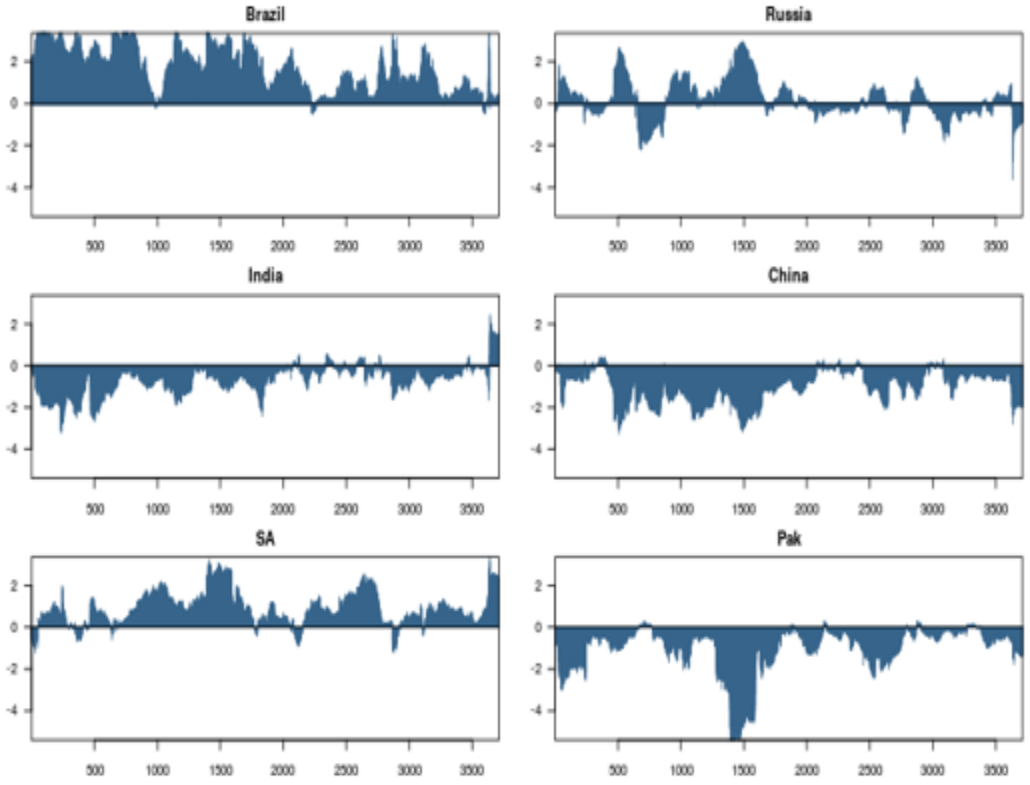

FIGURE 4.4: Contribution from a Specific Emerging Market to other Emerging Markets and Vice Versa is Netted off

The country is net giver (country information affect other countries stock market) if the value if net spillover is positive. If the value of net spillover is negative it means that country is net receiver (other countries information affect country stock market). Net spillover of Brazil is 8.49%, net spillover of Russia is -0.36%, India is -3.57%, China is -6.57%, South Africa is 6.22%, and Pakistan is -4.03%, The graph clearly provide that Russian market is recipient of return spillover in some periods and dissemination of return spillover in other periods. China, India

and Pakistan market is generally recipient of information while Brazil and South Africa market generally disseminate the information to other markets.

4.1.7 Dynamic Connectedness of Emerging Countries

Over the period of the time economic conditions are not same. New information arrives in the market and transmits from the market . The dynamics of returns change due to cross border investments, national news etc. so we should not assume constant average return and constant average volatility. We should consider this time varying effect, for this purpose we calculate average rate of return and re-estimate Spillover through 200 days rolling window. The study uses the Cholesky factorization based variance decompositions to calculate the variance decompositions used in dynamic connectedness table 4.8. This model exposes the order dependence of the variance decompositions.

Brazil contribution to its own market is 70.34%, contribution of Brazil to Russia is 11.1%. Likewise, 8.68% is the contribution of Brazil to India market, Brazil contribution to China is 4.71%, South Africa is 12.29% and Pakistan is 2.86%. Brazil total contributions to other markets is 39.64%, while other countries contribute only 29.57% to Brazil's market, Brazil contribution including its own is 110.08%.

Russia's contribution to its own market is 63.85%, Russia contribution to Brazil market is 9.76%, India 7.19%, China 3.44%, South Africa 14.56%, and Pakistan 2.24%. Russia total contributions to other markets is 37.20%. While other countries contribute 36.15% to Russia's market, Russia contribution including its own is 101.04%. India contribution to its own market is 68.76%. India contribution to Brazil is 5.52%, Russia 6.17%, India 4.05%, South Africa 8.828%, and Pakistan 2.61%. India total contributions to other markets is 27.17% While other countries contribute 31.24% to India market, India contribution including its own is 95.93%.

China contribution to its own market is 80.93%. China contribution to Brazil market is 2.22%, Russia 2.22%, India 3.37%, South Africa 3.73%, and Pakistan 1.32%. China total contributions to other markets is 12.87% While other countries contribute 19.07% to China market, China contribution including its own is 93.80%.

TABLE 4.8: Dynamic Connectedness of Emerging Countries

	Brazil	**Russia**	**India**	**China**	**South Africa**	**Pakistan**	**FROM**
Brazil	70.343	9.761	5.519	2.224	11.097	0.984	29.566
Russia	11.098	63.848	6.166	2.225	15.755	0.908	36.152
India	8.685	7.192	68.758	3.368	10.567	1.430	31.242
China	4.707	3.442	4.051	80.93	5.669	1.201	19.070
South Africa	12.293	14.556	8.828	3.729	59.284	1.309	40.716
Pakistan	2.859	2.245	2.609	1.323	2.902	88.063	11.937
Contribution to others	39.642	37.196	27.173	12.868	45.971	5.832	168.682
Contribution including own	110.076	101.044	95.931	93.798	105.26	93.894	TCI
Net Spillover	10.076	1.044	-4.069	-6.202	5.256	-6.106	28.114

South Africa's contribution to its own market is 59.28%. South Africa's contribution to Brazil market is 11.08%, Russia 15.76%, India 10.57%, China 5.67%, and Pakistan 2.90% South Africa's total contributions to the other markets is 45.97%, While other countries contribute 40.716% to South Africa's market, the South Africa contribution including its own is 105.26%.

Pakistan's contribution to its own market is 71.18%. Pakistan contribution to Brazil market is 4.76%, Russia 0.81%, India 2.9%, China 2.26%, and South Africa 2.76%. Pakistan total contributions to other markets is 26.98% While other countries contribute to Pakistan market is 28.81%, Pakistan contribution including its own is 98.17%. The graphical presentation of dynamic total connectedness is given in Fig 4.5. Country contribution to its own market and country contribution to other markets is equal to total contribution. Total contribution of Brazil is 110.075%, Russia is 101.04%, India is 95.93%, China is 93.80%, South Africa is 105.26%, Pakistan is 93.89%, Dynamic net spillover is 28.11% and static net spillovers is 28.72% of returns of emerging countries.

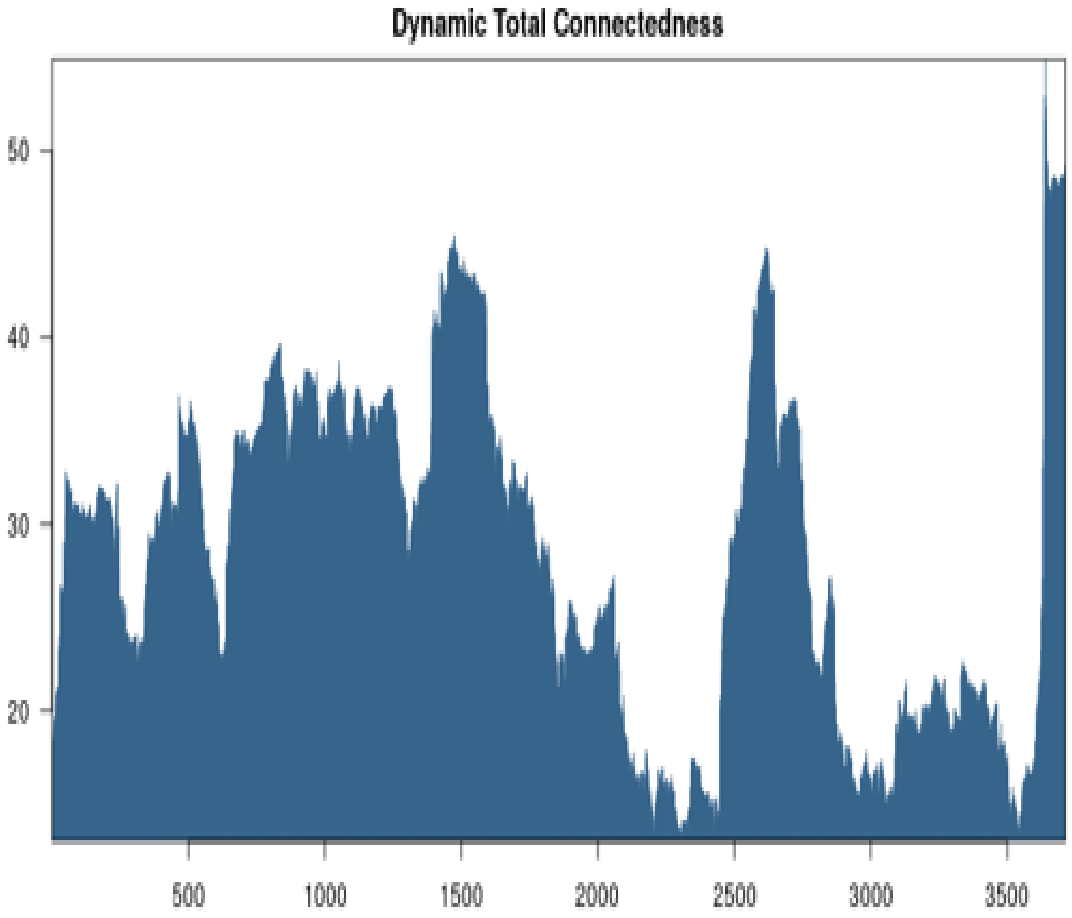

FIGURE 4.5: Graphical Behavior of Dynamic Total Connectedness

4.1.8 Hedge Ratios among Emerging Countries

Hedge Ratio is used to estimate that what portion or percentage is risk protected of your portfolio. If the p-value is above 0.05 then there is no significant Hedge among investments. The hedge strategy is optimal when a short position in Brazil volatility is hedged with a long position in Russia, India, China, South Africa and Pakistan.

The hedge strategy is not better when Russia volatility is hedged with Pakistan, while hedge is preferred when a short position in Russia is hedge with a long position in South Africa. Brazil, China, and India. The hedge is optimal when a short position in India is hedge with a long position in Russia, Brazil, China, and South Africa while hedge strategy is not better when India volatility is hedged with Pakistan.

TABLE 4.9: Hedge Ratio of Emerging Markets Return

	Hedge Efficiency	**p-value**
Russia/Brazil	0.14	0
India/Brazil	0.12	0
China/Brazil	0.07	0.02
South Africa /Brazil	0.2	0
Pakistan /Brazil	0.08	0.01
Brazil/Russia	0.11	0
India/Russia	0.14	0
China/Russia	0.08	0.01
South Africa/Russia	0.35	0
Pakistan/Russia	0.02	0.55
Brazil/India	0.09	0
Russia/India	0.13	0
China/India	0.11	0
South Africa/India	0.22	0
Pakistan/India	0.05	0.12
Brazil/China	0.06	0.05
Russia/China	0.05	0.13
India/China	0.09	0
South Africa/China	0.07	0.02
Pakistan /China	0.05	0.13
Brazil/South Africa	0.14	0
Russia/South Africa	0.31	0
India/South Africa	0.24	0
China/South Africa	0.1	0
Pak/South Africa	0.05	0.09
Brazil/Pakistan	0.05	0.13
Russia/Pakistan	0.03	0.35
India/Pakistan	0.05	0.15
China/Pakistan	0.04	0.19
South Africa/Pakistan	0.05	0.14

The hedge strategy is not better when China volatility is hedged with Pakistan, while hedge is preferred when a short position in China is hedge with a long position in Russia, Brazil, India, and South Africa.

The hedge strategy is not better when South Africa volatility is hedged with Pakistan, while hedge is preferred when a short position in South Africa is hedge

with long position in Russia, Brazil, India, and China.

The hedge strategy is not better when Pakistan volatility is hedged with Russia, Brazil, India, China and South Africa.

4.1.9 Portfolio Weights among Emerging Countries

The portfolio weights strategy **Table 4.10** is able to generate significant gains from risk reduction among emerging countries volatilities.

TABLE 4.10: Portfolio Weights of Emerging Markets Return

	Weights	**p-value**
Brazil/Russia	0.43	0
Brazil/India	0.59	0
Brazil/China	0.62	0
Brazil/South Africa	0.56	0
Brazil/Pakistan	0.78	0
Russia/Brazil	0.49	0
Russia/India	0.6	0
Russia/China	0.66	0
Russia/ South Africa	0.57	0
Russia/Pak	0.8	0
India/Brazil	0.31	0
India/Russia	0.26	0
India/China	0.44	0
India/ South Africa	0.35	0
India/Pakistan	0.64	0
China/Brazil	0.49	0
China/Russia	0.5	0
China/India	0.55	0
China/ South Africa	0.57	0
China/Pakistan	0.72	0
South Africa /Brazil	0.2	0
South Africa /Russia	0.14	0
South Africa /India	0.29	0
South Africa /China	0.42	0
South Africa /Pakistan	0.63	0
Pakistan/Brazil	0.41	0
Pakistan/Russia	0.4	0
Pakistan/India	0.42	0
Pakistan/China	0.43	0
Pakistan/ South Africa	0.46	0

4.2 Spillover between Returns of Developed Markets Return

Table 4.11 shows the descriptive statistics of return of Developed countries. It includes Mean, Variance, Skewness Kurtosis and Jarque-Bera. Moreover the spread of data is also assessed by Maximum & Minimum.

TABLE 4.11: Descriptive Statistics of Developed Markets Return

	U.S	U.K	Japan	France	Germany	Australia
Mean	0.0002	4.79E-05	0.0001	3.71E-05	0.0002	8.24E-05
Median	0.0004	0.0001	0.0000	0.0002	0.0006	0.0002
Maximum	0.1039	0.0938	0.1323	0.1059	0.1079	0.0676
Minimum	(0.1035)	(0.1151)	(0.1211)	(0.1309)	(0.1305)	(0.102)
Std. Dev.	0.0111	0.0117	0.0146	0.0139	0.0136	0.011
Skewness	(0.3193)	(0.4427)	(0.4671)	(0.3120)	(0.2422)	(0.7099)
Kurtosis	15.6438	13.7198	11.4034	11.5513	11.7119	10.9828
Jarque-Bera	26124.6	18859.12	11652.9	11982.98	12409.64	10715.89
Probability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Starting from U.S market, Average return in U.S market is 0.02%, maximum return earned in a day is 10.39%, maximum loss in one day is 10.35% and average risk of 1.11%. Skewness is negative and data is leptokurtic because Kurtosis is greater than 3. Finally the Jarque-Bera probability is significant which shows that the data is non normal.

Maximum return earned by U.K in a day is 9.38%, in U.K market investors face 11.51% maximum loss in one day and average risk of Russian market is 1.17%. Average return in Japan market is 0.01% maximum return earned in a day is 13.23%, maximum loss faced by the investors in one day is 12.11% and average risk of Japanese market is 1.46%. French market earned maximum return in a day is 10.59%, maximum loss faced by the investors in one day is 13.09% and per day average risk of Chinese market is 1.39%.

Average return in German market is 0.02% maximum return earned in a day is 10.79%, maximum loss faced by the investors in one day is 13.05% and per day average risk of German market is 1.36%,. In Australian market maximum return

earned in a day is 6.76% maximum loss faced by the investors in one day is 10.20% and per day average risk in this market is 1.10%.

In case of developed markets returns of Japan is high and risk of France is low. The mean return of all the developed countries is positive it shows that markets have positive average returns. Skewness of all the developed countries index is negative. Kurtosis of all variables are greater than 3, that shows presence of peakedness and fat tail distribution in the returns of all developed market index. Finally the Jarque-Bera probability is significant which shows that the data is non normal.

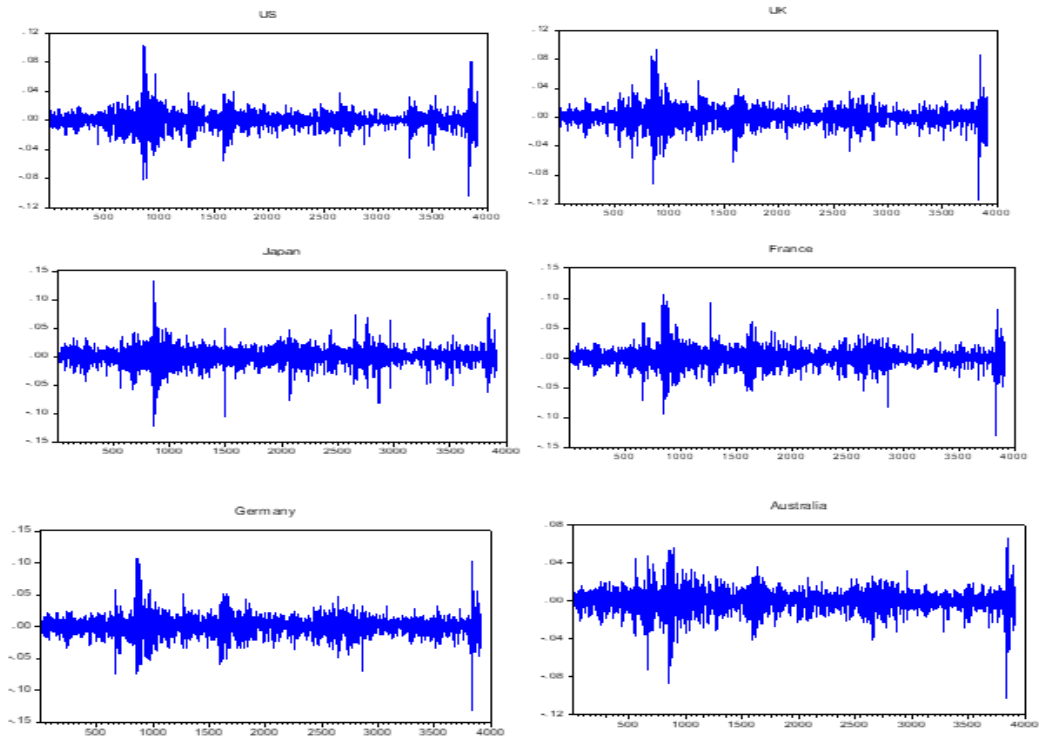

FIGURE 4.6: Return series of Developed Countries

The return of each developed market are presented graphically in Fig 4.6 The graph indicates periods of high return and low return as well as low and high volatile periods. Volatility in the returns of U.S is comparatively very low while the Australian region is highly volatile as compared to rest of developed countries. Moderate volatility clustering appears in markets of Germany, U.K, France, and Japan significantly. During the period of 2007 -2009, all these developed countries show high volatility it's the time period of credit crises. In 2020, all these countries show high volatility it's the time period when whole world is facing the condition

of pandemic. The mean of series above are constant so these are stationary and it shows that heteroskedasticity are present in it. Highest risk is observed in Japanese market .The range of return is also highest in Japanese market lays between -12.1% to 13.2%. The volatility of these series are not constant, some periods are highly volatile and some are calm periods. When volatility increases or decreases it becomes cluster. So this raw data indicates that GARCH model is applicable in it.

4.2.1 Correlation Analysis of Developed Countries

Table 4.12, depicts the correlation between return series of developed countries. U.S has strong significant correlation with Japan, Australia and weak significant correlation with U.K, France. Russia has strong significant correlation with France, Germany and Australia while weak correlation with Japan.

Table 4.12: Correlation Analysis of Developed Countries

	US	**UK**	**Japan**	**France**	**Germany**	**Austalia**
US	1					
UK	0.3259	1				
Japan	0.5214	0.3346	1			
France	0.3034	0.8938	0.3308	1		
Germany	0.2782	0.8504	0.3163	0.9304	1	
Australia	0.5331	0.4014	0.5811	0.370	0.3489	1

Japan has weak significant correlation with France and Germany. France has strong significant correlation with Germany while with Australia has weak correlation. Germany has weak correlation with Australia.

4.2.2 Time Varying Correlation between Developed Countries

Table 4.13 shows the maximum univariate GARCH model selected on the basis of AIC. All the series display requiring GJR-GARCH, EGARCH models and NA

TABLE 4.13: DCC - GARCH Models selected - Developed Countries

Countries	**U.K** Selected Model	**Japan** Selected Model	**France** Selected Model	**Germany** Selected Model	**Australia** Selected Model
U.S	NA	GJR/TARCH	NA	EGARCH	GJR/TARCH
U.K		EGARCH	EGARCH	GJR/TARCH	EGARCH
Japan			EGARCH	EGARCH	GJR/TARCH
France				GJR/TARCH	GJR/TARCH
Germany					EGARCH
Australia					

This table shows the DCC-GARCH model selected for Developed Countries on the basis of lowest possible Akaike Information Criteria (AIC).

means that, the stability condition for particular pair of countries is not met, so model cannot be applied. In short, the dynamic conditional correlation doesn't exists in these specified countries.

Table 4.14 reports the results of DCC -GARCH model across Developed countries. The table reports the impact of the past residual shocks ($\theta 1$) and lagged dynamic conditional correlation ($\theta 2$) with their respective p-values. First of all, the condition of the stability of the DCC model is met in all industries that $\theta 1 + \theta 2 < 1$. So, DCC model must be used for measuring the time varying conditional correlation.

$\theta 1$ is significant and $\theta 2$ are significant for the pair of U.S equity market with Japanese equity market, U.S equity market with German equity market, U.S equity market with Australian equity market, U.K equity market with French equity market, U.K equity market with German equity market, U.K equity.

Market with Australian equity market, Japanese equity market with Australian equity market, French equity market with German equity market, French equity market with Australian equity market, German equity market with Australian equity market. It indicates that, volatility of the current period can be predicted by using the past prices behavior and lagged dynamic condition correlation have also present it means the persistence of the volatility.

$\theta 1$ is insignificant and $\theta 2$ are significant for the pair of U.K equity market with Japanese equity market, Japanese equity market with French equity market. It shows that past residual shock are not present and lagged dynamic condition correlation is present between these pairs. $\theta 1$ is insignificant and $\theta 2$ are insignificant for the pair of Japanese equity market with German equity market. It shows that past residual shock have not present and lagged dynamic condition correlation is also not present between these pairs. Timing varying Correlation does not exist in U.S and U.K, U.S and France.

All the pairs of developed countries shows mixed behavior. In which pairs of some countries have significant values of both Theta 1 and Theta 2 which means passed residual and lagged dynamic both are find. Some pair of countries have significant values of Theta 1 and insignificant value of Theta 2 which means passed residual are present and lagged dynamic both are not find while some pair of countries have insignificant values of Theta 1 and significant value of Theta 2 which means passed residual are not present and lagged dynamic are present.

TABLE 4.14: Time Varying Correlation between Developed countries

Countries	**U. K**		**Japan**		**France**		**Germany**		**Australia**	
	θ_1	θ_2	θ_1	θ_2	θ_1	θ_2	θ_1	θ_2	θ_1	θ_2
U. S	-	-	0.0278	0.9417	_	_	0.0071	0.9922	0.0347	0.8383
			(0.0025)	(0.0000)			(0.0064)	(0.0000)	(0.0004)	(0.0000)
U. K			0.0068	0.9314	0.0683	0.9085	0.0706	0.8953	0.0162	0.0399
			(0.2718)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0014)	(0.0000)
Japan					0.0081	0.9650	0.0208	0.4362	0.0376	0.9398
					(0.0692)	(0.0000)	(0.1250)	(0.2542)	(0.0000)	(0.0000)
France							0.0562	0.9075	0.0151	0.9458
							(0.0000)	(0.0000)	(0.0054)	(0.0000)
Germany									0.0149	0.9427
									(0.0198)	(0.0000)
Australia										

This table summarizes the estimated coefficients from the DCC-GARCH model in a bivariate framework for all country pairs in the study. The p-values are reported in parenthesis. Theta (1) and Theta (2) are reported above the p-values.

4.2.3 Time Varying Correlation between Developed Countries

Tables 4.15 and 4.16 show the suitable univariate ADCC models and estimates form Developed countries-to-other Developed countries. The appropriate model is chosen on the basis of lowest possible Akaike Information Criteria AIC. NA means that, the stability condition for particular pair of countries is not met, so model cannot be applied. In short, the dynamic conditional correlation doesn't exists in these specified countries.

$\theta 3$ is significant and positive for U.K equity market with French equity market, U.K equity market with German equity market, Japanese equity market with Australian equity market, French equity with German equity market and French equity with Australian equity market that indicates, the correlation has been increased with the effect of negative news and shows that these series have negative return.

$\theta 3$ is insignificant and positive impact on strength of co-movement falling positive returns for the U.S equity market with Japanese equity market, U.S equity market with Australian equity market, U.K equity market with Australian equity market and German equity market with Australian equity market. The series of these pair of countries show no variations with respect to asymmetric effect. In short, any good or bad news arises in market, didn't effect the correlation. Timing varying Correlation does not exist in U.S and U.K, U.S and France, U.S and Germany.

All the pairs of developed countries shows mixed behavior in ADDC GARCH. In which pairs of some countries have significant values of Theta 1, Theta 2 and Theta 3 which means passed residual, lagged dynamic and bad/good news affect are find. Some pair of countries have insignificant values of Theta 1, Theta 2 and Theta 3 which means passed residual, lagged dynamic and bad/good news affect are not find. From all the above results and discussion it is concluded that the ADCC GARCH in pairs of developed countries show mix behavior. Bad and good news affect differently in every pair of developed countries. $\theta 3$ is significant and negative for U.K equity market with Japanese equity market.

$\theta 3$ is insignificant and negative for Japanese equity market with French equity market and Japanese equity market with German equity market it means that the correlation has been reduced with the effect of negative news in the equity market.

Table 4.15: ADCC GARCH Models Between Developed Countries

Countries	**U.K** Selected Model	**Japan** Selected Model	**France** Selected Model	**Germany** Selected Model	**Australia** Selected Model
U.S	NA	GJR/TARCH	NA	NA	GJR/TARCH
U.K		EGARCH	GJR/TARCH	GJR/TARCH	EGARCH
Japan			EGARCH	EGARCH	GJR/TARCH
France				GJR/TARCH	EGARCH
Germany					EGARCH
Australia					

This table shows the ADCC GARCH model selected for Developed Countries on the basis of lowest possible Akaike Information Criteria(AIC).

TABLE 4.16: ADCC - GARCH Estimates Between Developed Countries and Developed Countries

Countries	**U. K**		**Japan**			**France**			**Germany**			**Australia**		
	θ_1	θ_2 θ_3	θ_1	θ_2	θ_3	θ_1	θ_2	θ_3	θ_1	θ_2	θ_3	θ_1	θ_2	θ_3
U. S	_	_ _	0.024	0.938	0.005	_	_	_	_	_	_	0.027	0.876	0.003
			(0.001)	(0.000)	(0.096)							(0.085)	(0.000)	(0.546)
U. K			0.053	-0.170	-0.052	0.052	0.919	0.003	0.058	0.906	0.003	0.012	0.944	0.004
			(0.010)	(0.205)	(0.012)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.019)	(0.000)	(0.198)
Japan						0.055	0.127	-0.043	0.044	0.263	-0.028	0.025	0.953	0.006
						(0.015)	(0.749)	(0.104)	(0.028)	(0.454)	(0.155)	(0.000)	(0.000)	(0.002)
France									0.043	0.923	0.001	0.009	0.949	0.007
									(0.000)	(0.000)	(0.000)	(0.062)	(0.000)	(0.054)
Germany												0.010	0.946	0.005
												(0.053)	(0.000)	(0.165)
Australia														

This table summarizes the estimated coefficients from the ADCC-GARCH model in a bivariate framework between Developed Countries with Developed Countries. Values in parenthesis are the p-values. Theta (1), Theta (2) and Theta(3) are reported above the p-values.

4.2.4 Static Connectedness of Developed Countries

Table 4.17 report the details of Static connectedness of returns of developed countries. U.S contribution to its own market is 30.30% U.S contribution to U.K is 5.38%, Japan is 6.87%, France is 4.46%, Germany is 3.93% and Australia is 8.10%. U.S market has less influence on all other markets. U.S total contributions to other markets is 38.73% and U.S contribution including its own market is 59.02%. While other countries contribution is 69.70% to U.S market.

U.K contribution to its own market is 33.00% U.K contribution to U.S is 17.69%, Japan is 13.71%, France is 25.60%, Germany is 24.13% and Australia is 14.94%. U.K total contributions to other markets is 96.08% and U.K contribution including its own market is 129.08%. While other countries contribution is 67.0% to U.K market.

Japan contribution to its own market is 40.00%. Japan contribution to U.S is 7.22%, U.K is 4.82%, France is 4.62%, Germany is 4.39% and Australia is 10.08%. Japanese market has less influence on all other markets. Japan total contributions to other markets is 31.14% and Japan contribution including its own market is 71.14%. While other countries contribution is 60.00% to Japan's market.

France contribution to its own market is 32.11%. France contribution to U.S is 18.36%, U.K is 26.338%, Japan is 14.67%, Germany is 28.96% and Australia is 13.632%. French market has influence on all other markets. France total contributions to other markets is 101.96% and France contribution including its own market is 134.07%. While other countries contribution is 67.89% to French market.

Germany contribution to its own market is 33.44%. Germany contribution to U.S is 18.07%, U.K is 23.80%, Japan is 14.48%, France is 27.77% and Australia is 13.15%. Germany market has some influence on all other markets. Germany total contributions to other markets is 97.26% and Germany contribution including its own market is 130.70%. While other countries contribution is 66.56% to Germans market.

Australia contribution to its own market is 40.10% Australia contribution to U.S is 8.36%, U.K is 6.66%, Japan is 10.26%, France is 5.45% and Germany is 5.16%.

TABLE 4.17: Static Connectedness of Developed Markets

	U.S	**U.K**	**Japan**	**France**	**Germany**	**Australia**	**FROM**
U.S	30.296	17.692	7.222	18.36	18..074	8.356	69.704
U.K	5.376	33.004	4.823	26.338	23.789	6.661	66.996
Japan	6.871	13.714	40.003	14.674	14.476	10.262	59.997
France	4.457	25.598	4.621	32.108	27.768	5.449	67.892
Germany	3.927	24.132	4.387	28.96	33.439	5.155	66.561
Australia	8.097	14.941	10.084	13.632	13.148	40.098	59.902
Contribution to others	28.728	96.077	31.137	101.964	97.264	35.883	391.05
Contribution including own	59.023	129.081	71.14	134.072	130.703	75.981	TCI
Net Spillover	-40.977	29.081	-28.86	34.072	30.703	-24.019	65.175

Australian market has low influence on all other markets. Australia total contributions to other markets is 35.88% and Australia contribution including its own market is 75.98%. While other countries contribution is 59.90% to Australian market From all the above developed countries U.S contribution to other markets is very low and contribution from other markets of both Japan and Australia are very low. The contribution of each developed market to all other developed markets is presented graphically as **Fig 4.7**.

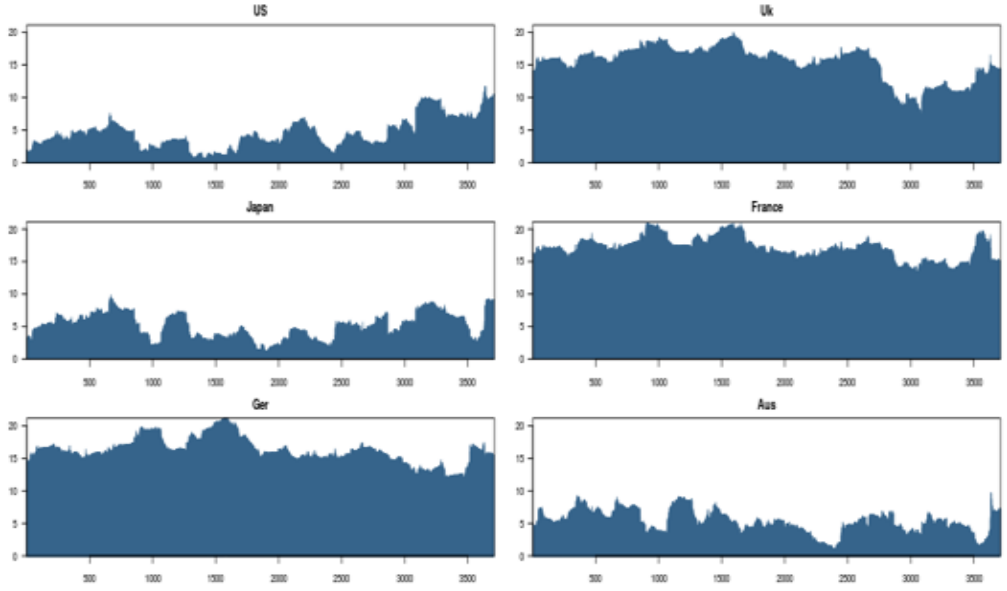

FIGURE 4.7: Contribution of each Developed Market to all other Developed Markets

U.S contribution to other markets is 28.73%, U.K contribution to other markets is 96.08%, Japan contribution to other markets is 31.14%, France contribution to other markets is 101.96%, Germany contribution to other markets is 97.26% and Australia contribution to other markets is 35.88%, Large contribution from U.K, France and Germany to other markets while little of contribution from U.S, Japan and Australia to other markets in term of return spillover is observed. Above graph 4.7 further provide that spillover of all above developed countries are not constant over time. The contribution of the returns from other developed markets to each developed markets in is provided graphically in **Fig 4.8**.

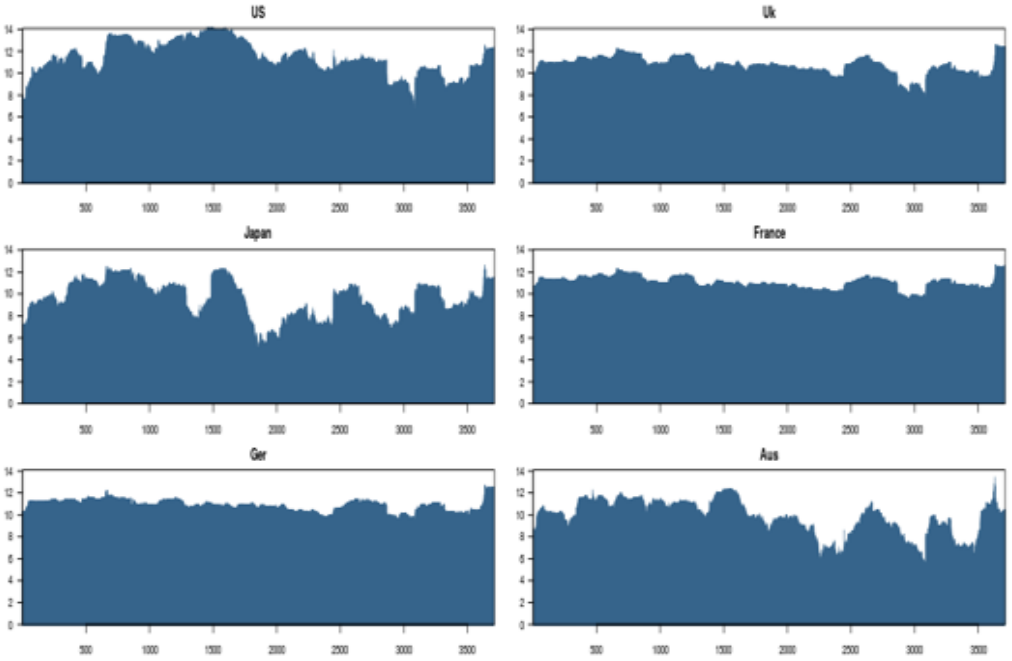

FIGURE 4.8: Contribution of the Returns from other Developed Markets to each Developed Markets

Other countries contribution to U.S is 69.70%, U.K 67.00%, Japan 60.00%, France 67.89%, Germany 66.56% and Australia 59.90%. Higher contribution from other countries to U.S, U.K, France and Germany is reported and lower contribution from other countries to Japan and Australia is reported. Generally, U.S, U.K, France and Germany are more connection with other markets. Japan and Australia are less connected with other markets. The mean spillover is not constant.

Contribution from a specific developed market to other developed markets and from other developed market to a specific developed market is netted off and expressed graphically in Fig 4.9

Net spillover of U.S is 8.49%, net spillover of U.K is -0.36%, Japan is -3.57%, France is -6.57%, Germany is 6.22%, and Australia is -4.03%,

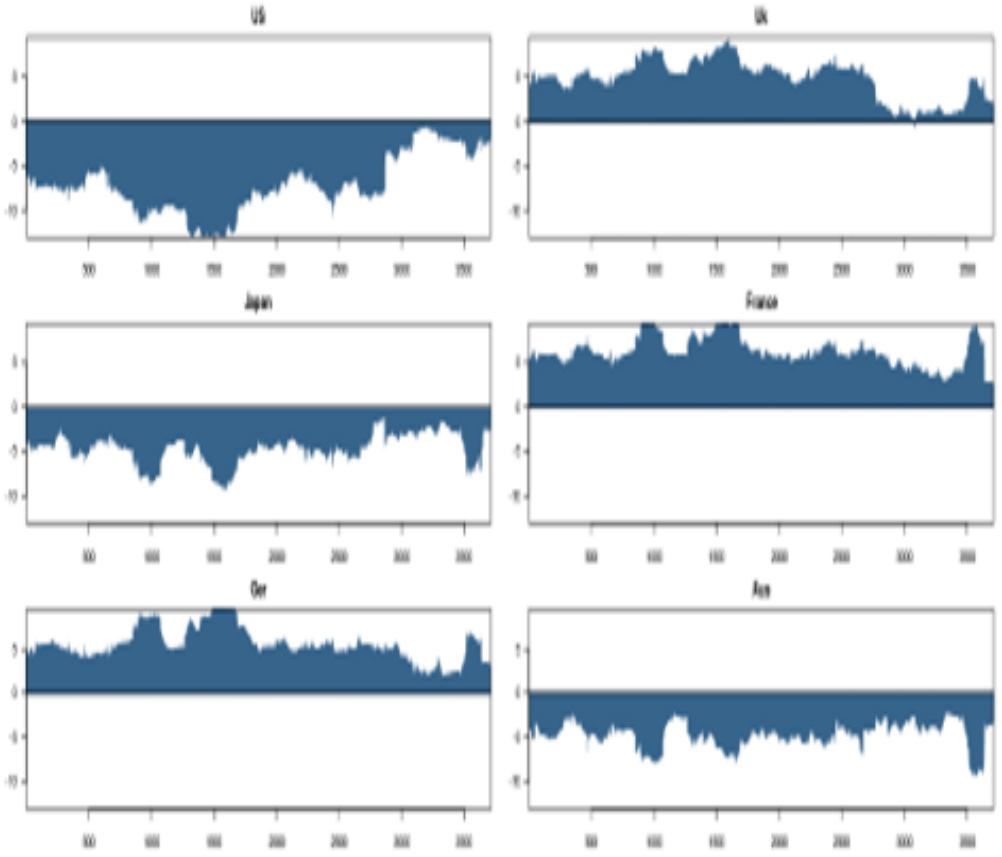

FIGURE 4.9: Contribution from a Specific Developed Market to other Developed Markets and Vice Versa is Netted off

U.S. Japan and Australia markets are generally recipient of information while U.K, France and Germany markets are disseminator of information to other markets.

4.2.5 Dynamic Connectedness of Developed Markets

Table 4.18 present the dynamic connectedness of return developed countries. U.S contribution to its own market is 31.7%, contribution of U.S to U.K is 4.27%. Likewise, 7.36% is the contribution of U.S to Japan market, U.S contribution to France is 3.91%, Germany is 3.81% and Australia is 7.05%. U.S total contributions to other markets is 26.40%, While other countries contribute 68.30% to U.S market, U.S contribution including own is 58.1%. U.K contribution to its own market is 35.91%, U.K contribution to U.S market is 7.49%, Japan 11.97%, France 24.78%,

Germany 23.44%, and Australia 14.39%. U.K total contributions to other markets is 91.7% While other countries contribute 64.1% to U.K market, U.K contribution including own is 127.61%.

Japan contribution to its own market is 42.89%. Japan contribution to U.S is 7.49%, U.K 4.28%, France 4.34%, Germany 4.13%, and Australia 10.12%. Japan total contributions to other markets is 30.36%. While other countries contribute 57.11% to Japan market. Japan contribution including own is 73.25%.

France contribution to its own market is 33.7%. France contribution to U.S market is 18.57%, U.K 26.19%, Japan 14.05%, Germany 29.77%, and Australia 13.84%. France total contributions to other markets is 102.42% While other countries contribute 66.3% to France market, France contribution including own is 136.12%.

Germany's contribution to its own market is 59.28%. Germany's contribution to Brazil market is 11.08%, Russia 15.76%, India 10.57%, China 5.67%, and Pakistan 2.9%. Germany's total contributions to the other markets is 45.97%, While other countries contribute 40.72% to German market, the Germany's contribution including its own is 105.26%.

TABLE 4.18: Dynamic Connectedness of Developed Markets

	U.S	**U.K**	**Japan**	**France**	**Germany**	**Australia**	**FROM**
U.S	31.705	17.123	7.489	18.565	17.876	7.242	68.295
U.K	4.265	35.908	4.283	26.192	23.98	5.371	64.092
Japan	7,363	11.971	42.887	14.053	13.181	10.545	57.113
France	3.909	24.782	4.343	33.696	28.903	4.366	66.304
Germany	3.808	23.437	4.131	29.772	34.76	4.092	65.24
Australia	7.051	14.385	10.117	13.841	13.086	41.519	58.481
Contribution to others	26.397	91.698	30.364	102.423	97.027	31.616	379.525
Contribution including own	58.102	127.606	73.251	136.119	131.786	73.135	TCI
Net Spillover	-41.898	27.606	-26.75	36.119	31.786	-26.865	63.254

Australia contribution to its own market is 41.88%. Australia contribution to U.S market is 7.24%, U.K 5.37%, Japan 10.54%, France 4.37%, and Germany 4.09%. Australia total contributions to other markets is 31.62% while other countries contribute to Australia market is 379.52%, Australia contribution including its own is 73.13%. The Graphical Presentation of Dynamic Total Connectedness is Present in Fig 4.10.

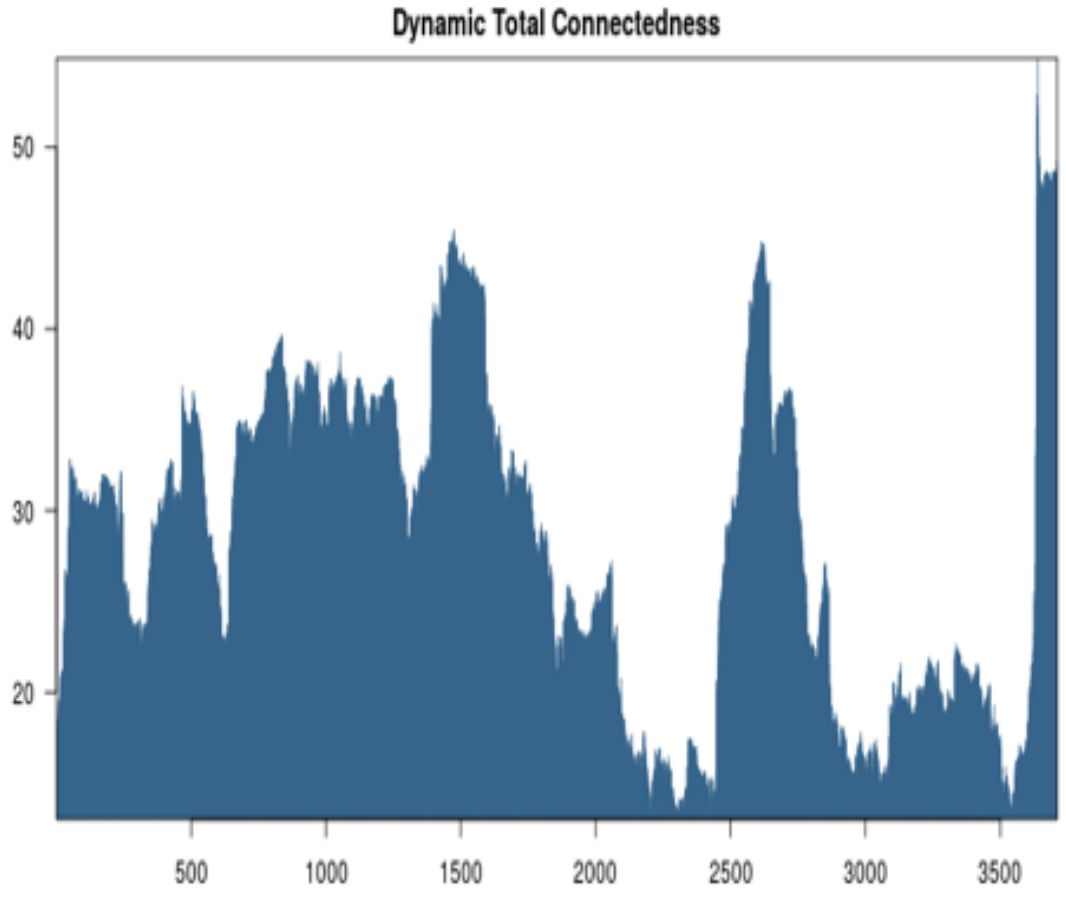

FIGURE 4.10: Graphical Behavior of Dynamic Total Connectedness

The sum of country contribution to its own market and country contribution to other markets is equal to total contribution. Total contribution of U.S is 58.1%, U.K is 127.6%, Japan is 73.2%, France is 136.12%, Germany is 131.79%, Australia is 73.13%, Dynamic net spillover is 63.25% and static net spillovers is 65.17% of returns of emerging countries.

Particularly, they are substantially higher between 2007-2009 and the second in 2015-2016, and start of 2020,it is the time of financial crisis time period, oil crises

time period and the pandemic situation of COVID-19 respectively.

4.2.6 Hedge Ratios among Developed Markets

Table 4.19 shows the hedge ratio strategy among the developed markets The hedge strategy is optimal when a short position in U.S volatility is hedged with a long position in Japan and Australia because hedge is significant. So hedge efficiency present among these countries. The hedge strategy is not preferred when U.S volatility is hedged with U.K, France and Germany, these are insignificant. The hedge strategy is not preferred when U.K volatility is hedged with U.S and Japan, so hedge efficiency not exist among them. While hedge is preferred when a short position in U.K is hedge with a long position in France, Germany and Australia because significant relation among them. The hedge strategy is optimal when a short position in Japan volatility is hedged with a long position in U.S. The hedge strategy is not preferred when U.S volatility is hedged with U.K, France and Germany, these are insignificant.

The hedge strategy is not preferred when France volatility is hedged with U.S and Japan, so hedge efficiency not exist among them. While hedge is preferred when a short position in France is hedge with a long position in U.K, Germany and Australia because significant relation among them. The hedge strategy is optimal when a short position in Germany volatility is hedged with a long position in U.K. France and Australia because hedge is significant. So hedge efficiency present among these countries. The hedge strategy is not preferred when Germany volatility is hedged with U.S and Japan, these are insignificant. The hedge strategy is optimal when a short position in Australia is hedge with a long position in U.S, U.K, Japan, France and Germany because significant relation among them. So hedge efficiency exist among them.

In developed countries the investor of U.S may diversify within developed countries. Germany is preferable for such investors and they will not get benefit of diversification if they invest in Australia. The countries that are more connected also face flow of contiguous effect.

Table 4.19: Hedge Ratio of Developed Markets Return

	HE	**p-value**
U.K/U.S	0.03	0.3
Japan/U.S	0.23	0
France/U.S	0.05	0.14
Germany/U.S	0.03	0.4
Australia/US	0.21	0
U.S/U.K	-0.03	0.38
Japan/U.K	0.02	0.58
France/U.K	0.81	0
Germany/U.K	0.76	0
Australia/U.K	0.11	0
U.S/Japan	0.21	0
U.K/Japan	0.05	0.13
France/Japan	0.03	0.28
Germany/Japan	0.02	0.6
Australia/Japan	0.35	0
U.S/France	-0.03	0.36
U.K/France	0.8	0
Japan/France	0.02	0.53
Germany/France	0.88	0
Australia/France	0.1	0
U.S/Germany	-0.03	0.36
U.K/Germany	0.73	0
Japan/Germany	0.01	0.87
France/Germany	0.87	0
Australia/Germany	0.08	0.01
U.S/Australia	0.2	0
U.K/Australia	0.13	0
Japan/Australia	0.3	0
France/Australia	0.11	0
Germany/Australia	0.1	0

4.2.7 Portfolio Weights among Developed Markets

Table 4.20 show portfolio weights strategy. There are significant gains from risk reduction among all developed markets volatilities except U.K-France, U.K-Germany and Germany-France.

TABLE 4.20: Portfolio Weights of Developed Markets Return

	Weights	**p-value**
United States/United Kingdom	0.41	0
United States /Japan	0.2	0
United States /France	0.35	0
United States /Germany	0.38	0
United States /Australia	0.32	0
United Kingdom / United States	0.45	0
United Kingdom Japan	0.3	0
United Kingdom /France	-0.01	0.85
United Kingdom /Germany	0.03	0.34
United Kingdom /Australia	0.38	0
Japan/ United States	0.52	0
Japan/ United Kingdom	0.55	0
Japan/France	0.47	0
Japan/Germany	0.5	0
Japan/Australia	0.51	0
France/ United States	0.58	0
France/ United Kingdom	0.29	0
France/Japan	0.42	0
France/Germany	0.13	0
France/Australia	0.52	0
Germany/ United States	0.57	0
Germany/ United Kingdom	0.26	0
Germany/Japan	0.4	0
Germany/France	0.06	0.06
Germany/Australia	0.5	0
Australia/ United States	0.32	0
Australia/ United Kingdom	0.34	0
Australia/Japan	0.18	0
Australia/France	0.27	0
Australia/Germany	0.3	0

4.3 Spillover across Emerging Markets and Developed Markets

Finally in this section correlation, spillover and connectedness in static and dynamic setting is conducted within and across emerging and developed markets

4.3.1 Correlation within and across the Emerging and Developed Countries

Table 4.20 shows correlation within and among the emerging and developed countries. All the developed markets and emerging markets exhibit low association with each other accept few markets. There is a strong significant correlation between Brazil with South Africa, U.K France, Germany, and a weak significant correlation with Russia, India, China, Pakistan, U.S, Japan, and Australia.

Russia has a strong significant correlation with South Africa U.K, France, Germany, and a weak significant correlation with India, China, Pakistan, U.S, Japan, and Australia. India has a strong significant correlation with South Africa, U.K, France, Germany, Australia and a weak significant correlation with China, Pakistan, U.S, and Japan. South Africa has a strong significant correlation with U.K, France, Germany, Australia and a weak significant correlation with Pakistan, U.S, and Japan. China and Pakistan have a weak significant correlation with all countries.

There is a significant strong correlation between U.S with Japan, Australia and a weak significant correlation with U.K, France, and Germany. The U.K has a strong significant correlation with France, Germany, Australia and a weak significant correlation with Japan.

Japan has a strong significant correlation with Australia and a weak significant correlation with France and Germany. France has a strong significant correlation with Germany and a weak significant correlation with Australia. Germany has a weak significant correlation with Australia. While the remaining have a weak significant correlation within and among emerging and developed countries.

Table 4.21: Correlation within and among Emerging Countries and Developed Countries

	Brazil	**Russia**	**India**	**China**	**South Africa**	**Pakistan**	**US**	**UK**	**Japan**	**France**	**Germany**	**Australia**
Brazil	1.0000											
Russia	0.3724	1.0000										
India	0.3131	0.3549	1.0000									
China	0.1598	0.1559	0.2385	1.0000								
South Africa	0.4421	0.5560	0.4489	0.2176	1.0000							
Pakistan	0.0553	0.0293	0.1347	0.0813	0.0918	1.0000						
US	0.1045	0.2356	0.2926	0.1832	0.3310	0.1317	1.0000					
UK	0.5343	0.5624	0.4285	0.1717	0.6746	0.0736	0.3259	1				
Japan	0.1705	0.3016	0.3431	0.2759	0.3606	0.1040	0.5214	0.3346	1.0000			
France	0.5331	0.5460	0.4204	0.1670	0.6592	0.0765	0.3034	0.8938	0.3308	1.0000		
Germany	0.5123	0.5270	0.4153	0.1605	0.6372	0.0709	0.2782	0.8504	0.3163	0.9304	1.0000	
Australia	0.2560	0.3009	0.4029	0.2663	0.4456	0.1171	0.5331	0.4014	0.5811	0.3700	0.3489	1.0000

4.3.2 Time Varying Correlation within and Across Emerging Countries with Developed Countries

Table 4.23 reports the results of DCC -GARCH model across Emerging Countries with Developed countries. The table reports the impact of the past residual shocks ($\theta 1$) and lagged dynamic conditional correlation ($\theta 2$) with their respective p-values.

First of all, the condition of the stability of the DCC model is met in all industries that $\theta 1 + \theta 2 < 1$. So, DCC model must be used for measuring the time varying conditional correlation. The appropriate model is chosen on the basis of lowest possible Akaike Information Criteria AIC. NA means that, the stability condition for particular industry is not met, so model can not be applied.

Table 4.24 estimates that $\theta 1$ is significant and $\theta 2$ are significant for the pair of Brazilian equity market with U.K equity market, Brazilian equity market with Japanese equity market, Brazilian equity market with German equity market, Russian equity market with U.S equity market, Russian equity market U.K equity market, Russian equity market French equity market, Russian equity market with German equity market, Indian equity market with U.S equity market, Indian equity market with U.K equity market, Indian equity market with Japanese equity market, Indian equity market with French equity market.

Indian equity market with German equity market, Indian equity market with Australian equity market, Chinese equity market with U.S equity market, Chinese equity market with Japanese equity market, Chinese equity market U.S equity market, Chinese equity market with Japanese equity market, Chinese equity market with Australian equity market, South African equity market with U.S equity market, South African equity market with U.K equity market, South African equity market with French equity market, South African equity market with German equity market, Pakistani equity market with U.S equity market, Pakistani equity market with Japanese equity market, Pakistani equity market with Australian equity market. It shows that past residual shock have no impact on correlation but significant lagged dynamic condition correlation exist between these pairs.

$\theta 1$ is insignificant and $\theta 2$ are significant for the pair of Brazilian equity market with U.S equity market, Russian equity market with Australian equity market, Chinese equity market with German equity market, South African equity market with Japanese equity market, Pakistani equity market with U.K equity market, Pakistani equity market with French equity market, Pakistani equity market with German equity market. It shows that past residual shock have no impact on correlation and lagged dynamic condition correlation exist between these pairs.

Table 4.22: DCC - GARCH Models between Emerging Markets with Developed Markets

Countries	**U.S Selected Model**	**U.K Selected Model**	**Japan Selected Model**	**France Selected Model**	**Germany Selected Model**	**Australia Selected Model**
Brazil	GJR/TARCH	EGARCH	GJR/TARCH	NA	GJR/TARCH	GJR/TARCH
Russia	GJR/TARCH	GJR/TARCH	GJR/TARCH	GJR/TARCH	EGARCH	GJR/TARCH
India	GJR/TARCH	EGARCH	GJR/TARCH	EGARCH	GJR/TARCH	EGARCH
China	GJR/TARCH	NA	GJR/TARCH	NA	GJR/TARCH	EGARCH
South Africa	GJR/TARCH	EGARCH	EGARCH	EGARCH	EGARCH	EGARCH
Pakistan	GJR/TARCH	EGARCH	GJR/TARCH	EGARCH	EGARCH	GJR/TARCH

This table shows the DCC-GARCH model selected for Emerging Countries with Developed Countries on the basis of lowest possible Akaike Information Criteria (AIC).

TABLE 4.23: Time Varying Correlation within and across Emerging Countries and Developed Countries

Countries	**U. S**		**U. K**		**Japan**		**France**		**Germany**		**Australia**	
	θ_1	θ_2	θ_1	θ_2	θ_1	θ_2	θ_1	θ_2	θ_1	θ_2	θ_1	θ_2
Brazil	0.004	0.994	0.008	0.989	-0.016	0.663			0.014	0.981	-0.009	0.519
	(0.254)	(0.000)	(0.002)	(0.000)	(0.000)	(0.000)	_	_	(0.006)	(0.000)	(0.336)	(0.199)
Russia	0.013	0.972	0.039	0.932	0.008	0.951	0.038	0.938	0.024	0.966	0.006	0.969
	(0.044)	(0.000)	(0.000)	(0.000)	(0.103)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.105)	(0.000)
India	0.044	0.946	0.021	0.927	0.021	0.898	0.021	0.930	0.018	0.947	0.019	0.904
	(0.000)	(0.000)	(0.003)	(0.000)	(0.024)	(0.000)	(0.005)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	0.004	0.004			0.008	0.987			0.004	0.987	0.004	0.994
China	(0.004)	0.000	_	_	(0.011)	(0.000)	_	_	(0.333)	(0.000)	(0.007)	(0.000)
South Africa	0.014	0.969	0.032	0.942	0.007	0.964	0.029	0.946	0.031	0.945	0.012	0.936
	(0.009)	(0.000)	(0.000)	(0.000)	(0.082)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.011)	(0.000)
Pakistan	0.015	0.938	0.013	0.884	0.042	0.745	0.005	0.915	0.005	0.939	0.012	0.951
	(0.047)	(0.000)	(0.109)	(0.000)	(0.021)	(0.000)	(0.396)	(0.000)	(0.388)	(0.000)	(0.055)	(0.000)

This table summarizes the estimated coefficients from the DCC-GARCH model in a bivariate framework for Emerging Countries with Developed Countries. The p-values are reported in parenthesis. Theta (1) and Theta(2) are reported above the p-values.

$\theta 1$ is insignificant and $\theta 2$ are insignificant for the pair of Brazilian equity market with Australian equity market. It shows that past residual shock have not impact on correlation and no lagged dynamic condition correlation is present between these pairs.

4.3.3 Asymmetric DCC GARCH Model within and Across Emerging Countries and Developed Countries

Tables 4.24 and 4.25 show the suitable univariate ADCC models and estimates form emerging countries-to-other Developed countries. The appropriate model is chosen on the basis of lowest possible Akaike Information Criteria (AIC). NA means that, the stability condition for particular industry is not met, so model cannot be applied. In short, the dynamic conditional correlation doesn't exists between these countries.

$\theta 3$ is significant and positive for the pair of Russian equity market with U.K equity market, Russian equity market with French equity market, Russian equity market with German equity market, Indian equity market with U.K equity market, Indian equity market with Japanese equity market, Indian equity market with Australian equity market, Chinese equity market with French equity market, Indian equity market with Australian equity market, South African equity market with U.K equity market, South African equity market with French equity market, South African equity market with German equity market, South African equity market with Australia equity market, Pakistani equity market with U.K equity market, Pakistani equity market with French equity market, Pakistani equity market with German equity market, that indicates, the correlation increases with the effect of negative news and shows that these series have negative return.

$\theta 3$ is significant and negative for the pair of Brazilian equity market with U.S equity market, Brazilian equity market with Australian equity market it means that the correlation has been reduces with the effect of negative news in the equity market.

Table 4.24: ADCC GARCH Models within and among Emerging Countries and Developed Countries

Countries	**U.S Selected Model**	**U.K Selected Model**	**Japan Selected Model**	**France Selected Model**	**Germany Selected Model**	**Australia Selected Model**
Brazil	GJR/TARCH	GJR/TARCH	GJR/TARCH	EGARCH	GJR/TARCH	GJR/TARCH
Russia	GJR/TARCH	GJR/TARCH	GJR/TARCH	GJR/TARCH	GJR/TARCH	GJR/TARCH
India	GJR/TARCH	GJR/TARCH	GJR/TARCH	EGARCH	EGARCH	EGARCH
China	GJR/TARCH	NA	GJR/TARCH	EGARCH	GJR/TARCH	GJR/TARCH
South Africa	GJR/TARCH	EGARCH	EGARCH	EGARCH	EGARCH	EGARCH
Pakistan	GJR/TARCH	EGARCH	GJR/TARCH	EGARCH	EGARCH	GJR/TARCH

This table shows the univariate ADCC GARCH model of Emerging Countries with Developed Countries on the basis of lowest possible Akaike Information Criteria (AIC).

All the pairs of within and across emerging and developed countries shows mixed behavior in DDC GARCH. In which pairs of some countries have significant values of Theta 1, Theta 2 and Theta 3 while in some pairs of countries have insignificant values of Theta 1, Theta 2 and Theta 3.

TABLE 4.25: ADCC - GARCH Models within and across Emerging Countries and Developed Countries

Countries	**U. S**			**U. K**			**Japan**			**France**			**Germany**			**Australia**		
	θ_1	θ_2	θ_3	θ_1	θ_2	θ_3	θ_1	θ_2	θ_3	θ_1	θ_2	θ_3	θ_1	θ_2	θ_3	θ_1	θ_2	θ_3
Brazil	0.042	0.021	-0.061	0.010	0.983	0.002	0.005	0.034	-0.046	0.008	0.985	0.002	0.013	0.979	0.003	0.031	-0.004	-0.057
	(0.038)	(0.936)	(0.029)	(0.009)	(0.000)	(0.331)	(0.845)	(0.906)	(0.125)	(0.005)	(0.000)	(0.235)	(0.001)	(0.000)	(0.095)	(0.116)	(0.985)	(0.018)
Russia	0.012	0.966	0.004	0.022	0.951	0.009	0.002	0.948	0.007	0.021	0.952	0.011	0.018	0.964	0.008	0.002	0.963	0.007
	(0.025)	(0.000)	(0.312)	(0.000)	(0.000)	(0.000)	(0.680)	(0.000)	(0.116)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.689)	(0.000)	(0.063)
India	0.020	0.949	0.005	0.014	0.945	0.006	0.012	0.922	0.008	0.015	0.945	0.004	0.054	0.715	-0.016	0.007	0.913	0.011
	(0.000)	(0.000)	(0.145)	(0.026)	(0.000)	(0.045)	(0.079)	(0.000)	(0.044)	(0.036)	(0.000)	(0.190)	(0.008)	(0.000)	(0.169)	(0.307)	(0.000)	(0.013)
China	0.003	0.996	0.001	_	_	_	0.007	0.986	0.001	-0.010	0.785	0.005	0.004	0.970	0.003	-0.010	0.898	0.017
	(0.013)	(0.000)	(0.228)				(0.017)	(0.000)	(0.357)	(0.000)	(0.000)	(0.000)	(0.375)	(0.000)	(0.380)	(0.000)	(0.000)	(0.000)
South	0.013	0.969	0.002	0.026	0.948	0.003	0.006	0.965	0.001	0.019	0.953	0.005	0.024	0.950	0.004	0.006	0.942	0.006
Africa																		
	(0.010)	(0.000)	(0.502)	(0.000)	(0.000)	(0.057)	(0.140)	(0.000)	(0.720)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.004)	(0.234)	(0.000)	(0.071)
Pakistan	0.013	0.933	0.006	-0.001	0.356	0.058	0.031	0.785	0.013	-0.007	0.563	0.046	-0.007	0.433	0.052	0.009	0.838	0.014
	(0.065)	(0.000)	(0.374)	(0.972)	(0.154)	(0.002)	(0.055)	(0.000)	(0.278)	(0.360)	(0.027)	(0.000)	(0.477)	(0.181)	(0.000)	(0.367)	(0.000)	(0.453)

This table summarizes the estimated coefficients from the ADCC-GARCH model in a bivariate framework between Developing Countries with Developed Countries. Values in parenthesis are the p-values. Theta (1), Theta (2) and Theta (3) are reported above the p-values.

4.3.4 Static Connectedness within and Across Emerging Countries and Developed Countries

Table 4.27 report the details of Static connectedness of returns of emerging countries. Brazil contribution to its own market is 38.98%, Brazil contribution to Russia is 7.36%, India is 10.04%, China is 6.4%, South Africa is 7.73%, Pakistan is 1.36%, U.S is 12.25%, U.K is 7.75%, Japan is 6.86%, France is 7.32%, Germany is 6.83% and Australia is 7.45%. Brazil market has some influence on all other markets. Brazil total contributions to other markets is 74.66% and Brazil contribution including its own market is 113.64%. While other countries contribution is 61.02% to Brazil's market.

Russia contribution to its own market is 37.23%, Russia contribution to Brazil is 6.13%, India is 4.92%, China is 2.17%, South Africa is 8.28%, Pakistan is 1.02%, U.S is 4.53%, U.K is 7.08%, Japan is 5.02%, France is 6.64%, Germany is 6.58% and Australia is 4.89%. Russian market has some influence on all other markets. Russia total contributions to other markets is 57.25% and Russia contribution including its own market is 94.48%. While other countries contribution is 62.77% to Russia's market.

India contribution to its own market is 42.04%, India contribution to Brazil is 4.34%, Russia is 4.22%, China is 3.6%, South Africa is 5.2%, Pakistan is 1.51%, U.S is 3.360%, U.K is 4.11%, Japan is 4.18%, France is 3.95%, Germany is 4.07% and Australia is 4.97%. Indian market has some influence on all other markets. India total contributions to other markets is 43.51% and India contribution including its own market is 85.52%. While other countries contribution is 57.99% to India's market.

China contribution to its own market is 69.73%, China contribution to Brazil is 1.1%, Russia is 0.72%, India is 2.04%, South Africa is 1.1%, Pakistan is 0.33%, U.S is 0.63%, U.K is 0.7%, Japan is 1.58%, France is 0.65%, Germany is 0.645% and Australia is 1.357%. Chinese market has some less influence on all other markets. China total contributions to other markets is 10.86% and China contribution including its own market is 80.59%. While other countries contribution is 30.27% to China's market.

TABLE 4.26: Static Connectedness within and across Emerging Countries and Developed Countries

	Brazil	Russia	India	China	SA	Pak	US	Uk	Japan	France	Ger	Aus	FROM
Brazil	38.979	6.130	4.338	1.098	8.583	0.164	1.103	11.979	1.805	11.667	10.596	3.556	61.021
Russia	7.360	37.229	4.225	0.720	10.676	0.015	1.511	11.342	3.099	10.683	10.195	2.944	62.771
India	6.395	4.918	42.014	2.043	7.775	0.614	2.703	7.925	3.941	7.694	7.767	6.211	57.986
China	3.352	2.167	3.602	69.735	3.251	0.326	1.184	3.534	3.551	3.137	3.049	3.112	30.265
SA	7.726	8.283	5.205	1.100	28.855	0.206	2.652	13.145	3.222	12.512	11.958	5.135	71.145
Pak	1.362	1.017	1.511	0.330	1.408	87.251	0.938	1.524	0.691	1.596	1.471	0.901	12.749
US	12.246	4.531	3.360	0.631	6.912	0.215	20.711	13.417	4.684	13.999	13.842	5.453	79.289
Uk	7.750	7.080	4.107	0.702	10.503	0.184	3.168	23.514	3.074	18.658	16.908	4.353	76.486
Japan	6.859	5.016	4.177	1.580	6.220	0.180	4.469	10.540	31.056	11.334	11.249	7.320	68.944
France	7.324	6.639	3.947	0.648	9.962	0.171	2.743	18.469	3.053	23.283	20.119	3.641	76.717
Ger	6.834	6.581	4.072	0.645	9.879	0.147	2.554	17.485	2.969	21.016	24.301	3.517	75.699
Aus	7.454	4.887	4.966	1.357	7.572	0.233	5.172	11.121	6.966	10.165	9.876	30.231	69.769
Contribution TO others	74.662	57.250	43.511	10.855	82.740	2.454	28.195	120.483	37.055	122.462	117.030	46.143	742.840
Contribution including own	113.642	94.480	85.524	80.589	111.595	89.705	48.906	143.997	68.111	145.745	141.331	76.374	TCI
Net spillovers	13.642	-5.520	-14.476	-19.411	11.595	-10.295	-51.094	43.997	-31.889	45.745	41.331	-23.626	61.903

South Africa contribution to its own market is 28.86%, South Africa contribution to Brazil is 8.58%, Russia is 10.68%, India is 7.78%, China is 3.25%, Pakistan is 1.1%. U.S is 6.91%, U.K is 10.5%, Japan is 6.22%, France is 9.96%, Germany is 9.88% and Australia is 7.57%. South Africa market has some influence on all other markets. South Africa total contributions to other markets is 82.74% and South Africa contribution including its own market is 111.6%. While other countries contribution is 71.14% to South Africa's market.

Pakistan contribution to its own market is 87.25%, Pakistan contribution to Brazil is 0.216%, Russia is 0.01%, India is 0.61%, China is 0.33%, South Africa is 0.2%, U.S is 0.21%, U.K is 0.18%, Japan is 0.18%, France is 0.17%, Germany is 0.15% and Australia is 0.23%.. Pakistan market has some very low influence on all other markets. Pakistan total contributions to other markets is 2.45% and Pakistan contribution including its own market is 89.7%. While other countries contribution is 12.75% to Pakistan's market

U.S contribution to its own market is 20.71%, U.S contribution to Brazil is 1.1%, Russia is 1.51%, India is 2.7%, China is 1.18%, South Africa is 2.65%, Pakistan is 0.94%, U.K is 3.17%, Japan is 4.47%, France is 2.74%, Germany is 2.55% and Australia is 5.17%. U.S market has less influence on all other markets. U.S total contributions to other markets is 28.19% and U.S contribution including its own market is 48.91%. While other countries contribution is 79.29% to U.S market.

U.K contribution to its own market is 23.51%, U.K contribution to Brazil is 11.98%, Russia is 11.34%, India is 7.92%, China is 3.53%, South Africa is 13.14%, Pakistan is 1.52%, U.S is 13.42%, Japan is 10.54%, France is 18.47%, Germany is 17.49% and Australia is 11.12%. U.K total contributions to other markets is 120.48% and U.K contribution including its own market is 143.99%. While other countries contribution is 76.49% to U.K market. Japan contribution to its own market is 31.06%, Japan contribution to Brazil is 1.805%, Russia is 3.1%, India is 3.94%, China is 3.55%, South Africa is 3.22%, Pakistan is 0.69%, U.S is 4.68%, U.K is 3.07%, France is 3.05%, Germany is 2.96% and Australia is 6.97%. Japanese market has less influence on all other markets. Japan total contributions to other markets is 37.06% and Japan contribution including its own market is 68.11%. While other countries contribution is 68.94% to Japan's market.

France contribution to its own market is 23.28%, France contribution to Brazil is 11.67%, Russia is 10.68%, India is 7.69%, China is 3.14%, South Africa is 12.51%, Pakistan is 1.6%, U.S is 13.99%, U.K is 18.66%, Japan is 11.33%, Germany is 21.02% and Australia is 10.02%.French market has some influence on all other markets. France total contributions to other markets is 122.46% and France contribution including its own market is 145.74%. While other countries contribution is 76.72% to French market.

Germany contribution to its own market is 24.3%, Germany contribution to Brazil is 10.59%, Russia is 10.19%, India is 7.77%, China is 3.05%, South Africa is 11.96%, Pakistan is 1.47%, U.S is 13.84%, U.K is 16.91%, Japan is 11.25%, France is 20.12% and Australia is 9.88%. Germany market has some influence on all other markets. Germany total contributions to other markets is 117.03% and Germany contribution including its own market is 141.33%. While other countries contribution is 75.7% to Germans market.

Australia contribution to its own market is 30.23%, Australia contribution to Brazil is 3.556%, Russia is 2.94%, India is 6.21%, China is 3.11%, South Africa is 5.13%, Pakistan is 0.9%, U.S is 5.45%, U.K is 4.35%, Japan is 7.32%, France is 3.641% and Germany is 3.52%. Australian market has low influence on all other markets. Australia total contributions to other markets is 46.14% and Australia contribution including its own market is 76.37%. While other countries contribution is 69.77% to Australian market

From all the above emerging countries and developed countries contribution to other markets and contribution from other markets of both China and Pakistan are very low.

From all the above sample countries French contribution to Germany is very high and U.S contribution to Pakistan is very low Contribution from individual market to other market is presented graphically in **Fig 4.11**.

Brazil contribution to other markets in term of volatility is 74.662%, Russia contribution to other markets is 57.250%, India contribution to other markets is 43.511%, China contribution to other markets is 10.855%, South Africa contribution to other markets is 82.740%, Pakistan contribution to other markets is 2.454%. U.S

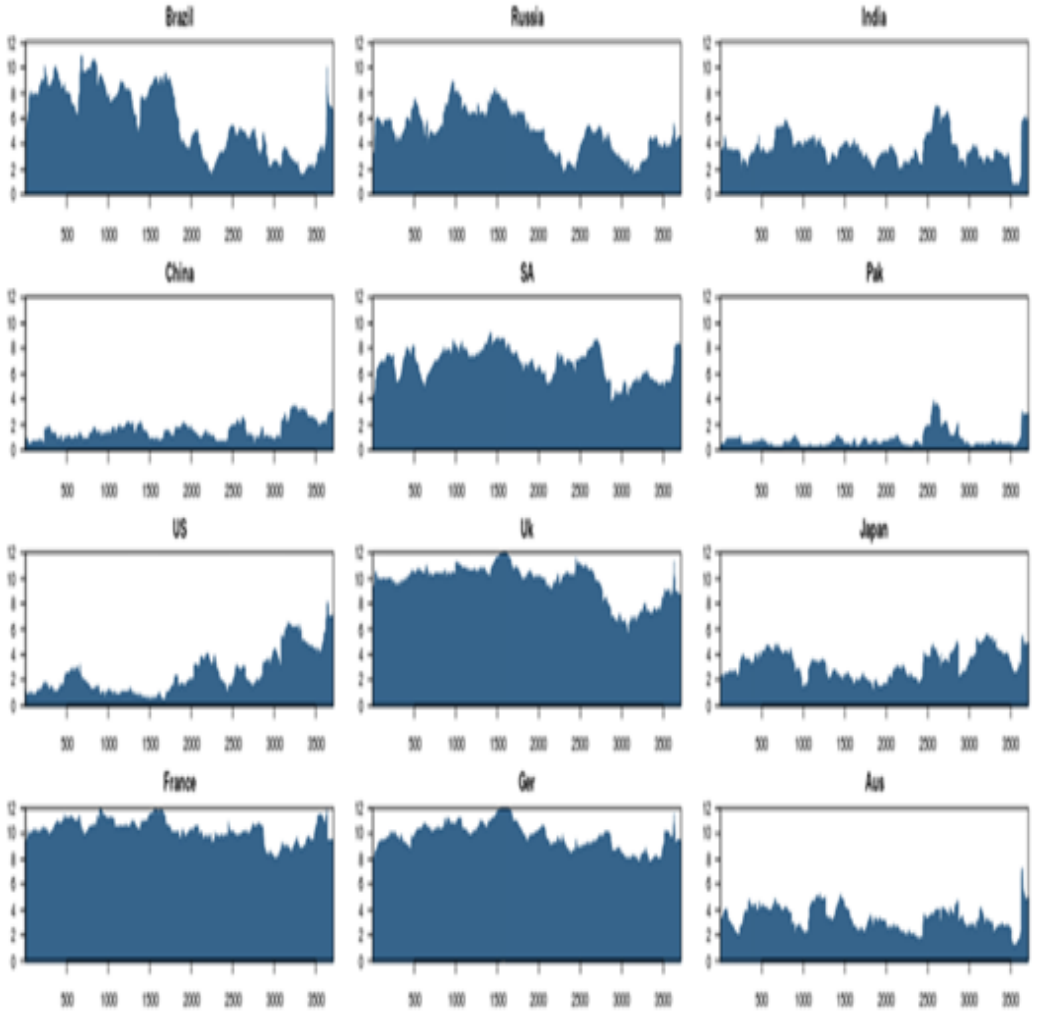

FIGURE 4.11: Contribution from Individual Market to other Market

contribution to other markets is 28.195%, U.K contribution to other markets is 120.483%, Japan contribution to other markets is 37.055%, France contribution to other markets is 122.452%, Germany contribution to other markets is 117.030% and Australia contribution to other markets is 46.143%, Large amount of contribution from U.K, France and Germany to other markets while small amount of contribution from China and Pakistan to other markets in term of return spillover is observed. Volatility spillover is higher in crisis. The spillover change over time.

The contribution from all markets to an individual market presented graphically in **Fig 4.12**.

Figure 4.12 presents there is a variation in each country. The volatility of Brazil is 61.021%, Russia 62.771%, India 57.985%, China 30.265%, South Africa

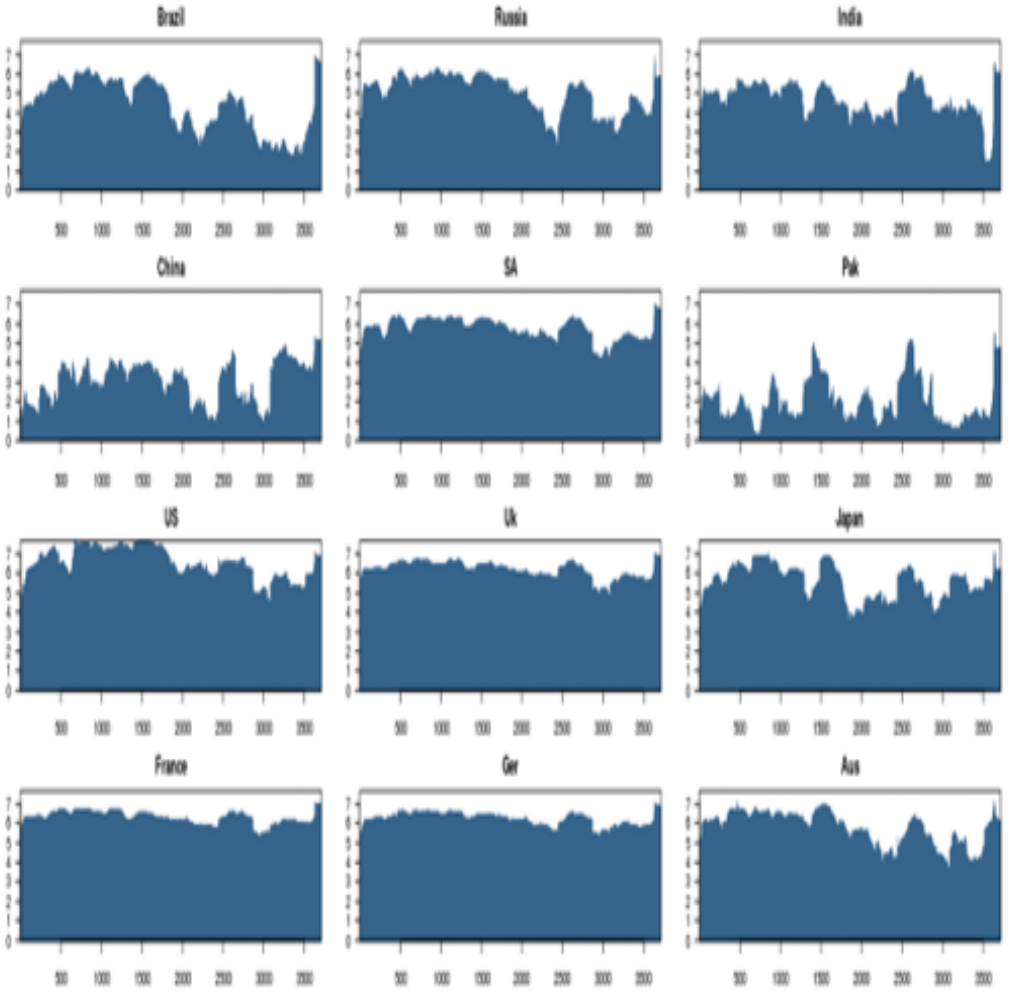

FIGURE 4.12: Contribution from all Markets to an Individual Market

71.145%, Pakistan is 12.749%, U.S is 79.289%, U.K 76.485%, Japan 68.944%, France 76.717%, Germany 75.699% and Australia 69.769%. Higher contribution from other countries to U.S is observed and lower contribution from other countries to China and Pakistan is observed. The mean spillover is not constant as it varies over time. The spillover is higher during crisis Period i.e. 2007-2009, 2015 and 2020. Above graph clearly provide that these markets are reciprocal volatility spillover effect as well as transmission of volatility.

To identify net recipient or transmission of volatility information net spillover effect is expressed as graph below. Net spillover of Brazil is 13.64%, net spillover of Russia is -5.52%, India is -14.48%, China is -19.41%, South Africa is 11.6%, Pakistan is -10.3%, U.S is -51.09%, U.K is 43.99%, Japan is -31.89%, France is 45.74%, Germany is 41.33%, and Australia is -23.62%. There is no large difference

present in the net spillover value of U.K, France and Germany, it means that if any crisis or instability occur in U.K, France and Germany then other countries are not highly affected. China, Pakistan, Japan, and Australia are the countries which are totally receiver of the information and U.K, France, and Germany are disseminator of the information. The difference between two indices reveals that volatility spread across other countries stock markets compared returns spillover.

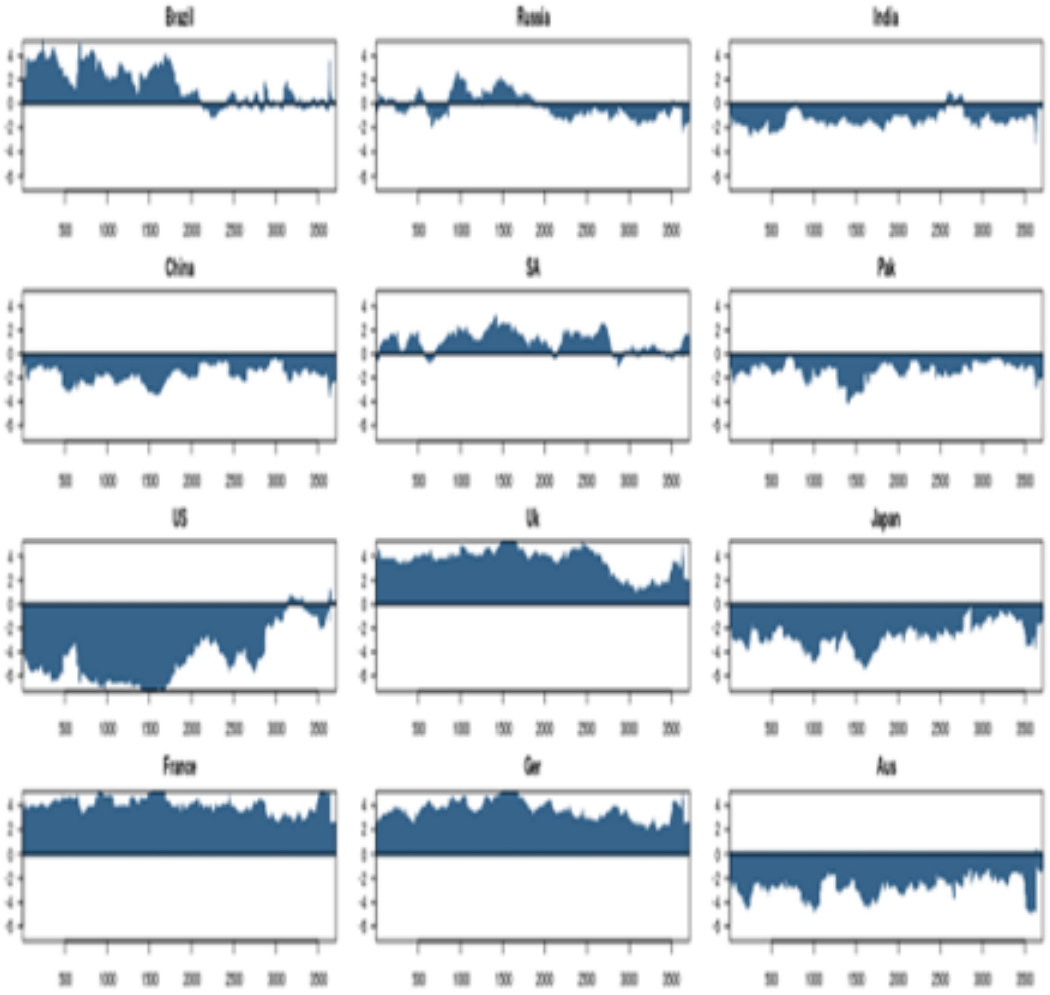

FIGURE 4.13: Net Spillover Effect

4.3.5 Dynamic Connectedness within and among Emerging Countries and Developed Countries

Table 4.25 report the details of Dynamic connectedness of returns of emerging countries and developed countries. Brazil contribution to its own market is

48.598% Brazil contribution to Russia is 6.930%, India is 5.681%, China is 3.936%, South Africa is 6.575%, Pakistan is 2.570%, U.S is 11.173%, U.K is 6.520%, Japan is 6.056%, France is 6.052%, Germany is 5.577% and Australia is 7.841%. Brazil market has some influence on all other markets. Brazil total contributions to other markets is 68.910% and Brazil contribution including its own market is 117.508%. While other countries contribution is 51.402% to Brazil's market.

Russia contribution to its own market is 40.866%, Russia contribution to Brazil is 6.342%, India is 4.705%, China is 2.717%, South Africa is 7.780%, Pakistan is 2.009%, U.S is 4.914%, U.K is 6.754%, Japan is 4.455%, France is 6.533%, Germany is 6.661% and Australia is 4.658%. Russian market has some influence on all other markets. Russia total contributions to other markets is 57.527% and Russia contribution including its own market is 98.393%. While other countries contribution is 59.134% to Russia's market.

India contribution to its own market is 45.487%, India contribution to Brazil is 3.492%, Russia is 3.692%, China is 3.210%, South Africa is 4.701%, Pakistan is 2.239%, U.S is 3.799%, U.K is 3.864%, Japan is 4.328%, France is 3.747%, Germany is 3.802% and Australia is 4.090%. Indian market has some influence on all other markets. India total contributions to other markets is 40.962% and India contribution including its own market is 86.450%. While other countries contribution is 54.513% to India's market.

China contribution to its own market is 64.846%, China contribution to Brazil is 1.513%, Russia is 1.423%, India is 2.226%, South Africa is 1.969%, Pakistan is 1.183%, U.S is 1.325%, U.K is 1.123%, Japan is 2.158%, France is 0.994%, Germany is 0.995% and Australia is 1.726%. Chinese market has less influence on all other markets. China total contributions to other markets is 16.635% and China contribution including its own market is 81.481%. While other countries contribution is 35.154% to China's market. South Africa contribution to its own market is 32.008%, South Africa contribution to Brazil is 6.921%, Russia is 9.545%, India is 6.747%, China is 4.307%, Pakistan is 2.579%. U.S is 6.920%, U.K is 10.382%, Japan is 5.540%, France is 9.514%, Germany is 9.455% and Australia is 7.182%. South Africa market has some influence on all other markets.

TABLE 4.27: Dynamic Connectedness within and across Emerging countries and Developed Countries

	Brazil	Russia	India	China	SA	Pak	US	Uk	Japan	France	Ger	Aus	FROM
Brazil	48.598	6.342	3.492	1.513	6.921	0.704	0.878	9.815	1.484	9.566	8.526	2.163	51.402
Russia	6.930	40.866	3.692	1.423	9.545	0.612	1.964	10.141	2.326	10.133	10.008	2.359	59.134
India	5.681	4.705	45.487	2.226	6.747	0.976	3.010	7.416	4.410	7.573	7.405	4.365	54.513
China	3.936	2.717	3.210	64.846	4.307	1.033	1.754	3.978	3.833	3.584	3.463	3.339	35.154
SA	6.575	7.780	4.701	1.969	32.008	0.761	2.618	12.838	3.011	12.128	11.660	3.952	67.992
Pak	2.570	2.009	2.239	1.183	2.579	77.562	1.142	2.547	1.635	2.564	2.487	1.484	22.438
US	11.173	4.914	3.799	1.325	6.920	0.693	22.046	12.784	4.881	13.863	13.352	4.250	77.954
Uk	6.520	6.754	3.864	1.123	10.382	0.582	2.566	26.257	2.719	18.808	17.173	3.253	73.743
Japan	6.056	4.455	4.328	2.158	5.540	0.852	4.904	9.120	34.214	10.858	10.200	7.315	65.786
France	6.052	6.533	3.747	0.994	9.514	0.520	2.456	18.133	2.861	25.106	21.406	2.679	74.894
Ger	5.577	6.661	3.802	0.995	9.455	0.531	2.495	17.139	2.765	22.101	25.946	2.532	74.054
Aus	7.841	4.658	4.090	1.726	7.182	0.785	4.164	10.647	6.819	10.344	9.802	31.943	68.057
Contribution TO others	68.910	57.527	40.962	16.635	79.091	8.048	27.951	114.558	36.742	121.523	115.482	37.690	725.120
Contribution including own	117.508	98.393	86.450	81.481	111.099	85.610	49.997	140.815	70.956	146.629	141.428	69.634	TCI
Net spillovers	17.508	-1.607	-13.550	-18.519	11.099	-14.390	-50.003	40.815	-29.044	46.629	41.428	-30.366	60.427

South Africa total contributions to other markets is 79.091% and South Africa contribution including its own market is 111.099%. While other countries contribution is 67.992% to South Africa's market.

Pakistan contribution to its own market is 77.562%, Pakistan contribution to Brazil is 0704%, Russia is 0.612%, India is 0.976%, China is 1.033%, South Africa is 0.761%, U.S is 0.693%, U.K is 0.582%, Japan is 0.852%, France is 0.520%, Germany is 0.531% and Australia is 0.785%. Pakistan market has very low influence on all other markets. Pakistan total contributions to other markets is 8.048% and Pakistan contribution including its own market is 85.610%. While other countries contribution is 22.438% to Pakistan's market

U.S contribution to its own market is 22.046%, U.S contribution to Brazil is 0.878%, Russia is 1.964%, India is 3.010%, China is 1.754%, South Africa is 2.618%, Pakistan is 1.142%, U.K is 2.566%, Japan is 4.904%, France is 2.455%, Germany is 2.495% and Australia is 4.164%. U.S market has less influence on all other markets. U.S total contributions to other markets is27.951 % and U.S contribution including its own market is 49.997%. While other countries contribution is 77.954% to U.S market.

U.K contribution to its own market is 26.257%, U.K contribution to Brazil is 9.815%, Russia is 10.141%, India is 7.416%, China is 3.978%, South Africa is 12.838%, Pakistan is 2.547%, U.S is 12.784%, Japan is 9.120%, France is 18.133%, Germany is 17.139% and Australia is 10.647%. U.K total contributions to other markets is 114.558% and U.K contribution including its own market is 140.815%. While other countries contribution is 73.743% to U.K market.

Japan contribution to its own market is 34.214%, Japan contribution to Brazil is 1.484%, Russia is 2.326%, India is 4.410%, China is 3.833%, South Africa is 3.011%, Pakistan is 1.635%, U.S is 4.881%, U.K is 2.719%, France is 2.861%, Germany is 2.765% and Australia is 6.819%. Japanese market has less influence on all other markets. Japan total contributions to other markets is 36.742% and Japan contribution including its own market is 70.956%. While other countries contribution is 65.786% to Japan's market. France contribution to its own market is 25.106%, France contribution to Brazil is 9.566%, Russia is 10.133%, India is

7.573%, China is 3.573%, South Africa is 12.128%, Pakistan is 2.564%, U.S is 13.863%, U.K is 18.808%, Japan is 10.858%, Germany is 22.101% and Australia is 10.344%.French market has some influence on all other markets. France total contributions to other markets is 121.523% and France contribution including its own market is 146.629%. While other countries contribution is 74.894% to French market.

Germany contribution to its own market is 25.946%, Germany contribution to Brazil is 8.526%, Russia is 10.008%, India is 7.405%, China is 3.463%, South Africa is 11.660%, Pakistan is 2.487%, U.S is 13.352%, U.K is 17.173%, Japan is 10.200%, France is 21.406% and Australia is 9.802%. Germany market has some influence on all other markets. Germany total contributions to other markets is 117.030% and Germany contribution including its own market is 141.331%. While other countries contribution is 75.699% to Germans market.

Australia contribution to its own market is 31.943%, Australia contribution to Brazil is 2.163%, Russia is 2.359%, India is 4.365%, China is 3.339%, South Africa is 3.952%, Pakistan is 1.484%, U.S is 4.250%, U.K is 3.253%, Japan is 7.315%, France is 2.679% and Germany is 2.532%. Australian market has low influence on all other markets. Australia total contributions to other markets is 37.690% and Australia contribution including its own market is 69.634%. While other countries contribution is 68.057% to Australian market From all the above emerging countries and developed countries contribution to other markets and contribution from other markets of both China and Pakistan are very low.

From all the above sample countries French contribution to Germany is very high and Pakistan contribution to India is very low. The above graph shows that connectedness is present between the market of developing and developed countries. There are periods of high connectedness and low connectedness. The above graph is also proved that connectedness increases during the period of crisis which is from 2008 to 2009 as well as oil crises time period of 2015. And the last year in which countries face the pandemic situation of COVID-19 and connectedness increases. It is also the evidence that when bad news came in market connectedness increases.

Dynamic total connectedness is presented in **Fig 4.14**.

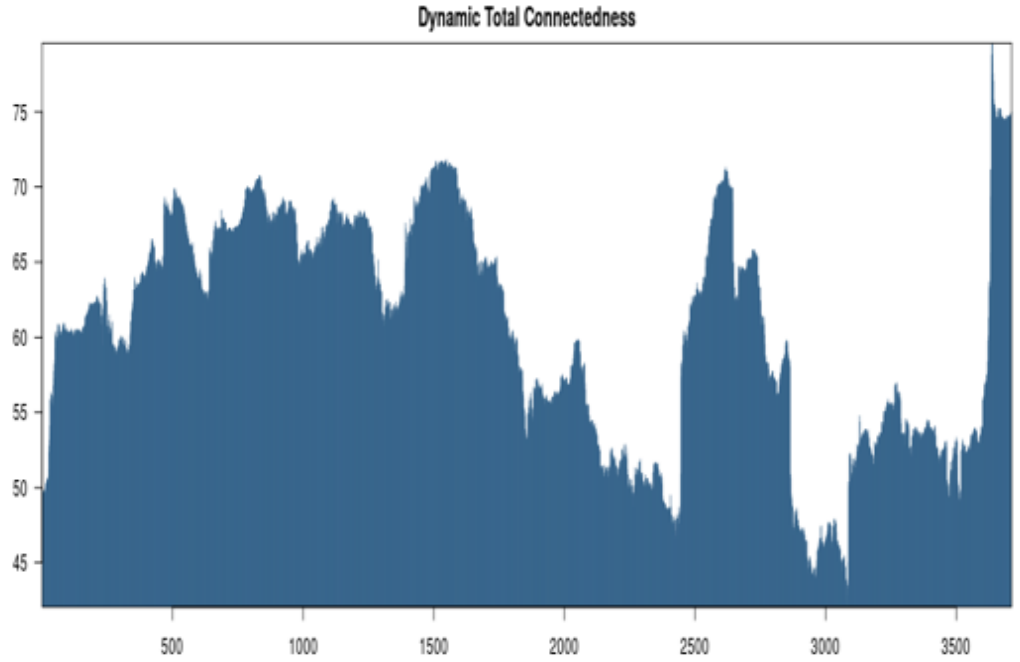

FIGURE 4.14: Dynamic Total Connectedness

4.3.6 Hedge within and Across Emerging Countries and Developed Countries

Table 4.27 shows the hedge strategy among the developed countries. The hedge strategy is optimal when a short position in Brazil volatility is hedged with a long position in Russia, India, China, South Africa, Pakistan, U.K, France, Germany and Australia because hedge ratio is significant. So hedge efficiency present among these countries. The hedge strategy is not better when U.S volatility is hedged with U.S, and Japan, these are insignificant.

The hedge strategy is not better when Russia volatility is hedged with Pakistan, so hedge efficiency not exist among them. While hedge is preferred when a short position in Russia is hedge with a long position in Brazil, India, China, South Africa, U.S, U.K, Japan, France, Germany and Australia because significant relation among them.

The hedge strategy is optimal when a short position in India volatility is hedged with Brazil, Russia, China, South Africa, U.S, U.K, Japan, France, Germany and

Australia because hedge ratio is significant. So hedge efficiency present among these countries. The hedge strategy is not better when India volatility is hedged with Pakistan, these are insignificant.

The hedge strategy is not better when China volatility is hedged with Brazil, Russia, Pakistan, U.S, U.K, France and Germany, so hedge efficiency not exist among them. While hedge ratio is better when a short position in China is hedge with a long position in India, South Africa, Japan and Australia because significant relation among them. The hedge strategy is optimal when a short position in South Africa volatility is hedged with a long position in Brazil, Russia, India, China, U.K, Japan, France, Germany and Australia because hedge ratio is significant. So hedge efficiency present among these countries. The hedge strategy is not better when South Africa volatility is hedged with Pakistan and U.S, these are insignificant.

The hedge strategy is not preferred when Pakistan volatility is hedged with Brazil, Russia, India, South Africa, U.S, U.K, Japan, France, Germany and Australia, as hedge efficiency not exist among them. The hedge strategy is optimal when a short position in Brazil volatility is hedged with a long position in Russia, India, China, South Africa, Pakistan, U.K, France, Germany and Australia because hedge is significant. So hedge efficiency present among these countries. The hedge strategy is not preferred when U.S volatility is hedged with U.S, and Japan, these are insignificant.

TABLE 4.28: Hedge Ratio within and among Emerging Markets and Developed Markets

	HE	p-value
Russia/Brazil	0.12	0
India/Brazil	0.12	0
China/Brazil	0.07	0.03
South Africa/Brazil	0.2	0
Pakistan/Brazil	0.08	0.01
US/Brazil	-0.01	0.83
UK/Brazil	0.25	0
Japan/Brazil	0.01	0.69
France/Brazil	0.26	0
Germany/Brazil	0.25	0
Australia/Brazil	0.11	0
Brazil/Russia	0.1	0

India/Russia	0.13	0
China/Russia	0.07	0.02
South Africa/Russia	0.34	0
Pakistan/Russia	0.02	0.63
US/Russia	0.07	0.03
UK/Russia	0.37	0
Japan/Russia	0.1	0
France/Russia	0.36	0
Germany/Russia	0.32	0
Australia/Russia	0.07	0.02
Brazil/India	0.08	0.01
Russia/India	0.12	0
China/India	0.11	0
South Africa/India	0.22	0
Pakistan/India	0.05	0.13
US/India	0.09	0
UK/India	0.18	0
Japan/India	0.07	0.02
France/India	0.18	0
Australia/India	0.15	0
Brazil/China	0.06	0.07
Russia/China	0.04	0.16
India/China	0.09	0
South Africa/China	0.07	0.03
Pakistan/China	0.05	0.15
US/China	0.06	0.07
UK/China	0.04	0.23
Japan/China	0.11	0
France/China	0.04	0.25
Germany/China	0.04	0.24
Australia/China	0.09	0
Brazil/South Africa	0.14	0
Russia/South Africa	0.31	0
India/South Africa	0.24	0
China/South Africa	0.1	0
Pakistan/South Africa	0.05	0.09
US/South Africa	0.06	0.05
UK/South Africa	0.43	0
Japan/South Africa	0.08	0.01
France/South Africa	0.43	0
Germany/South Africa	0.41	0
Australia/South Africa	0.17	0
Brazil/Pakistan	0.04	0.18
Russia/Pakistan	0.02	0.44
India/Pakistan	0.04	0.17
China/Pakistan	0.04	0.22
South Africa/Pakistan	0.04	0.18
US/Pakistan	0.04	0.24
UK/Pakistan	0.05	0.11
Japan/Pakistan	0.06	0.07

France/Pakistan	0.05	0.12
Germany/Pakistan	0.04	0.16
Australia/Pakistan	0.05	0.14
Brazil/US	0.03	0.38
Russia/US	0.07	0.04
India/US	0.06	0.05
China/US	0.07	0.02
South Africa/US	0.07	0.03
Pakistan/US	0.04	0.16
UK/US	0.04	0.26
Japan/US	0.23	0
France/US	0.05	0.13
Germany/US	0.03	0.33
Australia/US	0.21	0
Brazil/UK	0.25	0
Russia/UK	0.33	0
India/UK	0.21	0
China/UK	0.05	0.08
South Africa/UK	0.43	0
Pakistan/UK	0.05	0.09
US/UK	-0.02	0.56
Japan/UK	0.02	0.44
France/UK	0.81	0
Germany/UK	0.76	0
Australia/UK	0.11	0
Brazil/Japan	0.01	0.67
Russia/Japan	0.06	0.05
India/Japan	0.11	0
China/Japan	0.14	0
South Africa/Japan	0.08	0.01
Pakistan/Japan	0.04	0.26
US/Japan	0.21	0
UK/Japan	0.05	0.11
France/Japan	0.04	0.24
Germany/Japan	0.02	0.51
Australia/Japan	0.35	0
Brazil/France	0.26	0
Russia/France	0.33	0
India/France	0.21	0
China/France	0.06	0.07
South Africa/France	0.42	0
Pakistan/France	0.06	0.07
US/France	-0.02	0.56
UK/France	0.8	0
Japan/France	0.03	0.42
Germany/France	0.88	0
Australia/France	0.1	0
Brazil/Germany	0.24	0
Russia/Germany	0.32	0

India/Germany	0.19	0
China/Germany	0.04	0.18
South Africa/Germany	0.39	0
Pakistan/Germany	0.05	0.15
US/Germany	-0.02	0.53
UK/Germany	0.73	0
Japan/Germany	0.01	0.74
France/Germany	0.87	0
Australia/Germany	0.08	0.01
Brazil/Australia	0.09	0
Russia/Australia	0.06	0.06
India/Australia	0.16	0
China/Australia	0.17	0
South Africa/Australia	0.19	0
Pakistan/Australia	0.08	0.01
US/Australia	0.2	0
UK/Australia	0.13	0
Japan/Australia	0.3	0
France/Australia	0.11	0
Germany/Australia	0.1	0

The hedge strategy is not preferred when Russia volatility is hedged with Pakistan, so hedge efficiency not exist among them. While hedge is preferred when a short position in Russia is hedge with a long position in Brazil, India, China, South Africa, U.S, U.K, Japan, France, Germany and Australia because significant relation among them.

The hedge strategy is optimal when a short position in India volatility is hedged with a long position in Brazil, Russia, China, South Africa, U.S, U.K, Japan, France, Germany and Australia because hedge is significant. As hedge efficiency present among these countries. The hedge strategy is not preferred when India volatility is hedged with Pakistan, these are insignificant. The hedge strategy is not preferred when China volatility is hedged with Brazil, Russia, Pakistan, U.S, U.K, France and Germany, so hedge efficiency not exist among them. While hedge is preferred when a short position in China is hedge with a long position in India, South Africa, Japan and Australia because significant relation among them.

The hedge strategy is optimal when a short position in South Africa volatility is hedged with a long position in Brazil, Russia, India, China, U.K, Japan, France, Germany and Australia because hedge is significant. So hedge efficiency present

among these countries. The hedge strategy is not preferred when South Africa volatility is hedged with Pakistan and U.S, these are insignificant.

The hedge strategy is not preferred when Pakistan volatility is hedged with Brazil, Russia, India, South Africa, U.S, U.K, Japan, France, Germany and Australia, so hedge efficiency not exist among them.

4.3.7 Portfolio Weights within and among Emerging Countries and Developed Countries

Table 4.30 show portfolio weights for effective hedge. There are significant gains from risk reduction among all developed countries volatilities except U.K-France, U.K- Germany and Germany-France.

TABLE 4.29: Portfolio Weights within and among Emerging Markets and Developed Markets

	Weights	**p-value**
Brazil/Russia	0.43	0
Brazil/India	0.59	0
Brazil/China	0.62	0
Brazil/South Africa	0.56	0
Brazil/Pakistan	0.78	0
Brazil/US	0.76	0
Brazil/UK	0.6	0
Brazil/Japan	0.64	0
Brazil/France	0.49	0
Brazil/Germany	0.52	0
Brazil/Australia	0.7	0
Russia/Brazil	0.48	0
Russia/India	0.6	0
Russia/China	0.66	0
Russia/South Africa	0.57	0
Russia/Pakistan	0.8	0
Russia/US	0.74	0
Russia/UK	0.64	0
Russia/Japan	0.63	0
Russia/France	0.54	0
Russia/Germany	0.57	0
Russia/Australia	0.73	0
India/Brazil	0.31	0
India/Russia	0.26	0

India/China	0.44	0
India/South Africa	0.35	0
India/Pakistan	0.63	0
India/US	0.58	0
India/UK	0.45	0
India/Japan	0.42	0
India/France	0.37	0
India/Germany	0.38	0
India/Australia	0.49	0
China/Brazil	0.49	0
China/Russia	0.5	0
China/India	0.55	0
China/South. Africa	0.57	0
China/Pakistan	0.71	0
China/US	0.68	0
China/UK	0.65	0
China/Japan	0.5	0
China/France	0.58	0
China/Germany	0.59	0
China/Australia	0.63	0
South. Africa/Brazil	0.2	0
South. Africa/Russia	0.14	0
South. Africa/India	0.29	0
South. Africa/China	0.42	0
South. Africa/Pakistan	0.63	0
South. Africa/US	0.53	0
South. Africa/UK	0.3	0
South. Africa/Japan	0.35	0
South. Africa/France	0.18	0
South. Africa/Germany	0.21	0
South. Africa/Australia	0.43	0
Pakistan/Brazil	0.41	0

Pakistan/Russia	0.4	0
Pakistan/India	0.42	0
Pakistan/China	0.43	0
Pakistan/South. Africa	0.46	0
Pakistan/US	0.56	0
Pakistan/UK	0.57	0
Pakistan/Japan	0.46	0
Pakistan/France	0.5	0
Pakistan/Germany	0.51	0
Pakistan/Australia	0.56	0
United States/Brazil	0.4	0
United States /Russia	0.28	0
United States /India	0.37	0
United States /China	0.41	0
United States /South. Africa	0.36	0
United States /Pakistan	0.59	0
United States /UK	0.41	0
United States /Japan	0.2	0
United States /France	0.35	0
United States /Germany	0.38	0
United States /Australia	0.32	0
United States /Brazil	0.07	0.03
UK/Russia	0.09	0.01
UK/India	0.25	0
UK/China	0.4	0
UK/South. Africa	0.12	0
UK/Pakistan	0.63	0
UK/ United States	0.45	0
UK/Japan	0.3	0
UK/France	-0.01	0.85
UK/Germany	0.03	0.34
UK/Australia	0.38	0

Japan/Brazil	0.46	0
Japan/Russia	0.39	0
Japan/India	0.48	0
Japan/China	0.45	0
Japan/South. Africa	0.47	0
Japan/Pakistan	0.7	0
Japan/ United States	0.52	0
Japan/UK	0.55	0
Japan/France	0.47	0
Japan/Germany	0.5	0
Japan/Australia	0.51	0
France/Brazil	0.17	0
France/Russia	0.19	0
France/India	0.39	0
France/China	0.49	0
France/South. Africa	0.28	0
France/Pakistan	0.7	0
France/ United States	0.58	0
France/UK	0.29	0
France/Japan	0.42	0
France/Germany	0.13	0
France/Australia	0.52	0
Germany/Brazil	0.15	0
Germany/Russia	0.17	0
Germany/India	0.35	0
Germany/China	0.46	0
Germany/South. Africa	0.25	0
Germany/Pakistan	0.68	0
Germany/ United States	0.57	0
Germany/UK	0.26	0
Germany/Japan	0.41	0
Germany/France	0.06	0.06

Germany/Australia	0.5	0
Australia/Brazil	0.26	0
Australia/Russia	0.27	0
Australia/India	0.24	0
Australia/China	0.32	0
Australia/South. Africa	0.23	0
Australia/Pakistan	0.59	0
Australia/ United States	0.32	0
Australia/UK	0.34	0
Australia/Japan	0.18	0
Australia/France	0.27	0
Australia/Germany	0.3	0

Chapter 5

Conclusion and Recommendations

5.1 Conclusion

The purpose of this study is to investigate the volatility spillover and portfolio diversification opportunity within and across the emerging markets and developed markets. The representative index of emerging markets (Brazil, Russia, India, China, South Africa, and Pakistan) and developed markets (United States, United Kingdom, Japan, France, Germany and Australia) are examined for connectedness within and across markets.

The methodology include DCC GARCH model and spillover index approach proposed by Diebold and Yilmaz (2009, 2012) The time-varying correlations in the volatilities of each of the equity markets of emerging and developed countries are examined by DCC GARCH model proposed by (Engle, 2002). To examine spillovers in the volatility of equity market of emerging and developed markets the generalized version of the spillover index in Diebold and Yilmaz (2012, 2014, and 2015) is used. Diebold-Yilmaz Connectedness Index (DYCI) methodology is based on generalized variance decompositions obtained from a VAR model of range volatilities.

In case of emerging markets strong significant correlation with Brazil-South Africa, Russia-South Africa and India- South Africa while all other emerging markets

pairs have weak significant correlation. In case of developed markets strong significant correlation with U.S-Japan, U.S-Australia, U.K-France, U.K-Germany, U.K-Australia, Japan-Australia, and France-Germany, while all other developed markets pairs have weak significant correlation. In case of within and among emerging markets and developed markets strong significant correlation Brazil with South Africa, UK, France, Germany, Russia with South Africa, UK, France, Germany, India with South Africa, UK, France, Germany, Australia, South Africa with UK, France, Germany, Australia, U.S with Japan, Australia, U.K with France, Germany, Australia, Japan with Australia and France with Germany. Pakistan and China has no strong correlation with any emerging and developed markets.

The first objective of this study is to examine the time varying volatilities within and among the emerging and developed equity markets by using DCC GARCH model. As the correlation between the variables is found time varying, so Dynamic Condition Correlation DCC model is used and asymmetric behavior is assessed by Asymmetric Dynamic Conditional Correlation ADCC. The results of both these models are found significant. The implications of DCC and ADCC models provide a strong conceptual understandings that, countries are interconnected to each other's and with the passage of time, correlation also becomes time varying. The change in the market conditions are more precisely examined by using these indicators i.e. DCC & ADCC which support that, there exists a time-varying conditional correlations within and among emerging and developed markets.

The estimates of DCC and ADCC shows that most of the pairs within and among the developing markets and developed markets have statistically significant correlations. In the presence of high conditional correlation and volatility transmission, it can be argued that the investors have less opportunities of portfolio diversification within and among the emerging markets or developed markets. In this context, investing in the emerging equity market and developed equity market may help domestic and international investors to manage risk exposure in their portfolios. It help investors to increase the risk-adjusted performance of their hedged portfolios.

In case of static connectedness of emerging markets highest contribution of South Africa to other countries and smallest contribution of Pakistan to other countries is

observed, contribution of other countries to South Africa is high and contribution of other countries to Pakistan is low. In emerging markets net spillover is 28.721%. In case of static connectedness of developed markets highest contribution of France to other countries and smallest contribution of U.S to other countries is seen, contribution of other countries to U.S is high and contribution of other countries to Australia is low. In developed markets net spillover is 65.175%. In case of static connectedness within and among emerging markets and developed markets highest contribution of France to other countries and smallest contribution of Pakistan to other countries is reported, contribution of other countries to U.S is high and contribution of other countries to Pakistan is low. Net spillover is 61.903% within and across emerging and developed markets. This indicates that Pakistan is an isolated market that is less connected with other markets thus effective opportunity of diversification.

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 emerging markets highest contribution of South Africa to other countries and smallest contribution of Pakistan to other countries is observed. Contribution of other countries to South Africa is high and contribution of other countries to Pakistan is low. In emerging markets net spillover is 28.114%. In case of dynamic connectedness of developed markets highest contribution of France to other countries and smallest contribution of U.S to other countries is observed. Contribution of other countries to U.S is high and contribution of other countries to Japan is low. In developed markets net spillover is 63.254%. In case of dynamic connectedness within and among emerging markets and developed markets highest contribution of France to other countries and smallest contribution of Pakistan to other countries is observed. Contribution of other countries to U.S is high and contribution of other countries to Pakistan is low. Net spillover is 60.427% within and across the emerging and developed markets.

In emerging countries Pakistan and China are less connected countries so there is more benefit of portfolio diversification for other emerging countries. While in

South Africa and Brazil contiguous effect is found in it so less benefit of diversification for other emerging countries and risk professional needs to be careful because markets are more connected. There is a benefit of diversification in Developed countries like Japan and the US for other developed countries because they show less connectedness. While France and Germany are highly connected so contiguous effect flow in them so less opportunity of diversification and high risk is present in them. In across emerging and developed countries where there is more benefit of portfolio diversification are Pakistan and China while contiguous effect is found in U.K and France so less benefit of diversification in them for other emerging and developed countries.

The diversification benefits exists within emerging markets like China and Pakistan where markets are less connected to each other. In developed markets U.S and Germany show less connectedness so diversification benefit exist in these developed markets. While in case of both emerging and developed markets diversification benefit exists between Japan to Pakistan which are less connected to each other. It means that for the investors of emerging and developed market portfolio diversification opportunity exist within and across the market.

The study find several interesting results. Total spillovers vary considerably over time. Particularly, they are substantially higher between 2007-2009 and the second in 2015-2016, and start of 2020,it is the time of financial crisis time period, oil crises time period and the pandemic situation of COVID-19 respectively.

There is a possibility to create hedge within emerging markets like brazil with russia, india, china, south africa and Pakistan. There is also a possibility to create hedge in developed markets like Australia creates hedge with U.S, U.K, Japan, France and Germany. While when we go to create hedge among emerging and developed markets there are many countries where opportunity of creating hedge is present. This study also recommend the optimal weights for hedging. In case of emerging markets, developed markets, within and among emerging markets and developed markets. The portfolio weights are more effective at reducing risk. The portfolio weights permit significant diversification opportunities. Even more, that for emerging markets and developed markets, the hedge strategy is ineffective at lowering risk levels.

The empirical findings suggest that volatility spillovers do exist but shall offer portfolio diversification within and among emerging markets and developed markets.

5.2 Recommendations

The findings from the current study provide clear and explicit recommendation to all individuals connected to market, whether they are policy maker, investor's funds manager, risk managers and portfolio managers. They should keenly observe the information and changes occurring in sample of countries, especially occurring in global market. Few significant recommendations presenting from this study are:

This study indicates presence of time-varying conditional correlation. The dynamic nature of the correlation among countries and specially the asymmetric behaviour among markets creates need of portfolio restructuring regularly to optimize risk return relationship.

In emerging markets if the investors of China may diversify the best choice for them is Pakistan. They will have no benefit of diversification if they invest in India. In developed countries the investor of U.S may diversify within developed countries. Germany is preferable for such investors and they will not get benefit of diversification if they invest in Australia. The countries that are more connected also face flow of contiguous effect. For investors of emerging and developed markets, Pakistani investor may invest in Germany and Japanese investor may invest in Pakistani market because these markets show less connectedness and offer more benefit of portfolio diversification. The study further recommends optimal weights for portfolio diversification and creating optimal hedge. This study is valuable for regulators in order to construct macro stabilizing policies, efficient resource allocation and risk management. This study also provides useful insights for foreign investors, traders and fund managers in preparing investing and trading objectives for portfolio constructing and portfolio diversification.

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