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Return and Volatility Spillover from Global Interest Rate to Equity Market of South Asian Countries

by

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This postulation is dedicated to my parents and teachers, who are constantly a light for me in obscurity and their unflinching help, guided my unfocused words into Sound thoughts

CERTIFICATE OF APPROVAL

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Abstract

The purpose of this study is to investigate the return and volatility spillover from global interest rate to equity markets of South Asian countries and also from global interest rate to domestic interest rate of South Asian countries. The study employs the daily data of global interest rate of US, domestic interest rates and equity prices of five South Asian countries (China, India, Pakistan, Srilanka and Bangladesh) for the period of 01/2009 to 12/2019. Return and volatility spillover is measured by using ARMA (1,1) GARCH (1,1)-M model for both global interest rate to domestic interest rate and equity markets of South Asian countries specifications. Moreover, the time-varying nature of conditional correlation is further explored by using DCC-ADCC models for both aspects as well. The finding of the study provides strong evidence of return and volatility transmission from global interest rate to equity markets of China, India, Pakistan and Srilanka but there is limited evidence of diversification in Bangladesh. However, no evidence of return volatility has found in domestic interest rate of south Asian countries but there found volatility spillover in domestic interest rates for the given time period which indicates the limited evidence of diversification. In addition, DCC GARCH also reveals the time-varying nature of conditional correlation. The results also show the presence of asymmetric behavior among different countries.

Keywords: Return & volatility spillovers, DCC, ADCC, Global Interest Rate

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Abbreviations

ARMA-GARCH	Autoregressive Moving Averages GARCH
ADCC	Asymmetric Dynamic Conditional Correlation
DCC	Dynamic Conditional Correlations
EMH	Efficient Market Hypothesis
GARCH	Generalized Auto Conditional Hetroscedasticity
GARCH-M	Generalized Autoregressive Conditional Heteroscedasticity in Mean
GJR-GARCH	Glosten-Jagannathan-Runkle GARCH
MV-GARCH	Multivariate GARCH

Chapter 1

Introduction

The world's interest rate trend since the late 1970s essentially coincides with that of the U.S. In other words, the U.S. trend is the global trend over the past four decades. In fact, this has been increasingly the case for almost all other countries in the sample: idiosyncratic trends have been vanishing since the late 1970s. This convergence in cross-country interest rates is arguably the result of growing integration in international equity market.

Developments in the U.S. economy, owing to their scale and foreign relations, are expected to have important consequences for the global economy. The United States is the largest industrialized country in the world (at international exchange rates), responsible for approximately 22 per cent of economic GDP and more than a third of stock market capitalization.

It is dominant in virtually every global economy, accounting for approximately one-tenth of global trade flows, one-fifth of global FDI stock, nearly one-fifth of remittances, and one-fifth of global demand. Since the U.S. dollar is the most commonly used currency in world commerce and financial markets, shifts in U.S. monetary policy and market perception play a significant role in shaping conditions for global finance (M. Ahyan, Csilla, Franziska, Marc, 2017).

The role of the United States in global financial markets goes far beyond direct capital flows to and from the United States. The U.S. bond and equity markets are the largest and most liquid in the world. Swings in U.S. government debt rates are also closely replicated in other global capital markets. Similarly, cross-border

spillovers from U.S. equity markets are significant and depend more on openness to the global economy than on the size of actual bilateral portfolio flows (Ehrmann, Fratzscher, and Rigobon 2011; Rose and Spiegel 2011).

Global interest rates are on the increase after an extended span of record-low rates, suggesting that foreign investors will want to reassess their exposure to interest rate risks. Although higher interest rates do not necessarily turn into a decline in share prices, bond prices appear to be more uniformly affected and certain stock sectors may gain more than others (Trevir, 2019).

Globalization has been viewed over the past two decades as a prevailing force which has deepened international ties and financial globalization. It shows that the linkages correlated with a particular economy ultimately affect certain economies either favorably or negatively. Consequently, the impact of interest rate shocks in other countries has raised relevance from the academic and policymakers 'point of view about how such shocks are likely to influence the immediate community in other areas.

Bekaert, Hoerova, and Duca (2013) concluded that global financial development and circumstances are dictated by a global financial cycle, which, in effect, tends to be primarily influenced by US monetary policy. Since America has the largest economies in the world, any policy decision that the US does would have direct consequences on financial markets. The US economy continues to show signs of growth, rising interest rates could be the right step for America as the quantitative easing ends. Emerging markets will suffer at the same time. In circumstances where US interest rates are increasing while the dollar is appreciating, the exchange rate appears to broaden between developed nations and the US. As a result, dollar-denominated debt owed by developing countries is rising and becoming unmanageable (Trevir, 2019).

Interest rate is one of the important macroeconomic variables, which is directly related to economic growth. Generally, interest rate is considered as the cost of capital, means the price paid for the use of money for a period of time. From the point of view of a borrower, interest rate is the cost of borrowing money (borrowing rate). From a lender's point of view, interest rate is the fee charged for lending

money lending rate (Md. Mahmudul & Md. Gazi, 2009)."

Good investors always look for investing in an efficient market. In an inefficient market few people are able to generate extra ordinary profit causes of confidence losses of general people about the market. In such situations, as the interest rate charged by banks is rising to depositors, citizens move their money from the stock sector to the bank. Interest levels mainly influence stock markets by affecting market customer behaviors. Rising interest rates allow companies and customers to invest less and spend less, contributing to reduced profits and lower net sales. Lower sales and net revenue contribute to lower equity values and therefore lower overall price-earnings. The reverse is true of reduced interest rates, higher investment and better financial efficiency.

Interest rates often influence valuations of equities by increasing the discount rate. If the valuation of the equity in today's dollars is equivalent to the valuation of all potential profits, creditors will apply a discount rate that reflects the average interest rate over the time. Rising interest rates mean that the stock of a business is not as expensive now, which in turn will lower the value of the shares and the share price at the moment of the interest rate hike.

However, the object of this study is to analyse the effect on stock returns of seven Asian countries (China, India, Pakistan, Srilanka and Bangladesh) of the global (US) interest rate. The theoretical research is different in two distinct respects from the literature. First, we are looking at whether the effect of the global interest rate on South Asian countries 'domestic interest rate and stock market is positive or negative. A characteristic of the above conventional and voluminous literature is that it addresses just the adverse impact of domestic interest rates on equity market returns. There are very few studies that consider the impact of global interest rate on the equity market of South Asian countries.

Sahlstrom (2004), who analyzed macroeconomic news in asset valuations on European stock markets both domestically and worldwide (proxied by the US); Nasseh and Strauss (2000), who use a variation decomposition study and claim that German short-term interest rates have impacted equity prices in European countries; and Arora and Cerisola (2001), who analyzed the effect of US monetary policy on

the nation. They considered that US interest rate rates are having positive effects on sovereign risk.

Cheng and Glascock (2006) have shown in the integration process between the United States and three Asian countries – Chinese, Hong Kong and Taiwan – following the 1997 Asian financial crisis. Factors may lead to changes in Asian stock markets, or vice versa. Asian market integration with the US implies macroeconomic factors in the US can lead to movements in Asian stock markets, or vice versa.

Over the past couple of decades, stock market growth has grown more and more in line with its inclusion into the international capital markets of the Association of Southeast Asian Nations. Yet most ASEAN countries tend to be developing economies. Since most of them have the ownership of a small open economy, changes in US monetary policies impact their stock markets more easily.

Traditional economics implies a correlation between the success of the stock market and knowledge e.g. (Mitchell and Mulherin 1994). Shocks (information) from currency policy changes have a major role to play in the stock market as they have the effect of the macroeconomics, which often indirectly affect the stock market.

The US spillover effect of interest rate was investigated by (Kim and Nguyen 2009). Target interest rate news on equity returns and volatility returns on 12 Asian-Pacific stock markets is provided by the European Central Bank (FED) and the European Federal Reserve (ECB). Researchers found that a majority of stock markets responded to unexpected rate rises with large negative returns and that the volatility in return on these markets increased as a result of interest rate news. Those contributions by Kim (2003, 2008) showed that the US rate had direct effect on bonds in the ASEAN markets, even though the volume of knowledge and methodologies used in our paper are totally different.

The results of interest rates on stock markets in the countries of South Asian are calculated in this report. South Asian stock markets are the sector chosen for comprehensive research. This study examined the effect of the global interest rate on the equity market in South Asia. To this end, a quantitative investigation approach based on data from 2009 to 2019 is used. Microsoft Excel is used to

manage Eviews for a number of calculations. The regression analysis is applied to the hypothesis. The study reveals the link between the global interest rate and the equity market.

1.1 Theoretical Background

1.1.1 Efficient Market Hypothesis

Over the past few decades, capital markets across the world have evolved to evolve and develop. The theory that financial markets become more prone to economic shifts globally owing to these convergence rises (Fama & French, 1989). Stocks are more prone to shifts in U.S. monetary policy that may affect both industrialized and emerging economies 'financial markets. The effect on emerging economies of our monetary policy is more prominent relative to the effects on developed markets (Yang and Hamori, 2014).

The equity market efficiency has gained a lot of attention from different economists and practitioners in modern finance. Modern financial markets assume that the markets are effective. The term efficiency creates a link between information and stock prices. In this context, the EMH proposed that there exists timely and rapid incorporation of information to the stock prices.

So, every investor gets the desired returns from the investment (Reilly and Brown, 2011). According to Malkiel and Fama (1970) the allocation of resources is based on the decision of fair price discovery that can only be done when markets are efficient and reflect all relevant information. So, the assessment of the behavior of the equity market is considered very important.

Dyckman and Morse (1986) state that, "An efficient security market is a market if (a) the price of the traded security fully shows the all available information (b) these prices react immediately and in an un-bias form to new information". On the other hand, there is a chance that prices can mislead the investors and will further effect the decision making process of the selection of securities. So, the element of market inefficiency can prevail in the market and reject the EMH

(Aumeboonsuke and Dryver, 2014).

On the basis of the theoretical framework of EMH, Bachelier (1900) argued that the variations in commodity prices are random in nature. The study shows that all periodic events are covered by market prices however, it doesn't indicate a clear association with price changes. Samuelson et al. (1965) expanded the work of Bachelier and started a new debate in modern economics. It states that, if one could make certain that a price would rise, it would have effectively risen.

Although EMH studies in developing economies are various, the same does not extend to emerging markets. Kumar and Dhankar (2009) based on EMH analytical research and risk-return link for India, Pakistan, Sri Lanka and Bangladesh emerging-market markets. The analysis found auto-correlationship on equity returns, cross-relationship returns on stocks under risk and volatility and interdependence between South Asian stock markets and world stock markets.

About Pakistan's situation, Hasan, Shah and Abdullah (2007) analyzed Karachi Stock Exchange's weak-form market efficiency (KSE). The results show that the behavior of prices does not support random walks, and therefore they are not efficient in weak form. Technical analysis can be useful in forecasting short-term behaviors on the equity markets for such situations.

Research findings by Samarakoon (2005) check that, in terms of poor business efficacy, Sri Lankan stock is in reality stagnant and inefficient. The existence of an effective market model in a semi-stark shape compares with the conclusion found here. Furthermore, the semi-strong variant of the productive market assumptions shows comparable findings in the Colombo Stock Exchange, Sri Lanka (Abeyratna, Bandara and Colombage, 1999).

An efficient market is one in which prices reflect fully the available information, according to the Fox and Opong (1999). An implication of an efficient market is that it is impossible to make excess returns from this information, as current prices already reflect the information. Excess returns (if any) should not, however, be statistically significant from null. Market performance depends on the traders' ability to devote time and energy to collecting and distributing knowledge. More efficient markets attract more investors which lead to higher market

liquidity (Osei, 1998). Investors are concerned with market volatility, since the movement of stock prices affects their income.

Ngugi and Kabubo (1998) suggests that the major role of interest rates is to help mobilize financial resources and to focus on ensuring that resources are used efficiently to promote economic growth and development. Chen et al (1986) claimed the interest rate had a significant effect on the return on equity. The interest rate observed by Wongbangpo et. al (2002) had a negative impact on the South Asian countries. Nguyen (2007) found interest rate spread in the industrial analysis to have had a significant effect on the riskiness of capital-intensive industries.

However, Chan et al (1998) considered that interest rate had no relation to return on stock. The relationship between stock prices and selected economic variables for South Africa, Zimbabwe and Botswana is studied by Jefferis and Okeahalam (2000), for South Africa they demonstrated that the long-term interest rate negatively affects the stock market. Interest in shock transmission studies initially followed the 1987 stock market crash in the US, as researchers sought to uncover spillover effects before and after the crash (King & Wadhwani (1990) and Schwert (1990)). Koutmos and Booth (1995) examined in particular the difference between positive and negative shock spills arising from major news events and how it affects the volatility ties between stock markets.

While Lin, et. al (1990) uncovered differences in the strength of transmission between global and local shocks. De Santis and Gerard (1998) the studied, with mixed findings, the benefit of utilizing such techniques for investment purposes.

An efficient and effective equity market completely represents the available stock knowledge resulting in a homogeneous equity price expectation for investors. Investors value the stocks accordingly, keeping in mind the opportunities for reward and return (Sharp, 1964: Mossin, 1966). These requirements prohibit investors from making excessive returns by using the knowledge inherent in equity markets. If efficient equity market proves true, the random walk movement in equity markets is documented, resulting in investors realizing extra risk premium only by disclosing their portfolios to unpredictable equity price variations. Tremendous empirical work in developed equity markets supports effective market hypotheses.

The sector also has significant research opportunities in emerging equity markets such as India. The underlying hypothesis is that predicted equity price variations (predicted volatility) encourage the investors to modify their risk premium and remain invariable to these variations (Kumar and Dunkar, 2009). This research explores this phenomenon in the context of South Asia by looking at the relationship between stock market returns and predicted and unpredictable volatility. It also explores regional cooperation between these markets, as well as the global market.

Current research explores the alignment of equity markets by analyzing cross correlation in established equity market returns, but hardly any work undertaken to assess the interdependence between South Asian equity markets and the global interest rate in terms of equity returns and volatility by analyzing cross-relationships in equity returns and the degree of correlation between conditional volatilities.

The criticism on the idea of EMH was presented by Malkiel in (2003) that stock prices cannot be predicted; and gave his argument about the partial prediction of the stock prices (Malkiel, 2003). In response to Fama's study that states "prices adjust with the arrival of new information and spread speedily without any delay". Malkiel argues that "if information flow is speedily reflected in the stock prices then there is no link between todays price and tomorrows price because they are totally independent".

In this manner, technical analysis just examines the past price change to anticipate future prices and fundamental analysis just helps the investors to make the comparison based on profit, cash flows and other attributes of a firm. It doesn't support the argument that markets are fully efficient, because of the presence of lesser rationality in some market participants. The quick incorporation of information in stock prices cannot be uncovered by professionals and experts (Grossman and Stiglitz, 1980).

The theory of market efficiency strongly supports this study. Efficient market hypothesis (EMH) talks about the precise reflection of information from the prices at any point of time in the same way. If the efficient market theory holds accurate, it would prohibit investors from making extra returns by using the intrinsic

knowledge on equity stocks. By adding the extra risky stocks in their portfolios they will gain additional returns.

While empirical EMH tests and risk-return relationships are widely available for established equity markets, the focus on emerging equity markets such as India, Pakistan, Sri Lanka, etc. started with the economic liberalization of financial systems in those markets. With modernization and privatization, the massive investment opportunities in South Asian equity markets have attracted domestic and international institutional investors in general and lowered portfolio risk by diversifying their funds throughout the markets in particular.

1.2 Gap Analysis

Most empirical studies have concluded with the intention of the effect of interest rates on the stock prices of South Asian countries that it has a positive or negative effect on the equity market, however evidences were also mixed. Some studies tried to identify the channels of transmission Frobes and Rigobon (2002), and some have tried to link them to financial and commercial channels (Longstaff, 2010). Further, in many studies the evidence of the impact of global interest rates on equity market was also mixed. Some researchers confirmed the positive impact as well as negative impact on the equity market.

However, there is a historical discrepancy such that the essence of the foreign (U.S.) interest rate uncertainty is virtually distorted throughout the literature as a consequence of asymmetrical knowledge shocks and their spillover impact on the conditional fluctuations of certain stock prices. The impact of asymmetric innovations on the conditional volatility of equity prices because of the presence of positive and negative news is not clearly answered by these studies. Secondly, the results related to the impact of global (US) interest rate on domestic interest rate are not cleared.

Third, the impact of global (US) interest rate on equity markets shows mixed results (positive and negative) in different papers. Moreover, studies specific to the South Asian countries are quite less researched, which is the big gap and a

great motivation of the study that we are trying to examine the through advanced methodology.

1.3 Problem Statement

Economists tend to discuss the analysis report on the effect of global interest rate fluctuations on economies in the Asian countries. Although several researches indicate that significant shifts in share prices may be expensive for the domestic economy, research such as the welfare consequences of return fluctuations are contingent on how markets are determined. Equally unanswered is the methodological literature surrounding the consequences of global asset volatility.

The study examines the return and volatility spillover of global interest rate on the domestic interest rates and equity markets of the five emerging economies, and researchers from almost any age concluded that every country's equity market plays a vital position in economic development. It is not inaccurate to claim so. However, there are growing considerations that affect the stock sector. Such variables may minimize or improve efficiency. Government of every country should improve the factors which boost stock market performance and discourage those factors that impact on equity markets in a variety of ways.

Since it is the analysis of international interest rates and equity prices, and is focused on several papers and posts, interest rates influence the share market adversely. Moreover, the rate of interest reduces equity performance, although few analysts in their analysis have clarified that the global rate has a positive effect on the stock sector, such that the findings are mixed. This study explores several analyses of these variables and their relationships, which should allow us to consider this topic more thoroughly.

Most of the previous literature showed that the information about the co-movement among global interest rates and different markets is already studied. Moreover, the past literature also tells that the spillover effects are mostly seen across different countries or regions. Information about interest rate-to-market is available but the evidence on global interest rate specific information is inconclusive especially

in South Asian markets i.e. China, India, Pakistan, Srilanka and Bangladesh. So, the debate on the response of these types of transmission of information is still unexplored.

1.4 Research Questions

This study focused on the questions below. First, how it captures the global interest rate effect and transmission of volatility Spillover on the equity market by using the time series data. Second, it describes the return and volatility Spillover of global interest rate to domestic interest rates of South Asian countries.
The main questions of the study are given below:

Research Question: 1

What is the impact of Global interest rate on equity markets of South Asian countries?

Research Question: 2

How information created in the global interest rate is transmitted to the domestic rates of South Asian countries?

Research Question: 3

How information created in the global interest rate transmit to the equity markets of south Asian countries?

Research Question: 4

Is correlation among global interest rate and domestic interest rate time-varying?

Research Question: 5

Is correlation among global interest rate and equity markets time-varying?

Research Question: 6

Is there any asymmetrical behaviour in equity market and domestic interest rate?

1.5 Research Objectives

The primary objectives of the study are given below:

Research Objective: 1

To examine the effect of global interest rates on the equity markets of South Asian countries.

Research Objective: 2

To identify return and volatility Spillover from global interest rate to equity market of South Asian countries.

Research Objective: 3

To analyse the return and volatility Spillover from global to domestic interest rate.

Research Objective: 4

To review the possibility of dynamic conditional correlation between global and domestic rates.

Research Objective: 5

To analyse the possibility of dynamic conditional correlation between global interest rate and equity markets.

Research Objective: 6

To check the asymmetrical behaviour of conditional correlation between global and domestic interest.

Research Objective: 7

To explore the asymmetrical behaviour of conditional correlation between global interest rate and equity markets.

1.6 Significance of the Study

Just a handful of research centered on the return on developing capital markets and price spillage. Evidence on business transactions and transfers is challenging to locate, in particular, in South Asian equity markets. The equity markets in south Asia is a result of increasing economic growth in countries in South Asia due to socioeconomic policies and liberalization of financial markets, which have contributed to significant concern among local and international investors.

In this report, we investigated that how global (US) interest rates transfer knowledge and uncertainty to five recent liberalized markets – China's Shanghai Stock Exchange (SSEX), India's Bombay (BSE), Pakistan's Karachi Stock Exchange

(KSE), Sri Lanka's Colombo Stock Exchange (CSE), and Bangladesh Dhaka Stock Bourses (DSE). This is one of the few empirical research studies that aims to explore the global interest rate effect on equity markets, and return and volatility spillovers among five South Asian countries using advanced econometric methodologies.

Our study differs from the previous researches on this topic in three respects. First it attempts to identify the impact of global interest rate on domestic interest rates and transmission of Spillover volatility among South Asian countries' domestic interest rates by using time series data. Secondly it examines the return and volatility Spillover of global interest rate to equity market. Third it examines the effect of global interest rate on the equity markets of south Asian countries, either positive or negative.

Finally, when we talk about investors of the market, then the main objective of every investor is diversification. As diversification demands the better market for investments, so it is important to see that which market is providing diversification benefits to investors. The opposite direction of spillover can be used to determine that, which countries are better for diversification.

International diversification of investment portfolios is justified and desirable because unsystematic risk across countries can be reduced. Investing in emerging markets has been a major trend among investors well over last two decades. Emerging Asian markets reportedly offer investors in developed nations the potential of higher returns as well as risk reduction benefits through portfolio diversification. This may indicate emerging market funds generally are more focused on achieving diversification rather than taking active bets in these markets.

1.7 Plan of the Study

This chapter presents description, methodology, gap analysis, communication of issues, problems, objectives and significance of the study. Section 2 comprises research analyses and explanations for prior studies. Chapter 3 describes the latest thesis analysis test methods. Section 4 deals with data processing and tests.

Finally, Chapter 5 deals with the results of the analysis review, its conclusions and its limitations.

Chapter 2

Literature Review

International financial markets are the result of enhanced globalization and financial markets players are more conscious about that, how mean and volatility spillover or the transformation of shocks from one market to another market takes place over time. "This transmission mechanism is also highlighted in some important paper that includes Hamao et al. (1990), King and Wadhwani (1990), Engle and Susmel (1993), Lin et al. (1994), Karolyi (1995).

However, there exists a lack in the previous literature that most of these studies are done on some particular financial markets but don't provide the information regarding mean and volatility spillover or shocks transmission across industrial returns". As due to more globalization, the financial markets are coming more closer to each other, so it demands that there must exist some studies or research on how information about the movement of stocks and stock markets transmits from one market to other markets. "These studies are being further used by different policymakers and practitioners to make the process of decision making regarding asset pricing, strategies for trading and hedging more effectively.

The shocks from the emerging economies, such as the US, influence other economies through different distribution pathways, including the credit system, balance sheet system and exchange networks as the global economy is globalizing and worldwide financial markets converge. The accelerated rate of globalization and the ongoing convergence of emerging countries with the international economy is gradually growing. In this sense there is an important area of study in the patterns and

behavior of the capital markets of South Asian countries." This work aims to investigate the effect of global interest rate on the volatility and cross-relationship of South Asian countries in their equity returns.

2.1 Return and Volatility Relationship Between Global Interest Rate and Domestic Interest Rate

Recent research also highlighted the importance of global factors, particularly in highly integrated capital markets, that can spread changes in the interest rate conditions of one country to the rest of the globe. In Rey (2015) and Miranda-Agrippino and Rey (2017) adjustments will contribute to a global financial cycle that could produce beneficial global spillovers, regardless of the exchange rate regime. The interest rate spillovers in cross border capital flows have been noticed by (Bruno and Shin, 2015).

Interest levels in the United States (US) have a significant effect in many countries on economic conditions. With the increasing globalization, both in emerging and in industrialized countries, the impact of US interest rate shocks has become a major concern. However, Frankel et al. (2004) researched that how the domestic market movement of foreign interest rates relies on the exchange rate regime. In addition, they considered that interest levels under variable exchange-rate structures in countries respond slowly to shifts in foreign markets, which means a certain potential for monetary freedom in such exchange-rate regimes.

Bartosz Mac kowiak (2007) argued that the macroeconomic instability in emerging markets arisen from external shocks. In addition, the short-term interest rates and the exchange rates in a popular emerging market being influenced rapidly and strongly by a US interest-rate shock. The currency of a traditional developing market depreciated whether the shock reflect a downturn of U.S. monetary policy. It triggered inflation with no pause.

US interest-rate fluctuations described a greater fraction of the price-to-aggregate

volatility and real overall production in developing markets than the total price-to-aggregate variance and real overall performance in the U.S. itself. Such results were compatible with the notion that "as the US sneezes, emerging markets get cold." Meanwhile, U.S. policy hitting was not relevant in comparison to certain external hitches in the emerging market. Ironically, China and Malaysia have not reacted much inside the fixed community to adjustments in the US interest rate. Since the late 1990's to 2008, China and Malaysia held relatively steady policy levels. Hong Kong had a flow trend comparable to the interest rate in the United States. Some floats operated in Asia have patterns closed to US interest rates. The fast and rapid reactions of the controlled floaters to lower US interest rates reduced the pressures on appreciation in Asian countries especially. It avoided the cost swapping consequences of adjusting the interest rate between controlled floaters in the US and Asia. There were less interest rates in the free-floating category. Yet the US interest rate moved in general did not respond significantly (Kim and Yang, 2012).

The transfer of US interest-rate shocks to Ghana by a VAR method was explored by (Oguanobi, Akamobi, Ifebi and Maduka, 2015). They noticed that the Ghanaian economy's macroeconomic variables reacted just insignificantly to external interest-rate shocks. Over general, the Ghanaian economy was not particularly open to external shocks, their result said. That might, however, implied that the nation was home-made to its tremendous macroeconomic instability. Only an insignificant proportion of the domestic shocks could be linked to external shocks.

In an additional analysis the transmission of US interest rate shocks to Nigeria by the use of a VAR method was explored by (Oguanobi, Akamobi & Agu, 2014). They concluded that Nigeria's macroeconomic factors respond least to the fluctuations in global interest rates. They demonstrated that the Nigerian economy does not respond strongly to global shocks. This might, however, meant that the country's immense macroeconomic instability was domestic. Only a limited number of domestic shocks may be correlated with global shocks.

2.2 Return and Volatility Relationship Between Global Interest Rate and Equity Market

There has been substantial exposure in the literature to the connection between equity values and interest rates. Fama (1981) concluded that inflation predicted is adversely connected to projected economic activity and, in effect, was good for stock market returns. Bond yields also aligned adversely with expected inflation, mostly aided by the short-term rate of interest. At the other side, the effect at equity values of the long-term interest rate was based explicitly on a present valuation formula by the effects on the rate of return of the long-term interest rate. Instead of using either short-term or long-term interest rates, Campbell (1987) studied the connection between yield spread and returns on the equity market. He stated that the same variables that were used in the term structure to predict excess returns also predict excess returns on equities, deriving that a simultaneous analysis of returns on bills, stocks and bonds should be advantageous. His results have demonstrated the effectiveness of the term interest rate structure in forecasting excess returns on the US equity market.

Kaul (1990) examined the relationship between the inflation expectations and the equity markets, which, according to Fama's (1981) proxy theory, would be negatively correlated as the expected inflation is negatively correlated with the expected future economic economy, which, in impacts is positively correlated with the equity market returns. Instead of using short-term interest rates as alternatives for expected inflation, Kaul (1990) specifically designed the link between potential inflation and equity market returns.

The notion that economic shocks were important to emerging markets dated back to the empiric research (Calvo et al., 1993). These writers noted that foreign shocks compensate for a large fraction of the variation in actual exchange rates in Latin America between 1988 and 1991. This paper discussed East Asia as well as Latin America, more factors and a much longer study. In addition, this report discussed the effect of US interest rate shocks on emerging markets. The article therefore fallen into touch with the systemic VAR literature on the impact of US

interest rate shocks, initiated by (Sims, 1980).

Kim (2001) provided longitudinal VAR projections of the effect of U.S. interest rate policy changed on non-U.S. G-7 nations, yes. A significant contrast between Kim's findings and the findings of this paper was that Kim may not provide evidence for the opinion that the spillover impact of U.S. interest rate shocks on non-U.S. The G-7 nations are substantial. This disparity is in line with the belief that developing markets are more susceptible to external disruptions than big and established economies.

Lee (1997) utilized three-year cumulative declines to analyze the interaction between the equity market and the short-term interest rate. He attempted to predict the higher return (i.e. the difference between equity market returns and the risk-free short-term interest rate) on the Usual and Bad 500 index with the short-term interest rate, but noted that the correlation was not constant over time. Rapidly, it moves from a drastically negative to no correlation, or even a decent, but marginal, relationship.

Regrettably, many longitudinal experiments have been carried out since the 1970s on the links between asset values and interest rate. The macro-economic factors and market values checked with US economic detailed by (Fama, 1981; 1990; Chen, Roll and Ross, 1986; Chen, 1991). The strong positive association between stock returns and real interest rates has been shown by (Fama, 1981).

In recent years, scholarly work has centred on market fluctuations in Southern Asian countries. In calculating the variance at various beta rates of 50 S&P CNX Nifty Index-sourced securities, Ganesan and Yadav (2007) analysed the utility and prejudice of severe values.

Wei and Zang (2006) found that, over the period 1976-2000, average individual stock volatility has risen. They identified a variance in the inventory return to the equity return and a positive relation with equity return variance and intersectional volatility. Kothari (2000) recorded growing equity return volatility worldwide and analyzed whether or not disclosure is linked to such stock market volatility patterns in financial statement results.

In order to evaluate the effect of selected macro-economic variables on the stock

market in terms of monthly data from January 2001 to December 2010, Olweny with Omodi (2011) used both E-GARCH and T-GARCH data. The findings for interest rate-equivalent bond-market correlation demonstrated that there were leverage implications for equity return fluctuations between the good and bad data.

Over the duration from 1990 to 2012, Yang and Hamori (2014) studied the spillover impact of the US monetary policy on stocks in Indonesia, Singapore and Thai. They employed Markov-changing models, univariate and multivariate, and stated that US prices have affected certain markets in reverse during the boom, but that effect disappears during the recession. Moreover, the impact of the US monetary policy on spillover has only been calculated during the quiet time on the financial markets (Yang et al., 2003).

In fact, they discussed the asset price transfer process, in particular from the US to smaller economies (Yang et al., 2014). In brief they found that the treasury bill rate was most affected by the financial prices in the bull market, since a bull market continues longer than a down market.

In recent years Syriopoulos et al. (2015) have studied BRICS's complex risk-return properties and developed possible time-varying associations with the financial market. Their observational studies showed that the 2008 global financial crisis greatly impacted BRICS capital markets. In specific, Bekiros (2014) examined, through vector autoregression and multivariable GARCH representations, the contagion, decoupling, and spillover impact of the US financial crisis on the BRIC economies. The empirical findings suggested that since the US financial crisis the BRICs have been more interconnected and contagion is further assisted. In fact, the theory of decoupling was not backed by clear proof. There have also been the same contagion effects as the BRICS in the MENA area, leading to significant bond market falls and GDP levels.

Neaime (2012) explored the global and regional financial linkages between MENA capital markets and the more advanced equity markets and intra-regional equity relations between financial markets in the MENA countries by utilizing, for example, the causality of discrepancies in GARCH model, Threshold ARCH and M

models and the VAR study. Empirical studies indicated that, depending on their international convergence with the more developed capital markets, the spillover consequences of the latest global financial crisis in MENA countries differ according to their equity markets.

Guyot et al. (2014) researched the effects on MENA countries during the 1998-2011 era of global financial shocks to destabilizing asset prices in emerging markets. They found that external shocks raised equity costs in mature emerging economies by implementing a combination of SGMM and PVAR models. The study discussed equity returns and stability co-movement between the United States and a number of regional financial markets in the Middle East and North Africa prior to and following the 2008 global financial crisis.

Kim & Nguyen (2009) reported and spoke in his paper regarding the presence and the essence of the monetary interest rate news transmission from the United States. Throughout the duration from January 1999 and December 6, the Fed and the ECB were on the equity returns for the first two phases of 12 Asia-Pacific bond markets.

The economies of the US and the euro area were the two main economic blocks in the world, with major currency movements causing financial price volatility in their respective markets as well as in others. Through presenting detailed data on the spillover impact of such news on the financial markets in the Asia-Pacific region, the paper made a significant contribution to literature.

There was a small impression that disruptions were significant engines of developing markets development in developed economies. Rand and Tarp (2002) and Likened and Kose (2007) endorsed the opinion that GDP development in emerging markets was guided mainly by shocks to developed economies. Similarly, Kouparitsas (2001) noted that economic fluctuations in developed economies caused up to 70 percent of demand uncertainty in emerging markets.

Edwards (2010) utilized high-frequency data to analyzed the effect that shifts in the Federal Reserve Fund rate have on emerging-market interest rates. He also discussed the effects of fluctuations triggered by dollar-euro currencies, energy markets, risk levels and movements of money. The general assumption of Edward

was that there were specific business effects for shocks. The effect was swift for Latin American markets but for Asian markets the effect was felt for a long time. Dooley and Huthchinson (2009), who investigated how shocks were delivered during the US sub-prime crisis, published related results. They noted that emerging markets have been quite disconnected from US economy trends since the beginning of 2007 and mid-2008. However, in the post-summer cycle 2008, emerging markets responded very strongly to many news events. The proofs endorsed their theory of disassociation. Fidrmuc and Korhonen (2010) supported the theory of decoupling since over the period 1992-2007 they observed relatively few differences between China and India in the business cycle.

In other parts, Balli et al. (2015) have analyzed returns and volatility spillover effects using univariate GARCH models and variance ratios focused on Asian and Near East and North African (MENA) financial markets. They observed spillover impact on selected developing markets in Asia and MENA from established US, Europe, and Japan capital markets, although there was broad variability in the results across nations.

Additionally, Syriopoulos et al (2015) looked at the spillover impact of the bivariate VAR-GARCH model in capital markets between the United States and the BRICS nation including Brazil, Russia, India, and China. They have shown a lot of large stock returns and volatility spillovers between the US and BRICS.

Huo and Ahmed (2017) analyzed the effect of a new Shanghai – Hong Kong Market Connect launch, using the Shanghai Stock Exchange Composite Index and the Hong Kong Hang Seng Index results. Response to high-frequency one-minute interval variability spillovers from Shanghai to Hong Kong after the relation was noticed by the univariate models Glosden, Jagannathan and Runkle (GJR)-GARCH Glosten et al., (1993) and bivariate VAR-asymmetric model BEKK-GARCH.

The exponential GARCH model was used to monitor volatility transmissions as it measures asymmetries directly (Kumar, 2013). In several papers concerned with volatility spillover calculations in recent years, in addition to the GARCH multivariate index suggested by Diebold and Yilmaz (2009), the GARCH multi-model was added. For example, Erten et al. (2012) examined the volatility effects in

global equity markets, and Liu (2016) looked at the modeled volatility spillover effects between developed equity markets and emerging Asian equity markets (Li and Giles 2015).

The price trend and spillover consequences within Eurozone Economies were studied by the (MacDonald et al. 2018). The GARCH-BEKK model was also capable of evaluating return, volatility interaction and spillover volatility consequences (Kumar, 2013). This paper supplemented the recent literature by analyzing the impact on the stock sector of South Asian countries of global (US) interest rates. The purpose of this analysis is to determine the return and spread of volatility between the global interest rate and the advanced and developing countries of South Asia. In the time frame from January 2009 to December 2019, ARCH-GARCH models used to assess the impact of the global interest market on equity prices. This research works in different forms from the usage of multivariate ARCH-GARCH models.

The results show a favorable return-to-volatility relationship between the interest rates and the selected South Asian equity markets. In export markets with the exception of Srilanka and Bangladesh, this partnership is also good. The study also investigates the effect of global interest rates on the equity markets of South Asian countries and concluded that the effects of the global interest rates differs from market to market.

On the return and uncertainty spillovers from mature to developing capital markets were mainly focused on minority analysis. Evidence of company transactions and transfers is difficult to find, in particular, in South Asian equity markets. In the context of increased economic activity in those countries as a result of economic policies and the modernization of equity markets, South Asian equity markets have generated significant interest for local and foreign investors.

In this study, we examined how information is transmitted from the global interest rate to five newly liberalized South Asia Equity markets – the Shanghai Stock Exchange (SSEX) of China, the Indian's Bombay Stock Exchange (BSE), Pakistan's Karachi Stock Exchange (KSE), Sri Lanka's Colombo Stock Exchange (CSE) and Bangladesh's Dhaka Stock Exchange (DSE). Our analysis is threefold

different from the previous research on this topic.

Second, unlike other prior analyses focused on how foreign interest rates (sometimes US or regional interest rates) affect many stock markets, we are examining U.S. interest rate advances to examine the effects on South Asian equities of world shocks. Second, we considered the asymmetrical nature of the spread of volatility, i.e. That negative developments in one sector can lead to more volatile spillovers in another sector than the positive equivalent developments.

2.3 Time-Varying Conditional Correlation

Over the past two decades, there exists an extensive literature on different Multivariate GARCH models with respect to conditional variance-covariance and conditional volatility characteristics. First of all, Bollerslev et al. (1988) propose the very first multivariate GARCH model The VECH approach used to evaluate the conditional covariance matrix between the pair. The VECH approach is used when the estimated return dimensions of the large parameters increase to check the direct generalization of the univariate approach.

In addition, to make this model more precise and comprehensive, the earlier versions of Baba, Engle, Kraft & Korner's BEKK method is also used to determine the conditional covariance matrix and conditional constant correlation CCC with its other variants as well. Engle (2002) later pro- vides the concept of Dynamic Conditional Covariance DCC GARCH model in which the assumption of time varying conditional correlation is introduced rather than Constant Conditional Correlation CCC.

The work of Engle (2002) is further extended by Cappiello et al. (2006) which provided another approach of the Asymmetric Dynamic Conditional Correlation ADCC GARCH model which included the basic assumptions regarding positive and negative news shocks. Mostly, it is seen that the market volatility of the same sample size reflects more effects of the negative shock rather than positive shocks. In uni-variate GARCH models proposed by Engle and Ng (1993) these asymmetric behaviors were broadly discussed. However, there is limited literature

on the behavior and attitude of asymmetric relationships between stock markets, but global financial crises have given more importance to negative shocks and more turbulence.

There exists a huge body of literature on the cointegration, international financial integration and spillover effects on stock markets returns. For the purpose of the benefits of portfolio allocation and diversification, the outcomes of volatility transmission specially in the financial crises has attained a considerable focus in the previous literature. It is also revealed in the previous literature that the effects of negative shocks tend to increase the volatility of high magnitude as compared to the positive shocks (Engle and Ng, 1993).

To underline the significance of portfolio diversification and allocation, Kalotychou et al. (2014) analyzed the correlation of volatility across sectors using the U.S., U.K. and Japan stock market survey. They indicate following two points; (i) there exists a benefit of portfolio management for time varying volatility. (ii) they also uncover the dynamics returns correlations.

Using the time frame of 1995 to 1997, Scheicher (2001) used Vector Auto-regressive VAR CCC approach to investigated the co-integration among three European developing markets i.e. The Czech Republic, Poland and Hungary. The results showed that, there exists both regional and global transmission in returns but only volatilities transmission in regional market. The results suggested that, mean spillover of global shocks is found in Central Europe stock markets instead of volatility shocks.

Tse and Tsui (2002) investigated the impacts of time-varying conditional correlation between stock and forex markets using time-variating conditional correlation model VCC. Using the models Dynamic Conditional Correlation (DCC), Asymmetric Dynamic Conditional Correlation (ADCC), Generalized Dynamic Conditional Correlation (GDCC) and Asymmetric Generalized Dynamic Conditional Correlation (AGDCC), Cappiello et al. (2006) took a sample of 21 listed companies and 13 bond indices and investigated the asymmetric existence of the volatility between them. To determine the dynamic effects of correlation between U.S. and Japanese markets, in comparison with U.S. and Hong Kong markets,

McAleer et al., (2008) use Generalized Auto-regressive Conditional Correlation model (GARCC) in their study.

To examined the spillover effects of macroeconomic variables, energy and agriculture commodities, Manera et al. (2013) employed DCC-GARCH model in their study by taking the time frame of 1986 to 2010. They noticed a positive relationship between expected commodity and macroeconomic indicators. Moreover, they also observed a significant positive impact of oil market on the other energy commodities and reported a possible spillover effect across other commodities. In addition, they also concluded that the effect of dynamic conditional correlation DCC is more after 2004 (particularly in energy markets they even doubled) than before and a significant weak financial speculation in modeling commodity returns.

To research the complex correlation of volatility between Ghana's stock prices and Nigeria's oil prices, Lin et al. (2014) used the VAR-GARCH and DCC-GARCH models for the period 2002 to 2010. They explored that, for these two countries the variation for the optimal hedge ratio was different as; the optimized hedge ratio varied from 0.51 to 0.40 for Ghana and from 0.56 to 0.50 for Nigeria. Sadorsky (2014) examined the link between uncertainty and conditional probabilities between Dow Jones Specially Responsible Investment stock portfolio, gold and oil, using weekly return CCC and DCC GARCH models.

The results were same as of S&P 500 that, the investors of SRI could hedge their investment in gold and oil market by paying a similar amount as that of investors in S&P 500 expected to pay. For example, there is a very small difference between the normal hedge ratio of SRI to oil and S&P 500 to oil (as the hedge ratio of SRI to oil is 0.05 and the hedge ratio between S&P 500 and oil is 0.07).

Kasch-Haroutounian and Price (2001) chose the time frame of 1994 to 1998 and apply two different multivariate GARCH approaches the constant conditional correlation (CCC) and the BEKK models to examine the interrelationship among Central European markets; the Czech Republic, Poland, Hungary and Slovakia. The authors report that, Hungarian and Czech & Hungarian and Polish are positively related to each others with the values of 0.22 and 0.13, respectively. For the other pairs, correlations are found to be insignificant and very small."

From 1997 to 2008, Savva and Aslanidis (2010) study business ties between CEC and smooth transition CC (STCC) models, both within five CEE countries (Czech Republic, Poland, Slovakia, Slovenia) and in the euro area sector. The main CEE markets (Czech Republic, Poland, and Hungary) display a stronger connection than in Slovenia and Slovakia. Authors are still deeply intertwined in this area between the Czech Republic, Poland and Hungary. Furthermore, the authors also report that there exists an increasing correlation vis–vis euro area among CEE markets and between Polish, Slovenian and Czech markets. However, there find a stability between the pairs of other stock markets.

Wang and Moore (2008) use a DCC model to further analyze the interdependency between three developing markets (Czech Republic, Poland and Hungary) and the overall eurozone economy. Thanks to the growth of the EU the authors consider a strongly growing link between the CEE and the euro zone economy. Yet banking turmoil. Then political catastrophe. In comparison, the financial complexity and stronger similarities often apply explicitly to them. Yet the ties between monetary and macroeconomic trends do not have any connections or any impact at all.

Chong and Miffre (2010) chose the weekly data of prices from the period of 1981 to 2006 and investigate the hedging of stocks and treasury bills by using DCC-GARCH models with 25 different future contracts of commodities. The authors find a decreasing trend of correlation between commodity futures and S&P 500, over the time. This suggests that, for short term interest rate securities and strategic asset allocation, commodities are instruments very important. The study of Chong and Miffre (2010) embeds the sample period until 2006, so results are less influenced by the phenomenon of financialization (2004 onwards). Choi and Hammoudeh (2010) use the most important macroeconomic variable; Crude Oil as an industrial commodity, and study the behavior of volatility. In their study, they measure the volatility regimes and conditional correlations by using GARCH switching approach and DCC GARCH models, respectively. The results obtained from data sample of 1990 to 2006, they report that, correlation shows an increasing trend since 2003, Iraq war but decreasing with S&P 500. Again, a short period of financialization is also covered as the sample is until 2006.

During the period of 2001 to 2011, Creti et al. (2013) use DCC GARCH model on 25 commodities & stocks and explore the mechanism of conditional correlation. Prime importance in this paper is given to examine the linkage between S&P 500 and each commodity. The authors find that there exists a high conditional correlation throughout the whole period, critically more in sub-prime crises of 2008. In addition, they also examine that for crude oil, cocoa and coffee, speculative movements are found. In conclusion, they report that only gold is mostly negative associated or correlated with stocks and that the financialization of commodity market lowers their strong use in diversification, with main expectation for gold, cocoa and coffee.

Demiralay and Ulusoy (2014) investigate the relationship between S&P 500 and commodity markets. Using the asymmetric dynamic conditional correlation ADCC GARCH model, they study conditional correlation between Dow Jones- UBS-commodity index and its sub indices with S&P 500. In their study, they employ the weekly returns data and use Exponential GARCH EGARCH model during the time period from 1992 to 2013. They report that the correlation be- tween equities and commodity indices are found to be highly volatile. Moreover, they also find an increasing trend during the financial crises.

Using the weekly data sample from 1997 to 2009, Syllignakis and Kouretas (2011) investigate the correlation between CEEC countries (the Czech Repub- lic, Estonia, Hungary, Poland, Romania, Slovakia and Slovenia) vis–vis the U.S. Germany & Russia by using DCC GARCH model. The authors find that the corre- lation in the these countries stock market is time varying and exhibit an increasing trend over the time but this increase also reduced the benefits of diversification for these CEEC countries. The authors explore that, a huge degree of financial openness can broadly explain the shits occur in the coefficient of correlation, pro- vided on the availability of the outside investors in this region, leading to the final entry of the EU.

Chang et al. (2011) exhibit the hedging strategies to hedge crude oil prices and crude oil futures markets by using BEKK, CCC, DCC, and VARMA-GARCH. They take the sample of both WTI and BRENT crude oil prices. Their findings

provide an evidence on the time varying nature of hedging ratios that, they all show a changing behavior over the time. Comparison is made on the basis of hedging effectiveness by using both DCC and BEKK hedging models in which, hedges calculated from DCC prove the best rather than BEKK as they prove to be worst. Pan et al. (2014) conducts a study to determine the hedging effectiveness between crude oil prices and other petroleum products like oil and gasoline by using regime switching asymmetric dynamic conditional correlation RS-ADCC GARCH model. In this study, the hedging effectiveness of BEKK model is proved to be the best for hedging crude future with gasoline futures. The highest hedging effectiveness for hedging crude oil and heating oil is provided by the regime switching RS-ADCC model.

Although there is a huge amount of literature on time-varying conditional correlations and contagion on developed countries' stock and bond markets (Missio and Watzka, 2011: Kenourgios et al., 2011; Dungey and Fry, 2009; Bartram et al., 2007; Cappiello et al., 2006; Engle, 2002). However, related literature on emerging markets is limited to conditional correlations between global interest rates and equity markets. Past research in South Asian countries, which captured the positive or negative asymmetric effects over time, is limited on the comparisons between different markets.

2.4 Hypothesis of the Study

Hypothesis 1:

There exists a volatility spillover from global interest rates to domestic interest rates of South Asian countries.

Hypothesis 2:

There exists a return spillover from global interest rate to equity market of South Asian countries.

Hypothesis 3:

There exists a volatility spillover from global interest rate to equity market of South Asian countries.

Hypothesis 4:

There exist a time-varying conditional correlation between the South Asian countries' domestic interest rates and global interest rates.

Hypothesis 5:

There exists a time-varying conditional correlation between global interest rates and equity market of South Asian countries.

Hypothesis 6:

There exists an asymmetric behavior of time varying conditional correlation.

Chapter 3

Research Methodology

For this analysis the approach is divided into two key sections. The first part of this research examines the return and volatility transmission from global interest rate to domestic interest rates and equity markets of South Asian countries by using ARMA (1,1) GARCH In Mean approach presented by Liu and Pan (1997). In second part, time-varying conditional correlations between equity market are measured by using Dynamic Conditional Correlation (DCC) and Asymmetric-DCC (ADCC) Multivariate Generalized Auto-regressive Conditional Heteroscedasticity (MV-GARCH) models proposed by Engle (2002) and Cappiello et al. (2006), respectively.

3.1 Data Description

3.1.1 Population and Sample of the Study

The study sample is taken of 10 years starting from 01/01/2009 to 31/12/2019. This study uses the daily global (US) interest rates and the daily closing of equity prices in five Asian countries (China , India, Pakistan, Srilanka and Bangladesh) to examine spillovers of impact or return and volatility from the global (US) interest rates to the domestic interest rates and the global (US) interest rates to the equity market in South Asian countries and time varying conditional correlations,

respectively. This study considered secondary financial data, the data of Global (US) interest rate was obtained from website(investing.com) and the data of domestic interest rates and equity prices was obtained through different sources (e.g. investing.com, yahoo finance.com, SBP.com).

3.2 Description of Variables

3.2.1 Global Interest Rate–US

Global interest rates are increasing after a long record-low period, and foreign investors may want to reevaluate their allocations to the risk of interest rates.
The current study uses the daily domestic interest rates of US for the period of 01/2009 to 12/2019 from investing.com.

$$r_t = \text{In } \frac{US_t}{US_{t-1}}$$

Where: ln = Natural Log
USt = Global Interest Rate of t day
USt-1 = Global Interest Rate of t-1 day

3.2.2 Equity Prices–5 South Asian Countries

The current study uses the daily closing prices of the five South Asian countries selected on the basis of equity markets from 01/01/2009 to 31/12/2019. Equally weighted measure is used to calculate each country's average returns on equities. The detail about countries is mentioned in the following Table 3.1.

Sr. No	Countries	Equity Markets
1	China	Shanghai Stock Exchange (SSEX)
2	India	Bombay Stock Exchange (BSE)
3	Pakistan	Karachi Stock Exchange (KSE)
4	Srilanka	Colombo Stock Exchange (CSE)
5	Bangladesh	Dhaka Stock Exchange (DSE)

3.3 Econometric Model

Research methodology is a process in which various tools, techniques and concepts are used in a study to check the answer of the research question in a methodological manner. This paper applies ARMA GARCH model to determine precise and consistent proof of the return transmission and spillover effects.

3.3.1 Return and Volatility Spillover–ARMA GARCH

3.3.1.1 Global Interest Rate to Domestic Interest Rates

The study investigated the return and volatility transition from the global interest rate in the Southern Asian countries in the GARCH in the mean GARCH method (GARCH-M), proposed by (Liu and Pan, 1997). In the first point, a GARCH (1,1)-M econometric approach is used to form the related global interest rate returns sequence.

$$\mathrm{r}_{i,t} = \beta_0 + \beta_1.\nu_{i,t} + \beta_2.\varepsilon_{i,t-1} + \varepsilon_{i,t}, \varepsilon_{i,t} \sim N(0, \upsilon_{i,t}) \quad (3.1)$$

$$\nu_{i,t} = \gamma_0 + \gamma_1.\mu^2_{i,t-1} + \gamma_2.\nu_{i,t-1} \quad (3.2)$$

Where $\mathrm{r}_{i,t}$ is the interest market daily return at time t and $\varepsilon_{i,t}$ is the residual or unpredictable return in other words, the error term. Basically, the main objective of integrating the ARMA (i,j) GARCH structure into the model is to change the autocorrelation problem in the data.

In the second step, the impact of return and transmission of volatility along all interest markets is determined by accessing the standardized error term and its square in the very first step and including the structural break in the return and volatility equations of other markets as:

$$\mathrm{r}_{j,t} = \beta_0 + \beta_{j,1}.r_{j,t-1} + \beta_{j,2}.\nu_{j,t} + \beta_{j,3}.\varepsilon_{jt-1} + \lambda_{j,}\varepsilon_{j,t} + \varepsilon_{j,t}, \varepsilon_{j,t} \sim N(0, \upsilon_{i.t})... \quad (3.3)$$

$$\nu_{j,t} = \gamma_{j,0} + \gamma_{j,1}.\mu^2_{j,t-1} + \gamma_{j,2}.\nu_{j,t-1} + \pi_j.e^2_{jt}..... \quad (3.4)$$

Where $\varepsilon_{i,t}$ is the standardized error term for interest market and captures the mean return volatility spillover effect from such sources. To analyse the spillover volatility, the exogenous variable $\mathrm{e}^2_{i,t}$ – the square of the standardized error term is included in the conditional volatility equation and it is defined as $\mathrm{e}^2_{i,t} = \frac{\varepsilon^2_{i}t}{\upsilon_{it}}$. The subscript j refers to one of the country's market.

3.3.1.2 Global Interest Rate to Equity Markets

In order to analyze the return and dissemination of uncertainty through different equity markets in South-Asian nations, the same two-stage GARCH-in-mean method has been used. The first stage is the development of ARMA (1,1)-GARCH (1,1)-M econometric process for the respective worldwide interest rate rates sequence.

$$\mathrm{r}_{a,t} = \eta_0 + \eta_1.\nu_{a,t} + \eta_2.\varepsilon_{a,t-1} + \varepsilon_{a,t}, \varepsilon_{at} \sim N(0, \upsilon_{a,t})..... \quad (3.5)$$

$$\nu_{a,t} = \Phi_0 + \Phi_1.\mu^2_{a,t-1} + \Phi_2.\nu_{a,t-1}..... \quad (3.6)$$

Where $r_{a,t}$ is the equity markets daily return at time t and $\varepsilon_{a,t}$ is the residual or unpredictable return in other words, the error term. Basically, the main objective of integrating the ARMA (a,b) GARCH structure into the model is to change the autocorrelation problem in the data.
In the second step, the impact of return and transmission of volatility along all equity markets is determined by accessing the standardized error term and its square in the very first step and including the structural break in the return and volatility equations of other markets as:

$$r_{b,t} = \eta_{b,0} + \eta_{b,1}.r_{b,t-1} + \eta_{b,2}.\nu_{b,t} + \eta_{b,3}.\varepsilon_{b,t-1} + \psi_b.\varepsilon_{bt} + \varepsilon_{bt}, \varepsilon_{bt} \sim N(0, \upsilon_{i,t}).. \quad (3.7)$$

$$\nu_{b,t} = \Phi_{b,0} + \Phi_{b,1}.\mu^2_{b,t-1} + \Phi_2.\nu_{b,t-1} + \tau_b.e^2_{b,t}..... \quad (3.8)$$

Where $\varepsilon_{a,t}$ is the standardized error term for equity market and captures the mean return volatility spillover effect from such sources. To analyse the spillover volatility, the exogenous variable $e^2_{a,t}$ – the square of the standardized error term is included in the conditional volatility equation and it is defined as $e^2_{a,t} = \frac{\varepsilon^2_{a,t}}{\upsilon_{a,t}}$. The subscript b refers to the country's equity market.

3.3.2 Time-Varying Conditional Correlation – DCC and ADCC

The above statement suggests that the correlation is consistent over time, but that the correlation may vary over time. Thus, in this case, the Dynamic Conditional Correlation DCC GARCH approach is used and the possibility of any asymmetry in the model is recorded by the ADCC GARCH model. Dynamic Conditional Correlation method or DCC, models the volatilities and correlations in two steps.

The detail about the dynamics of correlation reached out to permit asymmetries vital for financial practice. The DCC furnishes a joint thickness work with tail dependence more prominent that the ordinary. This is investigated both by simultaneously and experimentally. The time aggregated DCC is exhibited as a valuable copula for financial decision making.

At a point when two stocks move same way, the correlation is expanded marginally. On the opposite side, when similar two stocks move inverse way, this correlation is diminished. In down markets, thus effect of movement of stocks can be stronger. Th correlations often are assumed to only temporarily deviate from a long run mean. In the case of upper as well as lower tail of the multiperiod joint length, a symmetric dcc model offers greater dependence on the neck, while an asymmetric dcc or a dcc gives greater dependence on the intensity from the lower neck.

Dynamic Conditional Correlation DCC

DCC is defined as:

$$Q = \overline{R} + \Sigma_{i}^{m}{}_{=1}\pi_i(\alpha_{t=i}\acute{\alpha}_{t=i} - \overline{R}) + \Sigma_{i}^{m}{}_{=1}\varepsilon_i(Q_{t-1} - \overline{R}).. \quad (3.9)$$

For most of the data set used in the research, DCC (1,1) is proved to be an adequate model.

• Diagonal Generalized GDCC

For the estimation of Diagonal Generalized DCC, the following steps are followed. . .

1. Choose a parameterization for P and Q as:

$$P = \alpha\acute{\alpha} = \beta\acute{\beta}..... \quad (3.10)$$

2. So that for any Z,

A.Z = diag$\{\alpha\}$.$Z diag\{\alpha\}$..... (3.11)

3. Hence for any i and j,

$Q_{i,j,t,-1} = \overline{\vartheta}_{i,j} + \alpha_i\alpha_j(\epsilon_{i,t} - \overline{\vartheta}_{i,j}) + \beta_i\beta_j(Q_{i,j,t} - \overline{\vartheta}_{i,j})$..... (3.12)

• Asymmetric Dynamic Conditional Correlation ADCC
ADCC is defined as:

$\sigma_t = min(\epsilon_{i,t}, 0)\overline{N} = \frac{1}{T}\Sigma_{t=1}^{T}\sigma_t\acute{\sigma}_t$..... (3.13)

1. Asymmetry may be enforced by zero definitions when all returns are negative, for example:

$\mu\sigma_{i,t}\sigma_{i,t}$..... (3.14)

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

G $(\sigma_t\acute{\sigma}_t - \overline{N})$..... (3.15)

• Asymmetric Generalized DCC AGDCC

The Asymmetric Generalized DCC can be expressed as,

$Q_t = \overline{R} + A.(\epsilon_{t-1}\acute{\epsilon}_{t-1} - \overline{R}) + B.(Q_{t-1} - \overline{R}) + G.(\sigma_t\acute{\sigma}_t - \overline{N})$..... (3.16)

And assuming a diagonal structure for A, B and G, the typical equation becomes,

$$Q_{i,j,t,+1} = \overline{\vartheta}_{i,j} + \alpha_i \alpha_j (\epsilon_{i,t} - \overline{\vartheta}_{i,j}) + \beta_i \beta_j (Q_{i,j,t} - \overline{\vartheta}_{i,j}) + \gamma_i \gamma_j (\sigma_t \acute{\sigma}_t - \overline{N}_{i,j}) \ldots\ldots\ldots \quad (3.17)$$

Chapter 4

Analysis of Data and Results

This chapter discusses the different tests used to study and analyze the phenomena under discussion and interprets the results obtained.

4.1 Graphic Representation

4.1.1 Stationarity of the Series

In research, the first and basic step of each analysis is the visualization of the behavior of the data. Visualization of the data means checking the stationarity of the series that the data must be static for further spillover analyses. It means that the mean of the series must be constant. All stationary graphs are attached in Appendix-A.

4.1.2 Descriptive Statistics

After checking the stationary properties of the series, the second step is to examine the behavior of data using the descriptive statistics of each series including Independent and Dependent variables. In this study global interest rate is independent and all other South Asian countries are taken as dependent variables as shown in Table 4.1. descriptive statistics gives information about measure of location, measure of dispersion and its measure of shape of data.

Table 4.1 includes first four important moments i.e. Mean, Variance, Skewness and Kurtosis. Here mean describes the average return, Standard deviation tells us about spread and dispersion of data, whereas Skewness and Kurtosis gives information about the shape of data. In this research the 10 years data of daily global interest rate of (US), domestic interest rate and closing prices of equity market of South Asian countries is used from 01/01/2009 to 31/12/2019.

Minimum average responses. The sample period is taken of 10 years starting from01/01/2009 to 31/12/2019. The study employs the daily global interest rates and domestic interest rates of five South Asian Countries.

Annual average returns compare domestic interest rates output in different countries of South Asia. The analysis reveals that interest rate returns are either optimistic or harmful. The maximum mean return benefit is that of India (NRI) (0.0074%) and the lowest of Srilanka (NRS) (0.019%).

Nevertheless, Bangladesh (NRB) has the greatest uncertainty (4.11%), which supports the rational danger and return relationship; the higher the risk, the better the return. However, both countries have a positive standard deviation. This also claims that it is more competitive than many sectors. In India (NRI), however, there is the lowest (0.72%) uncertainty, suggesting less variability. The numbers display the average and minimal value. And for growing sector, min. return earned / day. The average return / day is (0.0265% for China (NRC), the highest return / day is (30.6%) and the total return received or gross loss / day received is (23.13%).

Skewness tells us about data's asymmetric behavior. Skewness values of China (NRC), India (NRI), Srilanka (NRS) and Bangladesh (NRB) shows that distribution of returns positively skewed. On the other hand, Pakistan (NRP) shows only negative skewness. The downward pattern of skew indicates that portfolio returns are consistently depreciated. Kurtosis talks of the tailed distribution of the chance. The Kurtosis values are all optimistic and less than 3 suggest that all series are leptokurtic, i.e. short, peaked tails and heavily influenced by the bubble economy.

Table 4.1: Descriptive Statistics

		Mean	Maximum	Minimum	St. Deviation	Skewness	Kurtosis	Jarque-bera
US		-7.10E-05	0.107601	-0.167688	0.021321	-0.046094	6.039016	1219.068
Chi	**(NRC)**	0.000265	0.306913	-0.231329	0.032447	0.439953	20.60752	40986.62
Ind	**(NRI)**	7.44E-05	0.12237	-0.057205	0.007203	1.949121	40.64768	188857.1
Pak	**(NRP)**	-0.000108	0.119689	-0.119801	0.012995	-0.223291	44.7126	229408.5
Sri	**(NRS)**	-0.000196	0.190663	-0.190663	0.010425	1.349464	95.15662	1120954
Ban	**(NRB)**	1.86E-05	0.516491	-0.468903	0.041112	0.249586	63.84605	226469.1

"This table covers the descriptive statistics for the series of global interest rate and domestic interest rate of South Asian countries".

Minimum replies average. The sampling period is taken from 01/01/2009 to 31/12/2019, for 10 years. The study employs the daily global interest rates and closing equity prices of five South Asian Countries.

Average mean returns measure the south Asian equity market performance. The study resulted that all mean returns of the market are positive. The highest value of mean return in equity market is of Pakistan (KSE) i.e, (0.061%) and the lowest is of Bangladesh (DSE) i.e, (0.00081%). In addition, the standard deviation the standard deviation of all the equity markets is positive. From equity market the volatility of China (SSEX) is highest (1.30%) confirming that China is more volatile than rest of other selected south Asian countries.

Table 4.2: Descriptive Statistics

		Mean	Max.	Min.	St.Deviation	Skewness	Kurtosis	Jarque-bera
US		-7.10E-05	0.107601	-0.167688	0.021321	-0.046094	6.039016	1219.068
Chi	**SSEX**	0.000162	0.059359	-0.088729	0.01307	-0.87672	9.723271	6366.518
Ind	**BSE**	0.000447	0.154902	-0.073836	0.010339	0.849603	21.99362	47940.52
Pak	**KSE**	0.000611	0.076051	-0.051349	0.00988	-0.056372	7.266778	2401.754
Sri	**CSE**	0.00043	0.062596	-0.065156	0.007198	0.579416	15.559	20977.55
Ban	**DSE**	-8.15E-06	0.036847	-0.023588	0.005901	0.323066	6.632836	832.7829

"This table covers the descriptive statistics for the series of global interest rate and domestic interest rate of South Asian countries".

It also depicts the relationship between risk and return, it means that higher the rate of risk the higher will be the return. Whereas, the Bangladesh (DSE) shows lowest volatility that is (0.059%) which depict that Bangladesh is less volatile in Equity market. Bangladesh (DSE) resulted (0.059%) only which is least than all. Maximum and Minimum statistics exhibits the daily return earned at maximum and minimum level by the market. Such as the daily mean return of Pakistan (KSE) in equity market is (0.061%), its maximum return or profit earned is (7.60%) and the minimum return/maximum loss earned is (5.13%).

US interest rate show a negative mean return (0.0071%) and standard deviation (2.13%). Values of maximum and minimum show the max return earned/day and max loss earned/day that is (3.75%) and (3.32%), respectively.

For the past decade, interest rates around the world have been at historic lows. Lascelles (2020) examined that there are several reasons for this, including slow economic growth, low inflation, aging baby boomers in many countries, and high demand for government securities. Central banks have been buying bonds to keep their own interest rates low, and some foreign banks invest in U.S.

treasuries as a safety net. From both an economic and investment prism, the world is a more volatile place when interest rates are extremely low as one would imagine, yields from fixed income assets are reduced in a low or negative rate setting, which may force investors to take on more risk in the hopes of high reward. This quest for yield results in return-sensitive investors crowding into classes of riskier assets, increasing their valuations.

Negative returns from bonds occur over periods when the movement of capital is negative than the received revenue. Falling interest rates lead to short-term returns in excess of the average. Where negative returns from interest rate increases exist, they are, in essence, "temporary." Negative returns are only permanent if the investor cashes in (sells) the investment (super life.co.nz, 2015).

4.2 Return and Volatility Spillover from Global Interest Rate to Domestic Interest Rate

After preliminary analyzes, the first aspect of the methodology is to use an appropriate econometric model to examine the volatility spillover and return from global interest rate to domestic interest rate. **Table 4.3**, demonstrates the spillover volatility forecasts of global interest returns on domestic interest returns using respectively an ARMA GARCH (i,j) method.

In such analyzes, the global interest rate is taken as a benchmark and its effect is

then seen on that country's domestic interest rate, and the same process is done for all countries.

Simply put, shocks generated from the benchmark market, passed on to the other market to decide that, is there any transfer of return or volatility taking place or not? All ARCH and GARCH coefficients are reported in parenthesis, with their-i.

For China the β_1 is found to be significant and positive it means that, we can predict the mean returns of China (NRC) by using past interest rates behavior showing past behavior influences current volatility. In other words, market of China is inefficient, demonstrating that there are no possibilities for diversification in China.

On the other hand, for Pakistan (NRP), India (NRI), Sri Lanka (NRS) and Bangladesh (NRB) there was no effect on today's returns from past interest rates behavior, which means that these markets are efficient and provide investment opportunities. Investors can take advantage of diversification.

The coefficient of GARCH $\beta_2$is significant positive for Srilanka (NRS) indicating that, mean returns can be predicted through forecasted volatility but it is significant negative for Pakistan (NRP) that means, mean returns can be predicted through forecasted volatility but in an opposite direction.

The coefficient of standardized residual error term, β_3 has insignificant impact on India (NRI), Sri Lanka (NRS) and Bangladesh (NRB) that shows, these markets did not account for the process of correction on the basis of past shocks.

Whereas, it has significant negative impact on China (NRC) and Pakistan (NRP) resulting that these markets make some necessary adjustments for the next day on the basis of past shocks. Simply, the markets will move opposite to make correction.

The γ_1 coefficient is significant and positive for all industries this suggests that current period volatility can be predicted using past price behavior. The γ_2 the coefficient is also important and optimistic for all countries providing proof of continued volatility.

The results of mean spillover λ shows an insignificant impact on all countries domestic interest rate that mean, the returns of all these countries are not influenced by the fluctuations in the Global Interest Rate.

TABLE 4.3: Return & Volatility Spillovers From Global Interest Rate to Domestic Interest Rate of South Asian Countries ARMA GARCH Model

	US	**Chi (NRC)**	**Ind (NRI)**	**Pak (NRP)**	**Sri (NRS)**	**Ban (NRB)**
β_0	-0.000642	-0.000305	0.000772	0.000951	-0.001178	1.089627
	(0.3208)	(0.3945)	(0.4652)	(0.4719)	(0.4537)	(0.0000)
β_1	0.185923	0.465939	0.330054	0.42286	0.124155	-0.093221
	(0.6205)	0	(0.2659)	(0.2145)	(0.5888)	(0.5509)
β_2	1.725862	0.722464	-16.16627	-8.034243	10.03017	2.526413
	(0.3228)	(0.1611)	(0.078)	(0.0036)	(0.0472)	(0.0974)
β_3	-0.237029	-0.941261	-0.287176	-0.693993	-0.222728	-0.178485
	(0.5288)	(0.0000)	(0.3232)	(0.0445)	(0.3229)	(0.2636)
λ	-	0.000351	0.000517	-0.000197	-0.000139	0.000616
		(0.0730)	(0.0678)	(0.7089)	(0.7881)	(0.64)
γ_0	1.94E-06	8.30E-05	4.20E-05	0.000142	0.000103	5.59E-06
	(0.0002)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.024)
γ_1	0.040514	0.15001	0.15	0.15	0.15	0.028959
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
γ_2	0.955382	0.600004	0.6	0.6	0.6	0.886131
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
π	-	-1.41E-09	-1.10E-09	-2.46E-09	-1.18E-09	3.63E-08
		(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

"Where USR= United State Rate, NRC= Nominal Rate China, NRI= Nominal Rate India, NRP= Nominal Rate Pakistan, NRS= Nominal Rate Sri Lanka, NRB= Nominal Rate Bangladesh. Values in parenthesis are the p-values. denotes the parameters of mean spillover and λ denotes the parameters of volatility spillover".

In the same way, the results of spillover volatility also have a significant negative impact on all countries. It reveals that, the volatility of the global interest rate

decreasing the volatility of these countries domestic rates. In short it is bringing the cooling down effect for all these country's domestic rates.

4.3 Return and Volatility Spillover from Global Interest Rate to Equity Market

In order to approximate the return and uncertainty spillovers from world-wide interest rate to financial markets, using ARMA GARCH (a, b) model the first element of the approach is following preliminary assessments.

Table: 4.4, also mentions both ARCH and GARCH coefficients with p-value (in parenthesis). η_1 is seen to be significant and optimistic in India (BSE), Pakistan (KSE) and Srilanka (CSE) indicating that the mean returns of these markets can be calculated using actions of prices in the past.

In short, for the following sector, the business is inefficient that indicate, there exists no opportunities of diversification in these industries.

While, there found no impact of the past price behavior on today's returns in China (SSEX) and Bangladesh (DSE) that implies, these markets are efficient and provide investment opportunities. Portfolio manager can get the benefits of diversification.

The coefficient of standardized residual error term, η_3, is proven to be significantly negative for all countries that, with the exception of China (SSEX) and Bangladesh (DSE) that implies, rely on past shock and move opposite to make the correction on the following day.

For all countries the coefficient is large and optimistic, implying that by way of the past market activity the uncertainty of the current cycle is reliable.

For all countries, the coefficient of ϕ_2 is also important and positive, providing proof of the persistence of volatility. The sum of all countries ϕ_1 and ϕ_2 is closer to 1 indicating the nature of the long-term persistence.

The effects of mean spillover have a substantial positive effect on China (SSEX), Pakistan (KSE) and India (BSE), which means that the global interest rate has major spillover into the equity market. In Sri Lanka (CSE) and Bangladesh (DSE),

on the other side, there have been minor differences, which indicate that the return in all these countries is not important.

TABLE 4.4: Return & Volatility Spillovers from Global Interest Rate to Equity Market of South Asian Countries ARMA GARCH Model

	US	**Chi SSEX**	**Ind BSE**	**Pak KSE**	**Sri CSE**	**Ban DSE**
η_0	-0.000642	0.000415	-0.000218	0.000231	3.70E-06	0.784417
	(0.3208)	(0.1411)	(0.488)	(0.4283)	(0.9786)	(0.0000)
η_1	0.185923	-1.240798	1.875799	0.516005	0.724101	0.214655
	(0.6205)	(0.1406)	(0.0025)	(0.0072)	(0.0000)	(0.0753)
η_2	1.725862	-1.128466	-3.429387	3.058653	2.253599	4.217395
	(0.3228)	(0.5759)	(0.3451)	(0.3681)	(0.5271)	(0.6505)
η_3	-0.237029	1.217654	-1.846756	-0.421895	-0.566269	-0.127832
	(0.5288)	(0.1484)	(0.0029)	(0.0294)	(0.0000)	(0.2512)
Ψ	-	0.0005	0.000986	0.000541	-3.08E-06	3.05E-05
		(0.0027)	(0.0000)	(0.0004)	(0.9725)	(0.8183)
ϕ_0	1.94E-06	-2.31E-07	8.52E-07	2.10E-10	2.70E-06	1.20E-06
	(0.0002)	(0.0908)	(0.002)	(0.0000)	(0.0000)	(0.0002)
ϕ_1	0.040514	0.039137	0.057494	0.081537	0.124304	0.100172
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
ϕ_2	0.955382	0.960084	0.9302	0.888713	0.822869	0.857094
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
τ	-	1.53E-10	8.88E-11	2.03E-10	-9.88E-11	5.33E-11
		(0.0000)	(0.0077)	(0.0004)	(0.0000)	(0.1345)

"Where USR= United State Rate, SSEX= Shanghai Stock Exchange, BSE= Bombay Stock Exchange, KSE= Dhaka Stock Exchange. Values in parenthesis are the p-values Karachi Stock Exchange, CSE= Colombo Stock Exchange, DSE=. Ψ denotes the parameters of mean spillover and τ denotes the parameters of volatility spillover".

In the same direction, there are also beneficial impacts on China, India and Pakistan on volatility spillover, which also suggest that global interest rates are transferred rapidly to South Asian stock markets. Whereas it shows a significant negative impact on Srilanka that implies, the volatility of global interest rates transmits to equity market but in an opposite direction.

4.4 Time-Varying Conditional Correlation–DCC and ADCC

As mentioned in the methodology, ARMA GARCH model only incorporates the spillover effect by assuming Constant Conditional Correlation CCC. But if the correlation varies in moment, then Dynamic Condition Correlation DCC model will be used in this research. The importance of using this model is the detection over time of possible changes in conditional correlations, enabling us to detect dynamic investor behavior in response to any news and changes. In addition, the DCC metric is suitable to explore feasible contagion impacts conduct in evolving financial markets. In addition, the effects of any asymmetry are also recorded using the expanded variant of the DCC model, Asymmetric Conditional Dynamic Correlation ADCC.

4.4.1 DCC–GARCH (1,1) Model between Global Interest Rate and Domestic Interest Rate of South Asian Countries

The appropriate univariate DCC models and estimates between global and domestic interest rate markets are shown in Tables 4.5 and 4.6, respectively. On the grounds of the smallest possible Akaike Information Criteria-AIC, the suitable model is selected. NA means that, the stability condition for specified country is not met, so model cannot be applied. In short, the dynamic conditional correlation doesn't exist in that market.

Table: 4.6, outlines the outcomes of the global interest rate-to-domestic interest rate of South Asian market correlation using the DCC-GARCH model that explains the effect of previous residual shocks. The θ_1 represents past residual shocks and θ_2 shows lagged dynamic correlation with their p-values between global interest rate and domestic interest rate market.

TABLE 4.5: DCC MV-GARCH Estimates between Global Interest Rate & Domestic Interest Rate of South Asian Countries

Sr. No.	**Countries**	**Selected Model**
1	China	EGARCH
2	India	GJR/TARCH
3	Pakistan	GJR/TARCH
4	Srilanka	GJR/TARCH
5	Bangladesh	EGARCH

"The table shows the optimal bi-variate DCC GARCH model with respect to domestic interest rate and then appreciate model in chosen on the basis of lowest possible Akaike Information Criteria (AIC)".

While working on the DCC model, the first condition is to check the condition of stability as it must be less than 1 (i.e., range 1 + range 2 < 1). From the results the rest of all countries successfully fulfilled the necessary condition of stability.
This confirmation assures that DCC model must be used to measure the time varying conditional correlation. For Pakistan, the parameters of θ are found to be significantly negative. And for i.e. China, India and Bangladesh, found insignificant.
This finding interprets that there was a significant negative correlation between Pakistan's global interest rate and domestic interest rate markets. This significant negative variation shows the partial impact of past residual shocks on conditional correlation as the value of θ_1 is less than θ. On the other side this result also interprets that there is no correlation found in global interest rate and domestic interest market of China, India and Bangladesh.
In **Table:4.6**, While discussing the second parameters of θ_2, we found significantly

positive results in India, Pakistan and Bangladesh which express the impact of partial lagged dynamic conditional correlation. Whereas, insignificant results are examined in China it means that the interest rates of the country do not show any lagged effect on correlation.

TABLE 4.6: DCC MV-GARCH Estimates between Global Interest Rate & Domestic Interest Rate of South Asian Countries

Sr. No.	**Countries**	**Interest Rates**	
		θ_1	θ_2
1	China	0.033134	0.302784
		(0.0906)	(0.402)
2	India	0.002851	0.859676
		(0.6859)	(0.0011)
3	Pakistan	-0.00407	0.790827
		(0.0000)	(0.0000)
4	Srilanka	-0.001662	0.778481
		NA	NA
5	Bangladesh	0.006734	0.907006
		(0.6148)	(0.0000)

"This table summarizes the estimated coefficients from the DCC-MV-GARCH model in a bivariate framework for global interest rate and domestic interest rate. Values in parenthesis are the p-values. The Akaike Criteria (AIC) is used for the selection of a suitable univariate GARCH model".

4.4.2 DCC–GARCH (1, 1) Model between Global Interest Rate and Equity Market Of South Asian Countries

The appropriate univariate DCC models and estimates between global interest rate and equity market are shown in **Tables: 4.7** and **4.8**, respectively. On the grounds of the smallest possible Akaike Information Criteria-AIC, the suitable model is selected. NA means that, the stability condition for specified country is

not met, so model cannot be applied. In short, the dynamic conditional correlation doesn't exists in that market.

Table: 4.8, outlines the outcomes of the global interest rate-to-equity markets of south Asian market correlation using the DCC-GARCH model that explains the effect of previous residual shocks. The θ_1 represents past residual shocks and θ_2 shows lagged dynamic correlation with their p-values between global interest rate and domestic interest rate market.

While working for DCC model the first condition is to verify the strength condition as it must be less than 1 (i.e. $\theta_1 + \theta_2 < 1$). From the results rest of all countries successfully met the required stability condition. This confirmation insures that for measuring the time varying conditional correlation DCC model must be used. The parameters of θ_1 is found significantly negative only for Sri lanka and Bangladesh. And found insignificant for i.e. China, Pakistan and India. This result interprets that there found highly significant but negative correlation between global interest rate and equity markets of Sri lanka and Bangladesh. This significant negative variation shows the partial impact of past residual shocks on conditional correlation as the value of θ_1 is less than 0. On the other side this result also interprets that there is no correlation found in global interest rate and equity markets of China, India and Pakistan.

TABLE 4.7: DCC MV-GARCH Estimates between Global Interest Rate & Equity Market of South Asian Countries

Sr. No.	**Countries**	**Selected Model**
1	China	GJR/TARCH
2	India	EGARCH
3	Pakistan	EGARCH
4	Srilanka	GJR/TARCH
5	Bangladesh	GARCH

"The table shows the optimal bi-variate DCC GARCH model with respect to equity market and then appreciate model in chosen on the basis of lowest possible Akaike Information Criteria (AIC)".

In **Table: 4.8**, While discussing the second parameters of θ_2, we found significantly positive results in India, Pakistan Srilanka and Bangladesh which express the impact of partial lagged dynamic conditional correlation. Whereas, insignificant results are examined in China it means that the equity market of the country doesn't show any lagged effect on correlation.

TABLE 4.8: DCC MV-GARCH Estimates between Global Interest Rate & Equity Market of South Asian Countries

Sr. No.	**Countries**	**Equity Prices**	
		θ_1	θ_2
1	China	-0.01072	0.09735
		(0.3312)	(0.8415)
2	India	-0.01274	0
		(0.702751)	(0.0000)
3	Pakistan	0.002997	0.991919
		(0.2266)	(0.0000)
4	Srilanka	-0.004337	0.782318
		(0.0000)	(0.0014)
5	Bangladesh	-0.017815	0.985655
		(0.001)	(0.0000)

This table summarizes the estimated coefficients from the DCC-MV-GARCH model in a bivariate framework for global interest rate and equity market. Values in parenthesis are the p-values. The Akaike Criteria (AIC) is used for the selection of a suitable univariate GARCH model."

4.4.3 ADCC MV-GARCH Models

Tables: 4.9 and **4.10** show the suitable univariate DCC models and estimates form global interest rate-to-domestic interest rate of South Asian countries, respectively.

TABLE 4.9: ADCC MV-GARCH Models between Global Interest Rate & Domestic Interest Rate

Sr. No.	**Countries**	**Selected Model**
1	China	EGARCH
2	India	GJR/TARCH
3	Pakistan	GJR/TARCH
4	Srilanka	GARCH
5	Bangladesh	EGARCH

"This table shows the optimal univariate ADCC GARCH model with respect to domestic interest rate of South Asian countries and then the appropriate model is chosen on the basis of lowest possible Akaike Information Criteria (AIC)".

Table: 4.10 covers the estimates of ADCC GARCH model between global interest rate and domestic interest rate of south Asian countries. The first two parameters of this table are same as that of DCC GARCH models i.e. the impact of the past residual shocks (θ_1) and lagged dynamic conditional correlation (θ_2). An additional parameter of (θ_3) is used in this model that provides the information about the shocks of positive and negative news on dynamic conditional correlation. Like previous model of DCC, the first condition that is the stability of model is also met in all countires (i.e. $\theta_1 + \theta_2 < 1$). It means, the model is stable.

TABLE 4.10: ADCC MV-GARCH Estimates between Global Interest Rate & Domestic Interest Rates of South Asian Countries

Sr. No.	**Countries**	**Interest Rates**		
		θ_1	θ_2	θ_3
1	China	0.043668	0.297988	-0.030765
		(0.0773)	(0.3604)	(0.3929)
2	India	0.003529	0.829066	-0.00511
		(0.6384)	(0.0001)	(0.745)
3	Pakistan	-0.004188	0.956738	0.003175
		(NA)	(NA)	(NA)
4	Srilanka	-0.001637	0.768796	-0.040472
		(0.0000)	(0.0000)	(0.0000)
5	Bangladesh	0.006183	0.907128	0.000721
		(0.7651)	(0.0000)	(0.9722)

"This table summarizes the estimated coefficients from the ADCC-MV-GARCH model in a bi-variate framework for global and domestic interest rate. Value in parenthesis are the p-values. Theta (1), Theta (2) and Theta (3) are reported above the p-values. The Akaike Information Criteria (AIC) is used for the selection of a suitable uni-variate GARCH model."

The first parameter of θ_1 is found significant negative for Srilanka that means, there exists a partial impact of past residual shocks on correlation in interest rates. The second parameter θ_2 is examined highly significant for India, Srilanka and Bangladesh it means that, there exists the lagged dynamic conditional correlation in these countries. In results of parametric values of θ_3 expresses a significant negative result only for Sri lanka that indicates, the correlation has been decreased with the effect of negative news while, the remaining countries show no variations with respect to asymmetric effect. In short, any good or bad news arises in market, did not effect the correlation.

In contrast with DCC model, the results of ADCC model are more reliable and more authentic as it also capturing the asymmetric effect between the series. Now, we can say that in this study the most of the countries returns show significant time variation in its conditional correlations and few of them show asymmetric

behavior.

The appropriate univariate ADCC models and estimates between global interest rate and equity markets are shown in Tables 4.11 and 4.12 respectively. On the grounds of the smallest possible "Akaike Information Criteria"-AIC, the suitable model is selected. The results of ADCC GARCH model across global interest rate and equity markets of south Asian countries are shown in **Table: 4.12**.

TABLE 4.11: ADCC MV-GARCH Estimates Between Global Interest Rate & Equity Market

Sr. No.	**Countries**	**Selected Model**
1	China	EGARCH
2	India	EGARCH
3	Pakistan	EGARCH
4	Srilanka	GJR/TARCH
5	Bangladesh	GARCH

"This table shows the optimal univariate ADCC GARCH model with respect to equity market of South Asian countries and then the appropriate model is chosen on the basis of lowest possible Akaike Information Criteria (AIC)."

Herein model there are four parameters, from which the first two parameters are similar to the DCC GARCH models i.e. θ_1 reporting the impact of past residual shocks and θ_2 as a lagged conditional dynamic correlation. An additional parameter includes that is θ_3, which gives the information about the shocks created by negative and positive news on dynamic conditional correlation. As of DCC model, stability of model is checked at first. In this model the stability of model is met in all countries (i.e. $\theta_1 + \theta_2 < 1$).

TABLE 4.12: ADCC MV-GARCH Estimates between Global Interest Rate & Equity Market

Sr. No.	**Countries**	**Equity Prices**		
		θ_1	θ_2	θ_3
1	China	0.001614	0.834448	-0.01211
		(0.8395)	(0.0000)	(0.4336)
2	India	-0.012703	0.731431	0.005086
		(0.0000)	(0.0000)	(0.0000)
3	Pakistan	0.003884	1.002817	0.00176
		(NA)	(NA)	(NA)
4	Srilanka	-0.004336	0.78041	-0.012037
		(NA)	(NA)	(NA)
5	Bangladesh	-0.018295	0.98741	0.001226
		(0.0003)	(0.0000)	(0.5688)

"This table summarizes the estimated coefficients from the ADCC-MV-GARCH model in a bivariate framework for global interest rate and equity market. Value in parenthesis are the p-values. Theta (1), Theta (2) and Theta (3) are reported above the p-values. The Akaike Information Criteria (AIC) is used for the selection of a suitable univariate GARCH model."

The first parameter of θ_1 is found significant but negative for India and Bangladesh that means, there exists a partial impact of past residual shocks on correlation in equity market and insignificant for China. The second parameter θ_2 is examined highly significant for China, India and Bangladesh it means that, there exists the lagged dynamic conditional correlation in these countries. In results of parametric values of θ_3 expresses a significant result only for India that indicates, the correlation has been increased with the effect of negative news while, the remaining countries show no variations with respect to asymmetric effect. In short, any good or bad news arises in market, did not affect the correlation.

In contrast with DCC model, the results of ADCC model are more reliable and more authentic as it also capturing the asymmetric effect between the series. Now, we can say that in this study the most of the countries returns show significant time variation in its conditional correlations and few of them show asymmetric

behavior.

All the significant results of DCC and ADCC MV-GARCH models are similar to the findings of some previous researchers. For example, the sectoral correlations using DCC and ADCC models is also studied by Katzke et al. (2013) in which he employs the industrial returns of different sector pair like; Financials, Utilities, Industrials, Consumer Goods, Consumer Services and Telecom and finds the evidence about the dynamic nature of correlation between different sectors of South Africa. Ahmed and Naguib (2017) also report that the DCC model is sufficient to measure conditional correlations between time and time. They also find the dynamic conditional correlation between sector pairs of Financial Services, Banks, Construction and Material and Telecommunication.

Chapter 5

Discussion and Conclusion

5.1 Conclusion

This study focuses on two major objectives. The first purpose of this study addresses the return and volatility spillover from global interest rate to equity market of South Asian countries (China, Bangladesh, Pakistan, Srilanka and India). Movement of different domestic interest rates and equity prices with global interest rates has been checked by using ARMA GARCH model for the time frame of January 2009 to December 2019. These countries are, Bangladesh, Pakistan, Srilanka, China and India.

In case of domestic interest rates of China, Pakistan, Srilanka, India and Bangladesh there found no any evidence of return spillover from global interest rate. The results of return spillover are insignificant which shows that, in South Asian Countries global interest rate causes no impact.

Similarly, volatility spillover from global interest rate to domestic interest rate is observed in almost all countries e.g. China, India, Pakistan, Srilanka and Bangladesh. As the standardized residual error term is insignificant for India and Srilanka and shows significant but negative impact on China, Pakistan and Bangladesh so size of shock is not clearly observed for decision as compared to good or bad news. All the countries show a significant negative volatility spillover with respect to global interest rate. It means, small shocks are creating less volatilities

in these countries. Simply if a shock of depreciation comes, the people will prefer less trading and slow down the process which in result to reduce the volatility in market due to decrease in trading. Bangladesh shows a positive impact of global interest rate volatility which indicates that, the size of the shock is large and creating more volatility as compared to the rest of the countries. So, hypothesis 1 is supported here that, there exists a volatility spillover from global interest rate to domestic interest rate of South Asian countries.

On the other hand, in case of equity prices, for China, India, Pakistan, Srilanka and Bangladesh, the return spillover is observed in these countries from global interest rate. The results of return spillover are positive for China, India and Pakistan. The positive sign shows that, returns of these countries are increasing with respect to variations in global interest rate. It means, good news will increase the returns and bad news will decrease the returns in these countries. In simple words the depreciation of interest rate is increasing the returns of this sector. While, there found no evidence of return spillover in Srilanka and Bangladesh which shows that, returns of global interest rate have no impact on these countries. So, hypothesis 2 is also supported here that, there exists a return spillover from global interest rates to equity markets of different countries.

Similarly, in South Asian countries, spillover volatility is also measured from global interest rate to equity market. China, India and Pakistan show a significantly positive volatility spillover with respect to global interest rate. It means that these countries are highly volatile, the size of shock is large and creating more volatility as compared to rest of the countries. On the other hand, Srilanka shows a significant negative volatility spillover with respect to global interest rate. It means, small shocks are creating less volatility in this country. Simply, if a shock of depreciation comes, the people will prefer less investment and slow down the process which in result to reduce the volatility in market due to decrease in trading. Only one country Bangladesh shows no impact of volatility transmission from global interest rate. All the significant results across Asian markets are similar to the work done by previous researchers e.g. The various transmitting networks through multiple countries and regions are studied and their results are also being recorded

(Beirne et al., 2010; Choudhry, 2004; Floros, 2008; Gallo and Velucchi, 2009; Turhan etal., 2012; Wang and Wang, 2010). The spill between certain markets and the US is also explored by Choudhry (2004), as she enjoys good ties with all these nations. For this function he was using a non-linear GARCH-t model.

The prices and uncertainty spillover in the North America, Europe, and Asia bursaries are also being investigated by (Singh et al., 2010). Singh et al. (2010) suggested that Asian and European capital markets had gained global control. The interconnections between South Asian economies on the financial market are analyzed in Khan and Sajid (2007) by study the rate spectrum. They evaluate convergence with the United States and collect monthly interest rate figures between 1990 and 2006. Hypothesis 3 also sponsored that volatility spillovers occur on different stock markets or in South Asian countries, where there is minimal research on returns and volatility spillover.

The second aspect of the study covers the extension of previous model. As the correlation between the variables is found time varying, so Dynamic Conditional Correlation DCC model is used and asymmetric behaviour is assessed by Asymmetric Dynamic Conditional ADCC correlation. Results for most countries of both these models are found to be significantly positive as well as negative. All of the models' significant variations and stability show that correlation is not constant so strongly recommended is the dynamic conditional correlation model. Although the consistency of the model that indicates is not met for certain countries, correlation in these countries does not differ in time so that the DCC and ADCC models are not applied. The implications of the DCC and ADCC models provide a strong conceptual that, with the passage of time, countries are interconnected together. Correlation also varies according to time. All these results are similar to Sakthivel, Bodkhe, and Kamaiah (2012) studies of correlation and transmission of volatility across US, Indian, UK, Japan and Australian stock markets and long-term co-integration across global stock indices. DCC and ADCC also provides the support for hypothesis 4 and 5 that, there exist a time varying conditional correlation between global interest rate and equity markets of different South Asian countries. Moreover, hypothesis 7 is also supported for some markets that exhibit

the asymmetric behaviour.

In conclusion, the findings of the conditional correlation demonstrate that many of the business correlations actually differ considerably over time. This implies that assuming diversification based solely on constant correlations may result in an incorrect estimation of the diversification benefits. Therefore, to assess the efficacy and stability of diversification, one must take into account the volatility of the correlations. In this search the use of conditional correlation measures such as DCC can help. Our study findings have significant implications for the investors. Our evidence indicates that attempts to gain risk-adjusted returns are likely to be frustrated by investing in diversified emerging market equity funds. Although emerging markets can give investors in developing markets possible diversification advantages, these advantages are subject to the investor 's specific investment strategy used (Bekaert and Urius, 1999).

One potential explanation for this is that emerging market funds will face higher redemptions during times of crisis. Investors are more likely to move, by selling off securities and transitioning to more stable and liquid investments in established markets, despite the volatile nature of the developing markets. In comparison, in developing markets, investment only continues trickling after conditions settle and returns increase. This asymmetric nature of the fund flow may prove to be an obstacle to the ability of the managers to time the markets and outperform the benchmark index. This research aimed to investigate the potential of diversified emerging market stock funds to achieve risk-adjusted returns above and above a comparable market benchmark index. Amongst fund performance studies in developed markets, most reported no superior performance, which is consistent with one's expectations in informatively efficient markets. On the other hand, emerging markets are commonly seen as offering fund managers greater opportunities to exploit stock price mispricing and information asymmetries. Our findings do not help this idea, as we prove that diversified emerging market funds on average do not outperform their benchmark index.

5.2 Recommendations

When all the findings have been concluded, this study strongly recommends to all market players including investors, portfolio managers and policy makers to keep an eye on the information that arises in different countries ' markets. The combination of global interest rate and equity markets shows a spill over of return and volatility with each other, which implies that returns from global interest rates and volatility affect equity market yields and volatility. Most countries have a time-varying conditional correlation that reveals the lively existence of their interaction with the economy. In addition, there is also an asymmetric conduct. Investors can use these findings in South Asian countries in the decision-making process for investments. As market volatility is more influenced than returns are discovered. A list of few related study recommendations are mentioned below.

- A major source of stock market volatility, the FDI for foreign direct investment should be guided to the real sector through the provision of enabling environments and enhancing ease of business in the corporate climate of South Asian countries, as well as a major source of stock market volatility.
- The regulatory authorities of South Asia's nation will proactively raising the uncertainty of equity market return of order to regain investor trust.
- More work on certain variables that lead significantly to South Asian countries 'stock return instability, including but not limited to the following, oil prices, unemployment, the treasury bill rate, GDP and cash reserve ratios;
- Many countries have time-dependent conditional correlations that show the complex existence of the association between countries. In fact, these countries have an asymmetric behavior.
- Investors should take account of these developments in investment decision-making in different South Asian territories. Because the performance of the shares is more essential than the profits, investors will search for certain stock markets and financial assets that are declining or small in performance.

- Another alternative that investors may consider is to invest in funds focusing on specific emerging markets because geographically based funds have greater investment opportunities than those invested in multiple emerging markets. It is quite possible that the funds will benefit from information when they have a clear geographical focus.

- However, the considerable variations in finance often provide policymakers with guidance for the production in any nation of appropriate monetary and fiscal policies.

5.3 Future Research Direction

While, this research provides a thorough knowledge of the market wide transmission mechanism, this research is restricted to South Asian equity markets, i.e. country-specific work. Including more emerging markets in the sample size, a comparative analysis can also be performed. Moreover, the data used for this study is time series data that quickly outdates. That's why, taking another data set this phenomenon can be further explored.
Furthermore, all GARCH models used in this research (GARCH, GJR GARCH/ TARCH & EGARCH) were drawn overall allocation. So, a study on extreme movement using tailed distribution can also be conducted in near future.

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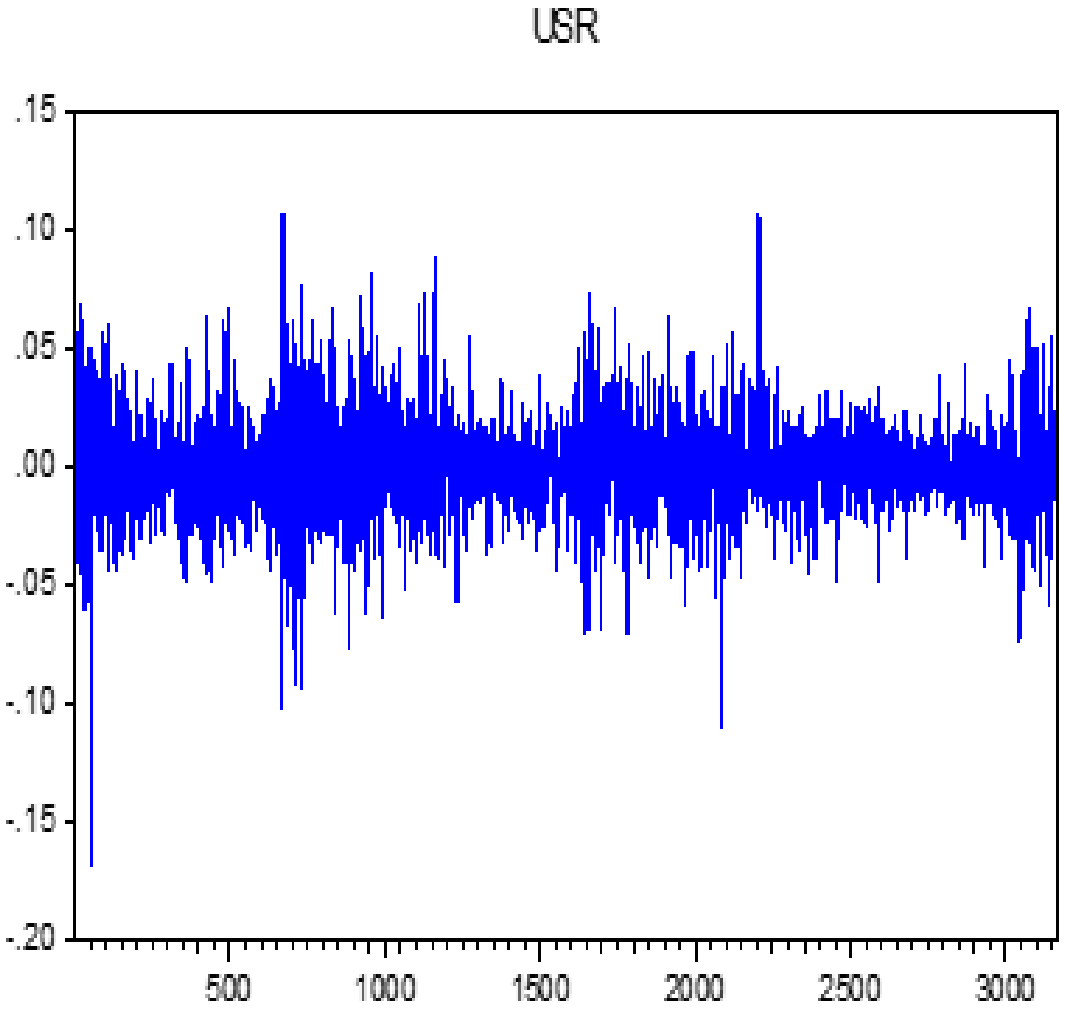
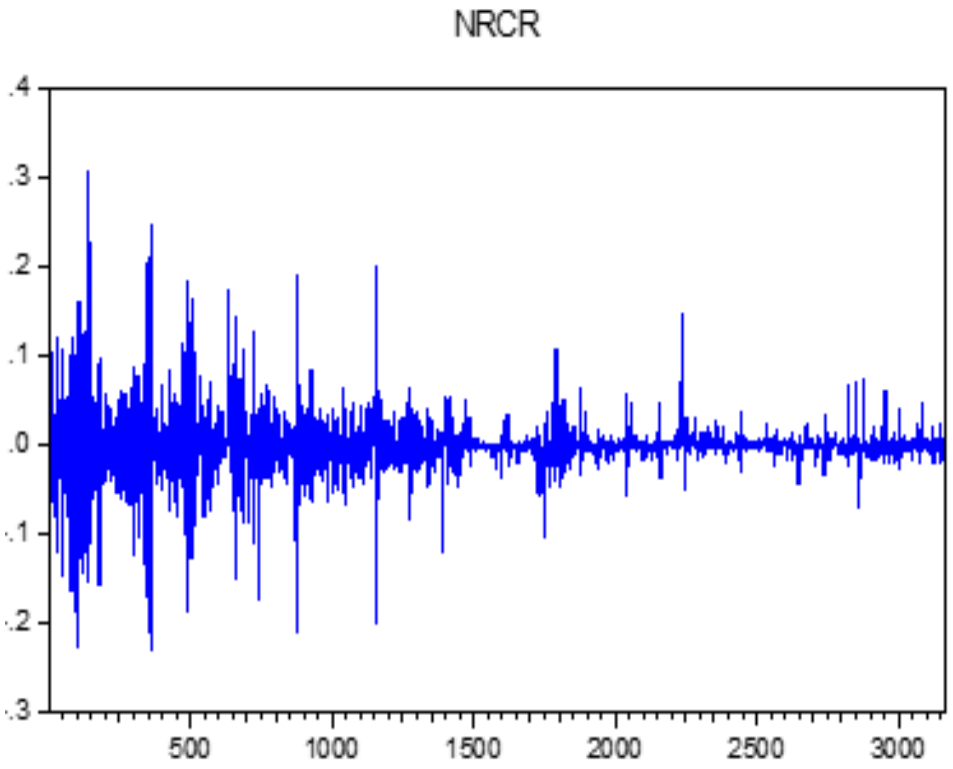
Appendix-A

Global Rate with Domestic Interest Rate of South Asian Countries

Stationary Graphs

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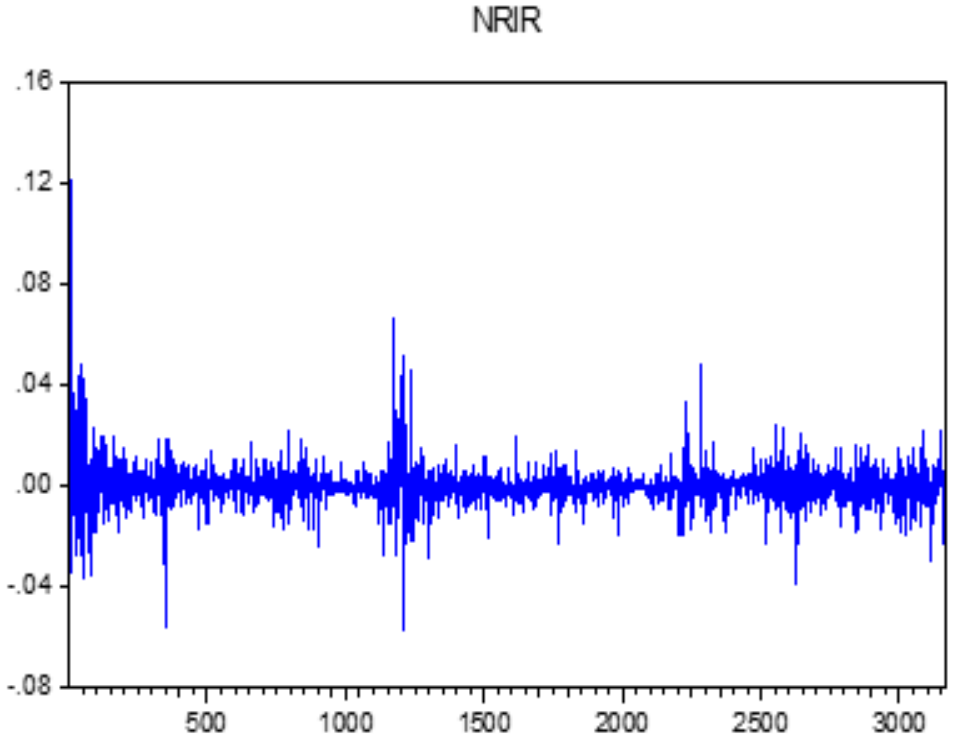
.3
.2
.1
.0
-.1
-.2
-.3
500
1000
1500
2000
2500
3000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.08
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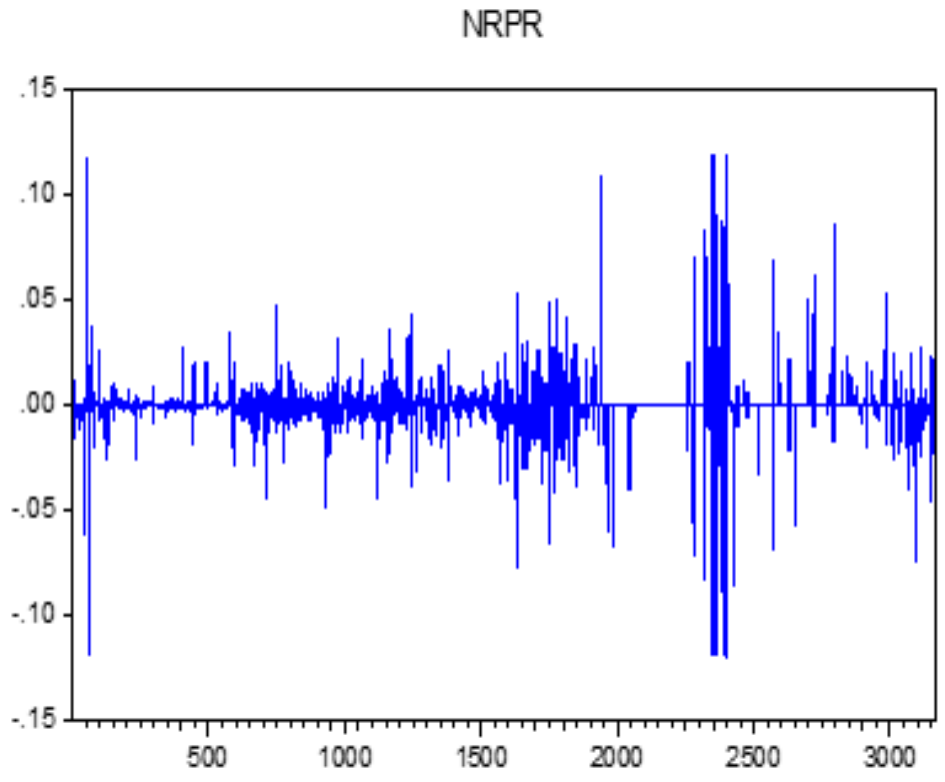
-.04
-.08
500
1000
1500
2000
2500
3000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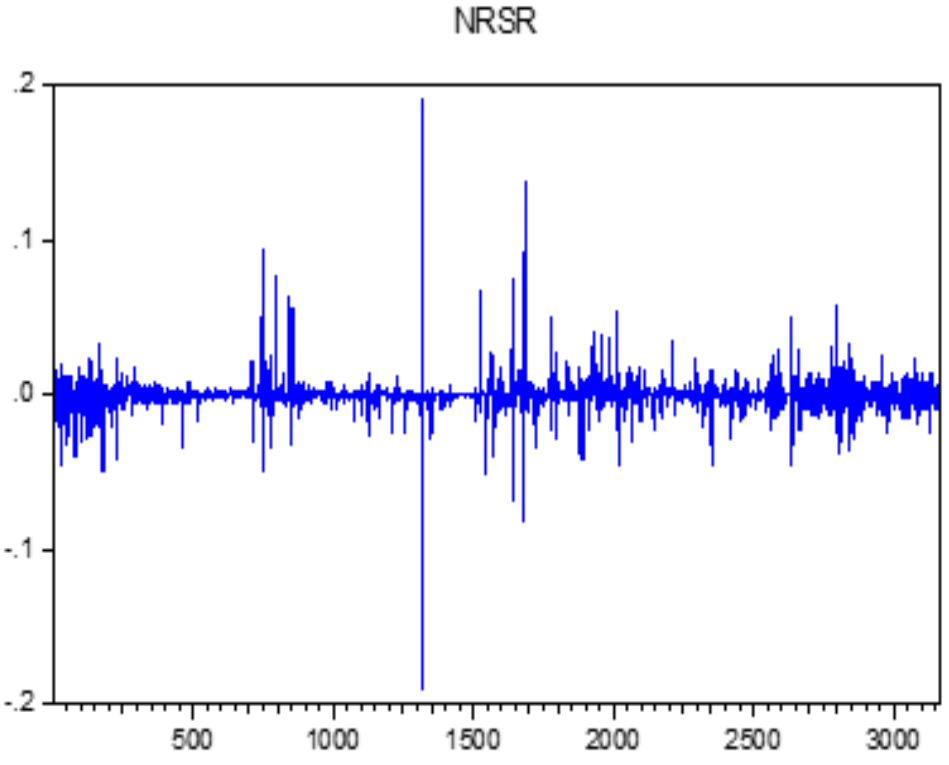
.05
.00
-.05
-.10
-.15
500
1000
1500
2000
2500
3000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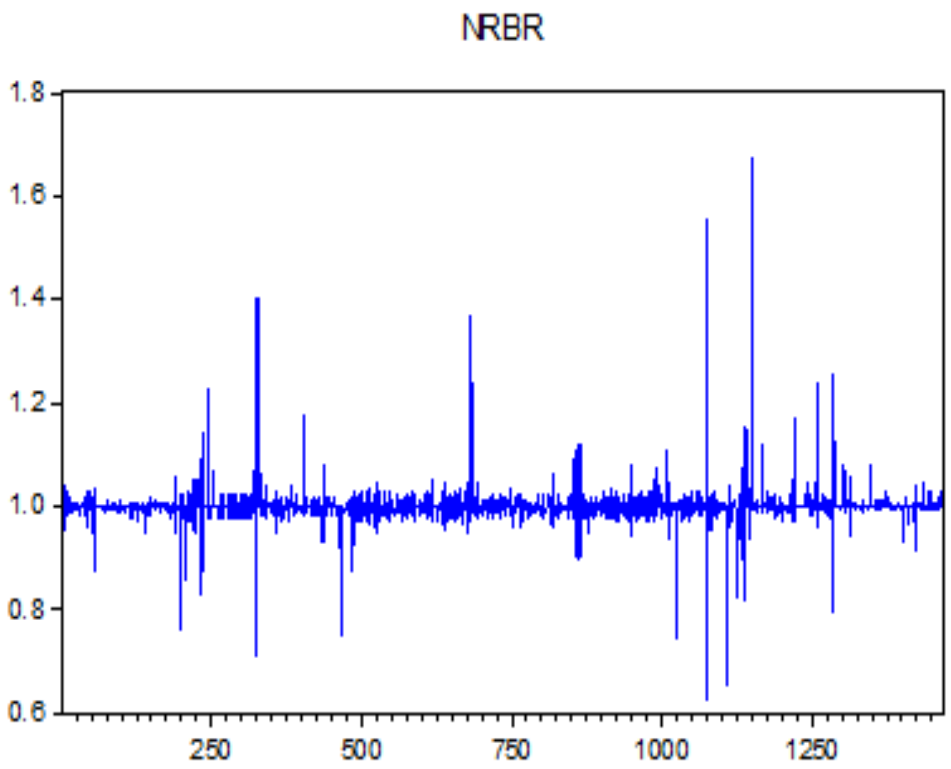
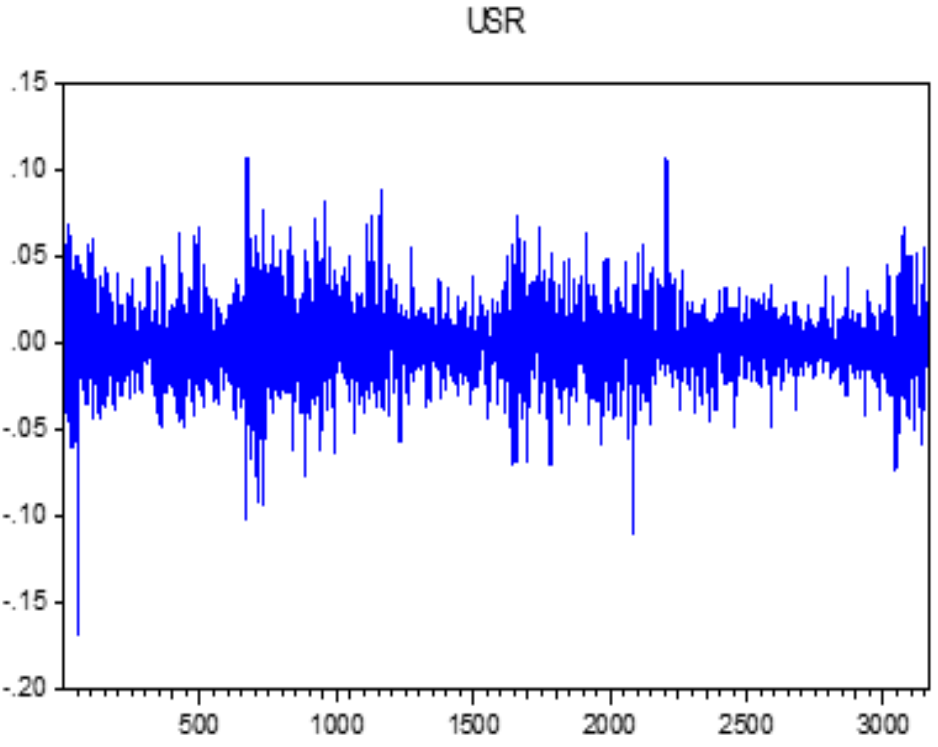
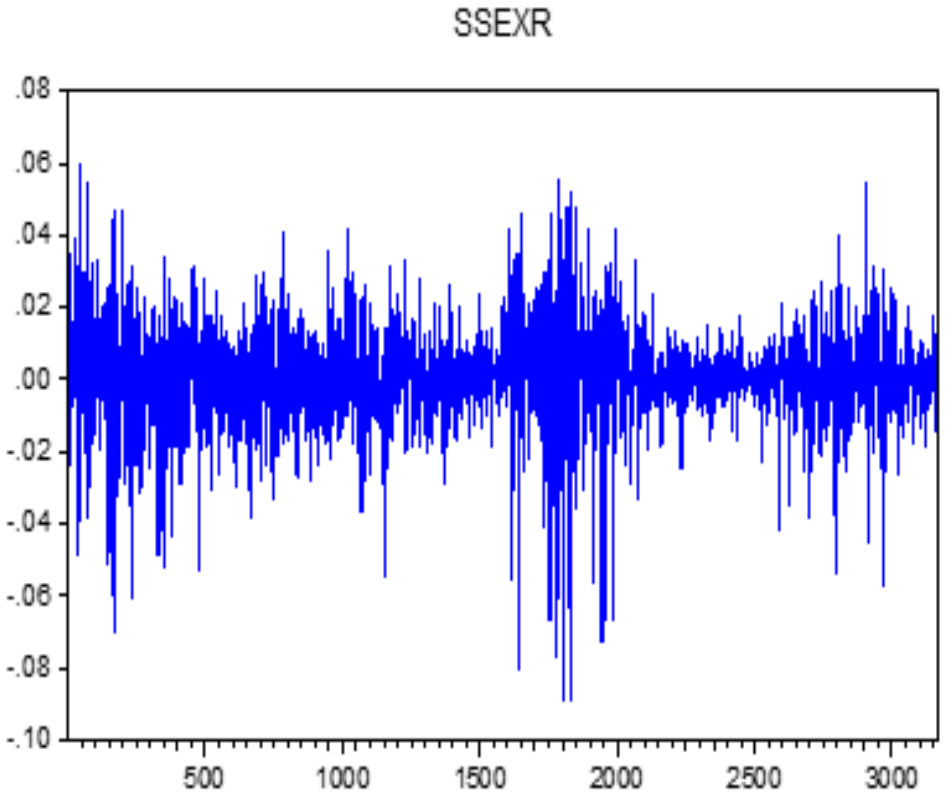
.1
.0
-.1
-.2
500
1000
1500
2000
2500
3000



Global Rate with Equity Market

Stationary Graphs

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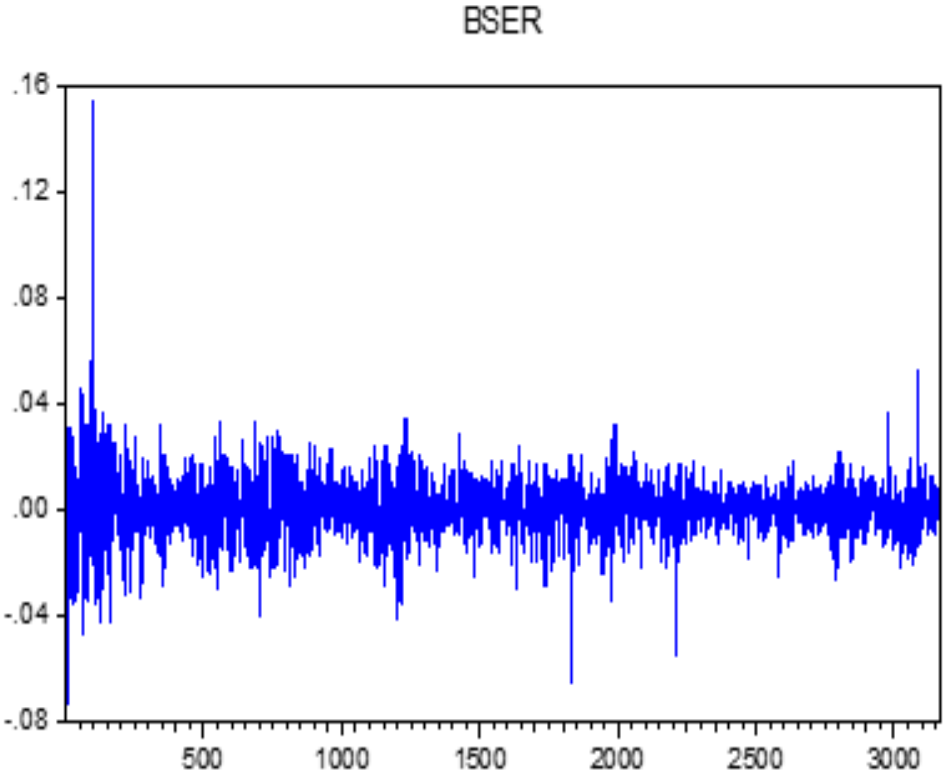
.04
.02
.00
-.02
-.04
-.06
-.08
-.10
500
1000
1500
2000
2500
3000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.08
.04
.00
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-.08
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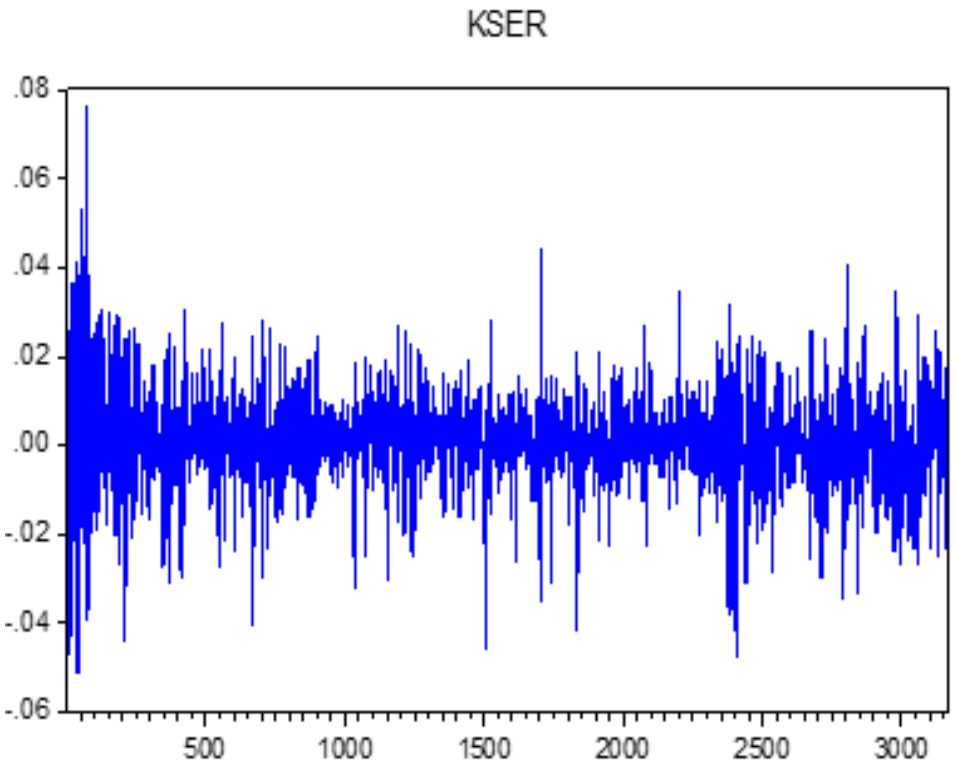
1000
1500
2000
2500
3000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.02
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-.04
-.06
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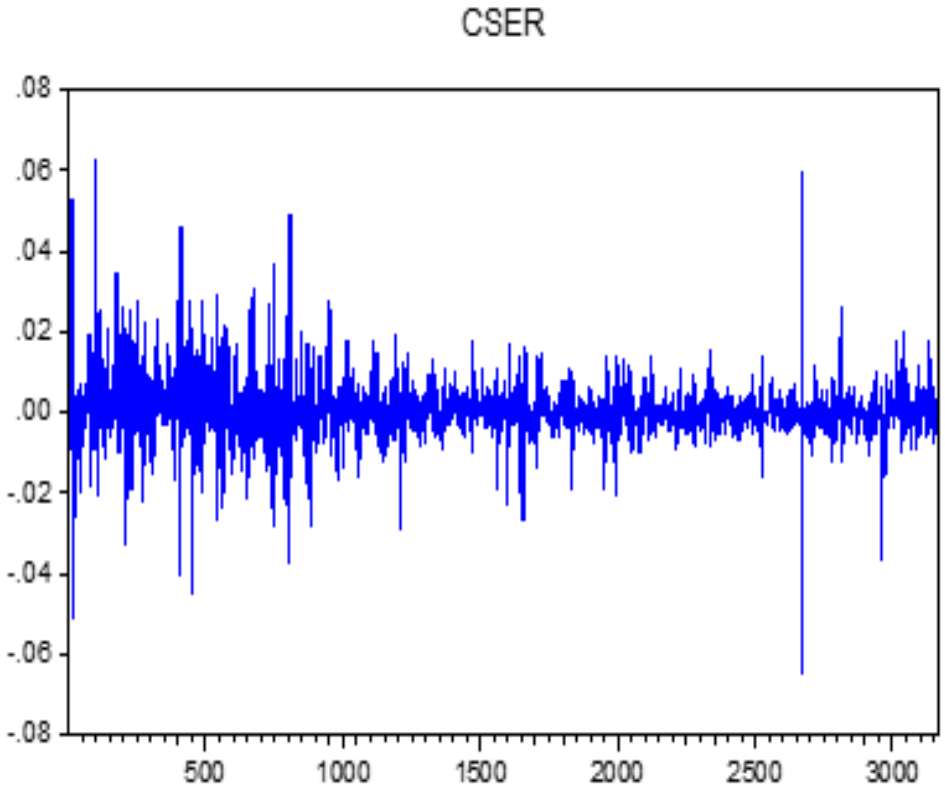
1000
1500
2000
2500
3000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.02
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-.02
-.04
-.06
-.08
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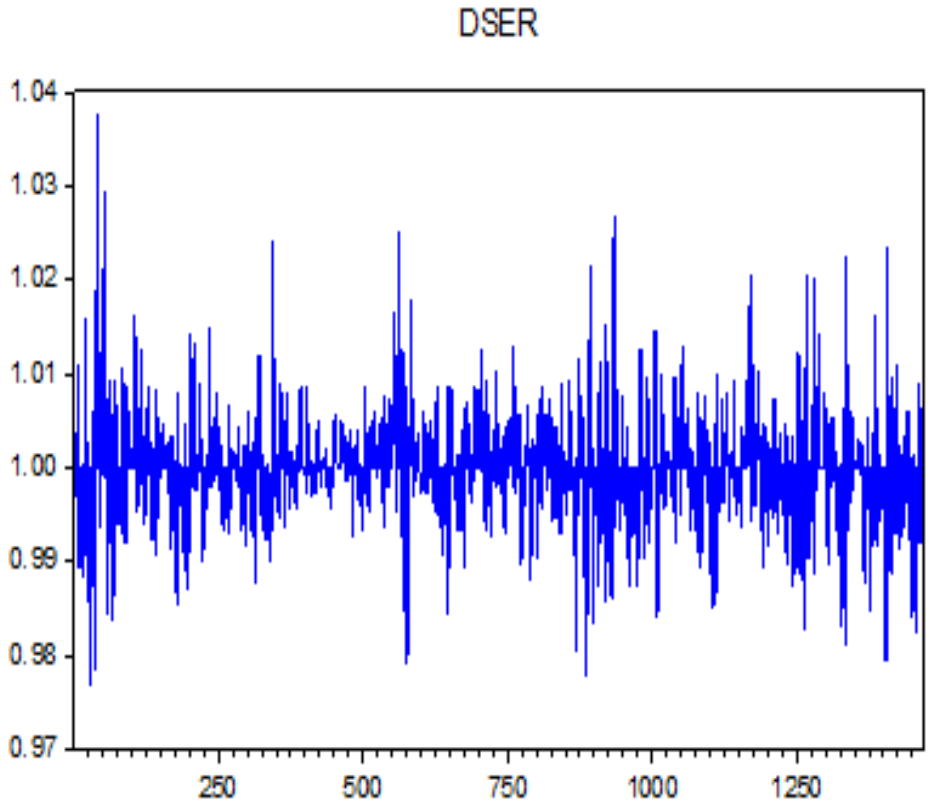
1000
1500
2000
2500
3000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1.03
1.02
1.01
1.00
0.99
0.98
0.97
250
500
750
1000
1250