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An Investigation of Systemic Risk Transfer from the United States to the Emerging Markets

by

Aroosa Zia

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Dedicated to my beloved parents and my siblings who always encourage and support me

CERTIFICATE OF APPROVAL

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(MMS181004)

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Abstract

The purpose of this study is to investigate the systematic risk transfer from US to the emerging markets. The study employs the daily data of US and emerging markets. This direct transfer of systemic risk is made possible by phenomena such as contagion and common shocks. The way in which these elements of interconnectedness can magnify seemingly small levels of systemic risk, and subsequently transfer between financial markets illustrate the necessity for a more in-depth analysis. This measurement is done using two approaches. Return and volatility spillover is measured by using Dynamic conditional correlation DCCGARCH (1,1)and ADCC model for US and emerging markets. DCCGARCH also reveals the time varying nature of conditional correlation. The results also show the presence of asymmetric behavior among emerging markets. Where a threshold generalized autoregressive conditional heteroskedastic (TGARCH) model is employed. The DCCGARCH approaches provides evidence for systemic risk transfer and therefore indicate that benefits of diversification are limited. The asymmetric DCC also provides evidence that in case of negative return the correlation among markets increase in some cases.

Keywords: Return & Volatility Spillovers, DCC GARCH, ADCC GARCH, Emerging Markets.

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Abbreviations

ADCC	Asymmetric Dynamic Conditional Correlations
CCC	Constant Conditional Correlations
CDS	Credit Default Swap
CEE	Central and Eastern Europe
DCC	Dynamic Conditional Correlations
EMH	Efficient Market Hypothesis
EU	European Union
FIGARCH	Fractionally Integrated Generalized Autoregressive
GARCH	Generalized Autoregressive Conditional Heteroscedasticity
GARCH-M	Generalized Autoregressive Conditional Heteroscedasticity in Mean
GDCC	Generalized Dynamic Conditional Correlation
GDP	Gross Domestic Product
GJR-GARCH	Glosten-Jagannathan-Runkle GARCH
GPB	Great Britain Pound
JPY	Japanese Yen
OIS	Overnight Indexed Swap
RS-ADCC	Regime Switching Dynamic Conditional Correlation
STCC	Smooth Transition Conditional Correlation
USD	United State Dollar

Chapter 1

Introduction

Systemic risk is a complex phenomenon and in the wake of the sub-prime crisis (Wang & Moore, 2009) the attention given to it has significantly increased. According to the definition systematic risk is the risk of a disruption to financial services that is due to an impairment of parts or all of the financial system and has the potential to have important adverse consequences for the actual economy (Board, 2009). The sub-prime crisis affected financial markets across the world not only the US economy and this is arguable (Board, 2009). This is because of the development of technology and information systems which facilitates more relation between international financial markets (Ryu & Kim, 2015). An investor looking for portfolio diversification as well as higher yields might invest in an emerging economy and which offers a greater yield on investment. There can, yet, also be inverse consequences as a result of these relations, in the form informational spillovers and contagion (Ryu & Kim, 2015). These elements are two of the three broad systemic risk elements, and the third one is common shocks. Among financial institutions contagion refers to the direct relations like those in the inter bank market. Informational spillovers are as contagion, but in an indirect meaning, where by bad news can result in a negative perception related entire financial institutions in that specific nation's financial system. Common shocks refer to indirect relations that might happen when they keep identical or similar assets. Such correlation among portfolios might lead to result in considerably huge losses and fire sales (Georg 2011). The interconnectedness of these elements and

systemic risk therefore ensure that in one financial system a negative shock has the potential to inversely impact on the whole worldwide economy and financial system.

It has been noticed that industries, markets, and stocks are becoming more and more synchronized over the last few years. In current times of international economic uncertainty, it has been confirmed that stock markets have gone beyond their fundamental relation and operating no more in isolation. This is due to the linkage of the international financial system that turns the coordinated actions, a reality in modern financial marketplaces and rapid information transmission by one marketplace to other. Foreign Investment in diverse asset either across sectors gives the profits of portfolio diversification. This strategy provides a clean empirical and theoretical framework to the investors that the correlation between sectors can be changed (dynamic) at any time of certain events happening. Under the period of international financial crises, it is seen that the stock markets normally disclose a system-wide movement and when it is most, and reflects diversification benefits. Fluctuation of Exchange rates (depreciation or appreciation) for many policy practitioners and economists has also been a matter of concern (Wesseh Jr & Niu, 2012).

A lot of devotion has been given to the efficiency of the Stock exchange through different practitioners and economists in modern finance. Markets are effected by the assumption of financial markets. The term efficiency makes a relation among stock price and information. In this context, the efficient market hypothesis proposed that there exists timely and the rapid incorporation of information to the stock prices. So, from the investment all investor acquires the desired returns (Reilly & Brown, 2011). According to Malkiel and Fama (1970) resources allocation is based on the fair price discovery decision that can only be complete when all relevant information reflect to market participants and markets are efficient. So, it is very significant to consider the assessment of the stock market behavior. Dyckman and Morse (1986) state that, "An efficient security market is a market if (a) all available information being fully shown by the price of the security traded

(b) these prices in an un-bias condition to new information and immediately react". On the other way, there is a chance that prices effect the decision making process of the selection of securities and will further can mislead the investors. So, the market inefficiency element reject the efficient market hypothesis and can stretch in the market (Aumeboonsuke & Dryver, 2014). Change, in prices as argued by (Bachelier, 1900), on the basis of the theoretical context of efficient market hypothesis, are random in nature. All periodic events are covered by market price shown by the study however, it doesn't indicate a clear link with the variation of price. The work of Bachelier expanded by the (Samuelson, 1965), and started a new discussion in current economics. According to Samuelson (1965), it would have efficiently increased if one could make some that a price would increase. The idea of efficient market hypothesis that is presented by (Malkiel, 2003) has a criticism that prices of stock can't be fully forecasted; and has debate about the partial forecasting the stock price (Malkiel, 2003).

In reply to Famas study that says "prices adjust without any delay of spread speedily and the arrival of new information", (Malkiel, 2003) stats that "there is no link among current price and future price if information flow is reflected speedily in the stock prices because they are independent". In this way, only the past prices variations tested by technical analysis to anticipate fundamental analysis and future prices just helps the investors to make the comparison based on cash flows, profit, and other benefits of an organization. Due to lower perspective of rationality, in some participants of market, it does not support the argument that the markets are fully efficient. The rapid incorporation of information in stock prices cannot be exposed by experts and professionals (Grossman & Stiglitz, 1980). The market efficiency theory strongly supports this study. Efficient market hypothesis says about the exact information reflection from the prices are in a same way at any point of time. With this information, when professionals and market participants forecast that in near future the prices will rise, they will set their prices appropriately so that there will not be a bigger effect on the market value of an organization. On the other hand, it is very difficult to exchange their prices adequately if there found a high level of probability in the world market. So,

if information arises in the prices of one market, then ultimately it will transmit the effects in the prices of other markets.

Between economies of nations, interdependencies have been rising and it is growingly tough to isolate for a state itself from the other nation's economic events (Solomon, 1977) Stewart, 1986). In returns of stock exchange market and organization performances through domestic borders such interdependence will tend to build relations. Concomitant with this rising interdependence between economies has been a rise in the flow of financial information between domestic borders and a rising capital markets globalization (Grauer & Hakansson, 1987; Llewellyn, 1981; Solnik & MacLeavey, 1991). By an instance of these universal movements of information, the financial statements of some organizations in the US could potentially give important information to prospective and existing stockholders of European corporations.' In a situation, the, sales and profitabilities and incomes of large American companies could affect estimates of market conditions faced by European organizations and suggest how these conditions may impact corporate earnings. Thus in Europe, stock prices might reacted to corporate announcements from the United State and lead to comovements likewise in returns' securities, public disclosure of company events in Europe could lead to reviews in the companies security prices in the US. In a number of studies correlations of returns' securities across the international stock markets have been documented (Eun & Resnick, 1984; Hamao, Masulis, & Ng, 1990; R. Engle, 2002; Schollhammer & Sand, 1985; Solnik & De Freitas, 1988; Beckers, Grinold, Rudd, & Stefek, 1992; Koch & Koch, 1991) and these might because, in part, to transfers transnational information.

As the center of investment through the world the capital market has been known. One of the most enduring discussions in business and economics after the years is whether it a consequence of increased economic action or whether capital market growth as in capitalization causes economic development. In a country market capitalization, which shows the market values of transactions shares, as a consequence an investigation of its plausible elements is discernable and that is of paramount concern on problem regarding to economic growth of countries. There

is also the opinion by development policy makers and economists that a better developed stock market is vital for the mobilization of financial incomes for long term investment and thus constitutes one of the main pillars of economic development. A precursor which has earlier, to this paradox been orchestrated by two different opinion of the (Samuelson, 1965) led technical and the (Malkiel & Fama, 1970) led fundamental market schools, is the held opinion that maintain balance in the capital market and the movements of stock price propel and so determine capitalization market. According to Malkiel and Fama (1970), credence to efficient market hypothesis which considers stock prices movements as providing correct signals for allocation in capital markets; that is organization's production-investment decisions from which investors choose, between different securities that show ownership of organizations events under the assumption that security prices at any stage "completely reflect' whole available information.

A portfolio manager goals to achieve a best return/risk trade-off in investment by diversifying his/her portfolios globally. The advantages of global diversification depend on the correlations among the foreign assets and domestic returns. In global equity returns correlations have been known to change with the passage of time (Erb, Harvey, & Viskanta, 1994; Longin & Solnik, 1995). Intuitively, in equity markets return correlations as the integration proceeds in segmented markets should be increasing (Bekaert & Harvey, 2002). In the diversification area the research has looked at the variations in advantages of diversifying into or from lesser markets. These advantages come from the localisation of economic specialization and economic activity from the segmentation of emerging markets and from the more established marketplaces (Bekaert & Harvey, 2002) Ibrahim 2006. Schmukler 2004;)and as expected by global trade theory (Bernstein, Weinstein, et al., 1998).

Between emerging markets and US, the relative structural difference and the continuing variations in the structures of these markets, might cause variations in the relative structural changes in the markets. These differences in the relative market structure among emerging market pair and US can influence the correlations among the market returns, among emerging market pairs and US. So it means

that the assessment of the varying correlations is important among equity returns of emerging markets and US.

Portfolio management research has looked into the aspects which might obtain the variations in the correlations with the passage of time. (Jithendranathan, 2005) analysis whether macroeconomic elements can cause variations in correlations in Russian equity returns and USA equity markets. The study finds that variation in exchange rates, interest rate spread, and variation in energy price index has positive association with the correlations among returns of two markets. (Loretan & English, 2000) test the linkage among correlations and volatility for bonds, foreign exchange and equities. The study of that an important proportion of the variations in correlations are explained by the differences in volatilities. Though, some researcher have find at this association from the only contagion perspective e.g. (Forbes & Rigobon, 2002) look at the evidence for contagion and volatility In the study the main objective the volatility because volatility is a portion of total risk of the expected returns asset from a theoretical standpoint and when the random variables movement is more instable, sample correlations among these variables are observed to grow. The variables remain unchanged despite the principal processes generating (Boyer, Gibson, Loretan, et al., 1997). High frequency and good quality data for volatility is readily available and this timely data availability makes the meaningful findings as matched to elements of macroeconomic. In case of the emerging markets, the data availability problem for macroeconomic variables is further exacerbated. It is necessary to note the study period includes both boom and crisis. To date, measure the correlations among asset returns several models have been used. The present study uses a particular course of multivariate GARCH models, Asymmetric Dynamic Conditional Correlation Model (ADCC model), to explore pair-wise time varying correlations among emerging markets & US. Use of the Asymmetric DCC GARCH model for estimation of conditional correlations is strongly supported by theory (R. F. Engle, Sheppard, Returns, & Cappiello, 2006). For estimating correlations the reason of applying a more complex model is to reach at a correlations estimate that is observed to give an estimate correlations which is near to the expected future correlations.

The Asymmetric DCC GARCH model permits for the revision of correlation approximations depend on immediate the asymmetric impacts and past conditional variances, thus producing more correct estimates of correlations. The study start with (Forbes & Rigobon, 2002) argument for the relationship between correlations and volatility which is based on the assumption that in correlation coefficients, heteroskedasticity can cause bias. They argue that in the crises period, higher correlations caused by higher volatility due to the bias but over the crises in Hong Kong and Mexico ,with the US market they do not find evidence of contagion.

Yoon (2005), however, following the similar argument of (Forbes & Rigobon, 2002), finds that the lower volatility causes to transfer upwards correlations coefficients by using a stochastic unit root test. The current literature support for this finding as the results shows that decline in volatility is an inverse relationship with the correlations in returns. If the returns volatility keeps declining, this statistically significant negative relationship advice that equity returns correlations are assumed to rise, thereby decreasing the advantages linked with emerging markets diversifying. For correlations estimating that are more relevant for optimization of portfolio, the result of their study is based on a computationally efficient process. The results also shows that among various market returns variations in volatility of the underlying asset can cause the variation in correlations with time. Two important issues are addressed by the study. First is to investigate the dynamics of the correlations; assessment of the correlations is necessary for an US investor and for a fund's manager because of the structural changes between emerging and US equity markets. This is the principal study that investigate the dynamics correlation of the emerging market returns with the US returns using a model that allows for correlations to change with the passage of time. The second part of this study is going to test for volatility as the element that might cause these variation in correlations with time. The financial crisis and higher volatility of emerging markets for portfolio managers has often been cited as two of the reasons to shy away from emerging markets. Understanding of this relationship might be of interest to investors who seek to advantages from diversification to emerging markets.

This study use an efficient method of correlations measuring and analyze to check correlations to change over time cause by variation in volatility.

1.1 Gap Analysis

World markets are interconnected with each other. With the passage of time the change in one marketplace effect the other markets, this process is dynamic process. Sometimes this transfer is accelerated and sometimes it slow down depending upon the global macroeconomic connections. In this situation it becomes important that how US market dictate the emerging markets and this study is for examine the effect of systematic risk transfer from US to emerging markets by using TGARCH models.

In literature there are many studies of systematic risk transfer in financial sectors of different countries. The debate of asymmetric behavior is also there. As the world markets are interconnected with each other and when a market suffer changes it effects other markets of the world. Therefore, it is important to explain the link between US and emerging markets.

1.2 Research Questions

Research Question: 1

Do US market and emerging markets exhibit asymmetric behaviour of volatility?

Research Question: 2

Does US market transfer risk to emerging markets?

Research Question: 3

Does US market have time varying correlation with emerging markets?

Research Question: 4

Does positive and negative shocks have some effect on emerging markets?

1.3 Objective of the Study

Research Objective: 1

To provide insight about asymmetric behaviour of volatility in United State and emerging markets.

Research Objective: 2

To investigate systematic risk transfer among the United State and emerging markets.

Research Objective: 3

To explore the possible volatility link between the United State and emerging markets.

1.4 Significance of the Study

In recent years, systematic risk transfer has received a lot of attention as a new solution to increase the resilienc of markets. However, the existing literature primarily focuses upon the quite difficult practice of pricing this debt issue and institution specific risks. Thus, aim of this study is to shed certain attention upon the risks associated with triggering emerging markets. More specifically, this study is going to investigate the risks of contagion among US to emerging markets. The key purpose of this study is to examined the systematic risk transfer from United States to the emerging markets by using DCC GARCH and ADDC-GARCH in the presence of asymmetric captured through T-GARCH models.Emerging markets has highly volatile and currency swings characteristic and people have more interest in emerging markets because of cross boarder investment. Emerging markets take yield from American market in emerging markets a lot ways to get benefits of opportunities and the high growth rates. The best one is to invest in emerging market. By diversifying investments into an emerging market's basket risk can be reduce, instead of only one. So in this situation it is necessary to measure the systematic risk transfer from US to emerging markets and it will be very helpful for investors and portfolio manager.

1.5 Plan of the Study

Chapter 1 covers the introduction, theoretical background, gap analysis, problem statement, objectives and significance of the research. Chapter 2 includes the literature review of the past studies and hypotheses developed for the study. The research methodology of the current study in Chapter 3. Data analysis and results are covered in Chapter 4. Finally, Chapter five conclude the findings of the study, recommendations & limitation of the current research study.

Chapter 2

Literature Review

The recession of 2007-2009 forced officials and academics to well recognize systemic risk. A valuable description of systemic risk according to the Federal Reserve governor Daniel Tarullo, is "Financial organizations are systemically significant if the failure of the organization to meet its obligations to creditors and customers would have significant adverse consequences for the financial system and the broader economy." By this explanation, it is the failure of a systemically significant organization to pay liabilities that is the reason of systemic suffering as well as negative externalities to the rest economy. Therefore, examine of systemic risk are connected with company's insolvencies or near insolvencies that are unavoidable outcomes of a decay in equity valuations for organizations those are strongly levered. Some researchers debate that when the currency depreciates, long run trade can be improved and some debate otherwise (Bahmani-Oskooee & Alse, 1994). To explore the dynamic connection among exchange rate movements and industrial returns number of studies has been conducted. This relation is further argued on two potential theoretical backgrounds in the literature of financial economics. The first one is the study by (Dornbusch & Fischer, 1980) state from a flow-oriented model, that future expected cash flows which ultimately affect the industry as a whole and the organization competitiveness is strengthened by the depreciation of local currency, which in turn leads to rise their exports.

Secondly, the stock-based models of exchange rate determination (also known as portfolio balance approach) established a linkage among exchange rates and prices

(Branson, 1983; Frankel, 1992). Variations in exchange rates provides the benefits for national industries. With the fluctuations in exchange rate. Any change happened in the prices might be due to (a) the terms of rivalry change with outside organizations for local importers and exporter competitors, (b) the input costs change for industries that use globally priced input, and (c) in foreign currency, rules modify the estimation of benefits designated. Through these negative arrangements of impacts, in a few industry exchange rates movements influence directly than others, while the exchange rate variations effect on an industry ought to depend fundamentally on the industry's linkages with the rest of the world economy. Understanding what normally compares to industry-specific transmission and relationships and magnified exchange rates explicit could furnish investment institutes and financial specialists with significant experiences for the portfolio optimization to minimize the risk i.e. diversification techniques. Investors, who depend on the historical estimates of correlations can get advantages to use the guidance and make efficient decisions from the diversification of portfolio.

Most of studies explore the link among stock and foreign exchange markets, the relationship between these markets is often unstable. Any changes in prices of stock indexes, caused by fluctuations in the exchange rate, turn the optimal investment strategy. Furthermore, the principle of mean reversion is applicable to long-term time interval and may lead to errors in the timing of the transaction. Chaudhuri and Wu (2003) said that incorrect conclusions caused by structural breaks about the stock market efficiency. According to (Jung & Maderitsch, 2014) volatility can change dramatically, in the forecast model if structural jumps are not reflected. In Russia (Mikhaylov, 2018) outlines in the oil market macroeconomic trends of supply and demand and the characteristics of the modeling in the conditions of unstable economic situation. (Mikosch & Stărică, 2004; Krämer & Azamo, 2007), argued that the volatility persistence level can be accounted through the autoregressive model for long memory (IGARCH).

The study proposes that the impact of volatility spillovers among exchange rate and national stock indexes takes place in both directions. As a currency market breaks can cause a variation of currency shock and currency rate in the stock

market is reflected. To detect structural variations in the volatility market the study use the fractal model by (Sansó, Aragó, Carrion, et al., 2004). The analysis was focused on the oil markets exporting countries, as China, Russia, India and Brazil from 03/ 2009 to 03/2017. Any countries use the floating exchange rate government in this period (Brazil and India). China is going to go to the free currency government. But Russia established the inflation targeting regime and eliminate the stock exchange rate band since the start of 2015. The study key hypothesis is that the effect of volatility spillover on emerging markets is foreseeable. Moreover, in currency and stock market volatility it is not clear whether there is a continuous long memory containing the structural breaks. In the analysis of volatility the presence of long memory plays a significant role, because it means that to predict future prices of asset current market trends can be used. In addition, the structural variations tend to rise the variance of the long persistence of volatility. Kasman, Kasman, and Torun (2009) previously a long memory found in eight stock markets of Eastern European. At the time, the existence of this aspect on the five stock markets in Central Europe suggested by (?, ?). The effect of structural breaks, there are no papers purposed the long memory FIGARCH constancy methodology for the oil exporting countries taking into account. American market examined by (Kim, Kim, & Lee, 2015) and the findings showed that the high exchange rate against the U.S$ affects the national index volatility, but decreases the U.S. market volatility.

In Japan (Jayasinghe & Tsui, 2008) have identified the relation among exchange rate and stock. The researchers argued that there exist a spillover impact among the stock prices volatility in six markets of Japan. The volatility of equities rises more as compare to the volatility of the exchange rate in these sectors. The volatility of exchange rates of three main Unites State trading partners (Japan, Canada and EU) and the stock market of America. In the period of structural breaks these data indicates that the volatility spillover effect is greater. Andreu and Vidal (2014) examined the link between Forex markets and stock for twelve emerging stock markets and found that there exist a positive significant influence in both directions in all selected markets, but Colombia. Findings of the study

of (Kasman et al., 2009) are great: currency and Interest rates fluctuations are the key determinants of the asset price volatility. Sudden variations caused by volatility breaks among currency and equity markets, have a short term impact. So about this long term shareholders should not place. In four developing nations (Walid, Chaker, Masood, & Fry, 2011) by using weekly data, explored the exchange rate volatility. According to the study stock indexes volatility depends on the variance and mean of the stock exchange rates. For the Chinese market Zhao (2010) showed that there exist also a correlation in the volatility dynamics of the exchange rates and volatility of prices of Chinese equities with the sample of 2001 - 2009.

Since 1990 an instant growth is seen in the investment international equity. A lot of evidences are being found on volatility spillover impact of exchange rate return on stock market return in different methods and in different nations. Variations in exchange rate has got an impact on stock market whether it is import or export oriented or both. India as an emerging economy the exchange rates changes and their effect on the return of the stock market are critical and significant in Indian context and that too post financial crisis like subprime crisis. The key objective of the study is to explore the spillover impact and to give an idea from exchange rate return to market return and vice versa how information is transmitted. To investigate the link of volatility among stock market return of India and the return from the currency pairs (four) actively traded in India. Two prominent indices of stock (NIFTY and SENSEX) are selected from two stock market Bombay Stock market & National Stock market and four currency couples selected for the study are GBPINR, USD-INR, JPY-INR, EURO-INR. The study uses daily log normal return with a timeframe of 2008 -2016 for all the chosen variables. Cointegration and GARCH models are apply to check the long term linkage and volatility spillover between these two stock markets. The results showed that between foreign exchange market and Indian stock market there exist a bidirectional volatility spillover and the stock markets move in tandem with each other. According to the study a long term association exists among these two stock markets and there is a movement of information between these markets. The findings can be useful

for international investors for effective hedging and portfolio diversification and also help the policy makers for taking important decisions. In a simple analysis the scaling properties encompass number of the volatility features of financial stock markets. That is the reason the study use them to investigation the different degree of advancement markets. Empirically this study the scaling properties of Stock Market daily indices, International Exchange rates and instruments of fixed income by applying the generalized Hurst method. Results indicate that the scaling exponents are linked with features of the particular markets and can be used to distinguish stock markets in their development phase. The robustness of the findings is examined by a computation of the scaling and both Monte-Carlo studies in the frequency-domain.

According to the study of Sung Y. Parka, Wonho Songa, Doojin Ryub the DCC between the financial markets of Korea and US and recognizes the elements of those correlations applying the VAR-DCC-MGARCH model. Both nations affected by the Global Financial Crisis (GFC) according to the study. Before the Global Financial Crisis though the shocks to the Korean stock market are not shared by the United State stock market, those to the United State market after the Global Financial Crisis are shared by the Korean stock market. The elements of the dynamic conditional linkage among the Korean and US markets using national macroeconomic variables and Korea/US financial variables also examined by the study. The findings imply that the financial variables of US are more important than national macroeconomic variables and that they have become more and more significant over time.

Another study investigate how information by the most significant and financial shocks and influential advanced stock market impact the dynamics of a top emerging financial market, considered as the macroeconomic dynamics of the both marketplaces. While there is several evidence in contradiction of the market relationship among emerging and advanced economies (Gilmore & McManus, 2002), the presence of information spillover from advanced to emerging markets supported by most of the studies, along with integration and links among these stock

markets. In their comprehensive appraisal of both empirical and theoretical studies on international market links and integration, (Kearney & Lucey, 2004) report enough evidence of market integration among emerging and developed markets. In Asia (Cha & Oh, 2000) find Strong market relations between emerging and developed markets. Since the Asian financial crisis the impact on Asian markets by developed stock markets have increased. According to the (Dooley, Folkerts-Landau, & Garber, 2009) negative shocks and bad news that start in developed stock markets intensely impact emerging economies. The Korean market dynamics reported by (Park, Ryu, & Song, 2017), which has a little open structure of economic, are provided by foreign shocks from developed stock markets. The study choose the most representative stock market in every case as sample and apply a novel econometric framework to examine volatility spillovers and information among markets. The study focus on the robust ties among Korea and US economies, which are better-documented in the study (Kim et al., 2015). As the strong effect of the United States market on the stock market of Korea determined by the growing contribution of foreign investors (D. Ryu, Ryu, & Hwang, 2017; Yang, Ryu, & Ryu, 2017), the open economy, and other features of the Korean markets (Kang, McIver, & Yoon, 2017; D. Ryu et al., 2017), The study investigate the DCC among the Korea and US stock markets and their elements, applying the vector autoregression-dynamic conditional correlations-multivariate generalized autoregressive conditional heteroskedasticity (VAR-DCC-MGARCH) model. The study further examine which reasons (national and global) have superior explanatory control in terms of explanation the dynamics and time-series properties of the market of Korea and investigate the roles of common market shocks. The study conclude from the estimated conditional variances, that the Global Financial Crisis shocks are common to the markets of Korea and US, but rest shocks in every nation are not. In the market of Korea the volatility before the GFC is not distributed by the United State stock market seen in the estimated conditional covariance, but after the GFC the volatility in the US market is shared by the markets of Korea. So, the study conjecture that after the GFC there occur spillover impact from the market of United State to the Korean stock market.

A study conducted by Csilla Horvátha, Feray Adıgüzelb examined the relationship among compulsive buying and hedonic shopping motivations in developed and emerging markets using a framework with 520 mall visitors female in four states representing two emerging (Russia & Turkey) and two developed (the Germany & Netherlands) markets. The findings show that shopping motivations of hedonic are positively linked to compulsive buying. Though, various hedonic shopping motivations seem to contribute to the advancement of compulsive buying in developed and emerging nations. In advanced markets idea shopping, satisfaction seeking and play role were found to be the main hedonic shopping motivations paying towards compulsive buying. So, the image looks very different in emerging markets. It is very interesting that non out of two motivations (idea shopping and gratification seeking) clearly linked to important drivers of buying compulsive regarding to the current studies, predominantly based on advanced nations, is look to be related to compulsive buying in emerging markets. Instead, in such nations the major motivation is found to be escapade seeking. Moreover it is very interesting that role play has an inverse impact on buying compulsive, which is the reverse of what study found in advanced nations. In emerging states findings of the study, together with the limited research, call for in-depth and by research in such states on the moderating part of economic conditions and domestic culture in the expansion of compulsive shopping motives and buying.

Emerging markets have taken a main role on the world economic stage. Propelled by rising incomes and favorable demographics, these economies are rising at a pace twice that of their advanced counterparts. They now show well over one-half of world GDP and make more than three-quarters of international economic growth. Till now, on a nominal basis, emerging markets represent less than one-third the value of entire world stock market capitalization. This substantial discount offers an enticing chance to participate in some very compelling, real-growth investment opportunities. The populations of various emerging market nations are decades younger than those in the advanced world. Health care is becoming progressively accessible and, since the 1980s, post-secondary enrolment rates have increased more than ten-fold. Over this same period, GDP per capita has increased by

more than 7.5 times. Energized by these dynamics, emerging market consumers are having a profound effect on the international economy. Their new demand for utilities, health care, infrastructure and other goods and services is creating outstanding opportunities of investment.

Over the last two decades the growing economic integration of global stock exchanges has become particularly significant. The increased flow of capital and the substantial development of technology among nations are between the main aspects contributing to this assumed globalization. However, understanding the extent and nature of relationships among diverse financial markets is vital for financial institutions and managers of portfolio. The returns volatility is sometimes used as a natural examine of the hazard of financial assets holding (Brooks, 2002), however, when quote to global equity stock markets integration, authors not only examine causality relations of returns, but they also measure effects of volatility spillover. Information regarding volatility spillover impacts is helpful for the use of hedging tactics and value at risk. Currently, as the emerging markets has more significant, economists have attention not only on advanced nations (Karolyi, 1995; Bae & Karolyi, 1994), but they have also give attention to emerging markets (Worthington, 2004; Goetzmann, Kumar, et al., 2005; Lin et al., 2006).

For example, the range of the relationships among developed stock markets and emerging stock markets has helpful for investors in both developed & developing nations. If emerging stock markets are just weakly integrated with their advanced countries, external shocks might have less influence on the emerging markets, and then the developed market investors can get advantage by adding the emerging market stocks in their investment portfolio, as risk should reduce by this diversification, Instead of this, if the emerging stock markets are completely integrated with the advanced stock markets, in the emerging stock markets the volatility might decrease as it will be mostly examined by the developed stock markets' volatilities, and the national emerging investors will advantage from a small capital cost (Li, 2007). Thanks to recent expansions in econometrics, and the linked software econometrics, in adding to investigating returns of the markets spillovers among

equity markets, now the study can also investigate examine spillovers among various markets by applying multivariate GARCH (MGARCH) models. Everyone take benefit of these expansions, by examining relationships among some emerging Asian stock markets and two developed stock markets. The six Asian emerging markets used in the study are Indonesia, Malaysia, China, India, the Philippines and Thailand. The study use the Japan and U.S. to show advanced nations in two different geographical regions and the study use an asymmetric BEKK model proposed by (R. Engle, 2002), and developed by (Kroner & Ng, 1998), to explore both volatility spillovers and shock between two developed markets and each emerging market.

The data sample of the study is includes both the 1997 Asian financial crisis and the 2007 subprime financial crisis and Spans 20 years. Though the empirical finance study is rich in literatures devotion on the transmissions and dynamic relationships among major stock markets, the study differentiates itself from these in three main aspects. First, on the contrary of testing transmissions only among advanced stock markets, the study explore the linkages among the Asian emerging markets and developed markets. Next, the study not only investigate the long run association among different markets, but also relate the findings with various samples, and the two short-run periods are chosen based on two current financial crises. Finally, the third one that is more important, the study consider volatility spillovers and past shock between different stock markets, whereas the past literature give more attention on markets returns transmissions. The study investigate the relationship of stock exchange between the Asian six emerging nations and U.S., Indonesia, Japan, Malaysia, China, India the Thailand and Philippines during 1/1/ 1993 to 31/12/2012. The spillover volatility is modeled by an asymmetric multivariate GARCH model. Study find significant volatility spillovers and unidirectional shock by the United State market to both the Japanese and the Asian developing markets. It is also explored that the volatility spillovers effect among the United State Stock market and the markets of Asia are bidirectional and stronger in the financial crisis of Asia. Additional, between the past 5 years, the relationships among the Japanese market and the emerging markets of Asian

became clearer. The study pays to the literature by investigating both the long and short times and focusing on volatility spillovers and shock instead of return spillovers, most other studies which have been the primary focus.

The study explore spillover impact of the current United State financial crisis on 5 Asian emerging nations through measuring conditional correlations of financial asset returns between states applying multivariate GARCH models. The study objective a novel method that simultaneously measures the conditional correlation coefficient and the impacts of its determining elements with the passage of time, which can be apply to recognize the networks of spillovers. In September 2008 the study find certain indication of financial contagion about the Lehman Brothers collapse. Moreover, explore a leading role of overseas investment for the conditional correlations in global financial markets. The dollar Libor-OIS feast, foreign investment and the sovereign CDS premium are make to be important elements affecting foreign stock markets.

While the episode is deliberated the first international crisis from the Great crises (Horen & Claessens, 2009), it looks that emerging markets economies were anyhow capable to decrease the effect of these outer shocks by the United State until and unless the insolvency of Lehman Brothers in 10/ 2008, which caused in a direct shock that has spread around emerging economies increasingly (Dooley & Hutchison, 2009). In Taiwan the equity price, for example, in three months fall by 38.5% following 15/09/2008. In the similar time, the Korean Won depreciated in contradiction of the United State by dollar 19.2%, which indicates to robust deteriorating spillover impacts on actual areas. In spite of the significance of understanding the contagion nature or spillover impacts in financial markets, the profession has unsuccessful to reach a consensus even on the presence of contagion in previous financial crises. Modifying for heteroskedasticity bias, (Forbes & Rigobon, 2002) explore virtually no indication of increases in "unconditional" cross-market correlation coefficients, which is a little at odds with earlier evidence of contagion (among others, (King & Wadhwani, 1990; Lee, Lee, & Lee, 2010; Calvo, Leiderman, & Reinhart, 1996). Corsetti, Pericoli, and Sbracia (2005), so, pointed their analysis can be biased to the null hypothesis that means no report

and contagion stronger evidence of contagion with a substitute analysis. The study explores the transmission of the present United State crisis to financial stock markets in five emerging economies of Asia: the Philippines, Korea, Indonesia, Thailand & Taiwan. The study select these emerging market economies other than nations with completely established financial markets because financial markets in advanced nations are well integrated with each other. So it observed rather than obvious that adverse shocks would propagate to other selected nations by extremely integrated financial stock market networks as well as actual activities networks. However, the propagation tools in these Asian emerging nations are not recently very well identified because they are not completely integrated with the other world adding the emerging markets and U.S. normally represent low correlations with advanced markets. While China is one of the most influential economies between Asian nations, study not includes China in main empirical test because work strongly depend on marketable assets where government interferences play a partial role. For instance, Yuan of China has virtually stayed pegged to the U.S. dollar for about two years from the summer of 2008 after being allowed steady appreciations against the dollar until the start of the financial crisis. Hong Kong also has employed same foreign stock exchange market intervention strategies.

2.1 Time Varying Conditional Correlation

Since the past two decades, there exists a wide literature on diverse Multivariate GARCH models with respect to conditional volatility and conditional variance-covariance characteristics. First of all, the first multivariate GARCH model propose from (Bollerslev, Engle, & Wooldridge, 1988). To determine the conditional covariance matrix among the series through the VECH model. The VECH model is used to check the direct generalization of uni-variate approach when the estimated returns dimensions of large parameters grows. In addition, to make this model more comprehensive and precise, the earlier versions of Engle, Baba, Korner's and Kraft & BEKK model is also apply to determine the conditional constant correlation (CCC) and conditional covariance matrix as well as with its other

variants. Later (R. Engle, 2002) provides the idea of Dynamic Conditional Covariance (DCC) GARCH model in which rather than Constant Conditional Correlation (CCC) the assumption of time varying conditional correlation is introduced. Cappiello, Engle, and Sheppard (2006) further extended the work of (R. Engle, 2002) in which they give another idea of Asymmetric Dynamic Conditional Correlation (ADCC) GARCH model that includes the underlying assumptions of negative & positive shocks of news. Mostly, it is observed that the volatility of the market which have same sample size reflects more impact of the negative shock instead of positive shocks. In uni-variate GARCH models proposed by (R. F. Engle & Ng, 1993) these asymmetric behaviors are broadly discussed. Nevertheless, a limited literature exists on the behavior of asymmetric correlations between the stock markets but global financial crises give it more importance with respect to negative shocks and more turbulence. There exists a huge body of literature on the spillover effects and co-integration on stock markets returns and global financial integration. For the purpose of the advantages of diversification and portfolio allocation, the results of volatility transmission specially in the financial crises has attained a considerable attention in the prior literature. It is also shown in the past literature that the impact of negative shocks tend to increase the high volatility magnitude as compared to the positive shocks (R. F. Engle & Ng, 1993). Scheicher (2001) uses VAR-CCC model with the time frame of 1995 to 1997, to investigate the co-integration among three developing markets of Europ i.e., Poland, Hungary and The Czech Republic. The result of their study show that, there exists both global and regional returns transmission but only in regional market volatilities transmission. This outcomes suggest that, mean spillover of global shocks is found instead of volatility shocks in Central Europe markets. Price and (Kasch-Haroutounian & Price, 2001) apply two different multivariate GARCH approaches with the time period of 1994 to 1998, the BEKK and the constant conditional correlation (CCC) techniques to check the interrelationship between European Central markets; Poland, Hungary, Slovakia and the Czech Republic. The researcher report that, Polish and Hungarian and Czech & Hungarian are significantly related to each others with the values of 0.13 and 0.22

respectively. For the rest pairs, correlations are found to be smaller and insignificant. Savva and Aslanidis (2010) examined the relationship among market and both between five Eastern and Central European countries with the taking time frame of 1997 to 2008 (the Czech Republic, Slovenia and Slovakia, Poland, Hungary) and vis- -vis euro area market by applying smooth transition conditional correlation CC (STCC) and constant conditional correlation (CCC) models. The evidence of higher correlation is found among the largest markets of CEE (Poland, Hungary & the Czech Republic) in comparison to the Slovakia and Slovenia. A strong inter relationship of the Poland Hungary and Czech Republic, in this area is also found by (Savva & Aslanidis, 2010). The authors also repeat that there exists correlation increasing vis–vis euro area between Polish and between CEE markets, Czech and Slovenian markets. So, between the pairs of other stock markets they find a stability. Tse (2000) check the impact of time varying conditional correlation among foreign exchanges and stock markets by applying time varying conditional correlation model VCC.

Using Asymmetric Dynamic Conditional Correlation (ADCC), Dynamic Conditional Correlation (DCC), Asymmetric Generalized Dynamic Conditional Correlation (AGDCC) Generalized Dynamic Conditional Correlation (GDCC) models, (Cappiello et al., 2006). (?, ?) also examine the interdependent linkage among three emerging markets (Poland, Hungary and the Czech Republic) vis–vis the aggregate euro zone market. The researchers observe a substantial correlation among euro area market and CEE due to financial crises and enlargement of E.U. However, they also get a direct linkage among higher correlation and financial depth. Furthermore, between monetary and macroeconomic developments there is no relationship or any influence exists on correlations. During the period of 2001 to 2011, (Creti, Joëts, & Mignon, 2013) use DCC GARCH model on stocks & 25 commodities and investigate the mechanism of conditional correlation. Prime importance in this paper is given to explore the linkage between each commodity and S& P 500. According to these authors a high conditional correlation exists during the entire period, critically more in crises period of 2008. In addition, they also investigate that for cocoa, coffee and crude oil, speculative movements

are found. Finally, they report that only gold is mostly correlated or negative associated with the financialization of commodity and stock market lowers their strong use in diversification, with main expectation for coffee, cocoa and gold. The weekly prices data from 1981 to 2006 chosen by (Chong & Miffre, 2010) and explore the hedging of treasury bills and stocks by applying DCC-GARCH models with twenty five different future contracts of commodities. A declining trend of correlation among S&P 500 and commodity futures is found by (Chong & Miffre, 2010) over the time. This suggests that, for the strategic allocation of asset and short term interest rate securities very significant. The study of (Chong & Miffre, 2010) embeds until 2006 sample period, so, by the phenomenon of financialization results are less influenced. The most significant macroeconomic variable Crude Oil as an industrial commodity is used by (Choi & Hammoudeh, 2010) study to explore volatility behavior.

In their study, by using DCC GARCH and GARCH switching approach models, they measure the conditional correlations and volatility regimes. The results of the data from 1990 to 2006, they addressed that, since 2003 correlation shows an increasing trend. (Demiralay & Ulusoy, 2014) examine the linkage among commodity markets and S&P 500. Using the ADCC GARCH model, the study provide evidence observed conditional correlation among S&P 500 with UBS-commodity index of Dow Jones and its sub indices. To focus on the importance of diversification and portfolio allocation, (Kalotychou, Staikouras, & Zhao, 2014) investigate the volatility correlation among sectors using the stock exchange sample of the Japan, U.K and U.S. They addressed these two points; (i) for the time varying volatility there exists a benefit of portfolio management. (ii) They also expose the correlations for the dynamics returns.In their framework, they use the weekly data of returns and use Exponential GARCH EGARCH model with the sample of 1992 to 2013. The study states that the correlation among commodity indices and equities are found to be volatile highly. Furthermore, in financial crises using the weekly data of returns from 1997 to 2009 it find an increasing trend. Kouretas and Syllignakis(2011) check the correlation among CEEC countries (Estonia, Hungary ,the Czech Republic, Slovakia & Slovenia ,Poland, Romania,) vis–vis the

Germany, Russia and U.S. by applying DCC GARCH model. The authors find that the correlation in the these countries stock market exhibit an increasing trend over the time and time varying correlation for these CEE nations reduce the advantages of diversification. The authors investigate that, a huge degree of financial openness can broadly explain the correlation coefficient, provided the availability of the external investors. (Chang, McAleer, & Tansuchat, 2011) show the hedging strategies to hedge crude oil futures markets and prices of crude oil by using CCC, BEKK, DCC, and VARMA-GARCH. The study use, the sample of both BRENT and WTI prices of crude oil. Their results provide an evidence on the time varying nature of hedging ratios that, they all show a varying behavior with the passage of time.

On the basis of hedging effectiveness, comparison is made through both BEKK and DCC models of hedging in which, hedges measured from DCC appear better than BEKK. A study to determine the hedging effectiveness is conducted by (Pan & Hsueh, 1998) between prices of crude oil and other petroleum products like gasoline and oil by applying regime switching asymmetric dynamic conditional correlation RS-ADCC GARCH model. The BEKK hedging effectiveness model appear to be the better for hedging gasoline futures with crude future with in this study. The highest hedging effectiveness for heating oil and hedging crude oil is provided by the regime switching RS-ADCC model.To investigate the dynamic relationship of volatility among equity prices of oil and Ghana prices of Nigeria, for the sample of 2002 to 2010, Lin et al. (2014) apply DCC-GARCH and VAR-GARCH models in their study.They analyze that, the changes for ratio of optimal hedge is different for both these countries as; from 0.51 to 0.40 for Ghana and 0.56 to 0.50 for Nigeria, the optimal hedge ratio varies. (Sadorsky, 2014) investigates the relationship of conditional correlations and volatility between Dow Jones Specially Responsible Investments equity portfolio, oil and gold by applying DCC GARCH and CCC models for weekly data of returns. The findings are same as the result of S&P 500 that, in gold and oil market the SRI investors can hedge their investment by giving a same amount as that of S&P 500 investors expect to pay. The difference among the average hedge ratio of SRI with oil and S&P 500

with oil is 0.02 (as hedge proportion among the S&P 500 and oil is 0.07and SRI with oil is 0.05 and) that is very less. Thus, there is a huge amount of literature on contagion on the stock and bond markets and time-varying conditional correlations of developed nations (Bartram & Wang, 2005; R. Engle, 2002; Missio & Watzka, 2011; Cappiello et al., 2006; Dungey & Fry, 2009; Kenourgios, Samitas, & Paltalidis, 2011) So, on emerging markets conditional correlations between, stock, bond markets, industries there is limited related literature. The evidences on the correlations among different markets and industries are limited in prior literature that must capture the negative or positive asymmetric effects with the passage of time.

2.2 Hypothesis of the Study

H_1: There is systematic risk transfer from US to the emerging markets and vice versa.

H_2: There is asymmetric systematic risk transfer from US to emerging markets and vice versa.

Chapter 3

Data Description and Methodology

The methodology is divided in two stages. In the first stage GARCH processes are used to investigate residuals for each market to examine the potential for systematic risk transfer from United State to the emerging markets. To measure contagion effect from United States to emerging markets a Dynamic Conditional Correlation (DCC) & (ADCC) models are used respectively. Secondly to consider the asymmetric shocks Threshold Generalized Auto-regressive Conditional Heteroscedasticity (TGARCH) model is used for estimation of residuals and then there are used to study the time varying correlation through DCC/ADCC GARCH.

3.1 Brief Description of Selected Markets

This bring description of markets selected for the study is given blow.

United State Stock Market (S&P 500/GSPC)

The New York Stock Exchange is an American stock market situated at, New York City. Number of listed companies at New York Stock market are 2400. It is the world's biggest stock exchange with market capitalization of US $30.1 trillion on 2/ 2018.The S&P 500/GSPC index is used as representative of market performance.

Chines Stock Exchange (SSE Index)

The Shanghai Stock Exchange (SSE) is a stock market that is located at Shanghai china. It is one of the two stock markets working individually in the People's Republic of China, the other being the Shenzhen Stock market. Shanghai Stock Exchange's market capitalization at US$5.5 trillion as of April 2018 and it is the world's 4th biggest stock exchange. There 1515 companies are listed in shanghai stock market, listed securities 13902 and listed stock are 1558 on Aug, 2019.

Pakistani Stock Exchange (KSE 100)

Pakistan stock exchange is a market with exchange, at Karachi, Islamabad and Lahore. In 2017 Pakistan stock market is reclassified as a MSCI Emerging stock Market. On February 23, 2018, number of companies listed at Pakistan stock exchange are 559. It has market capitalization of $84 billion on Feb 23, 2018. PSX-100 is taken as representative index of market.

Russian Stock Market (MOEX)

It is representative index of Moscow stock exchange that is the Russian biggest stock exchange which is situated in Moscow Russia. In 2018 Moscow market capitalization is $576.12 billion and 221 corporations are listed in 2018.The representative index of market is MOEX.

Indian stock market (BSESN)

Bombay Stock Exchange Ltd is first stock market of Asia established in 1875. Bombay Stock market is an Indian stock market situated at Mumbai. The Bombay Stock markets's total market capitalization of more than $2.2 trillion as on April 2018 and it is the world's 10th leading stock exchange. Number of registered companies are 5,461 in May 2019. It is represented by Sensex 30.

Brazil Stock Market (BVSP) Brazil Stock market Index is located in São Paulo, Brazil. Brazil stock market's capitalization is US$ 1.0 trillion in 2018.Number of listing companies in Brazilian stock market is 368.The representative index is Ibovespa/Bovespa.

South African Stock Market (JSE) Johannesburg Stock Exchange is the biggest stock market in Africa. It is located in Johannesburg, South Africa. JSE has 472 listed companies and average per month traded figure is US$6.399 billion.

South Africa's Market Capitalization data is stated on 12,520.972 ZAR bn in Nov 2018.

3.2 Methodology

The use of correlations to investigate spillover and successively the probability of systematic risk transfer is casement to have biases. That is, in time of high volatility, correlation coefficients grow and be biased up (Forbes & Rigobon, 2002). To forecast these biases, a dynamic conditional correlation (DCC) model is used. A Dynamic conditional correlation model investigate the co-movement among the markets through taking the correlations of variations in the market returns, and offers the benefit of timevarying volatility into account, though also addresses the feedback effects by not assuming unidirectionaility (Frank & Hesse, 2009). A dynamic conditional correlation (DCC) technique employs standardized series of returns, which means that conditional volatilities are essential to be measured. To sort out this, TGARCH method is taken. This is also called Glosten-Jagannathan-Runkle GJR-GARCH method (Glosten, Jagannathan, & Runkle, 1993). The TGARCH method taken by (Rabemananjara & Zakoian, 1993) is an addition of the standard TGARCH method but contains the lagged conditional variances and Standard Deviation as a regressor. For the dynamics of volatility The TGARCH model equations are as below:

$$\sigma_m,_t^2 = \omega_{m,G} + \alpha_{m,G} r_{m,t-1}^2 + \gamma_{m,G} r_{m,t-1}^2 I_{m,t-1}^- + \beta_{m,G} \sigma_{m,t-1}^2 \ldots\ldots\ldots\ldots\ldots\ldots \quad (3.1)$$

$$\sigma_i,_t^2 = \omega_{i,G} + \alpha_{i,G} r_i^2,_{t-1} + \gamma_{i,G} r_i^2,_{t-1} I_i^-,_{t-1} + \beta_{i,G} \sigma_i^2,_{t-1} \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.2)$$

With:

$$\mathrm{I}_{t-1} = \begin{cases} 0, if r_{t-1} \geq \mu \\ 1, if r_{t-1} < \mu \end{cases} \quad \text{..... (3.3)}$$

The volatility is so measured via maximizing the log probability for both stock markets' data sequence. The returns of the markets are then better adjusted to make standardized returns through distributing with these volatilities. A model of mean-reverting correlation permits the correlations to revert to the average long-run correlation $\rho_{ij} = E(z_{i,t}z_{j,t})$. The correlation dynamics are driven via the variable qij. Using correlation setting and targeting the first unconditional correlation seed opinion $\overline{\rho}_{ij} = \frac{1}{T}\sum_{t=1}^{T} z_{i,t}z_{j,t}$ a specification in the situation of a GARCH (1,1) model can be illustrated . The conditional correlations for the two objects are then found through standardizing $q_{ij,t-1}$ as:

$$\rho_{12,t} = \frac{\rho_{12,t}}{\sqrt{q_{11,2}q_{22,t}}} \text{..... (3.4)}$$

Wherever:

$$\mathrm{q}_{11,t+1} = 1 = \alpha(z_{1,t}^2 - 1) + \beta(q_{11,t} - 1) \text{..... (3.5)}$$

$$q_{12,t+1} = \rho_{12} + \alpha(z_{1,t}z_{2,} - \overline{\rho}_{12}) + \beta(q_{12,t} - \overline{\rho}_{12}) \ldots\ldots \quad (3.6)$$

$$q_{22,t+1} = 1 = \alpha(z_{2,t}^2 - 1) + \beta(q_{22t} - 1) \ldots\ldots\ldots\ldots\ldots \quad (3.7)$$

For the volatilities, the similar quasi-maximum probability process is applied to discover the persistence parameters and β by adjusting $q_{11,0} = 1, q_{22} = 1$ and $q_{12,o} = \overline{\rho}_{12}$. The quasi-maximum likelihood system offers fixed, ineffective estimations, but to avoid mathematical optimisation in high dimensions is the best choice (Christoffersen, 2012). The log likelihood equation which is maximized by taking the bivariate normal distribution function for $z_{1,t}$ and $z_{2,t}$.

Chapter 4

Data Analysis and Discussion

This chapter covers the symmetric and asymmetric model applied to explore the transfer of systematic risk from US to emerging markets. The models used for estimation are GARCH and GJR-GARCH. Finally DCC-GARCH and ADCC-GARCH are used for explaining the time varying behavior of correlation.

4.1 Data Description

Table 4.1: US and Emerging Market Countries

Sr.No	Country Name	Indexes	Time Period
1	US	GSPC	7/1997-4/2019
2	China	SSE	7/2002-4/2019
3	Brazil	BVSP	7/1997-4/2019
4	Russia	MOEX	7/2002-4/2019
5	India	BSESN	7/1997-4/2019
6	South Africa	JSE	7/2002-4/2019
7	Pakistan	KSE	7/1997-4/2019

4.2 Graphical Representation of Returns

In general a rising trend is observed in stock market of India as reported in figure 1.The figure 2 indicates the volatility of the return is not constant across the year there are periods of high volatility and low volatility.

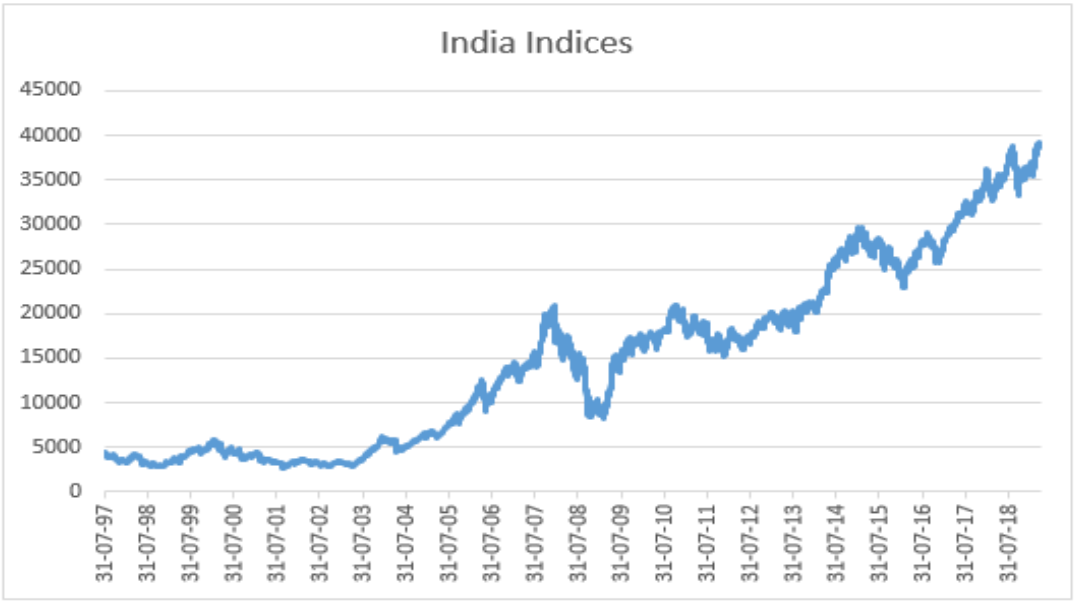

FIGURE 4.1: Research Model

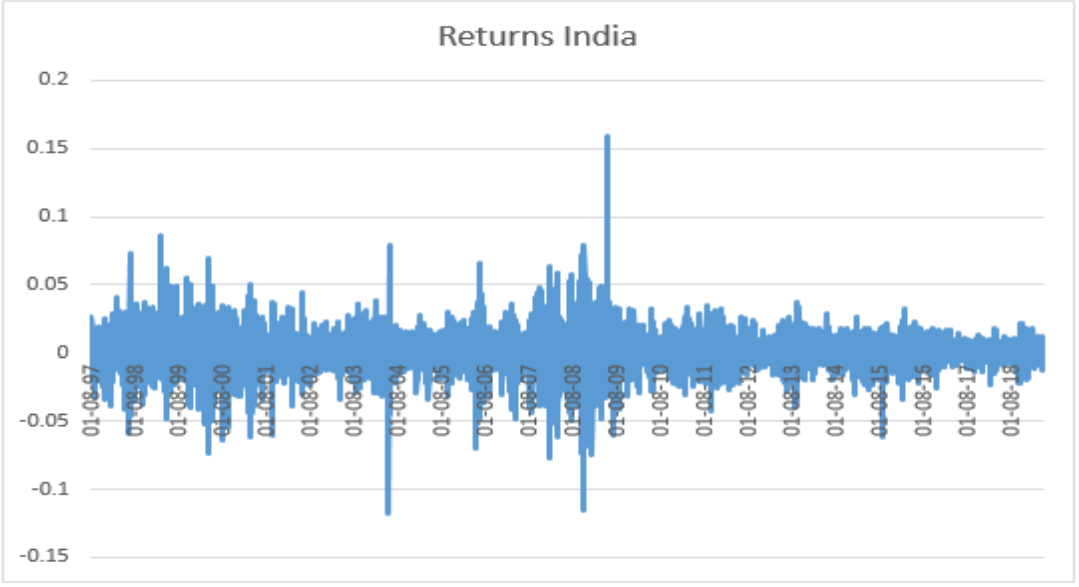

FIGURE 4.2: Research Model

In general a rising trend is observed in stock market of Brazil as reported in figure 3.The figure 4 indicates the volatility of the return is not constant across the year there are periods of high volatility and low volatility.

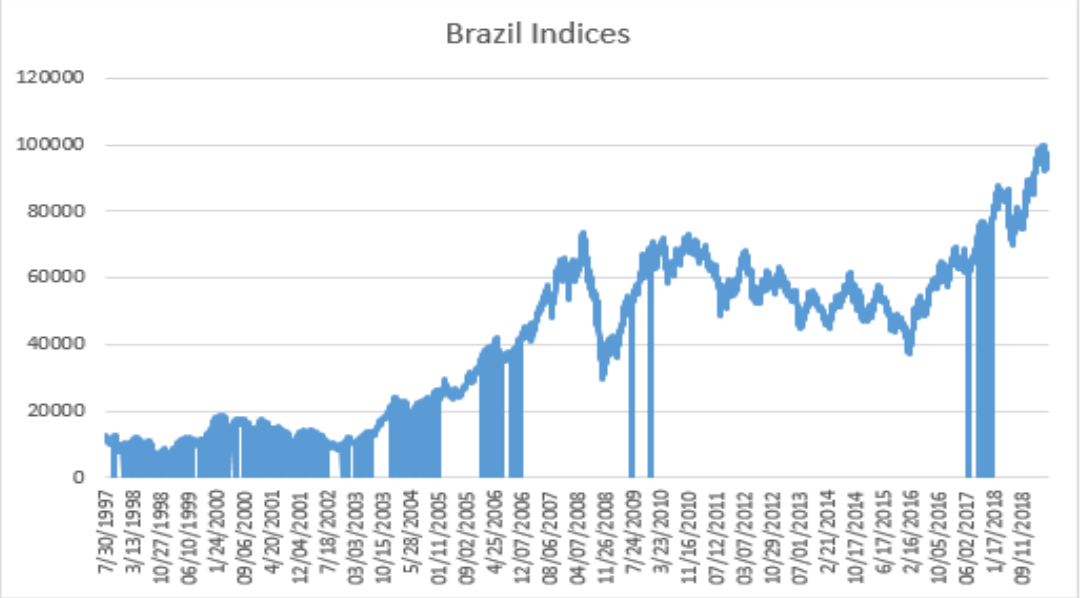

FIGURE 4.3: Research Model

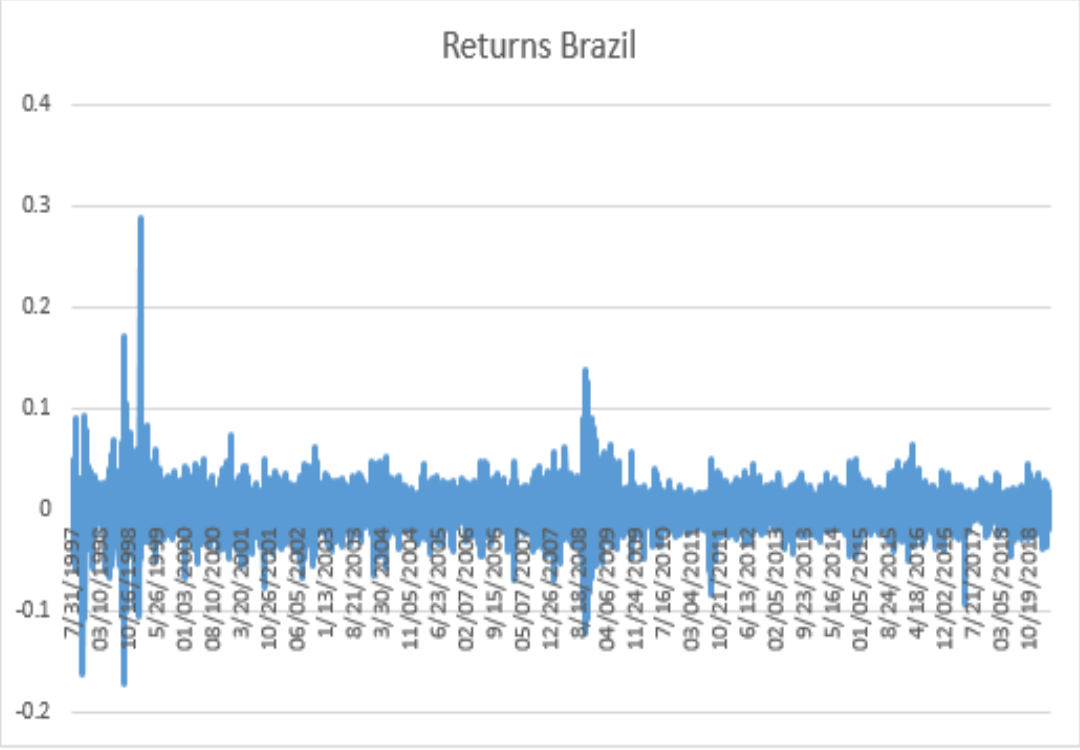

FIGURE 4.4: Research Model

In general a rising trend is observed in stock market of US as reported in figure 5.The figure 6 indicates the volatility of the return is not constant across the year there are periods of high volatility and low volatility.

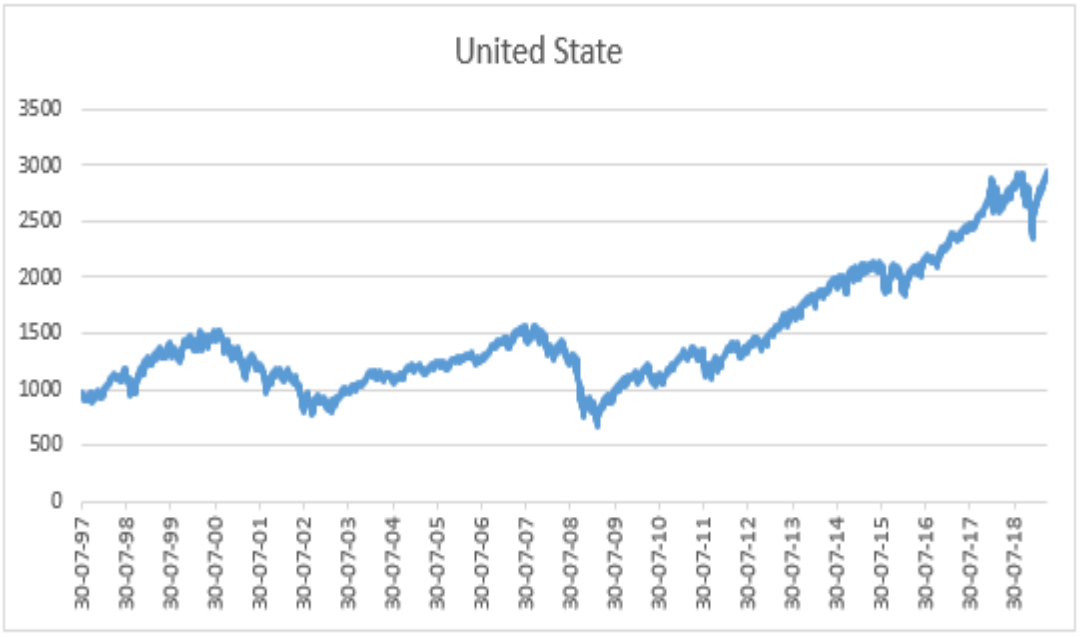

FIGURE 4.5: Research Model

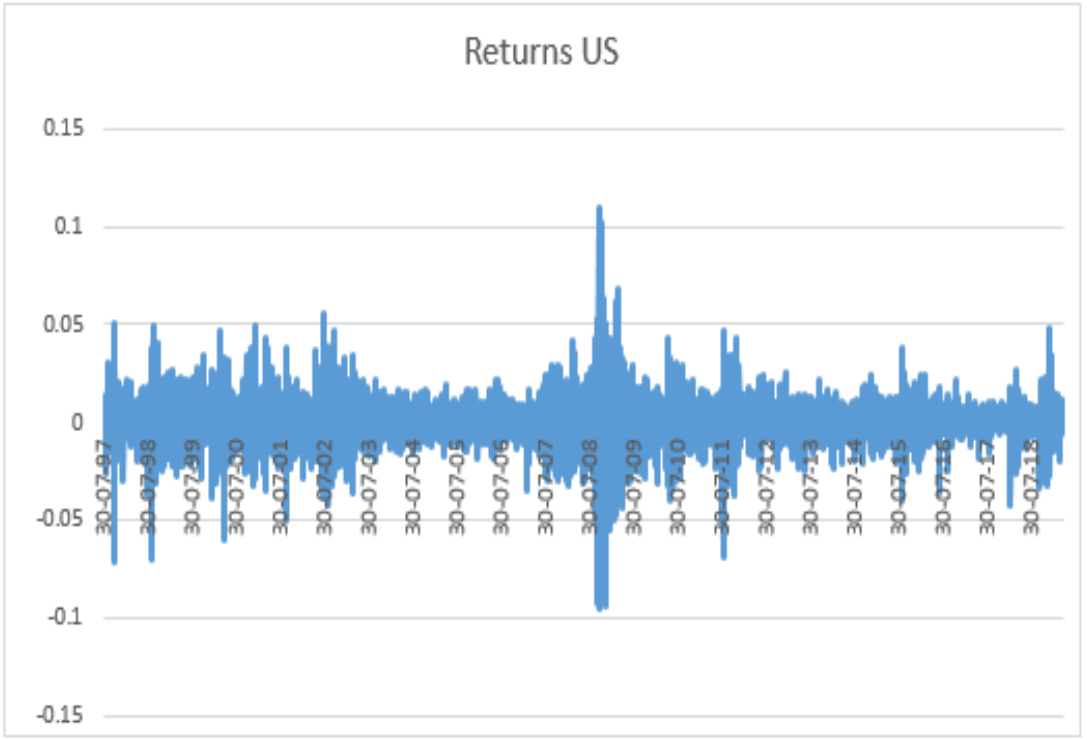

FIGURE 4.6: Research Model

In general a rising trend is observed in stock market of China as reported in figure 7.The figure 8 indicates the volatility of the return is not constant across the year there are periods of high volatility and low volatility.

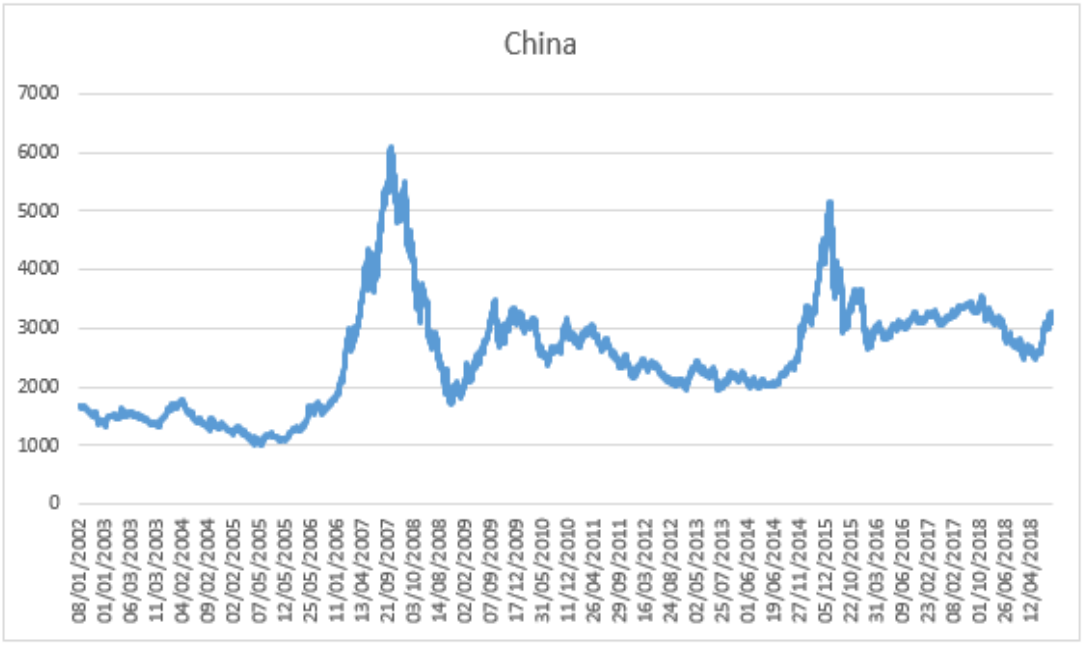

FIGURE 4.7: Research Model

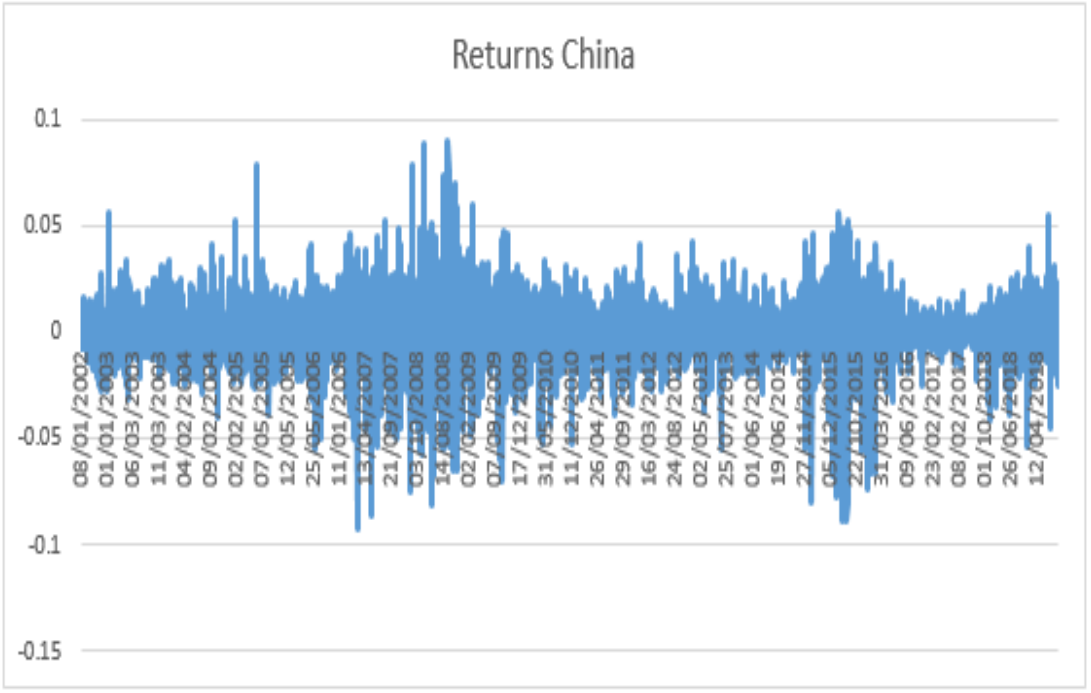

FIGURE 4.8: Research Model

In general a rising trend is observed in stock market of South Africa as reported in figure 9.The figure 10 indicates the volatility of the return is not constant across the year there are periods of high volatility and low volatility.

FIGURE 4.9: Research Model

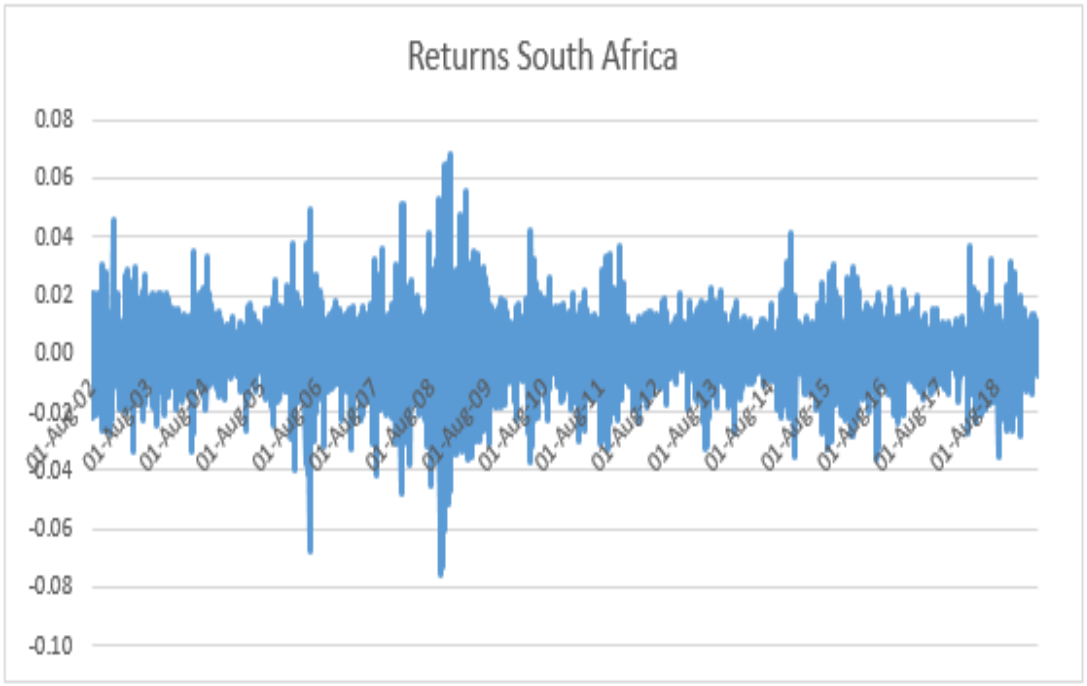

FIGURE 4.10: Research Model

In general a rising trend is observed in stock market of Pakistan as reported in figure 11.The figure 12 indicates the volatility of the return is not constant across the year there are periods of high volatility and low volatility.

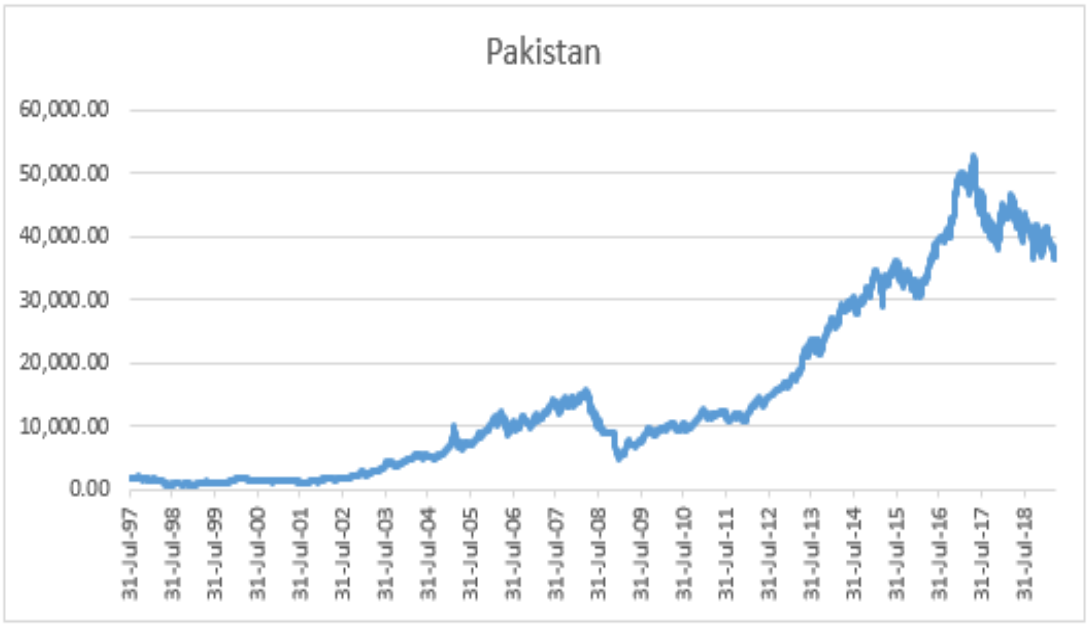

FIGURE 4.11: Research Model

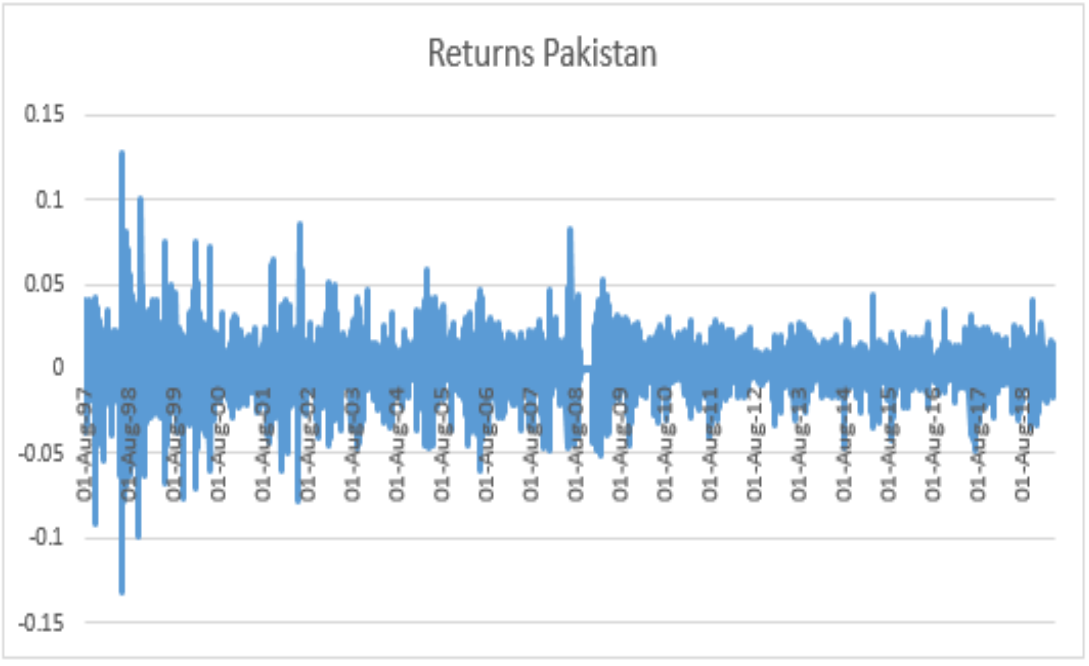

FIGURE 4.12: Research Model

In general a rising trend is observed in stock market of Russia as reported in figure 13.The figure 14 indicates the volatility of the return is not constant across the year there are periods of high volatility and low volatility.

FIGURE 4.13: Research Model

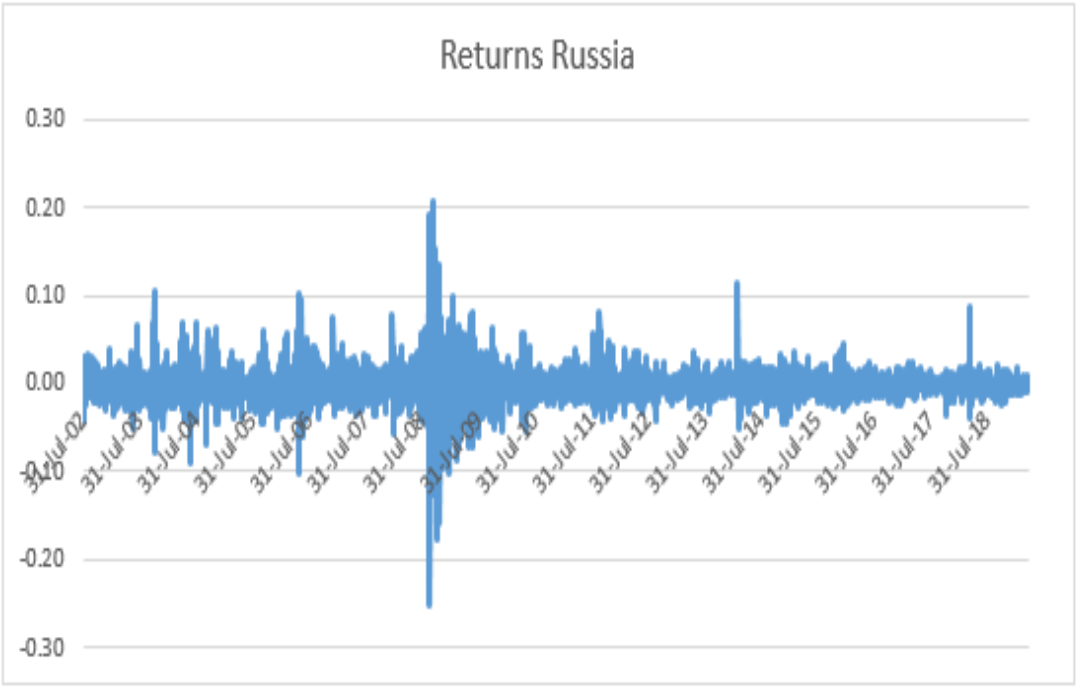

FIGURE 4.14: Research Model

TABLE 4.2: Descriptive Statistics

Returns	Mean	SD	Skewness	Minimum	Maximum	Kurtosis
BVSP	0.0003	0.0217	0.3496	-0.1721	0.2883	16.5747
SSE	0.0001	0.0157	-0.5367	-0.0926	0.0889	7.5759
GSPC	0.0001	0.0131	-0.2101	-0.0947	0.1096	10.4869
JSE	0.0004	0.0117	-0.158	-0.0758	0.0683	6.5213
KSE	0.0006	0.0158	-0.3667	-0.1321	0.1276	9.0059
MOEX	-5E-04	0.0198	0.2559	-0.2523	0.2066	23.4696
BSESN	0.0001	0.0131	-0.2101	-0.0947	0.1096	10.4869

This tables contains the descriptive statistics for US and selected emerging markets.

The mean returns evaluate the performance of the indices of selected countries. The average returns of Brazilian stock exchange is (0.032%), the average returns of Chines stock market is (0.0185%), The average returns of US market is (0.00955%),The average return of South African market is (0.0453%), the average return of Pakistani stock market is (0.0635%),the average return of Russian stock market is (0.00055%) and as well as the average return of the Indian stock market is (0.0095%). Maximum and minimum value show the max and min return in a day. The highest return earned in a day is 28.8% and the maximum loss incurred in a day is 17.2%. The risk of Brazilian market is insighted filloerd by Russion and Pakistani equally market. The minimum risk is seen for South African market.

Skewness value expresses the asymmetric behaviour of data. Skewness values of Chines stock Exchange (SSE Index), United State stock market (S&P 500/GSPC), South African Stock Market (JSE), Pakistani Stock Exchange (KSE 100), Indian stock market (BSESN) expresses that distribution of returns are negatively skewed. The returns of Russian Stock market (MOEX) and Brazil stock market (BVSP) are positively skewed. The data is positively skewed. The leptokurtic behaviour indicates that data series in peaked and has fat tail.

4.3 Systematic Risk Transfer between the US and Emerging Markets

Systematic risk transfer and return among the US and selected Emerging Markets are examined applying TGARCH model.

4.3.1 Systematic Risk Transfer between US and Brazil

Table: 4.3.1 represents the results of TGARCH model for US and Brazilian market.

Table 4.3: Risk Modeling by Using TGARCH 1 Model

	US	**Brazil**
Mean equation		
C	0.00022	0.000271
	-0.000117	-0.000219
	-0.048423	0.012977
	-0.014489	-0.0148
RU(-1)		
Variance equation		
		8.90E-06
β	2.22E-06	-8.71E-07
	-1.72E-07	
		0.019157
β		-0.005427
	-0.005354	
	-0.005604	
		0.112516
β	0.186451	-0.008069
	-0.009675	
		0.897134
β	0.891662	-0.006444
	-0.006335	

Table: 4.3 shows results of TGARCH model for US and Brazil. It shows that lagged return have significant link with the current returns as evident from auto regressive process. β is significant indicating the missing variable that may influence volatility. The $\beta 2$ is significant it indicates that past price behavior influences

current volatility. $\beta(1)$is significant and positive indicates the asymmetric behavior. The volatility of negative news is high in comparison of positive news. The persistence of volatility is observed as $\beta 3$ is significant and positive. The sum of ARCH and GARCH term is closer to 1 so volatility is long run in return.

Table: 4.3 summarizes the results of Dynamic Conditional Correlation (DCC GARCH) among returns of US and Brazil.

TABLE 4.4: Dynamic Conditional Correlation between Forecasted Return of US & Brazil

	Coefficient	**Std.Error**	**Z-Statistic**	**Prob.**
θ_1	0.126809	4.52E-09	28083438	0.00
θ_2	0.873191	3.05E-08	28628048	0.00

Stability condition: theta (1) + theta (2) < 1 is met.

This table shows the effect of the past residual shocks (θ_1) and lagged dynamic conditional correlation (θ_2) with their respective prob-values of forecasted returns. The first condition of DCC model is to check the stability condition as it must be less than 1 (i.e. $\theta_1 + \theta_2 < 1$). The mandatory stability condition is met for these two countries forecasted series which means model is stable. It means, DCC model can be used for measuring the time varying conditional correlation. The value of θ_1 is significant that shows a highly correlation between forecasted return series. For US and Brazil the significant variations implies that, there exists the impact of past residual shocks on correlation. The value of θ_2 is significant it shows that the lagged and current correlation exist among forecasted return of US and Brazil. This clearly indicates that the presence of information transfer between US and Brazilian market.

TABLE 4.5: Asymmetric Dynamic Conditional Correlation between of US & Brazil

	Coefficient	**Std. Error**	**Z-Statistic**	**Prob.**
θ_1	0.1	6.03E-05	1658.233	0.00
θ_2	0.85	5.74E-05	14803.18	0.00
θ_3	0	7.33E-06	0	1
Log likelihood	16.39782	Schwarz criterion		-65.57982
Avg. log likelihood	-65.58594	Hannan-Quinn criter.		-68.1095
Akaike info criterion	-68.11432			

* Stability condition: theta(1) + theta(2) < 1 is met.

Dynamic conditional correlation (DCC) & asymmetric dynamic conditional correlation ADCC models are used to investigate shocks and transmission of volatility. In addition the ADCC model explain either the negative & positive shocks are of similar magnitude or have different effects. The **Table: 4.5** shows the result of ADCC between US market and Brazil market.In the table the parameter of θ_1 is significantly positive for US to Brazil and its shows highly significant positive effect of past residual shocks on correlation. The lagged dynamic correlation θ_2 with its prob values is significant which means that the lagged and current correlation exist between US and Brazil, the mandatory stability is met for these two countries. Finally θ_3 is significant and coefficient value is positive which means that the correlation is higher when returns are negative which is indicator of asymmetric effect. From the both models results of DCC and ADCC, it can be said that asymmetric risk is transferred from US to Brazil and correlation between those markets change over time and in negative markets correlation becomes high.

TABLE 4.6: Dynamic Conditional Correlation between Volatility of US & Brazil

	Coefficient	**Std. Error**	**Z-Statistic**	**Prob.**
θ_1	0.711774	0.014974	47.53543	0.0000
θ_2	0.051457	0.022418	2.295348	0.0217

Stability condition: theta (1) + theta (2) < 1 is met.

The volatility transfer between US and Brazil is examined by using DCC-GARCH model. This table shows the effect of the past residual shocks (θ_1) and lagged dynamic conditional correlation (θ_2) with their respective prob-values. The first condition of DCC model is to check the stability condition as it must be less than 1 (i.e. $\theta_1 + \theta_2 < 1$). Both countries US and Brazil positively met the mandatory stability condition. It means, DCC model must be used for measuring the time varying conditional correlation. The value of θ_1 is significant that shows a highly correlation. The significant variations implies that, there exists the impact of past residual shocks on correlation. The value of θ_2 is significant it shows that the lagged and current correlation exist in the expected. Therefore volatility transfer exist between the markets.

4.3.2 Systematic Risk Transfer between US Market and Indian Market

TABLE 4.7: Risk Modeling for US and India by Using TGARCH 1, 1 Model

	US	**India**
Mean equation		
		0.000233
	0.000233	-0.000115
C	-0.000115	
	-0.043031	-0.043031
	-0.014169	-0.014169
RI(-1)		
Variance equation		
		2.13E-06
	2.13E-06	-1.64E-07
	-1.64E-07	
	-0.010204	
	-0.00504	-0.010204
		-0.00504
		0.192512
	0.192512	-0.009189
	-0.009189	
		0.894804
	0.894804	-0.006158
	-0.006158	

The above **Table 4.7**, represents the results of TGARCH model for US and Indian market. The above table shows results of TGARCH model for US and India. It shows that lagged return have significant link with the current returns as evident from auto regressive process. β_o is significant indicating the missing variable that may influence volatility. The β_2 is significant it indicates that past price behavior influences current volatility. $\beta(1)$is significant and positive indicates the asymmetric behavior. The volatility of negative news is high in comparison of positive news. The persistence of volatility is observed as β (3) is significant and positive. The sum of ARCH and GARCH term is closer to 1 so volatility is long run in return. Table below summarizes the results of Dynamic Conditional Correlation (DCC GARCH) among returns of US and India.

TABLE 4.8: Conditional Correlation between Forecasted Return of US & India

	Coefficient		**Std. Error**	**Z-Statistic**	**Prob.**
θ_1	0.128151		2.09E-07	613744.5	0.0000
θ_2	0.871843	7.67E-07	1137162		0.0000

Stability condition: theta (1) + theta (2) ¡ 1 is met.

This table shows the effect of the past residual shocks (θ_1) and lagged dynamic conditional correlation (θ_2) with their respective prob-values of forecasted returns. The first condition of DCC model is to check the stability condition as it must be less than 1 (i.e. $\theta_1 + \theta_2 < 1$). The mandatory stability condition is met for these two countries forecasted series which means model is stable. It means, DCC model can be used for measuring the time varying conditional correlation. The value of θ_2 is significant that shows a highly correlation between forecasted return series. For US and India the significant variations implies that, there exists the impact of past residual shocks on correlation. The value of θ_2 is significant it shows that the lagged and current correlation exist among forecasted return of US and India. This clearly indicates that the presence of information transfer between US and Indian market.

TABLE 4.9: Asymmetric Dynamic Conditional Correlation between of US & India

	Coefficient	**Std. Error**	**Z-Statistic**	**Prob.**
θ_1	0.123681	9.29E-08	1331709.	0
θ_2	0.868894	5.33E-07	1629225	0
θ_3	0.001978	2.84E-09	695648.3	0.00000
Log likelihood	16.5835	Schwarz criterion		-66.3229
Avg. log likelihood	-66.32887	Hannan-Quinn criter.		-73.1546
Akaike info criterion	-73.15925			

Stability condition theta(1)+theta(2) < 1 is met

Dynamic conditional correlation (DCC) and asymmetric dynamic conditional correlation ADCC models are used to investigate shocks and transmission of volatility. In addition the ADCC model explain either the negative and positive shocks are of similar magnitude or have different effects. This table shows the result of ADCC between US market and india market.In the table the parameter of θ_1 is significantly positive for US to india and its shows highly significant positive effect of past residual shocks on correlation. The lagged dynamic correlation θ_2 with its prob values is significant which means that the lagged and current correlation exist between US and India, the mandatory stability is met for these two countries. Finally θ_1 is significant and coefficient value is positive which means that the correlation is higher when returns are negative which is indicator of asymmetric effect. From the both models results of DCC and ADCC,it can be said that asymmetric risk is transferred from US to India and correlation between those markets change over time and in negative markets correlation becomes high.

TABLE 4.10: Dynamic Conditional Correlation between Volatility of US & India

	Coefficient	**Std. Error**	**Z-Statistic**	**Prob.**
θ_1	0.126532	6.64E-07	190521.1	0.000000
θ_2	0.873458	8.58E-07	1018432	0.0000

Stability condition: theta (1) + theta (2) < 1 is met.

The volatility transfer between Us and India is examined by using DCC-GARCH. This table summarizes the effect of the past residual shocks (θ_1) and lagged dynamic conditional correlation (θ_2) with their respective prob-values. Both the values of theta shows insignificant results that means model is stable as the stability condition is met. The first condition of DCC model is to check the stability condition as it must be less than 1 (i.e. $\theta_1 + \theta_2 < 1$). The mandatory stability condition is met which means that DCC model is stable. It means, DCC model must be used for measuring the time varying conditional correlation. The value of θ_1 is significant that shows a highly correlation. The significant variations implies that, there exists the impact of past residual shocks on correlation. The value of θ_2 is significant it shows that the lagged and current correlation exist are in the expected. Therefore, the volatility transfer exist between the markets.

4.3.3 Systematic Risk Transfer between US Market and Pakistani Market

TABLE 4.11: Risk Modeling for US and Pakistan by Using TGARCH 1,1 Model

	US	**Pakistan**
Mean equation		
	0.000211	0.000706
	-0.000116	-0.000148
C		
Variance equation		
	-0.040972	0.122953
	-0.014436	-0.014572
RK(-1)		
β_o	2.10E-06	6.24E-06
	-1.64E-07	-2.98E-07
β_1	-0.010795	0.104426
	-0.005078	-0.006942
β_2	0.191648	0.10646
	-0.009181	-0.011591
β_3	0.896569	0.816765
	-0.006156	-0.005863

Table: 4.11 represents the results of TGARCH model for US and Pakistani market. The above table shows results of TGARCH model for US and Pakistan. It shows that lagged return have significant link with the current returns as evident from auto regressive process. β_o is significant indicating the missing variable that may influence volatility. The β_2 is significant it indicates that past price behavior influences current volatility. $\beta(1)$is significant and positive indicates the asymmetric behavior. The volatility of negative news is high in comparison of positive news. The persistence of volatility is observed as β_3 is significant and positive. The sum of ARCH and GARCH term is closer to 1 so volatility is long run in return.

Table: 4.11 summarizes the results of Dynamic Conditional Correlation (DCC GARCH) between returns of US and Pakistan.

Table 4.12: Dynamic Conditional Correlation between Forecasted Return of US & Pakistan

	Coefficient	**Std. Error**	**Z-Statistic**	**Prob.**	
θ_1	0.731575	0.015004	48.75718	0.00	Stability
θ_2	0.164412	0.017611	9.335841	0.00	

condition: theta (1) + theta (2) < 1 is met,

This table shows the effect of the past residual shocks (θ_1) and lagged dynamic conditional correlation (θ_2) with their respective prob-values of forecasted returns. The first condition of DCC model is to check the stability condition as it must be less than 1 (i.e. $\theta_1 + \theta_2 < 1$). The mandatory stability condition is met for these two countries forecasted series which means model is stable. It means, DCC model can be used for measuring the time varying conditional correlation. The value of θ_1 is significant that shows a highly correlation between forecasted return series. For US and Pakistan the significant variations implies that, there exists the impact of past residual shocks on correlation. The value of θ_2 is significant it shows that the lagged and current correlation exist among forecasted return of US and Pakistan. This clearly indicates that the presence of information transfer between US and Pakistan market.

TABLE 4.13: Asymmetric Dynamic Conditional Correlation between of US & Pakistan

	Coefficient	**Std. Error**	**Z-Statistic**	**Prob.**
θ_1	0.439564	0.020751	21.18282	0.0000
θ_2	0.234227	0.033749	6.940254	0.0000
θ_3	22.19915	2.787336	7.964289	0.0000
Log likelihood	117080.2	Schwarz criterion		-43.6561
Avg. log likelihood	10.91962	Hannan-Quinn criter.		-43.6673
Akaike info criterion	-43.67325			

Stability condition: theta (1) + theta (2) < 1 is met

Dynamic conditional correlation (DCC) and asymmetric dynamic conditional correlation ADCC models are used to investigate shocks and transmission of volatility. In addition the ADCC model explain either the negative and positive shocks are of similar magnitude or have different effects. The **Table: 4.13** shows the result of ADCC between US market and Pakistani market.In the table the parameter of θ_1 is significantly positive for US to Pakistan and its shows highly significant positive effect of past residual shocks on correlation. The lagged dynamic correlation θ_2 with its prob values is significant which means that the lagged and current correlation exist between US and Pakistan, the mandatory stability is met for these two countries. Finally θ_3 is significant and coefficient value is positive which means that the correlation is higher when returns are negative which is indicator of asymmetric effect. From the both models results of DCC and ADCC,it can be said that asymmetric risk is transferred from US to Pakistan and correlation between those markets change over time and in negative markets correlation becomes high.

TABLE 4.14: Dynamic Conditional Correlation between Volatility of US & Pakistan (KSE)

	Coefficient	**Std. Error**	**Z-Statistic**	**Prob.**
θ_1	-0.00135	0.000379	-3.56631	0.0004
θ_2	0.912905	0.276792	3.298162	0.001

Stability condition: theta (1) + theta (2) < 1 is met,

The volatility transfer between US and Pakistan is examined by using Dynamic Conditional Correlation (DCC GARCH) model. This table shows the effect of

the past residual shocks (θ_1) and lagged dynamic conditional correlation (θ_2) with their respective prob-values. The first condition of DCC model is to check the stability condition as it must be less than 1 (i.e. $\theta_1 + \theta_2 < 1$). It means, DCC model must be used for measuring the time varying conditional correlation. The value of θ_1 is significant that shows a highly correlation. The significant variations implies that, there exists the impact of past residual shocks on correlation. The value of θ_2 is significant it shows that the lagged and current correlation exist. As the stability condition is met it can be say that the model is stable. Finally the time varying correlation is observed in this model. Therefore, the volatility transfer exist between the markets.

4.3.4 Systematic Risk Transfer between US Market and Russian Market

Table: 4.15 represents the results of TGARCH model for US and Russian market.

TABLE 4.15: Risk Modeling for US and Russia by Using TGARCH 1,1 Model

	US	**Russia**
Mean equation		
		0.000701
	0.00031	-0.000206
C	-0.000122	
	-0.070125	0.016415
	-0.016139	-0.01563
RM(-1)		
Variance equation		
β_1	2.08E-06	5.85E-06
	-1.80E-07	-4.57E-07
β_2	-0.010639	0.072448
	-0.005937	-0.006709
β_3	0.185869	0.06117
	-0.012353	-0.008117
β_4	0.892725	0.878629
	-0.007648	-0.005946

The above table shows results of TGARCH model for US and Russia. It shows that lagged return have significant link with the current returns as evident from

auto regressive process. β_o is significant indicating the missing variable that may influence volatility. The β_2 is significant it indicates that past price behavior influences current volatility. $\beta(1)$is significant and positive indicates the asymmetric behavior. The volatility of negative news is high in comparison of positive news. The persistence of volatility is observed as β_3 is significant and positive. The sum of ARCH and GARCH term is closer to 1 so volatility is long run in return.

Table: 4.15 below summarizes the results of Dynamic Conditional Correlation (DCC GARCH) between returns of US and Russia.

Table 4.16: Dynamic Conditional Correlation between Forecasted Return of US & Russia (MOEX)

	Coefficient	**Std. Error**	**Z-Statistic**	**Prob.**
θ_1	0.109688	3.95E-09	27754213	0.0000
θ_2	0.866811	3.98E-08	21768299	0.0000

* Stability condition: theta(1) + theta(2) $<$ 1 is met.

This table shows the effect of the past residual shocks (θ_1) and lagged dynamic conditional correlation (θ_2) with their respective prob-values of forecasted returns. The first condition of DCC model is to check the stability condition as it must be less than 1 (i.e. $\theta_1 + \theta_2 < 1$). The mandatory stability condition is met for these two countries forecasted series which means model is stable. It means, DCC model can be used for measuring the time varying conditional correlation. The value of θ_1 is significant that shows a highly correlation between forecasted return series. For US and Russia the significant variations implies that, there exists the impact of past residual shocks on correlation. The value of θ_2 is significant it shows that the lagged and current correlation exist among forecasted return of US and Russia. This clearly indicates that the presence of information transfer between US and Russia market.

TABLE 4.17: Asymmetric Dynamic Conditional Correlation between of US & Russia

	Coefficient	**Std. Error**	**Z-Statistic**	**Prob.**
θ_1	0.130673	6.57E-07	198998.2	0.000000
θ_2	0.863563	7.21E-06	119799.7	0.000000
θ_3	-341.0046	0.001512	-225569.3	0.000000
Log likelihood	14.35072	Schwarz criterion		-57.3887
Avg. log likelihood	-57.39619	Hannan-Quinn criter.		-64.5164
Akaike info criterion	-64.52225			

* Stability condition: theta(1) + theta(2) $<$ 1 is met.

Dynamic conditional correlation (DCC) and asymmetric dynamic conditional correlation ADCC models are used to investigate shocks and transmission of volatility. In addition the ADCC model explain either the negative and positive shocks are of similar magnitude or have different effects. The **Table: 4.17** shows the result of ADCC between US market and Russia market.In the table the parameter of θ_1 is significantly positive for US to Russia and its shows highly significant positive effect of past residual shocks on correlation. The lagged dynamic correlation θ_2 with its prob values is significant which means that the lagged and current correlation exist between US and Russia, the mandatory stability is met for these two countries. Finally θ_3 is significant and coefficient value is positive which means that the correlation is higher when returns are negative which is indicator of asymmetric effect. From the both models results of DCC and ADCC,it can be said that asymmetric risk is transferred from US to Russia and correlation between those markets change over time and in negative markets correlation becomes high.

TABLE 4.18: Dynamic Conditional Correlation between Volatility of US & Russia (MOEX)

	Coefficient	**Std. Error**	**Z-Statistic**	**Prob.**
θ_1	0.261072	0.020022	13.03899	0.0000
θ_2	0.657511	0.028537	23.04035	0.0000

* Stability condition: theta (1) + theta (2) $<$ 1 is met.

The volatility transfer between US and Russia is examined by using Dynamic Conditional Correlation (DCC GARCH) model. This table shows the effect of the past residual shocks (θ_1) and lagged dynamic conditional correlation (θ_2) with their respective prob-values. The first condition of DCC model is to check the stability condition as it must be less than 1 (i.e. $\theta_1 + \theta_1 < 1$). As the stability condition met it can be say that the model is stable. It means, DCC model must be used for measuring the time varying conditional correlation. All the value of θ_1 is significant that shows a highly correlation. The significant variations implies that, there exists the impact of past residual shocks on correlation. The value of θ_2 is significant it shows that the lagged and current correlation exist are expected. Therefore, the volatility transfer exist between the markets.

4.3.5 Systematic Risk Transfer between US Market and Chines Market

Table: 4.19 represents the results of TGARCH model for US and Chines market.

Table 4.19: Risk Modeling for US and China by Using TGARCH 1,1 Model

	US	**China**
Mean equation		
		0.000139
	0.000282	-0.000174
C	-0.000123	
	-0.069502	0.014493
	-0.016381	-0.016217
RC(-1)		
Variance equation		
β_o	2.00E-06	9.11E-07
	-1.82E-07	-1.68E-07
β_1	-0.010832	0.053966
	-0.006047	-0.00446
β_2	0.184682	0.005325
	-0.012638	-0.0052
β_3	0.895488	0.941846
	-0.007624	-0.003406

The above table shows results of TGARCH model for US and China. It shows that lagged return have significant link with the current returns as evident from auto regressive process. β_o is significant indicating the missing variable that may influence volatility. The β_2 is significant it indicates that past price behavior influences current volatility. $\beta(1)$is significant and positive indicates the asymmetric behavior. The volatility of negative news is high in comparison of positive news. The persistence of volatility is observed as β_3 is significant and positive. The sum of ARCH and GARCH term is closer to 1 so volatility is long run in return.

Table: 4.9 below summarizes the results of Dynamic Conditional Correlation (DCC GARCH) between returns of US and China.

TABLE 4.20: Dynamic Conditional Correlation between Forecasted Return of US & China

	Coefficient	**Std. Error**	**Z-Statistic**	**Prob.**
θ_1	0.107621	2.87E-09	37501015	0.0000
θ_2	0.866172	2.36E-08	36739968	0.0000

*Stability condition: theta (1) + theta (2) < 1 is met.

This table shows the effect of the past residual shocks (θ_1) and lagged dynamic conditional correlation (θ_2) with their respective prob-values of forecasted returns. The first condition of DCC model is to check the stability condition as it must be less than 1 (i.e. $\theta_1 + \theta_2 < 1$). The mandatory stability condition is met for these two countries forecasted series which means model is stable. It means, DCC model can be used for measuring the time varying conditional correlation. The value of θ_1 is significant that shows a highly correlation between forecasted return series. For US and China the significant variations implies that, there exists the impact of past residual shocks on correlation. The value of θ_2 is significant it shows that the lagged and current correlation exist among forecasted return of US and China. This clearly indicates that the presence of information transfer between US and China market.

TABLE 4.21: Asymmetric Dynamic Conditional Correlation between of US & China

	Coefficient	**Std. Error**	**Z-Statistic**	**Prob.**
θ_1	0.122781	6.60E-07	186142.6	0.0000
θ_2	0.871783	5.66E-08	15404750	0.0000
θ_3	0.085467	2.60E-06	32898.22	0.0000
Log likelihood	24.74965	Schwarz criterion		-98.98434
Avg. log likelihood	-98.99187	Hannan-Quinn criter.		-64.6543
Akaike info criterion	-64.66022			

* Stability condition: theta (1) + theta (2) < 1 is met.

Dynamic conditional correlation (DCC) and asymmetric dynamic conditional correlation ADCC models are used to investigate shocks and transmission of volatility. In addition the ADCC model explain either the negative and positive shocks are of similar magnitude or have different effects. The **Table: 4.21** shows the result of ADCC between US market and China market.In the table the parameter of θ_1 is significantly positive for US to China and its shows highly significant positive effect of past residual shocks on correlation. The lagged dynamic correlation θ_2 with its prob values is significant which means that the lagged and current correlation exist between US and China, the mandatory stability is met for these two countries. Finally θ_3 is significant and coefficient value is positive which means that the correlation is higher when returns are negative which is indicator of asymmetric effect. From the both models results of DCC and ADCC,it can be said that asymmetric risk is transferred from US to China and correlation between those markets change over time and in negative markets correlation becomes high.

TABLE 4.22: Dynamic Conditional Correlation between Volatility of US & China ()

	Coefficient	**Std. Error**	**Z-Statistic**	**Prob.**
θ_1	0.55078	0.040992	13.4362	0.0000
θ_2	0.335076	0.052159	6.424093	0.0000

* Stability condition: theta (1) + theta (2) < 1 is met.

The volatility transfer between US and China is examined by using Dynamic Conditional Correlation (DCC GARCH) model. This table shows the effect of the past residual shocks (θ_1) and lagged dynamic conditional correlation (θ_2) with their respective prob-values. The first condition of DCC model is to check the stability condition as it must be less than 1 (i.e. $\theta_1 + \theta_2 < 1$). As other countries US and China also positively met the mandatory stability condition. It means, DCC model must be used for measuring the time varying conditional correlation. The value of θ_1 is significant that shows a highly correlation. The significant variations implies that, there exists the impact of past residual shocks on correlation. The value of θ_2 is significant it shows that the lagged and current correlation exist are expected. Therefore, the volatility transfer between exist between the markets.

4.3.6 Systematic Risk Transfer between US Market and South African Market

Table: 4.23 represents the results of TGARCH model for US and South African market.

Table 4.23: Risk Modeling for US and South Africa by Using TGARCH 1,1 Model

	US	**South Africa**
Mean equation		
C	0.000309 -0.000122 -0.067806 -0.016215	0.000308 -0.000145 0.0269 -0.016519
RJ(-1)		
Variance equation		
β_o	2.06E-06 -1.77E-07	1.68E-06 -2.74E-07
β_1	-0.011437 -0.005883	0.001348 -0.005986
β_2	0.187158 -0.01237	0.126486 -0.01143
β_3	0.893157 -0.007588	0.92084 -0.00739

The above table shows results of TGARCH model for US and South Africa. It shows that lagged return have significant link with the current returns as evident from auto regressive process. β_o is significant indicating the missing variable that may influence volatility. The β_2 is significant it indicates that past price behavior influences current volatility. $\beta(1)$is significant and positive indicates the asymmetric behavior. The volatility of negative news is high in comparison of positive news. The persistence of volatility is observed as β_3 is significant and positive. The sum of ARCH and GARCH term is closer to 1 so volatility is long run in return.

Table: 4.24 summarizes the results of Dynamic Conditional Correlation (DCC GARCH) between returns of US and South Africa.

TABLE 4.24: Dynamic Conditional Correlation between Forecasted Return of US & South Africa (JSE)

	Coefficient	**Std. Error**	**Z-Statistic**	**Prob.**
θ_1	0.124923	4.86E-07	256828.3	0.0000
θ_2	0.873824	1.20E-06	727231.6	0.0000

* Stability condition: theta (1) + theta (2) < 1 is met.

This table shows the effect of the past residual shocks (θ_1) and lagged dynamic conditional correlation (θ_2) with their respective prob-values of forecasted returns. The first condition of DCC model is to check the stability condition as it must be less than 1 (i.e. $\theta_1 + \theta_2 < 1$). The mandatory stability condition is met for these two countries forecasted series which means model is stable. It means, DCC model can be used for measuring the time varying conditional correlation. The value of θ_1 is significant that shows a highly correlation between forecasted return series. For US and South Africa the significant variations implies that, there exists the impact of past residual shocks on correlation. The value of θ_2 is significant it shows that the lagged and current correlation exist among forecasted return of US and South Africa. This clearly indicates that the presence of information transfer between US and South Africa market.

TABLE 4.25: Asymmetric Dynamic Conditional Correlation between of US & South Africa

	Coefficient	**Std. Error**	**Z-Statistic**	**Prob.**
θ_1	0.122781	6.60E-07	186142.6	0.0000
θ_2	0.871783	5.66E-08	15404750	0.0000
θ_3	0.085467	2.60E-06	32898.22	0.0000
Log likelihood	24.74965	Schwarz criterion		-98.98434
Avg. log likelihood	-98.99187	Hannan-Quinn criter.		-64.6543
Akaike info criterion	-64.66022			

* Stability condition: theta(1) + theta(2) < 1 is met.

Dynamic conditional correlation (DCC) and asymmetric dynamic conditional correlation ADCC models are used to investigate shocks and transmission of volatility. In addition the ADCC model explain either the negative and positive shocks are of similar magnitude or have different effects. This shows the result of ADCC between US market and south African market.In the table the parameter of θ_1 is significantly positive for US to South Africa and its shows highly significant positive effect of past residual shocks on correlation. The lagged dynamic correlation θ_2 with its prob values is significant which means that the lagged and current correlation exist between US and South Africa, the mandatory stability is met for these two countries. Finally θ_3 is significant and coefficient value is positive which means that the correlation is higher when returns are negative which is indicator of asymmetric effect. From the both models results of DCC and ADCC,it can be said that asymmetric risk is transferred from US to South Africa and correlation between those markets change over time and in negative markets correlation becomes high.

TABLE 4.26: Dynamic Conditional Correlation between volatility of US & South Africa (JSE)

	Coefficient	**Std. Error**	**Z-Statistic**	**Prob.**
θ_1	0.662365	0.025238	26.24497	0.0000
θ_2	0.129277	0.034865	3.707899	0.0002

* Stability condition: theta (1) + theta (2) < 1 is met.

The volatility transfer between US and South Africa is examined by using Dynamic Conditional Correlation (DCC GARCH) model. This table shows the effect of the past residual shocks (θ_1) and lagged dynamic conditional correlation (θ_2) with their respective prob-values. The first condition of DCC model is to check the stability condition as it must be less than 1 (i.e. $\theta_1 + \theta_2$¡1). US and South Africa also positively met the mandatory stability condition. It means, DCC model must be used for measuring the time varying conditional correlation. All the value of θ_1 is significant that shows a highly correlation. The significant variations implies that, there exists the impact of past residual shocks on correlation. The value of θ_2 is significant it shows that the lagged and current correlation exist are expected. Therefore, the volatility transfer between the markets.

Chapter 5

Conclusion and Recommendations

The main objective of this study is to explore the systematic risk transfer from US to the emerging markets by using GARCH process. To investigate the systematic risk transfer from US to emerging markets dynamic conditional correlation (DCC) & asymmetric dynamic conditional correlation models (ADCC) are used respectively. Next the potential impact of volatility spillover from US to emerging markets by using TGARCH model with the indices of US and selected emerging markets i.e. china, Russia, South Africa, India, Pakistan, Brazil and time frame is different for each country like for Pakistani, Indian, and US and Brazil time frame is 7/1997 to 4/2019 and for China, Russia and south Africa time frame is 7/2002 to 4/2019. A volatility spillover impact that is more responsive to positive shocks as compare to negative shocks, and also addresses the weak effect over period in this model. So, in the situation for a volatility spillover effect by the financial area of United States to financial area of emerging market is relatively weak. And finally, a decline effect of US equity market on the emerging market are examine. The study first applies TGARCH model for risk modeling keeping in view the asymmetric behavior of the volatility on arrival of good or bad news. All emerging markets along with US exhibit the presence of asymmetric behavior of volatility. The residuals of the returns series are estimated and correlation is estimated. The significant correlation which is time varying in nature is observed when DCC model

is applied. This shows that the US market and representative markets have significant time varying correlation which is indicator of systematic risk transfer between US and markets of Brazil, India, Russia, China, South Africa and Pakistan. The behavior of correlation is also examined during potential negative market conditions by using ADCC model. That shows the correlation is high during negative returns and low in during positive returns. This is also supports the systematic risk transfer in varying market conditions.
The result of dynamic conditional correlation (DCC) for both the standardize series and variance series are significant that means past residual shocks exist and relationship between lagged and current correlation exist. Not only in returns but also in volatility.

5.1 Recommendations

After concluding and reporting all the results, this study strongly recommends to all market members including portfolio managers, policy makers and investors, to keep awareness of the information appearing in different markets. Some necessary recommendations of this study are detailed as.

1. The markets are interconnected so systematic risk transfer across markets, therefore benefit of diversification across markets are low.

2. Asymmetric volatility exist in all markets so indicates should be in all markets so investors should be vigilant that bad news may create more volatility.

3. The markets has asymmetric dynamic conditional correlation which indicates that correlation increase in case of negative return .so in case of crises the objective of portfolio diversification will not be achieved.

4. The markets has not only exhibit connectedness in returns but also volatility. So volatility effect of one market will also transfer to other.

5. Markets has time-varying conditional correlation which means the dynamic correlation present between markets.

6. US and emerging market are interconnected and risk is transferred from each pair of market.

5.2 Limitations and Future Directions

Although this study gives a good understanding on the systematic risk transfer through US market and emerging markets, but obviously it doesn't cover all other aspects. This study is limited only to the six selected emerging markets that is not enough and it can be increase. At last, the models used for this study was DCC-GARCH, ADCC-GARCH and T-GARCG taken on over all distribution. So, a study on extreme movement using E-GARCH,VAR, and Marginal Expected Shortfall (MES) models as so on can also be conducted in near future

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