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Sukuk and International Financial Markets: Co-movement Dynamics

by

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I am dedicating this thesis to my beloved parents whose unconditional support have been constant source of inspiration during my studies. Moreover, I am in debt to my supervisor Dr. Arshad Hassan whose feedback and intellectual support helped me enormously to fulfill this academic work.

CERTIFICATE OF APPROVAL

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Abstract

The major purpose of this research is to investigate the bivariate relationship of sukuk with international financial markets in terms of co-movement dynamics. This study employs the techniques of ARDL, DCC GARCH and Copula to examine the long and short run co-movement, the time varying correlation in the volatility and tail dependence structure. The results of this study conclude that sukuk indices that are based on maturity and credit risk rating are less correlated in long run with global equity in contrast to global bond. However, the short run relationship of sukuk with global equity and global bond is almost same. MENA sukuk is correlated with MENA equity and MENA bond in short run and it has long run correlation only with MENA bond. The study also finds that there is little evidence of past residual shocks and lagged dynamic conditional correlation. Moreover, the upper and lower tail dependence is present in most of the pairs of sukuk with international financial markets. This study is beneficial for regulatory authorities with respect to creating macro stabilization policies, efficient resource allocation and risk management. Furthermore, this study is also effective and useful for fund managers and traders in formulating investment and trading objectives for portfolio structuring and portfoilio diversification.

Key words: Sukuk, Equity, Bond, ARDL, DCC GARCH, Tail Dependence, Copula Functions

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Abbreviations

SPG	S&P Global 1200 Index
WGBI	FTSE World Government Bond Index
DJ13	Dow Jones Sukuk 1-3 Year Total Return Index
DJ35	Dow Jones Sukuk 3-5 Year Total Return Index
DJ710	Dow Jones Sukuk 7-10 Year Total Return Index
DJAAA	Dow Jones Sukuk AAA Rated Total Return Index
DJAA	Dow Jones Sukuk AA Rated Total Return Index
DJA	Dow Jones Sukuk A Rated Total Return Index
DJBBB	Dow Jones Sukuk BBB Rated Total Return Index
DJT	Dow Jones Sukuk Total Return Index
SPMS	S&P MENA Sukuk Index
SPMD	S&P MENA Bond Index
DJME	Dow Jones MENA Total Return Index
LG	Log of S&P Global 1200 Index
LB	Log of FTSE World Government Bond Index
L13	Log of Dow Jones Sukuk 1-3 Year Total Return Index
L35	Log of Dow Jones Sukuk 3-5 Year Total Return Index
L710	Log of Dow Jones Sukuk 7-10 Year Total Return Index
LAAA	Log of Dow Jones Sukuk AAA Rated Total Return Index
LAA	Log of Dow Jones Sukuk AA Rated Total Return Index
LA	Log of Dow Jones Sukuk A Rated Total Return Index
LBBB	Log of Dow Jones Sukuk BBB Rated Total Return Index
LT	Log of Dow Jones Sukuk Total Return Index
LMS	Log of S&P MENA Sukuk Index

LMD	Log of S&P MENA Bond Index
LME	Log of Dow Jones MENA Total Return Index
RG	Logged Return of S&P Global 1200 Index
RB	Logged Return of FTSE World Government Bond Index
R13	Logged Return of Dow Jones Sukuk 1-3 Year Total Return Index
R35	Logged Return of Dow Jones Sukuk 3-5 Year Total Return Index
R710	Logged Return of Dow Jones Sukuk 7-10 Year Total Return Index
RAAA	Logged Return of Dow Jones Sukuk AAA Rated Total Return Index
RAA	Logged Return of Dow Jones Sukuk AA Rated Total Return Index
RA	Logged Return of Dow Jones Sukuk A Rated Total Return Index
RBBB	Logged Return of Dow Jones Sukuk BBB Rated Total Return Index
RT	Logged Return of Dow Jones Sukuk Total Return Index
RMS	Logged Return of S&P MENA Sukuk Index
RMD	Logged Return of S&P MENA Bond Index
RME	Logged Return of Dow Jones MENA Total Return Index

Chapter 1

Introduction

Sukuk is a new class of financial instrument that is built on Islamic financial contracts with flexible structure. It provides an alternative source of financing mainly for the big corporations and sovereign organizations, in contrast to conventional bonds that are loan based on interest.

Sukuk is an emerging component of Global Islamic Financial System. According to IIFM Sukuk Report, (2019) the global outstanding sukuk issuance in 2018 reached USD 490.80 billion, which is 12.87% increase from USD 434.80 billion in 2017. From country point of view, only five countries constitute the 91.41% of the total global sukuk issuance volume. Of these five countries, Malaysia, Saudi Arabia, Indonesia, UAE and Turkey hold 49.32%, 20.10%, 11.98%, 7.46% and 2.55% of the total sukuk issued respectively. After them are Qatar, Bahrain and Pakistan that hold 1.98%, 1.58% and 1.62% of the sukuk issued accordingly. The sukuk issuance has expanded quickly and there is still potential for further development. Furthermore, this comparatively new market has caught the attention of academic researchers and policy makers all around the world and is also attracting the policy makers of non-Islamic Asian, European and African countries. It is now flattering an alternate way of financing in order to fulfil the financial needs of giant corporations and encourage maintainable economic growth in the world (Zulkhibri, 2015).

The causality between financial markets indicate how good one financial market responds to information spillover. If the feedback of one financial market is quicker than another financial market; the co-movement is likely to be present in the data (Floros and Vougas, 2007). This means that, the co-movement relationship illustrates how good two financial markets are linked and how quick one market responds to the information spillover from the other market. If bidirectional feedback exists between two financial markets, then it is likely for investors to employ past information of prices to foresee future returns. Therefore, it is necessary to determine the information flow and co-movement dynamics between two financial markets.

In the past few years, researchers investigate conventional bond markets in terms of time varying correlations. Many empirical studies indicate that no constant relationship is present between world conventional bond markets and it adjusts over the period (Yang, 2005). Cappiello et al. (2006) examine the co-movement between conventional bond markets in global context and findings report the same that the co-movement between conventional bond markets changes over time and is not static. The advantages of global diversification relay on the cointegration and correlation of global conventional bond markets; if correlation is negative or does not exist, then the global diversification benefit can be achieved in the longer term.

The co-movement relationship among conventional bond markets is important because it explains how good the conventional bond markets are linked and how quick one market transmit the new information to another. If markets are connected and reactive to one another, fund managers and investors can employ past data to forecast the future returns. Even though sukuk, market reached USD 490.80 billion globally by the end of 2018 that is extraordinary growth. Surprisingly, there are not enough investigations on the co-movement of sukuk with equity and bond markets in global terms. The trend to issue sukuk has increased dramatically with respect to foreign currency, especially in American Dollar, whereas Malaysia has enhanced the sukuk issuance from different regional markets, like

Turkey and Singapore. The listing of sukuk is also growing in cross border markets, and sukuk are listed on many dominant equity markets specially in Europe, such as the Luxembourg Stock Exchange (LuxSE), Irish Stock Exchange (ISE) and London Stock Exchange (LSE).

Globalization and technological development strengthen the co-movements and cross class correlation that makes it difficult for diversification opportunities. So, to gain the advantage of global portfolio diversification, investors and find managers are more concerned in determining the causality and co-movement among indices. Majority of global financial markets are represented by equity and conventional bonds and sukuk markets therefore, it is essential to find out the linkages among them. In this regard, this study examines the dynamics of co-movement between sukuk and international financial markets.

1.1 Theoretical Background

This study discusses phenomenon of sukuk in the theoretical background of main finance theory "Efficient Market Theory". This theory is proposed in 1960 by economist Eugene Fama. As reported by Fama an efficient market is defined as "A market in which prices always fully reflect available information is called efficient". Efficient Market Theory claims that financial markets integrate and consider complete available information. This Theory is built upon some assumptions. It also assumes that financial securities are never priced incorrectly. Likewise, this implies that financial securities are never overvalued or undervalued as well as investors can never constantly surpass or beat the overall market, by applying investment strategies.

Market efficiency comprises of three stages that include weak form, semi strong form and strong form market efficiency. These different stages illustrate different levels of adhesiveness to market efficiency theory. The first one, weak form efficiency claims that current prices of financial securities completely demonstrate all available security market data. This indicate that information is included

in financial security prices and volume data are fully incorporated in current security prices. The second one, semi strong form efficiency points out that all available public information is also incorporated in the prices of financial securities. This is more broadly and extensive than security price data and volume, since it also contains all other applicable information, such as company statements, news articles, etc. The third and last one, strong form efficiency sometimes referred to as the perfect market theory. It explains that private inside information also does not help you.

Efficient Market Theory suggests that financial security prices change on the arrival of new information. The information may be created in the same market or in the different market so, information created in one market influences the other markets as well. When the new information arrives in conventional markets then Islamic markets are also influenced. Information may be transmitted from conventional bond markets to sukuk markets and from sukuk markets to conventional bond markets.

1.2 Research Gap

There are limited studies on the co-movement and cointegration of sukuk with stocks and bonds. In case of stocks the co-movements are determined between conventional and Islamic stocks and sukuk (Akhtar et al., 2016; Aloui et al., 2015b). In case of bonds the studies are on the relationship of sukuk with conventional bond like Maghyereh and Awartani (2016) that investigate the transmission of returns and volatility between sukuk, stock and conventional bond market. In another study of sukuk (Bhuiyan et al., 2019) that examine the co-movement between global sukuk and conventional bond markets of six Emerging and six Developed countries and there exist no cointegration among the pairs of sukuk and conventional bond indices. The study compares the overall global sukuk average behavior with each country's sovereign bond average behavior which is not good combination as sukuk index is global and is not linked with just one country. Hence, the objective of this research is to fill that gap by studying

the interrelationships of Global Sukuk Index with Global Bond Index and Global Equity Index, Global Sukuk Indices based on maturity and credit rating with Global Bond Index and Global Equity Index; and MENA Sukuk Index with MENA Bond Index and MENA Equity Index. This study investigates these connections in terms of cointegration, time varying correlations in volatility and dependence structure.

1.3 Problem Statement

Sukuk and conventional bonds are not independent from each other although the feature of shariah compliant is present in sukuk. However, the response on the arrival of new information of sukuk and bond is different. The response of sukuk across maturity period and across credit risk rating is also not same. Therefore, this requires investigation on the dynamics of co-movement among sukuk and global financial markets.

1.4 Research Questions

The problem statement of research gap leads to the following research questions:

- Does long term relationship exist between sukuk and international financial markets?
- Does short term relationship exist between sukuk and international financial markets?
- Do international financial markets lead sukuk market?
- Do systematic risk transfers from international financial markets to sukuk?
- Is time varying correlation exits between sukuk and international financial markets?

- Does dependence structure exist between sukuk and international financial markets?

1.5 Research Objectives

The objectives of the study are given below:

- To explore the relationship between sukuk and international financial markets.
- To study the time varying correlation in the volatility between sukuk and international financial markets.
- To examine the dependence structure between sukuk and international financial markets.

1.6 Significance of the Study

During past few years, Islamic finance is witnessing an extraordinary and striking growth in various sectors specially in sukuk, mutual funds, Islamic stocks and Islamic banks (Raza and Ashraf, 2019; Nasr et al., 2016). It is observed that Islamic finance has strike 2.5 trillion USD total assets, growing at the rate of 8.3% by the end of 2017. These latest statistics point out that Islamic banks which function in major Muslim and non-Muslim countries have the total asset of 1.557 trillion USD in 2017 (Islamic Financial Services Industry Stability Report, 2018) with impressive advancement even in the non-Muslim countries including Europe and North America. Yet most of the development and growth of Islamic finance is powered by sukuk and shariah compliant stock issuances and their addition in Islamic and non-Islamic investment portfolios.

There are limited studies that examine bond market integration and co-movement with other bond markets and with sukuk. As stated by Warnock and

Burger (2003), the non-availability of financial data is a barrier to research on portfolios of global conventional bonds, particularly while comparing the bond yields between different financial markets. The historical data of the conventional bond returns is limited, plus the indices of emerging bond markets did not show up until the mid-1990s. Hansson et al. (2013) observe that majority of researches that target conventional bond diversification analyses are limited to advanced economies only, like USA, UK, Germany and Japan and they emphasize only sovereign bond markets. Moreover, there are lack of studies on sukuk market intercorrelation and co-movement with conventional bond markets. As Globalization and cross border cashflows are also increasing in conventional and Islamic markets. Therefore, this research examine the dynamics of co-movement between sukuk and global financial markets in the context of cointegration, time varying correlation and dependence structure.

1.7 Organization of Study

This thesis comprises of five major chapters. Chapter 1 focuses on underlying idea of the study by providing Introduction, Theoretical Background, Research Gap, Problem Statement, Research Questions, Research Objectives and Significance of Research. Chapter 2 narrates the conclusions and results of survey of topic that includes the theoretical as well as empirical arguments from the past researches. Chapter 3 contains the definitions of variables and the methodologies that are employed for investigation that including Auto Regressive Distributed Lag Model (ARDL), DCC GARCH and Copula function. Chapter 4 elaborates the empirical results and explains the findings. Lastly, Chapter 5 summarizes the research outcomes and provides recommendations.

Chapter 2

Literature Review

A growing yet still very few studies has been carried out on sukuk literature. According to Zulkhibri (2015) limited number of Islamic academic institutions, inadequacy of global standard of the courses of Islamic finance, the unavailability and inconsistency of data and conflict on the understanding of sukuk concept across different researchers and scholars are the major reasons. Most of studies of sukuk provide theoretical studies and focus mainly in terms of structure. As Miller et al. (2007) argue that sukuk and conventional bonds are same and are typically designed based on western standards. Similarly, Wilson (2008) endorse this argument and affirm that investors and financiers are endeavoring to render sukuk comparable to conventional bonds so that non-familiar investors can measure the risk of these Islamic assets.

Fathurahman and Fitriati (2013) investigate the comparative analysis between sukuk and conventional bond returns by employing the techniques of Single Index, Markowitz and Yield to Maturity (YTM). Sukuk and conventional bonds that are actively involved for trading and are listed on the Indonesia Stock Exchange (IDX) and Indonesia Bond Pricing Agents (IBPA) in 2011 are chosen as the sample of study. The findings of this study imply that average YTM and risk of sukuk is significantly higher than conventional bonds. On the contrary Azmat et al. (2017) identify that sukuk and conventional bonds are same with respect to rating of firmss specific market and financial ratio by applying ordered probit technique on the data of 458 Malaysian corporate bonds. Authors also claim that sukuk which

have higher credit risk ratings are secured from global financial and economic turmoil.

This stream of literature indentifies and explores the relationship of sukuk in terms of co-movement and causality, volaitility, risk and dependence structure.

2.1 Relationship of Sukuk in terms of Co-movement and Causality

Aloui et al. (2015b) examine the relationship of sukuk and shariah compliant stock indices in terms of co-movement for the countries of Gulf Cooperation Council (GCC). The wavelet squared approach is employed on the indices of shariah compliant stocks as well as global, corporate and financial services sukuk. The results suggest that there exist strong dependence between the indices of shariah compliant stocks and sukuk. The findings also provide strong evidence that the long run horizon is dominent and the degree of co-movement among both asset classes is different over time and frequency. Another study but in similar vein (Aloui et al., 2015c) investigates the interactive linkages between sukuk and Islamic equities of GCC countries. The bivariate two-state Markov switching EGARCH model is applied on the weekly dataset of 2008-2013. The findings report that index of sukuk and Dubai financial stock market is positively correlated, which indicate that if sukuk is included in Islamic portfolio then the diversification benefits can not be achieved.

Sclip et al. (2016) investigate sukuk and international stock markets in terms of co-movement and volatility behavior by employing DCC GARCH model. The sample of 68 most liquid sukuk which are listed in main sukuk markets, five international and developing equity markets for the time span of 2010-2014 are collected. The findings report that there exist strong correlation among sukuk and stock markets of United States and Europe. The results also reveal that relationship of volatility among the indices of sukuk and regional stock market are stronger at the time of crisis.

Najeeb et al. (2017) investigate the local and foreign currency sukuk portfolios over different investment horizon in order to examine the strategy of held to maturity. The results illustrate that the benefits of both long and short run diversification can be obtained by local currency sukuk since the markets of different local currency sukuk are weakly correlated over different holding periods thus enabling both long term and short term diversification benefits. Whereas the long term correlation is present in foreign currency sukuk over different markets for long term holding period.

Ariff et al. (2017) investigate the yeild behavior for the markets of sukuk and conventional bonds by comparing risk free treasury sukuk with risk free treasury bonds and AAA rated sukuk with AAA rated conventional bonds by applying the technique of Auto Regressive Distributed Lag (ARDL). There are seventeen markets in the world where sukuk and conventional bonds are traded and the outsanding value is 1200 USD billion. This study employ the data of Malaysia covering the period from 2005 to 2014. The findings of the study report that the average yeilds of treasury sukuk are considerably higher in premium as compared to treasury bonds. Moreover, AAA rated sukuk have lower return in discount than that of AAA rated bonds and the return of short run sukuk is lower as compared to long run sukuk.

Naifar et al. (2017) study the effect of global and regional uncertainity elements including financial and economic on the dynamics of sukuk and conventional bond returns. Quantile Regression approach is applied on the data of 2010 to 2014. The empirical results report that sukuk returns do not depend on global and regional uncertainity of economic policy but causal relationship is in bearish market. Whereas the causal relationship and co-movent is present between conventional bond market and global economic and financail market uncertainity factors. Therefore this study confirms that sukuk markets are distinct in relation to the co-movement and cointegration with global and regional uncertainity factors as compared to conventional bonds.

Reboredo and Naifar (2017) examine how financial and economic factors affect global sukuk market. The data of financial and economic factors include the

returns of international equity markets, volatility of international equity markets (VIX), interest rate dynamics in the USA and Europe and economic policy uncertainity whereas the data for global sukuk is Dow Jones Sukuk Index covering the period from 2010 to 2014. The empirical findings of quantile regression approach report that prices of US bond have negative effect and causlity impacts on prices of global sukuk whereas the co-movement is present only between European Monetary Union bond prices and global sukuk prices. The findings also indicate that financial uncertainity has negative effect that is limited to intermediate quantiles of global sukuk and global sukuk prices are not affected by economic policy uncertainity or uncertainity of equity markets. Therefore, the study conclude that sukuk are distinctive assets from conventional bonds.

Bhuiyan et al. (2018) examine the co-movement and time varying correlations in the volatility for the indices of Thomson Reuters BPA Malaysia Sukuk with conventional bonds of emerging markets including Malaysia, Singapore, Indonesia, China, South Korea and India. The technique of wavelet coherence and DCC GARCH is applied on the sample from 2010 to 2015. The results conclude that fixed income investors of emerging markets can have the portfolio diversification benefits by incorporating sukuk in their portfolio. This study also concludes that portfolio diversification is not fesasible domestically but global and regional investors can gain the advantages of portfolio diversification. In another study (Bhuiyan et al., 2019), they investigate the bivariate co-movement dynamics for the pairs of sukuk and conventional bond markets. The wavelet technique is applied on the data of sukuk and 12 foreign bonds covering the period from 2010 to 2015. A total of 24 pairs of Malaysias sukuk and Dow Jones sukuk and bond indices are tested. In case of developed markets the findings indicate that no cointegration is present for the pairs of Malaysian sukuk with UK, USA, German and Canadian conventional bond indices. Whereas there exist co-movement for the pairs of Malaysias sukuk with Austrailia and Japan bond indices. On other hand in case of emerging markets, the co-movement is present for the pairs of Malaysia's sukuk with Malaysian and South Korean bond markets except China, India Indonesia and Singapore. Moreover, the study finds no evidence of co-movement for

the pairs of Dow Jones Sukuk market with developed and emerging markets.

Haque et al. (2017) examine the causal and lead lag relationship for the sukuk and conventional bonds market returns of Malaysia. The time period of this study covers is from 2007 to 2013. The results report that causal relationship is present between sukuk and conventional bonds. For robustness, this study employ wavelet coherence appraoch as well and findings report that sukuk lead conventional bonds in long term inventment horizon than short term.

Widad and Hadjer (2018) examine the causality between sukuk, crude oil and precious metals including silver and gold in Asia pacific during recent oil crisis. This study applies VAR model on the daily data of these variables covering the period from 2009 to 2016. The results of granger causality test and impulse response report that there is substantial evidence of the relationship of sukuk with commodity market variables including oil, gold and silver. Therefore, Islamic financial markets does not provide diversification benefits during oil crisis.

Asutay and Hakim (2018) invetigate the extent of global financial and economic combination over sukuk markets by applying Standard Perfect Financial Integration Indiactors (SPFII). The eight sukuk issuing countries are selected covering the priod from 2004 to 2014 in order to determine the extent of financial openness and degree of regularity of financial connnections. The findings report that countires such as UK, Qatar, Bahrain, Saudi Arabia and UAE apear to be more correlated in their individual measures as compared to other countries in the sample. Moreover, results also indicate that the overall economy of sample is not in state of stable integration unlike as is suggested by the sukuk relationship.

2.2 Relationship of Sukuk in terms of Volatility and Risk

With respect to volatility, Aloui et al. (2015a) explore the spillover in volatility between three GCC sukuk markets and GCC shariah compliant stocks in

global context. The dynamic conditional correlations is estimated using Student-t-distribution on the closing prices for period from 2008 to 2013. The results reveal that there is a strong persistence of behavior and neagtive time varying correlation between sukuk and shariah compliant stock markets.

Balcilar et al. (2016) study to investigate the benefits of international diversification of sukuk by dynamic spillovers and correlation between the markets of sukuk, stock and convetional bonds. Firstly they investigate the risk transmission from global equity and debt markets as well as Islamic equity markets to sukuk markets. Moreover, they also examine the dynamic conditional correlation between sukuk and coneventional financial markets by applying Markov regime-switching DCC GARCH model. The findings report that asymmetric spillover effects are present from global debt and equity markets to sukuk markets, as compared to emerging bond markets sukuk has the distinct pattern in the transmission of shocks of global markets. The results of dynamic conditional correlation suggest that sukuk has a low degree of association with global stock market, and in some episodes the nagative correlation is also observed prticularly in crisis periods. Study also state that sukuk offer useful benefits of portfolio diversification in comparison to conventional bonds and suggest sukuk as sustainable alternate to its conventional counterparts.

Kenourgios et al. (2016) examine whether there exist decoupling impact of global financial turmoil and Eurozone sovereign debt crises on Islamic financial markets. The multivariate APARCH-A-DCC framework is applied on datasets of various emerging and developed markets and the indices of global sukuk and shariah compliant stocks during the period of 2007 to 2015. The empirical output report that majority of indices of sukuk and Islamic stocks are not vulnerable to global shocks that are ordinary for the international financial system. Results also state that Islamic stock indices of emerging markets provide effective benefits of portfolio diversification in contrast to the developed market indices of Islamic stock market.

Hassan et al. (2018) apply DCC GARCH technique to study the conditional correlations and volatility linkages of the markets of sukuk and conventional bonds

in US, EU and emerging markets. The daily data of six corporate bond indices is selected and for sukuk they construct index of 68 most liquid sukuk of major Muslim and non-Muslim countries. The results of this study report that returns of sukuk are more stable as compared to the returns of US and EU conventional bonds. The study also find that there exist higher persistence and lower reaction of conditional volatility among sukuk and conventional bonds in terms of market shocks. The study identifies that positive time varying conditional correlation is present among sukuk and leading conventional bond market returns that is indicated by changing mcroeconomic and market conditions. In further, during economic turmoil, dynamic correlation tend to increase among sukuk and conventional bond markets. Moreover, the significant behavioral shifts are also present in sukuk and bond relationship that are explained by stock market uncertainity, US credit information, crude oil prices and market liquidity.

Rusgianto and Ahmad (2013) examine the global sukuk in terms of volatility behavior by considering the structural breaks associated with global financial crises. This study employs the daily data of global sukuk index for the time frame of 2007 to 2011. The results show that the volatility before-crisis and during-crisis is more vulnerable to market events in contrast to post-crisis period and positive shocks are more volatile than negative shocks.

Maghyereh and Awartani (2016) investigate the return and volatility spillover of sukuk and conventional bonds with stocks in global context. The technique of Spillover index is employed on the sample of Dow Jones Citigroup Sukuk Index, Dow Jones Citigroup Global Bond Index, Dow Jones Global Stock Market Index and Dow Jones Islamic Stock Market Index covering the period from 2005 to 2014. The findings report that the transmission mechanism of sukuk is distintive from conventional bonds but it is not high among sukuk and conventional bond markets. It is also observed that both financial markets are vulnerable to information spillover from international equity markets. On other hand, the information spillover is high from equities to sukuk but low from equities to conventional bonds because sukuk are more exposed to equity. Moreover, the returns and volatility

spillover from sukuk markets to other financial markets is very small and negligible, whereas the transmission from equitites can not be ignored. Therefore, the findings report that sukuk are net recipient of returns and volatility spillover from stock and conventional bond markets.

Raei and Cakir (2007) explore the effect of sukuk on the cost and risk structure of portfolio investments by applying Delta-normal and Monte Carlo simulation approach. Because of the unavailability of secondary data of sukuk and conventional bonds, this study is limited only on the sovereign countries of Malaysia, Pakistan, Qatar and Bahrain. The results report that sukuk markets are less exposed to risk and are different from conventional bonds. Moreover, after investing certain amount of funds in sukuk in the well diversified investment portfolio may considerably decrease the value at risk (VaR) in contrast to if funds are invested only in conventional bonds.

Nasir and Farooq (2017) study the sukuk and conventional bond markets of Pakistan by doing the comparative analysis in terms of risk. Value at Risk technique is applied on the sample of 15 sukuk and 30 Term Finance Certificates (TFCs). Two individual portfolios of sukuk and conventional bonds are created seperately of equal investments and the results reveal that sukuk are more stable and less risky in comparison to conventional bonds. The findings explain the risk and stability of sukuk with the perspective of liquidity and diversfication theory. Moreover, the results report that correlation is very low and nagative among most of sukuk securities that help in diversifying their risk.

As scholars and economists point out that risk shifting behavior is the major cause of world economic and financial turmoil therefore, Hamzah et al. (2018) examine the risk shifting behavior in sukuk and conventional bonds of Malaysian corporations. In their research, they investigate the operating risk of each organization by comparing pre and post issuance of debt. Operating risk of firm is estimated through coefficient of variation of Earning Before Interest, Taxes, Depreciation and Amortization (EBITDA). EBITDA can easily obtained be from the accounting data of firms and is not model specific. Results report that there exist risk shifting behavior in both sukuk and conventional bond markets. Moreover,

this study states that if equity feature of convertible bond is embded in bond and if sukuk is purely equity based then risk shifting behavior can be mitigated.

2.3 The Dependence Structure of Sukuk

Naifar et al. (2016) examine the tail dependence between the returns of sukuk and equity markets through Archimedean Copulas in case of Saudia Arabia. Three archimedean copula are used in this study to examine the tail dependence through Gumbel, Clayton and Frank. The equally weighted sukuk index is constructed for daily data of most liquid sukuk that are negotiable and can be traded in secondary market. The results suggest that the symmetric dependence in tail is present between the markets of sukuk and stocks volatility. In addition this suggest that volatility of equity markets are connected with the same concentration and the association is invulnerable to extreme events.

In another study, Naifar (2016) explore the relationship of sukuk of three biggest sukuk issuing countries Malaysia, United Arab Emirates and Saudi Arabia with their local, regional and global stock markets in terms of tail dependence structure. The tail dependence structure is examined by the funstions of Archimedean Copulas including Gumbel, Clayton, Frank and AMH. The findings indicate that there exist dependence only in the terms of volatility of the indices of sukuk with considered equity markets. Moreover, there exist upper tail dependence for Malaysia and United Arab Emirates and is not symmetric. Whereas the symmetric dependence is present in Saudia Arabian markets. It is also observed that the sensitivity of local sukuk yeilds is high to international stock markets.

2.4 Hypotheses of the Study

Hypothesis 1

There exists long term relationship between sukuk and international financial markets.

Hypothesis 2

The short term relationship exists between sukuk and international financial markets.

Hypothesis 3

International financial markets lead sukuk market.

Hypothesis 4

Systematic risk transfers from international financial markets to sukuk.

Hypothesis 5

Time varying correlation exits between international financial markets and sukuk.

Hypothesis 6

Tail dependence structure exists between international financial markets and sukuk.

Chapter 3

Data Description and Methodology

3.1 Data Description

This study examines the dynamics of co-movement between sukuk and international financial markets. The international financial markets are represented by S&P Global 1200 that is equity index and FTSE World Government Bond Index that is bond market index. The sukuk indices are selected based on maturity and credit risk rating. Moreover, the co-movement is also examined between MENA sukuk, MENA equity and MENA bond index. All indices are in U.S. dollar denominated and are obtained from S&P Dow Jones Indices and Thomson Reuters. The time periods of all indices are based on availability of data. **Table 3.1** presents the names and time periods of all indices.

The indices of sukuk and international financial markets are transformed into returns by computing the differences of natural log of the daily closing prices through following equation:

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

Where ln is natural log

R_t is the return of all indices of sukuk and international financial markets

P_t is the price of index at time t

P_{t-1} is the price of index at time $t-1$

TABLE 3.1: Sample and Sample Period

S. No.	Names of Indices	Symbol	Time Period
1	FTSE World Government Bond Index	WGBI	Dec 07, 2017 to Sep 30, 2019
2	S&P Global 1200 Index	SPG	Sep 30, 2009 to Sep 30, 2019
3	Dow Jones Sukuk Total Return Index	DJT	Sep 30, 2009 to Sep 30, 2019
4	Dow Jones Sukuk 1-3 Year Total Return Index	DJ13	Sep 30, 2009 to Sep 30, 2019
5	Dow Jones Sukuk 3-5 Year Total Return Index	DJ35	Sep 30, 2009 to Sep 30, 2019
6	Dow Jones Sukuk 7-10 Year Total Return Index	DJ710	Sep 30, 2009 to Sep 30, 2019
7	Dow Jones Sukuk A Rated Total Return Index	DJA	Sep 30, 2009 to Sep 30, 2019
8	Dow Jones Sukuk AA Rated Total Return Index	DJAA	Sep 30, 2009 to Sep 30, 2019
9	Dow Jones Sukuk AAA Rated Total Return Index	DJAAA	Sep 30, 2009 to Sep 30, 2019
10	Dow Jones Sukuk BBB Rated Total Return Index	DJBBB	Sep 30, 2009 to Sep 30, 2019
11	S&P MENA Bond Index	SPMD	Jul 31, 2013 to Sep 30, 2019
12	Dow Jones MENA Total Return Index	DJME	Jul 31, 2013 to Sep 30, 2019
13	S&P MENA Sukuk Index	SPMS	Jul 31, 2013 to Sep 30, 2019

Moreover, **Table 3.2** represents the time periods of all the pairs of sukuk with international financial markets. For the pairs of sukuk with global equity the time period is from Sep 30, 2009 to Sep 30, 2019. The time period for the pairs of sukuk with global bond is from Dec 07, 2017 to Sep 30, 2019. The pairs of MENA sukuk with MENA equity and MENA bond have the time period from Jul 31, 2013 to Sep 30, 2019.

TABLE 3.2: Time Periods of All Pairs of Sukuk with International Financial Markets

S. No.	Sukuk Pairs	Time Period
1	LG-L13	Sep 30, 2009 to Sep 30, 2019
2	LG-L35	Sep 30, 2009 to Sep 30, 2019
3	LG-L710	Sep 30, 2009 to Sep 30, 2019
4	LG-LAAA	Sep 30, 2009 to Sep 30, 2019
5	LG-LAA	Sep 30, 2009 to Sep 30, 2019
6	LG-LA	Sep 30, 2009 to Sep 30, 2019
7	LG-LBBB	Sep 30, 2009 to Sep 30, 2019
8	LG-LT	Sep 30, 2009 to Sep 30, 2019
9	LB-L13	Dec 07, 2017 to Sep 30, 2019
10	LB-L35	Dec 07, 2017 to Sep 30, 2019
11	LB-L710	Dec 07, 2017 to Sep 30, 2019
12	LB-LAAA	Dec 07, 2017 to Sep 30, 2019
13	LB-LAA	Dec 07, 2017 to Sep 30, 2019
14	LB-LA	Dec 07, 2017 to Sep 30, 2019
15	LB-LBBB	Dec 07, 2017 to Sep 30, 2019
16	LB-LT	Dec 07, 2017 to Sep 30, 2019
17	LME-LMS	Jul 31, 2013 to Sep 30, 2019
18	LMD-LMS	Jul 31, 2013 to Sep 30, 2019

Where LG=Log of Global Equity Index, LB=Log of Global Bond Index, L13=Log of 1-3 Year Sukuk Index, L35=Log of 3-5 Year Sukuk Index, L710=Log of 7-10 Year Sukuk Index, LAAA=Log of AAA Rated Sukuk Index, LAA=Log of AA Rated Sukuk Index, LA=Log of A Rated Sukuk Index, LBBB=Log of BBB Rated Sukuk Index, LT=Log of Total Return Sukuk Index, LMS=Log of MENA Sukuk Index, LMD=Log of MENA Bond Index, LME=Log of MENA Equity Index.

3.2 Econometric Models

This study examines the co-integration between sukuk and international financial markets through Auto Regressive Distributed Lag Model (ARDL). The time varying correlation in the volatility between sukuk and international financial markets is examined through DCC GARCH approach. Dependence structure between sukuk and international financial markets is tested using Copula approach. The details of each model are given below:

3.2.1 Auto Regressive Distributed Lag Model (ARDL)

There are several methodologies to examine the presence of long term counterbalance connection between time series variables. The commonly used techniques

are Engle and Granger (1987) approach, fully modified OLS method of Hansen and Phillips (1990), Johansen (1988) and Johansen and Juselius (1990) Maximum Likelihood cointegration technique and Johansen (1991) tests. According to these methods the time series variables under observation should be integrated of order one that is I(1). Moreover, these techniques have low power and do not have properties for small samples. Therefore, the approach of Auto Regressive Distributed Lag (ARDL) model to explore the cointegration relationship is found to be well known in last couple of years.

In contrary to above discussion, this study uses ARDL approach that is suggested by Pesaran et al. (2001) in order to examine the long and short term relationship for the pairs of sukuk with international financial markets. Pesaran and Shin (1998) show that under ARDL approach the set of many time series that have dissimilar integration order can be tested. Moreover, ARDL model can accommodate plenty of time series variables in contrast to other Vector Autoregressive (VAR) models.

Firstly, the unit root test is applied on data to avoid the possibility of spurious regression. This test is compulsory because Ouattara (2004) suggests that bound test assumes variables are integrated of order I(0) or I(1) and no variable is I(2) because estimated F-statistics given by Pesaran et al. (2001) becomes null and invalid with the presence of I(2) variable. Likewise, this study employs other diagnostic tests as well in order to determine that the problems related to serial correlation, heteroscedasticity and conflict to normality do not exist.

Secondly, the presence of long and short term correlation is tested after when data is based on the integration order of I(0) and I(1). The short run relationship is examined through Error Correction Model (ECM) that deals with the dynamics of variable in short run as well as the speed of adjustment toward long term correlation. Therefore, the coefficient of speed of adjustment is measured through dynamic model.

The following equation explores the correlation for the pairs of sukuk with international financial markets:

$$LI_t = \beta_0 + \beta_1 LS_t \mu_t \tag{3.2}$$

Where

I = International Financial Markets

S = Sukuk Markets

The equation 3.2 can be represented in ARDL as:

$$LI_t = \beta_0 + \sum \psi_i LI_{t-i} + \sum \beta_1 LS_{t-i} + \mu_t \tag{3.3}$$

Where i scales from 1 to p and q respectively

Finally, the equation of ECM is estimated through the variables difference and lagged long term solution that determine the speed of adjustment of returns into equilibrium.

The following equation represent ECM:

$$LI_t = \Gamma_0 + \Gamma_1 \Delta LS_{t-i} + ECM + \mu_t \tag{3.4}$$

The stability of long and short term coefficients is tested by using cumulative sum of recursive residuals (CUSUM). If plots of CUSUM are within the critical limit of five percent, then model is found to be stable.

3.2.2 DCC GARCH

Multivariate GARCH model is useful to calculate the dynamic conditional correlation where correlations and volatilities are function of past returns. To resolve the computational problems, the technique of Dynamic Conditional Correlation (DCC) GARCH is employed (Engle, 2002), that is extended from Constant

Correlation estimator (CCC) drawn by introducing the time varying impact in the correlation matrix. It is also observed that DCC GARCH provides the enhanced results and is more effective as compared to CCC GARCH.

The following equation exhibits multivariate DCC model:

$$\begin{cases} \varepsilon_t = \sigma_t \eta_t \\ \sigma_t^2 = w + \sum_{i=1}^{q} \alpha_{oi} \varepsilon_{t-i}^2 + \sum_{j=1}^{p} \beta_{oj} h_{t-j} \end{cases} \tag{3.5}$$

Where

σ_t^2 : Any univariate GARCH model

α_{oi} and β_{oj} : Non-negative constants

w : (strictly) positive constant

$$\begin{cases} H_t = D_t R_t D_t \\ D_t = diag(\sigma_{11t}^{\frac{1}{2}} ..... \sigma_{NNt}^{\frac{1}{2}}) \\ R_t = diag[Q_t]^{-1} Q_t diag[Q_t]^{-1} \end{cases} \tag{3.6}$$

Where D_t is a $n \times n$ diagonal matrix of time-varying standard deviations from univariate GARCH models with $\sqrt{h_{it}}$ on the diagonal and R_t is a correlation matrix, with the $n \times n$ symmetric positive definite matrix $Q_t = (q_{ij,t})$ given by:

$$Q_t = (1 - \alpha - \beta)\overline{Q} + \alpha \mu_{t-1} \acute{\mu}_{t-1 + \beta Q_{t-1}} \tag{3.7}$$

where standardized residuals $\mu_t = \varepsilon_{it}/\sqrt{h_{iit}}$ and α and β are non-negative scalar parameters satisfying $\alpha + \beta < 1$.

3.2.3 Copula Approach

Copula is composed of two marginal distributions that is the joint distribution function. Similarly, a marginal distribution function f(x) another f(y) are mapped onto a joint copula function $C(f(x), f(y)|\psi)$, where ψ is a set of data available at time $t-1$. Copula functions are highly beneficial to examine the co-movement between time series variables that are based on several distributions. In recent times, copulas are widely being employed in risk management as well as in investigating the co-movement in the financial markets (Rodriguez, 2007). Mostly the returns of financial time series are not normally distributed and exhibit heavly tailness and skewness. In addition, the co-movement between the returns of financial time series have non-linear structures that cannot be completely explained by classical correlation coefficients.

Let F(x) is the marginal distribution of a variable x and F(y) be the marginal distribution of y and the joint distribution of x and y is G(x,y), then for every (x,y), the copula function C is shown as:

$$C(F(x), F(y)) = G(x, y) \tag{3.8}$$

The change in one variable is conditional upon other(s) in most financial time series data. To integrate conditionalities in the above copula the conditional parameter Ω is used in such a way that $F_{1|\Omega}$ and $F_{2|\Omega}$ be the marginal distribution of x and y, respectively, conditional upon Ω. Then, the copula function is defined as:

$$F_{1,2|\Omega}(x, y|\Omega) = C(F_{1|\Omega}(x|\Omega), F_{2|\Omega}(y|\Omega)|\Omega) \tag{3.9}$$

The bivariate distribution is designed in a way that need not be normal and can be employed in financial research, especially in time series data. The copulas that represent the bivariate distribution are different form of copulas in the copula family. The most prominent among them are Gaussian copula, t-Student copula, Gumbel Copula, Clayton copula, and Frank copula.

The very basic and fundamental copula distribution is the Gaussian Copula that can be represented as follows:

$$\Phi_p(\Phi^{-1}(x), \Phi^{-1}(y)) = \int_{-\infty}^{\Phi^{-1}(x)} \int_{-\infty}^{\Phi^{-1}(y)} \frac{1}{2\prod(1-p^2)} e \int \{-\frac{s^2 - 2pst + t^2}{2(1-p)}\} dsdt \tag{3.10}$$

Where,

Φ^{-1} : inversion of cumulative distribution function (cdf) of standard normal distribution and

Φ_p : cdf of standard bivariate normal distribution with Pearson correlation

There is no upper and lower tail dependence in the bivariate Gaussian Copula, and it has the symmetric distribution. As compared to Gaussian copula, t-Student Copula has both upper and lower tail dependence and with parameter p and v the tail dependence is presented by:

$$\lambda = 2t_{v+1}\left(- \sqrt{v+1}\sqrt{\frac{1-p}{1+p}}\right) \tag{3.11}$$

Where,

t_{v+1} : univariate t distribution function with $v+1$ degrees of freedom
The value of λ depends on the parameters.

To integrate tail dependencies, Embrechts et al. (2005) propose using the Clayton Copula and Gumbel Copula in order to examine the dependence in the lower tail and upper tail respectively. The Clayton Copula with the dependence parameter $\theta\varepsilon(0, \infty)$ can be written as:

$$max[(x^{-\alpha} + y^{-\alpha} - 1)^{\frac{-1}{\alpha}}, 0] \tag{3.12}$$

where α is the copula parameter and x and y are the variables with a marginal distribution of f(x) and f(y), respectively. This copula parameter shows lower tail

dependence and zero upper tail dependence. The lower tail dependence (λ_1) is normalized as $2^{-\frac{1}{\alpha}}$. When $\alpha = 0$, there is no tail dependence.

The following equation represents The Gumbel Copula with dependence parameter $\theta\varepsilon(0, \infty)$:

$$C(x, y|\Omega) = exp\{-[(-lnx)^{\theta} + (-lny)^{\theta}]^{\frac{1}{\theta}}\} \tag{3.13}$$

where *exp* is the exponential function and ln is the natural logarithm. For $\theta > 1$, the copula generates an upper tail dependence and maximum dependencies is achieved when$\theta \to \infty$. The Gumbel parameter θ is normalized as $(\lambda_{\mu})2 - 2^{\frac{1}{\theta}}$.

As copulas are fitted based on one more specific parameter therefore, according the type of copula one or more initial values are proposed, and then final parameters are estimated. Parameters estimation are carried out by the technique of pseudo-maximum likelihood, that consist in maximizing numerically the following expression:

$$\hat{l(\theta)} = \left[\sum i = 1 \;\; Nln\{c\hat{\theta(}U \sim i1, U \sim i2)\}\right] \tag{3.14}$$

Where the arguments of the copula density c are called pseudo observations:

$$U \sim i1 = NN + 1 \sum j = 1NI(L_j1 \leq L_i1) \tag{3.15}$$

And

$$U \sim i2 = NN + 1 \sum j = 1NI(L_j2 \leq L_i2) \tag{3.16}$$

With aim to establish a comparison between the adjusted models, the Akaikes Information Criterion AIC and Schwarzs Bayesian Criterion BIC are estimated.

Chapter 4

Results, Data Analysis and Discussions

4.1 Descriptive Statistics and Unit Root Test

Table 4.1 displays the descriptive statistics of returns of sukuk and international financial markets to present quantitative descriptions of all the variables in comprehensible form. Descriptive statistics are broken down in to measure of central tendency and measure of variability. Measure of central tendency includes the results of mean, median and mode, whereas as the measure of variability explains the results of standard deviation, variance, minimum, maximum, skewness and kurtosis.

Average mean returns measure the performance of the indices of sukuk and international financial markets and for all markets the mean is positive, so it indicates that all variables have positive average returns. Maximum average return (0.04%) is exhibited by S&P Global 1200 and thus can be regarded as the best return. Maximum and minimum values show the maximum and minimum return in a day. The maximum return earned in a day 8.51% and the maximum loss incurred in a day 17.43% is by Dow Jones Sukuk 7-10 Year Total Return Index. The highest risk (0.84%) is observed in S&P Global 1200 whereas the minimum risk (0.09%) is observed in S&P MENA Sukuk index. Skewness can be described

Table 4.1: Descriptive Statistics

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	J. Bera	Prob.
RG	0.0004	0.0007	0.0465	-0.0540	0.0084	-0.5094	7.3738	2186	0.0000
RB	0.0001	0.0000	0.0056	-0.0081	0.0018	-0.2035	4.7237	61	0.0000
R13	0.0001	0.0001	0.0210	-0.1264	0.0027	-39.1425	1837.1610	365000000	0.0000
R35	0.0002	0.0002	0.0246	-0.0225	0.0014	0.6833	95.7457	932419	0.0000
R710	0.0002	0.0000	0.0851	-0.1743	0.0048	-14.6470	699.7614	52706515	0.0000
RAAA	0.0001	0.0001	0.0222	-0.0191	0.0015	1.3860	77.3598	600079	0.0000
RAA	0.0002	0.0001	0.0285	-0.0179	0.0017	0.6795	48.5580	225136	0.0000
RA	0.0001	0.0002	0.0199	-0.1061	0.0025	-30.2753	1307.9790	185000000	0.0000
RBBB	0.0002	0.0002	0.0530	-0.1062	0.0030	-14.9140	637.5981	43740635	0.0000
RT	0.0002	0.0002	0.0199	-0.0502	0.0018	-12.0990	342.9339	12586737	0.0000
RMS	0.0001	0.0000	0.0082	-0.0086	0.0009	-0.1303	13.0346	8073	0.0000
RMD	0.0002	0.0000	0.0095	-0.0091	0.0014	-0.0577	8.6428	2552	0.0000
RME	0.0001	0.0001	0.0532	-0.0522	0.0066	-0.8885	16.0922	13987	0.0000

This table displays the descriptive statitics of sukuk and international financial markets. Where RG=Logged Return of Global Equity Index, RB=Logged Return of Global Bond Index, R13=Logged Return of 1-3 Year Sukuk Index, R35=Logged Return of 3-5 Year Sukuk Index, R710=Logged Return of 7-10 Year Sukuk Index, RAAA=Logged Return of AAA Rated Sukuk Index, RAA=Logged Return of AA Rated Sukuk Index, RA=Logged Return of A Rated Sukuk Index, RBBB=Logged Return of BBB Rated Sukuk Index, RT=Logged Return of Total Return Sukuk Index, RMS=Logged Return of MENA Sukuk Index, RMD=Logged Return of MENA Bond Index, RME=Logged Return of MENA Equity Index.

as the degree of distortion from the symmetrical bell curve or normal distribution in the set of data. The skewness for Dow Jones Sukuk AAA Rated Total Return Index and Dow Jones Sukuk AA Rated Total Return Index is positive only and demonstrates that data is positively skewed while other variables are negatively skewed at left. Kurtosis for all variables is greater than 3 that indicates the presence of peaked and fat tail distribution in the returns of sukuk and international financial markets. Dow Jones Sukuk 1-3 Year Total Return Index and Dow Jones Sukuk A Rated Total Return Index have more fat tails while FTSE World Government Bond Index and S&P Global 1200 have less fat tails. It explains the data is non-normal emphasis on fat tails is desired. Finally, the sukuk and international financial markets Jarque-Bera probabilities are significant that indicates the data is non-random in nature.

Many financial time series may exhibit non stationarity or trending behavior therefore it is essential to apply the unit root test. Mostly studies recommend applying unit root test before examining the cointegration. Two widely used Augmented Dickey Fuller (ADF) and Phillip-Peron (PP) are applied in this study to examine the integration order for all time series variables. According to Dickey Fuller error terms must be statistically independent and data should be homoscedastic. But in some cases, these assumptions may not be true for some data. Therefore, another important technique of Phillip-Peron is applied as well to examine the stationarity of the data. These tests are applied at level and first difference with assumption of constant and trend. **Table 4.2** displays the results of unit root test and shows that Phillip-Peron test verifies the ADF test results. The data is presented in log for smoothening of the results. Thus, it can be concluded that mostly time series variables are not stationary at level, but series become stationary at the first difference of logarithmic transformation. Only the indices of S&P Global 1200, Dow Jones Sukuk 1-3 Year Total Return and Dow Jones Sukuk 7-10 Year Total Return are stationary at level. The ARDL model can safely be implemented for all pairs of sukuk and international financial markets as no series is found integrated at I(2) and all series are either integrated of order zero I(0) or at the first difference I(1).

Table 4.2: Unit Root Analysis

Series	ADF at Lvl	ADF at 1st	PP at Lvl	PP at 1st	Int. Ordr
LG	-3.8483	-45.4921	-3.4829	-45.2335	I(0)
	(0.0143)	(0.0000)	(0.0414)	(0.0000)	
LB	-1.2642	-20.4902	-1.3697	-20.5673	I(1)
	(0.8950)	(0.0000)	(0.8686)	(0.0000)	
L13	-4.4582	-51.3451	-4.4582	-51.3538	I(0)
	(0.0017)	(0.0000)	(0.0017)	(0.0000)	
L35	-1.3297	-51.0966	-1.3046	-51.1455	I(1)
	(0.6178)	(0.0001)	(0.6296)	(0.0001)	
L710	-3.6115	-16.9304	-3.7194	-61.7245	I(0)
	(0.0290)	(0.0000)	(0.0212)	(0.0000)	
LAAA	-1.4985	-54.3436	-2.3755	-54.4189	I(1)
	(0.5345)	(0.0001)	(0.3924)	(0.0000)	
LAA	-1.7343	-46.2442	-1.6947	-46.4623	I(1)
	(0.4138)	(0.0001)	(0.4339)	(0.0001)	
LA	-2.9978	-47.8783	-3.0598	-47.9519	I(1)
	(0.1330)	(0.0000)	(0.1163)	(0.0000)	
LBBB	-2.4987	-17.9283	-2.8656	-54.7304	I(1)
	(0.3288)	(0.0000)	(0.1740)	(0.0000)	
LT	-2.6898	-32.1388	-2.5990	-37.5062	I(1)
	(0.2409)	(0.0000)	(0.2808)	(0.0000)	
LMS	0.4754	-18.0504	0.3729	-44.1938	I(1)
	(0.9859)	(0.0000)	(0.9818)	(0.0001)	
LMD	0.3989	-20.6863	0.3582	-41.4698	I(1)
	(0.9829)	(0.0000)	-0.9812	(0.0000)	
LME	-1.2991	-39.0755	-1.4074	-39.5032	I(1)
	(0.6321)	(0.0000)	(0.5801	(0.0000)	

Where LG=Log of Global Equity Index, LB=Log of Global Bond Index, L13=Log of 1-3 Year Sukuk Index, L35=Log of 3-5 Year Sukuk Index, L710=Log of 7-10 Year Sukuk Index, LAAA=Log of AAA Rated Sukuk Index, LAA=Log of AA Rated Sukuk Index, LA=Log of A Rated Sukuk Index, LBBB=Log of BBB Rated Sukuk Index, LT=Log of Total Return Sukuk Index, LMS=Log of MENA Sukuk Index, LMD=Log of MENA Bond Index, LME=Log of MENA Equity Index.

4.2 An Application of ARDL Model

This section is comprised of three sub sections. The first sub section discusses the results of ARDL of Sukuk with Global Equity Market. The second sub section address the results of ARDL of Sukuk with Global Bond Market. The third section is about the results of ARDL of Global MENA Sukuk with Global MENA Bond and Global MENA Equity.

4.2.1 ARDL of Sukuk with Global Equity

ARDL model is applied on sukuk indices based on maturity and credit rating with global equity. The most common measures to estimate the number of lags are Akaike Information Criterion, Schwarz Bayesian Criterion, Hannan-Quinn and Log Likelihood equation. If no autocorrelation is observed, then the lag period that offers the smallest critical value is recognized as the lag period of model. This study uses AIC as model selection criterion. The lag that minimize the AIC criterion for the pairs of global equity with 1-3 year sukuk, 3-5 year sukuk, AA rated sukuk, BBB rated sukuk and total return sukuk is 4. The lag length for the pairs of global equity with 7-10 year sukuk, AAA rated sukuk and A rated sukuk is 2. No autocorrelation exists at these durations of lags. **Table 4.3** present the findings of lag length for the pairs of global equity with sukuk based on maturity and credit rating.

TABLE 4.3: Lag Length Sukuk with Global Equity

LG-L13		**LG-L35**		**LG-L710**		**LG-LAAA**	
Lag	AIC	Lag	AIC	Lag	AIC	Lag	AIC
0	-4.38160	0	-3.5084	0	-2.9900	0	-4.0958
1	-15.72050	1	-17.0273	1	-14.5566	1	-16.9801
2	-15.73570	2	-17.0535	2	**-14.6029***	2	**-16.9957***
3	-15.73670	3	-17.0540	3	-14.6025	3	-16.9928
4	**-15.7372***	4	**-17.0557***	4	-14.6028	4	-16.9925
LG-LAA		**LG-LA**		**LG-LBBB**		**LG-LT**	
Lag	AIC	Lag	AIC	Lag	AIC	Lag	AIC
0	-3.3005	0	-3.7045	0	-3.3515	0	-3.6472
1	-16.6291	1	-15.8985	1	-15.5083	1	-16.5170
2	-16.6663	2	**-15.9215***	2	-15.5445	2	-16.6422
3	-16.6651	3	-15.9211	3	-15.5457	3	-16.6424
4	**-16.6664***	4	-15.9204	4	**-15.5463***	4	**-16.6442***

Where LG=Log of Global Equity Index, L13=Log of 1-3 Year Sukuk Index, L35=Log of 3-5 Year Sukuk Index, L710=Log of 7-10 Year Sukuk Index, LAAA=Log of AAA Rated Sukuk Index, LAA=Log of AA Rated Sukuk Index, LA=Log of A Rated Sukuk Index, LBBB=Log of BBB Rated Sukuk Index, LT=Log of Total Return Sukuk Index.

Table 4.4 reports the diagnostic tests results of all pairs of sukuk with global equity before applying the ARDL tests. The problem of auto-correlation is tested through Breusch-Godfrey test. The normality of the models is tested through Histogram test, model specification error is examined through Ramsey RESET Test and heteroscedasticity is tested through White test. The findings of these tests illustrate that the problem of auto-correlation does not exist. The issue regarding normal distribution of data is not present as well. Similarly, the model specification error with reference to functional form is also not been observed. Shrestha and Chowdhury (2005) indicate that as time series variables are composite of various integration order therefore, the presence of heteroscedasticity has no influence on estimates. So the problem of heteroscedasticity is naturally to be detected.

TABLE 4.4: Diagnostic Tests of Sukuk with Global Equity

		LG-L13		LG-L35		LG-L710		LG-LAAA	
Item	**Test Applied**	**Value**	**Prob**	**Value**	**Prob**	**Value**	**Prob**	**Value**	**Prob**
Serial Correlation	Breusch-Godfrey Test (F-stat)	2.2147	0.0650	0.7671	0.5465	0.9999	0.3681	0.0621	0.9398
Normality	Histogram Test (Jarque-Bera)	2374.4330	0.0000	2297.9680	0.0000	2304.5990	0.0000	2335.0500	0.0000
Functional Form	Ramsey RESET Test (F-stat)	0.5410	0.4621	0.2781	0.5980	0.1535	0.6952	0.0254	0.8734
Heteroscedasticity	White Test (F-stat)	15.3517	0.0000	14.7734	0.0000	13.7550	0.0000	19.6076	0.0000
		LG-LAA		**LG-LA**		**LG-LBBB**		**LG-LT**	
Item	**Test Applied**	**Value**	**Prob**	**Value**	**Prob**	**Value**	**Prob**	**Value**	**Prob**
Serial Correlation	Breusch-Godfrey Test (F-stat)	1.6393	0.1616	0.3357	0.7149	0.6140	0.6526	1.1004	0.3546
Normality	Histogram Test (Jarque-Bera)	2395.9270	0.0000	2332.7990	0.0000	2461.4150	0.0000	2364.0310	0.0000
Functional Form	Ramsey RESET Test (F-stat)	0.0243	0.8760	1.7465	0.1864	0.0507	0.8219	0.1984	0.6561
Heteroscedasticity	White Test (F-stat)	15.1813	0.0000	22.0823	0.0000	19.8920	0.0000	17.3773	0.0000

Where LG=Log of Global Equity Index, L13=Log of 1-3 Year Sukuk Index, L35=Log of 3-5 Year Sukuk Index, L710=Log of 7-10 Year Sukuk Index, LAAA=Log of AAA Rated Sukuk Index, LAA=Log of AA Rated Sukuk Index, LA=Log of A Rated Sukuk Index, LBBB=Log of BBB Rated Sukuk Index, LT=Log of Total Return Sukuk Index.

Table 4.5 and **Table 4.6** reports the results regarding AIC based selected ARDL models of all pairs of sukuk with global equity. It shows 1-3 year sukuk returns do not significantly explains the returns of Global Equity. Whereas 7-10 year sukuk, AAA rated sukuk, AA rated sukuk and BBB rated sukuk have statistically significant impact on global equity. The 3-5 year sukuk, A rated sukuk and total return sukuk have no contemporaneous but lag effect with global equity.

Table 4.5: AIC Based Selected Model of Sukuk with Global Equity (A)

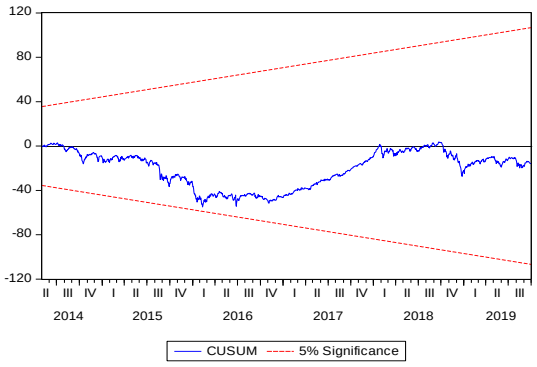
LG-L13: ARDL(4, 0, 0)			**LG-L35: ARDL(4, 3)**			**LG-L710: ARDL(4, 1, 0)**			**LG-LAAA: ARDL(4, 1)**		
Variable	Coef.	Prob	Variable	Coef.	Prob	Variable	Coef.	Prob	Variable	Coef.	Prob
LG(-1)	1.1077	0.0000	LG(-1)	1.1132	0.0000	LG(-1)	1.1083	0.0000	LG(-1)	1.1123	0.0000
LG(-2)	-0.1084	0.0002	LG(-2)	-0.1056	0.0003	LG(-2)	-0.1072	0.0003	LG(-2)	-0.1136	0.0001
LG(-3)	-0.0498	0.0890	LG(-3)	-0.0619	0.0353	LG(-3)	-0.0511	0.0813	LG(-3)	-0.0493	0.0902
LG(-4)	0.0389	0.0474	LG(-4)	0.0446	0.0237	LG(-4)	0.0451	0.0212	LG(-4)	0.0408	0.0362
L13	0.0033	0.7099	L35	-0.1873	0.1070	L710	0.0867	0.0099	LAAA	-0.6506	0.0000
D1	0.0008	0.1535	L35(-1)	-0.0704	0.6673	L710(-1)	-0.0771	0.0220	LAAA(-1)	0.6510	0.0000
C	0.0702	0.1424	L35(-2)	0.5829	0.0004	D1	0.0002	0.7523	C	0.0707	0.0844
@TREND	0.0000	0.0055	L35(-3)	-0.3227	0.0055	C	-0.0076	0.2378	@TREND	0.0000	0.0039
			C	0.0613	0.0598						
			@TREND	0.0000	0.0142						
F-statistic		420725	F-statistic		328654	F-statistic		420480	F-statistic		425855
Prob(F-statistic)		0.0000	Prob(F-statistic)		0.0000	Prob(F-statistic)		0.0000	Prob(F-statistic)		0.0000
D.W stat.		2.0026	D.W stat.		2.0006	D.W stat.		2.0014	D.W stat.		2.0001

Where LG=Log of Global Equity Index, L13=Log of 1-3 Year Sukuk Index, L35=Log of 3-5 Year Sukuk Index, L710=Log of 7-10 Year Sukuk Index, LAAA=Log of AAA Rated Sukuk Index.

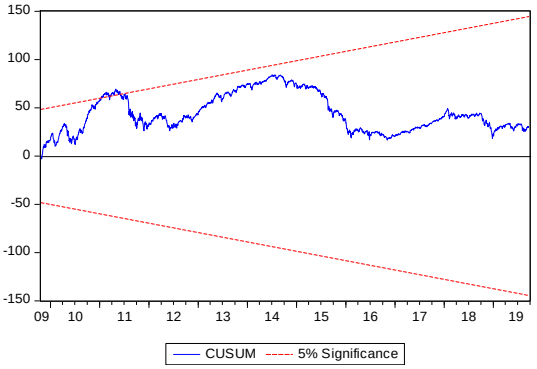
Table 4.6: AIC Based Selected Model of Sukuk with Global Equity (B)

LG-LAA: ARDL(4, 3)			**LG-LA: ARDL(4, 2)**			**LG-LBBB: ARDL(4, 1)**			**LG-LT: ARDL(4, 2)**		
Variable	Coef.	Prob	Variable	Coef.	Prob	Variable	Coef.	Prob	Variable	Coef.	Prob
LG(-1)	1.10330	0.00000	LG(-1)	1.11010	0.00000	LG(-1)	1.09960	0.00000	LG(-1)	1.10580	0.00000
LG(-2)	-0.10510	0.00040	LG(-2)	-0.10420	0.00040	LG(-2)	-0.10230	0.00050	LG(-2)	-0.10000	0.00070
LG(-3)	-0.05410	0.06580	LG(-3)	-0.05380	0.06610	LG(-3)	-0.04860	0.09630	LG(-3)	-0.05320	0.06980
LG(-4)	0.04650	0.01880	LG(-4)	0.04080	0.03720	LG(-4)	0.04170	0.03310	LG(-4)	0.03740	0.05640
LAA	0.19640	0.04060	LA	-0.10810	0.10130	LBBB	0.18380	0.00080	LT	0.10690	0.25920
LAA(-1)	-0.21720	0.12450	LA(-1)	-0.03770	0.69490	LBBB(-1)	-0.18280	0.00080	LT(-1)	-0.33770	0.02640
LAA(-2)	0.23580	0.09550	LA(-2)	0.16260	0.01400	C	0.06680	0.03370	LT(-2)	0.23540	0.01300
LAA(-3)	-0.21390	0.02570	C	-0.02660	0.00970	@TREND	0.00000	0.02200	C	0.05120	0.16980
C	0.06510	0.02650							@TREND	0.00000	0.04160
@TREND	0.00000	0.00470									
F-statistic		327849	F-statistic		421497	F-statistic		422169	F-statistic		368582
Prob(F-statistic)		0.00000	Prob(F-statistic)		0.00000	Prob(F-statistic)		0.00000	Prob(F-statistic)		0.00000
D.W stat.		2.00100	D.W stat.		2.00110	D.W stat.		2.00060	D.W stat.		2.00030

Where LAA=Log of AA Rated Sukuk Index, LA=Log of A Rated Sukuk Index, LBBB=Log of BBB Rated Sukuk Index, LT=Log of Total Return Sukuk Index.



LG-L13



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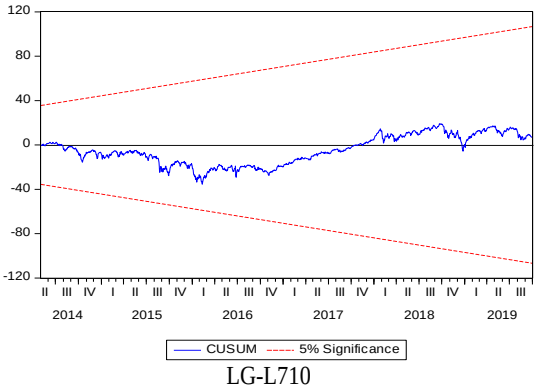
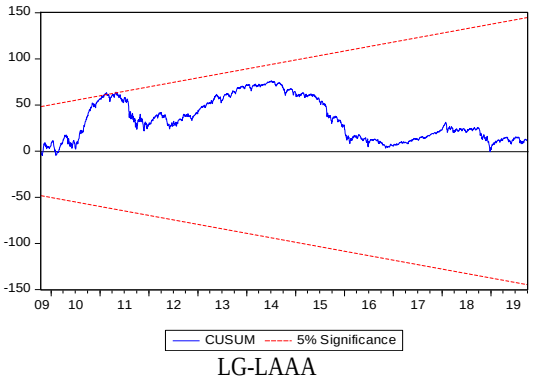
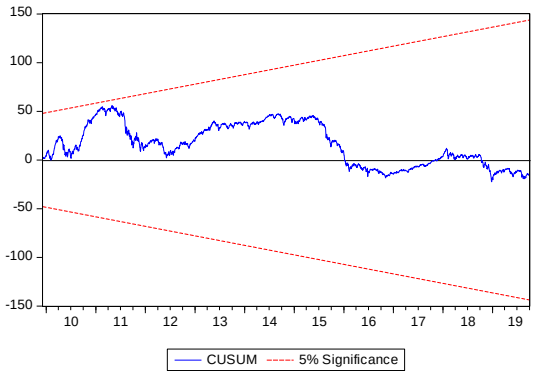


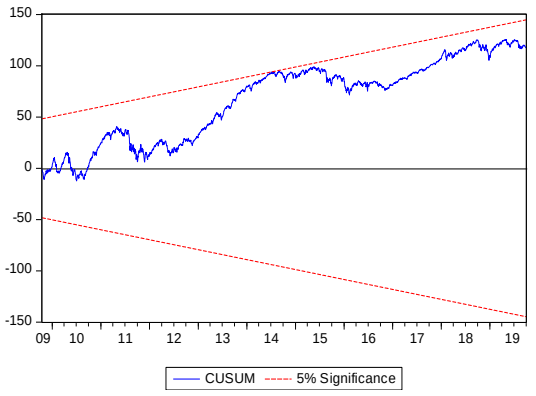
LG-L710



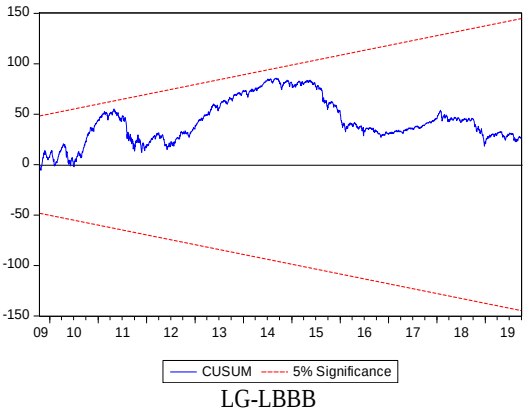
LG-LAAA



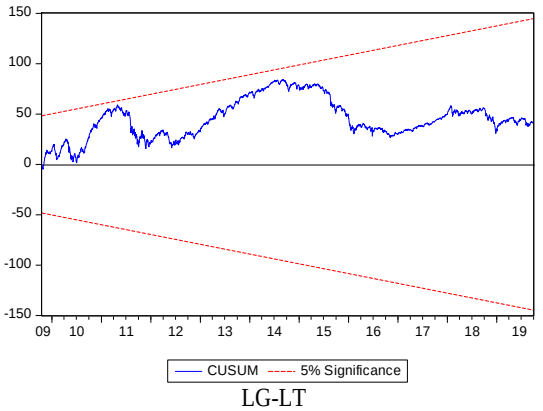
LG-LAA



LG-LA



LG-LBBB



LG-LT

FIGURE 4.1: CUSUM of Sukuk with Global Equity

CUSUM is plotted to examine the stability in ARDL model. **Figure 4.1** displays the cumulative sum of recursive residuals of all pairs of sukuk with global equity and also shows that it is inside the critical limits of 0.05 which indicate the overall goodness of fit and stability of the models. Plot of CUSUM for 3-5 year sukuk marginally cross the critical lines of 0.05 but it is safe to conclude that model is stable and suggests the overall goodness of fit.

Table 4.7 provides the results of long run coefficient results under ARDL approach. It is noted that 1-3 year sukuk, 3-5 year sukuk, AAA rated sukuk, AA rated sukuk, BBB rated sukuk and total return sukuk has statistical insignificant long run effect on global equity. Whereas only 7-10 year sukuk and A rated sukuk has statistically significant long run impact on global equity.

Table 4.7: ARDL Model for Estimated Long Run Coefficient of Sukuk with Global Equity

LG-L13			**LG-LAA**		
Variable	Coefficient	Prob	Variable	Coefficient	Prob
L13	0.2861	0.7097	LAA	0.1131	0.8227
D1	0.0714	0.1174	C	6.8710	0.0043
C	6.0071	0.1095	@TREND	0.0003	0.0000
@TREND	0.0003	0.0001			
LG-L35			**LG-LA**		
Variable	Coefficient	Prob	Variable	Coefficient	Prob
L35	0.2501	0.6764	LA	2.3478	0.0000
C	6.2470	0.0263	C	-3.7310	0.0002
@TREND	0.0003	0.0007			
LG-L710			**LG-LBBB**		
Variable	Coefficient	Prob	Variable	Coefficient	Prob
L710	1.9593	0.0000	LBBB	0.1010	0.8723
D1	0.0337	0.7487	C	6.9694	0.0124
C	-1.5499	0.1959	@TREND	0.0003	0.0046
LG-LAAA			**LG-LT**		
Variable	Coefficient	Prob	Variable	Coefficient	Prob
LAAA	0.0422	0.9553	LT	0.4684	0.5032
C	7.2248	0.0465	C	5.1715	0.1234
@TREND	0.0004	0.0000	@TREND	0.0003	0.0089

Where LG=Log of Global Equity Index, L13=Log of 1-3 Year Sukuk Index, L35=Log of 3-5 Year Sukuk Index, L710=Log of 7-10 Year Sukuk Index, LAAA=Log of AAA Rated Sukuk Index, LAA=Log of AA Rated Sukuk Index, LA=Log of A Rated Sukuk Index, LBBB=Log of BBB Rated Sukuk Index, LT=Log of Total Return Sukuk Index.

In **Table 4.8** the error correction model is reported that captures the dynamics of short term correlation of sukuk with global equity. Error correction model provides that changes in 1-3 year sukuk, 3-5 year sukuk, A rated sukuk and total return sukuk has statistically insignificant short term effect on global equity. Whereas the changes in 7-10 year sukuk, AAA rated sukuk, AA rated sukuk and BBB rated sukuk have statistically significant short term effect on global equity. Moreover, 3-5 year sukuk, AA rated sukuk, A rated sukuk and total return sukuk have short term lagged effect on global equity. Short term elasticities of 7-10 year sukuk, AAA rated sukuk, AA rated sukuk and BBB rated sukuk are 0.09, -0.65, 0.20 and 0.18 respectively.

It is also observed that 1-3 year sukuk, 3-5 year sukuk and total return sukuk are not statistically significant in long and short term. Whereas 7-10 year sukuk is statistically significant both in long and short term. AAA rated sukuk, AA rated sukuk and BBB rated sukuk are not statistically significant in long term, but they are statistically significant in short term. A rated sukuk is found to be statistically significant in long term but it is statistically insignificant in short term.

Error Correction Model ECM(-1) provides one period adjustment from a long term disequilibrium. The ECM(-1) coefficient demonstrates about the degree of disequilibrium in the short term is fixed in the long term. Practically ECM(-1) is supposed to be negative and statistically significant. The result also shows negative and statistically significant ECM(-1) and tells that the adjustment process is slow and is below 1 percent. The structural break is observed during May 2014 to June 2015 and is corrected using dummy variable.

Table 4.8: Error Correction Model for Short Run Effect of Sukuk with Global Equity

LG-L13			**LG-LAA**			**LG-L35**			**LG-LA**		
Variable	Coef.	Prob	Variable	Coef.	Prob	Variable	Coef.	Prob	Variable	Coef.	Prob
D(LG(-1))	0.1193	0.0000	D(LG(-1))	0.1127	0.0000	D(LG(-1))	0.1230	0.0000	D(LG(-1))	0.1172	0.0000
D(LG(-2))	0.0109	0.5799	D(LG(-2))	0.0076	0.7010	D(LG(-2))	0.0173	0.3822	D(LG(-2))	0.0131	0.5087
D(LG(-3))	-0.0389	0.0474	D(LG(-3))	-0.0465	0.0188	D(LG(-3))	-0.0446	0.0237	D(LG(-3))	-0.0408	0.0372
D(L13)	0.0033	0.7099	D(LAA)	0.1964	0.0406	D(L35)	-0.1873	0.1070	D(LA)	-0.1081	0.1013
D(D1)	0.0008	0.1535	D(LAA(-1))	-0.2358	0.0955	D(L35(-1))	-0.5829	0.0004	D(LA(-1))	-0.1626	0.0140
D(@TREND())	0.0000	0.0055	D(LAA(-2))	0.2139	0.0257	D(L35(-2))	0.3227	0.0055	ECM(-1)	-0.0071	0.0005
ECM(-1)	-0.0117	0.0001	D(@TREND())	0.0000	0.0047	D(@TREND())	0.0000	0.0142			
			ECM(-1)	-0.0095	0.0003	ECM(-1)	-0.0098	0.0002			
$ECM = LG - (0.2861 * L13 + 0.0714 * D1 + 6.0071 + 0.0003 * @TREND)$			$ECM = LG - (0.1131 * LAA + 6.8710 + 0.0003 * @TREND)$			$ECM = LG - (0.2501 * L35 + 6.2470 + 0.0003 * @TREND)$			$ECM = LG - (2.3478 * LA - 3.7310)$		
LG-L710			**LG-LBBB**			**LG-LAAA**			**LG-LT**		
Variable	Coef.	Prob	Variable	Coef.	Prob	Variable	Coef.	Prob	Variable	Coef.	Prob
D(LG(-1))	0.1132	0.0000	D(LG(-1))	0.1092	0.0000	D(LG(-1))	0.1221	0.0000	D(LG(-1))	0.1157	0.0000
D(LG(-2))	0.0060	0.7619	D(LG(-2))	0.0069	0.7261	D(LG(-2))	0.0085	0.6644	D(LG(-2))	0.0157	0.4291
D(LG(-3))	-0.0451	0.0212	D(LG(-3))	-0.0417	0.0331	D(LG(-3))	-0.0408	0.0362	D(LG(-3))	-0.0374	0.0564
D(L710)	0.0867	0.0099	D(LBBB)	0.1838	0.0008	D(LAAA)	-0.6506	0.0000	D(LT)	0.1069	0.2592
D(D1)	0.0002	0.7523	D(@TREND())	0.0000	0.0220	D(@TREND())	0.0000	0.0039	D(LT(-1))	-0.2354	0.0130
ECM(-1)	-0.0049	0.0035	ECM(-1)	-0.0096	0.0003	ECM(-1)	-0.0098	0.0002	D(@TREND())	0.0000	0.0416
									ECM(-1)	-0.0099	0.0002
$ECM = LG - (1.9593 * L710 + 0.0337 * D1 - 1.5499)$			$ECM = LG - (0.1010 * LBBB + 6.9694 + 0.0003 * @TREND)$			$ECM = LG - (0.0422 * LAAA + 7.2248 + 0.0004 * @TREND)$			$ECM = LG - (0.4684 * LT + 5.1715 + 0.0003 * @TREND)$		

Where LG=Log of Global Equity Index, L13=Log of 1-3 Year Sukuk Index, L35=Log of 3-5 Year Sukuk Index, L710=Log of 7-10 Year Sukuk Index, LAAA=Log of AAA Rated Sukuk Index, LAA=Log of AA Rated Sukuk Index, LA=Log of A Rated Sukuk Index, LBBB=Log of BBB Rated Sukuk Index, LT=Log of Total Return Sukuk Index.

4.2.2 ARDL of Sukuk with Global Bond

ARDL model is applied on sukuk indices based on maturity and credit rating with global bond. As following the initial step for ARDL the result of Akaike Information Criterion for selecting the lag length are reported in **Table 4.9** The lag length that minimizes the AIC criterion for 1-3 year sukuk, AAA rated sukuk and A rated sukuk is 3, whereas for 3-5 year sukuk, 7-10 year sukuk, AA rated sukuk, BBB rated sukuk and total return sukuk the lag length is 2. No autocorrelation is observed on these period of lags.

TABLE 4.9: Lag Length of Sukuk with Global Bond

LB-L13		**LB-L35**		**LB-L710**		**LB-LAAA**	
Lag	AIC	Lag	AIC	Lag	AIC	Lag	AIC
0	-10.6746	0	-10.1461	0	-9.6295	0	-10.8243
1	-22.0945	1	-21.2209	1	-19.8923	1	-20.9461
2	-22.3492	2	**-21.4733***	2	**-20.1269***	2	-21.2460
3	**-22.3565***	3	-21.4705	3	-20.1216	3	**-21.2701***
LB-LAA		**LB-LA**		**LB-LBBB**		**LB-LT**	
Lag	AIC	Lag	AIC	Lag	AIC	Lag	AIC
0	-10.0971	0	-9.8433	0	-10.0522	0	-10.0431
1	-21.2202	1	-20.3504	1	-20.4188	1	-20.8418
2	**-21.4609***	2	-20.6805	2	**-20.5352***	2	**-21.1506***
3	-21.4563	3	**-20.6833***	3	-20.5283	3	-21.1498

Where LB=Log of Global Bond Index, L13=Log of 1-3 Year Sukuk Index, L35=Log of 3-5 Year Sukuk Index, L710=Log of 7-10 Year Sukuk Index, LAAA=Log of AAA Rated Sukuk Index, LAA=Log of AA Rated Sukuk Index, LA=Log of A Rated Sukuk Index, LBBB=Log of BBB Rated Sukuk Index, LT=Log of Total Return Sukuk Index.

Table 4.10 reports the results for diagnostic tests that are important to check before applying ARDL. It is observed that there exist no issues of autocorrelation and conflicts to normal distribution. Similarly, in functional form, model specification error is not present. The issue of heteroscedasticity is normal and does not influence the estimates of ARDL.

Table 4.10: Diagnostic Tests of Sukuk with Global Bond

		LB-L13		**LB-L35**		**LB-L710**		**LB-LAAA**	
Item	Test Applied	Value	Prob	Value	Prob	Value	Prob	Value	Prob
Serial Correlation	Breusch-Godfrey Test (F-stat)	0.8784	0.4522	0.6138	0.5417	0.2841	0.7528	1.2641	0.2861
Normality	Histogram Test (Jarque-Bera)	71.5700	0.0000	135.2605	0.0000	91.1152	0.0000	188.6934	0.0000
Functional Form	Ramsey RESET Test (F-stat)	0.1492	0.6995	0.0251	0.8742	0.0474	0.8278	0.0005	0.9813
Heteroscedasticity	White Test (F-stat)	8.6311	0.0000	9.0047	0.0000	8.0695	0.0000	4.4894	0.0000
		LB-LAA		**LB-LA**		**LB-LBBB**		**LB-LT**	
Item	Test Applied	Value	Prob	Value	Prob	Value	Prob	Value	Prob
Serial Correlation	Breusch-Godfrey Test (F-stat)	1.4555	0.2344	0.7829	0.5039	0.3586	0.6989	0.4033	0.6684
Normality	Histogram Test (Jarque-Bera)	99.6193	0.0000	112.4233	0.0000	54.2065	0.0000	100.5594	0.0000
Functional Form	Ramsey RESET Test (F-stat)	0.0097	0.9216	0.0006	0.9799	0.0243	0.8761	0.0017	0.9671
Heteroscedasticity	White Test (F-stat)	7.8763	0.0000	3.5500	0.0001	12.5183	0.0000	8.9227	0.0000

Where LB=Log of Global Bond Index, L13=Log of 1-3 Year Sukuk Index, L35=Log of 3-5 Year Sukuk Index, L710=Log of 7-10 Year Sukuk Index, LAAA=Log of AAA Rated Sukuk Index, LAA=Log of AA Rated Sukuk Index, LA=Log of A Rated Sukuk Index, LBBB=Log of BBB Rated Sukuk Index, LT=Log of Total Return Sukuk Index.

Table 4.11 and **Table 4.12** reports the results of ARDL based on AIC selected models of all pairs of sukuk with global bond. The results indicate that 1-3 year sukuk, 3-5 year sukuk, BBB rated sukuk and total return sukuk have no contemporaneous but lag effect with global bond. Whereas 7-10 year sukuk, AAA rated sukuk, AA rated sukuk and A rated sukuk significantly explains the returns of global bond.

Table 4.11: AIC Based Selected Model of Sukuk with Global Bond (A)

LB-L13: ARDL(1, 3)			**LB-L35: ARDL(1, 3)**			**LB-L710: ARDL(1, 2)**			**LB-LAAA: ARDL(3, 4)**		
Variable	Coef.	Prob	Variable	Coef.	Prob	Variable	Coef.	Prob	Variable	Coef.	Prob
LB(-1)	0.9911	0.0000	LB(-1)	0.9907	0.0000	LB(-1)	0.9837	0.0000	LB(-1)	0.9366	0.0000
L13	0.3096	0.0584	L35	0.0962	0.3209	L710	0.1363	0.0059	LB(-2)	-0.0426	0.5078
L13(-1)	1.1771	0.0000	L35(-1)	1.0047	0.0000	L710(-1)	0.3656	0.0000	LB(-3)	0.0997	0.0338
L13(-2)	-1.1731	0.0000	L35(-2)	-0.8929	0.0000	L710(-2)	-0.4966	0.0000	LAAA	0.2316	0.0056
L13(-3)	-0.3050	0.0624	L35(-3)	-0.2036	0.0364	C	0.1601	0.0407	LAAA(-1)	0.8657	0.0000
C	0.0583	0.2390	C	0.0841	0.1414				LAAA(-2)	-0.7376	0.0000
									LAAA(-3)	-0.1420	0.2291
									LAAA(-4)	-0.2113	0.0286
									C	0.0404	0.4412
F-statistic		13771.0000	F-statistic		15071.0000	F-statistic		18914.0000	F-statistic		10030.0000
Prob(F-statistic)		0.0000	Prob(F-statistic)		0.0000	Prob(F-statistic)		0.0000	Prob(F-statistic)		0.0000
D.W stat.		1.9428	D.W stat.		1.9552	D.W stat.		2.0508	D.W stat.		2.0018

Where LB=Log of Global Bond Index, L13=Log of 1-3 Year Sukuk Index, L35=Log of 3-5 Year Sukuk Index, L710=Log of 7-10 Year Sukuk Index, LAAA=Log of AAA Rated Sukuk Index.

TABLE 4.12: AIC Based Selected Model of Sukuk with Global Bond (B)

LB-LAA: ARDL(2, 3)			**LB-LA: ARDL(1, 3, 0)**			**LB-LBBB: ARDL (1,3)**			**LB-LT: ARDL (1,2)**		
Variable	Coef.	Prob	Variable	Coef.	Prob	Variable	Coef.	Prob	Variable	Coef.	Prob
LB(-1)	0.8795	0.0000	LB(-1)	0.9858	0.0000	LB(-1)	0.9815	0.0000	LB(-1)	0.9879	0.0000
LB(-2)	0.1158	0.0130	LA	0.1011	0.0898	LBBB	0.1311	0.0655	LT	0.1193	0.1161
LAA	0.5493	0.0000	LA(-1)	0.7067	0.0000	LBBB(-1)	0.2680	0.0182	LT(-1)	0.8723	0.0000
LAA(-1)	0.5441	0.0000	LA(-2)	-0.7036	0.0000	LBBB(-2)	-0.3893	0.0000	LT(-2)	-0.9870	0.0000
LAA(-2)	-0.8647	0.0000	LA(-3)	-0.0994	0.0959	C	0.1650	0.0293	C	0.1150	0.0655
LAA(-3)	-0.2274	0.0264	D1	-0.0002	0.4742						
C	0.0472	0.3834	C	0.1377	0.0474						
F-statistic		13380.0000	F-statistic		13828.0000	F-statistic		16121.0000	F-statistic		20460.0000
Prob(F-statistic)		0.0000	Prob(F-statistic)		0.0000	Prob(F-statistic)		0.0000	Prob(F-statistic)		0.0000
D.W stat.		2.0167	D.W stat.		2.0140	D.W stat.		1.9232	D.W stat.		1.9880

Where LAA=Log of AA Rated Sukuk Index, LA=Log of A Rated Sukuk Index, LBBB=Log of BBB Rated Sukuk Index, LT=Log of Total Return Sukuk Index.

In **Fig 4.2** CUSUM is plotted to check long and short run coefficients stability in the ARDL error correction models of all pairs of sukuk with global bond. It shows that it is inside the critical limits of 0.05 which indicate the overall goodness of fit and stability of all models.

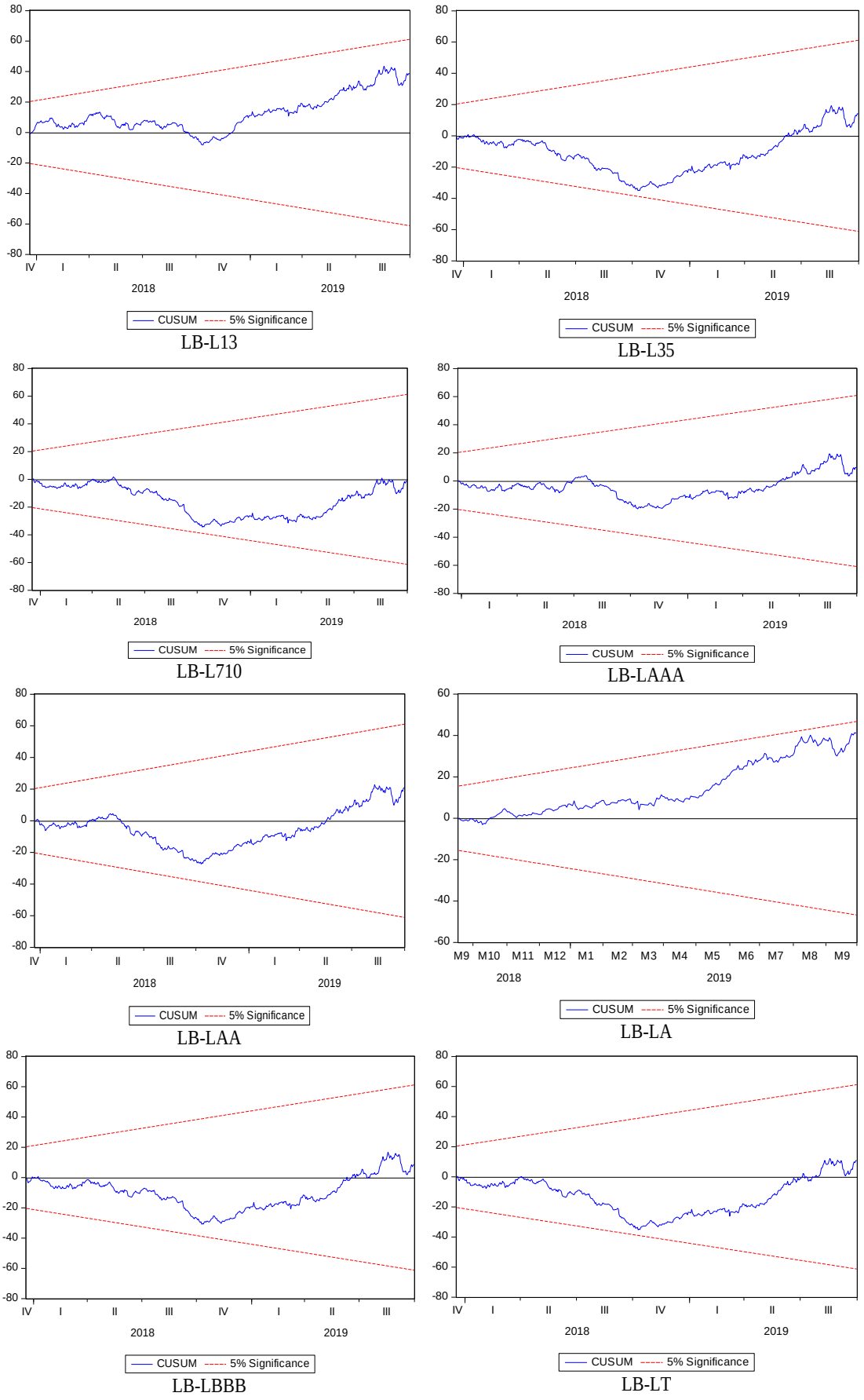


FIGURE 4.2: CUSUM of Sukuk with Global Bond

Table 4.13 provides the long term coefficient results of all pairs of sukuk with global bond under ARDL approach. It is observed that 1-3 year sukuk, 7-10 year sukuk, A rated sukuk, BBB rated sukuk and total return sukuk have statistically significant long run impact on global bond. Whereas 3-5 year sukuk, AAA rated sukuk and AA rated sukuk has statistically insignificant long run effect on global bond.

TABLE 4.13: ARDL Model for Estimated Long Run Coefficient of Sukuk with Global Bond

LB-L13			**LB-LAA**		
Variable	Coefficient	Prob	Variable	Coefficient	Prob
L13	0.9607	0.0354	LAA	0.2748	0.6643
C	6.5556	0.0052	C	10.0516	0.0016
LB-L35			**LB-LA**		
Variable	Coefficient	Prob	Variable	Coefficient	Prob
L35	0.48800	0.08010	LA	0.34640	0.01390
C	9.02680	0.00000	D1	-0.01570	0.43270
			C	9.72240	0.00000
LB-L710			**LB-LBBB**		
Variable	Coefficient	Prob	Variable	Coefficient	Prob
L710	0.3317	0.0005	LBBB	0.5278	0.0000
C	9.8340	0.0000	C	8.9380	0.0000
LB-LAAA			**LB-LT**		
Variable	Coefficient	Prob	Variable	Coefficient	Prob
LAAA	1.0154	0.0810	LT	0.3830	0.0324
C	6.3825	0.0294	C	9.5163	0.0000

Where LB=Log of Global Bond Index, L13=Log of 1-3 Year Sukuk Index, L35=Log of 3-5 Year Sukuk Index, L710=Log of 7-10 Year Sukuk Index, LAAA=Log of AAA Rated Sukuk Index, LAA=Log of AA Rated Sukuk Index, LA=Log of A Rated Sukuk Index, LBBB=Log of BBB Rated Sukuk Index, LT=Log of Total Return Sukuk Index.

Table 4.14 displays the error correction of long term correlation that captures the dynamics of short term correlation of sukuk with global bond. According to the results of error correction models the changes in 1-3 year sukuk, 3-5 year sukuk, A rated sukuk, BBB rated sukuk and total return sukuk have statistically insignificant shorter-run but have significant lagged impact on global bond. Whereas the changes in 7-10 year sukuk, AAA rated sukuk and AA rated sukuk

have statistically significant short term effect on global bond. Short term elasticities of 7-10 year sukuk, AAA rated sukuk and AA rated sukuk are 0.14, 0.23 and 0.55 respectively.

Moreover, it is observed that 1-3 year sukuk, A rated sukuk, BBB rated sukuk and total return sukuk are statistically significant in long term but are not statistically significant in short term. 3-5 year sukuk is turned out to be insignificant both in long and short term. Whereas 7-10 year sukuk is found to be statistically significant both in long and short run. AAA rated sukuk and AA rated sukuk are statistically insignificant in long term but are statistically significant in short run.

The ECM(-1) coefficient tells about the extent of the disequilibrium in the short term is fixed in the long term. Practically ECM(-1) needs to be negative and significant. The result also shows negative and statistically significant ECM(-1) for the pair of 7-10 year sukuk with global bond and tells that the adjustment process is slow as 1.63 percent. For the pairs of AAA rated sukuk and AA rated sukuk with global bond ECM(-1) is negative but statistically insignificant that tells there is no disequilibrium in the short term is fixed in the long term.

Table 4.14: Error Correction Model for Short Run Effect of Sukuk with Global Bond

LB-L13			**LB-LAA**			**LB-L35**			**LB-LA**		
Variable	Coef.	Prob	Variable	Coef.	Prob	Variable	Coef.	Prob	Variable	Coef.	Prob
D(L13)	0.3096	0.0584	D(LB(-1))	-0.1158	0.0130	D(L35)	0.0962	0.3209	D(LA)	0.1011	0.0898
D(L13(-1))	1.1731	0.0000	D(LAA)	0.5493	0.0000	D(L35(-1))	0.8929	0.0000	D(LA(-1))	0.7036	0.0000
D(L13(-2))	0.3050	0.0624	D(LAA(-1))	0.8647	0.0000	D(L35(-2))	0.2036	0.0364	D(LA(-2))	0.0994	0.0959
ECM(-1)	-0.0089	0.1365	D(LAA(-2))	0.2274	0.0264	ECM(-1)	-0.0093	0.1463	D(D1)	-0.0002	0.4742
			ECM(-1)	-0.0047	0.4380				ECM(-1)	-0.0142	0.0551
$ECM = LB - (0.9607 * L13 + 6.5556)$			$ECM = LB - (0.2748 * LAA + 10.0516)$			$ECM = LB - (0.4880 * L35 + 9.0268)$			$ECM = LB - (0.3464 * LA - 0.0157 * D1 + 9.7224)$		
LB-L710			**LB-LBBB**			**LB-LAAA**			**LB-LT**		
Variable	Coef.	Prob	Variable	Coef.	Prob	Variable	Coef.	Prob	Variable	Coef.	Prob
D(L710)	0.1363	0.0059	D(LBBB)	0.1311	0.0655	D(LB(-1))	-0.0571	0.2275	D(LT)	0.1193	0.1161
D(L710(-1))	0.4966	0.0000	D(LBBB(-1))	0.3893	0.0000	D(LB(-2))	-0.0997	0.0338	D(LT(-1))	0.9870	0.0000
ECM(-1)	-0.0163	0.0430	ECM(-1)	-0.0185	0.0231	D(LAAA)	0.2316	0.0056	ECM(-1)	-0.0121	0.0778
						D(LAAA(-1))	0.7376	0.0000			
						D(LAAA(-2))	0.1420	0.2291			
						D(LAAA(-3))	0.2113	0.0286			
						ECM(-1)	-0.0063	0.3328			
$ECM = LB - (0.3317 * L710 + 9.8340)$			$ECM = LB - (0.5278 * LBBB + 8.9380)$			$ECM = LB - (1.0154 * LAAA + 6.3825)$			$ECM = LB - (0.3830 * LT + 9.5163)$		

Where LB=Log of Global Bond Index, L13=Log of 1-3 Year Sukuk Index, L35=Log of 3-5 Year Sukuk Index, L710=Log of 7-10 Year Sukuk Index, LAAA=Log of AAA Rated Sukuk Index, LAA=Log of AA Rated Sukuk Index, LA=Log of A Rated Sukuk Index, LBBB=Log of BBB Rated Sukuk Index, LT=Log of Total Return Sukuk Index.

4.2.3 ARDL of MENA Sukuk with MENA Equity and MENA Bond

In this subsection ARDL model is applied on the pairs of MENA sukuk with MENA equity and MENA bond. In order to choose lag length, the result of Akaike Information Criterion is reported in **Table 4.15**. In both pairs of MENA sukuk with MENA equity and MENA bond the lag length that minimizes the AIC criterion is 5. No autocorrelation is seen on this duration of lag.

TABLE 4.15: Lag Length of MENA Sukuk with MENA Bond and MENA Equity

LME-LMS		**LMD-LMS**	
Lag	AIC	Lag	AIC
0	-4.4481	0	-10.2341
1	-18.3471	1	-22.6151
2	-18.3731	2	-22.6313
3	-18.3763	3	-22.6365
4	-18.3816	4	-22.6458
5	**-18.3825***	5	**-22.6491***

Where LMS=Log of MENA Sukuk Index, LMD=Log of MENA Bond Index, LME=Log of MENA Equity Index.

The findings of diagnostics tests are presented in **Table 4.16** which are important to check before applying ARDL. The issues regarding autocorrelation and normal distribution conflicts are not observed in both pairs. Similarly, in functional form no model specification error is seen. The issue of heteroscedasticity is normal and does not influence the estimates of ARDL.

TABLE 4.16: Diagnostic Tests of MENA Sukuk with MENA Equity and MENA Bond

		LME-LMS		**LMD-LMS**	
Item	Test Applied	Value	Prob	Value	Prob
Serial Correlation	Breusch-Godfrey Test (F-stat)	0.7215	0.6073	1.8273	0.1043
Normality	Histogram Test (Jarque-Bera)	10768.8200	0.0000	2049.7850	0.0000
Functional Form	Ramsey RESET Test (F-stat)	0.2423	0.6226	3.1630	0.0755
Heteroscedasticity	White Test (F-stat)	16.7245	0.0000	17.5556	0.0000

Where LMS=Log of MENA Sukuk Index, LMD=Log of MENA Bond Index, LME=Log of MENA Equity Index.

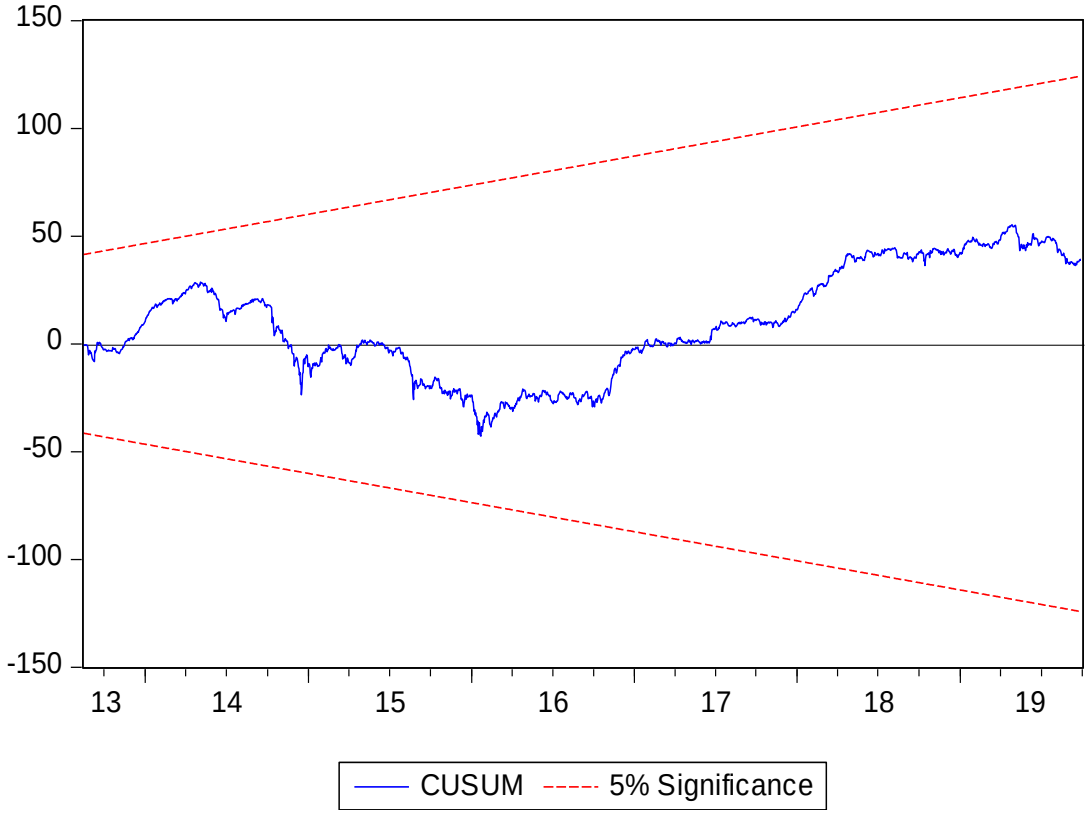
The results of AIC based selected ARDL models of the pairs of MENA sukuk with MENA equity and MENA bond are shown in **Table 4.17** The findings indicate that MENA sukuk significantly explains the returns of MENA equity and MENA bond.

TABLE 4.17: AIC Based Selected Model of MENA Sukuk with MENA Equity and MENA Bond

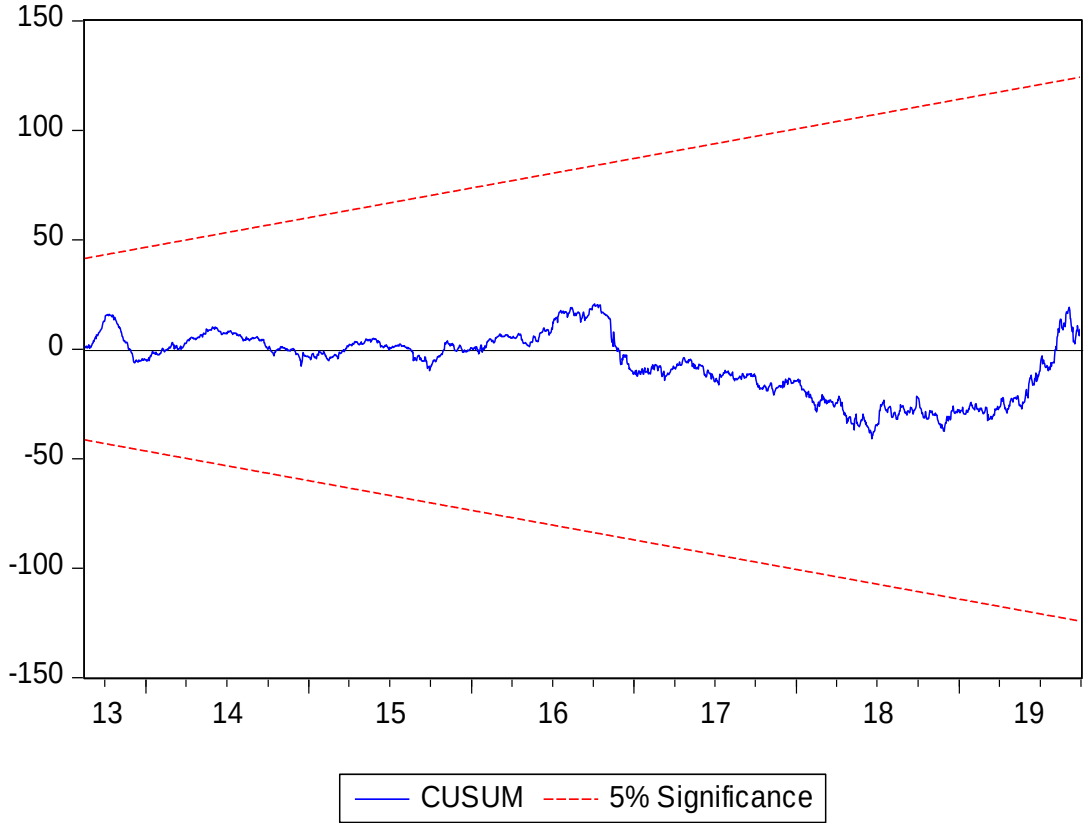
LME-LMS: ARDL(3, 4)			**LMD-LMS: ARDL(3, 4)**		
Variable	Coef.	Prob	Variable	Coef.	Prob
LME(-1)	1.0812	0.0000	LMD(-1)	0.9804	0.0000
LME(-2)	-0.0405	0.2311	LMD(-2)	0.0572	0.0745
LME(-3)	-0.0430	0.0609	LMD(-3)	-0.0461	0.0448
LMS	1.0717	0.0000	LMS	1.2650	0.0000
LMS(-1)	-0.5335	0.0194	LMS(-1)	-1.1725	0.0000
LMS(-2)	-0.7725	0.0007	LMS(-2)	-0.1336	0.0043
LMS(-3)	0.4645	0.0420	LMS(-3)	0.0909	0.0187
LMS(-4)	-0.2300	0.1494	LMS(-4)	-0.0395	0.0372
C	0.0146	0.2646	C	-0.0085	0.0072
F-statistic		77621	F-statistic		2011968
Prob(F-statistic)		0.0000	Prob(F-statistic)		0.0000
D.W stat.		2.0037	D.W stat.		2.0023

Where LMS=Log of MENA Sukuk Index, LMD=Log of MENA Bond Index, LME=Log of MENA Equity Index.

In **Fig 4.3** cumulative sum of recursive residuals CUSUM is plotted to check stability in the ARDL error correction models of MENA sukuk with MENA equity and MENA bond. The results show that the parameters remain durable over the entire study period because the recursive line is in critical bound of 0.05.



LME-LMS



LMD-LMS

FIGURE 4.3: CUSUM of MENA Sukuk with MENA Equity and MENA Bond

Table 4.18 presents the long term coefficient results of MENA sukuk with MENA equity and MENA bond under ARDL approach. It is observed from estimated coefficients that MENA sukuk has statistically insignificant long run impact on MENA equity but has statistically significant impact in long term on MENA bond.

TABLE 4.18: ARDL Model for Estimated Long Run Coefficient of Sukuk with MENA Equity and MENA Bond

LME-LMS			**LMD-LMS**		
Variable	Coefficient	Prob	Variable	Coefficient	Prob
LMS	0.0881	0.9381	LMS	1.2181	0.0000
C	6.2260	0.2449	C	-1.0029	0.0000

Where LMS=Log of MENA Sukuk Index, LMD=Log of MENA Bond Index, LME=Log of MENA Equity Index.

TABLE 4.19: Error Correction Model for Short Run Effect of MENA Sukuk with MENA Equity and MENA Bond

LME-LMS			**LMD-LMS**		
Variable	Coef.	Prob	Variable	Coef.	Prob
D(LME(-1))	0.0835	0.0003	D(LMD(-1))	-0.0111	0.6281
D(LME(-2))	0.0430	0.0609	D(LMD(-2))	0.0461	0.0448
D(LMS)	1.0717	0.0000	D(LMS)	1.2650	0.0000
D(LMS(-1))	0.7725	0.0007	D(LMS(-1))	0.1336	0.0043
D(LMS(-2))	-0.4645	0.0420	D(LMS(-2))	-0.0909	0.0187
D(LMS(-3))	0.2300	0.1494	D(LMS(-3))	0.0395	0.0372
ECM(-1)	-0.0023	0.0805	ECM(-1)	-0.0085	0.0034
$ECM = LME - (0.0881 * LMS + 6.2260)$			$ECM = LMD - (1.2181 * LMS - 1.0029)$		

Where LMS=Log of MENA Sukuk Index, LMD=Log of MENA Bond Index, LME=Log of MENA Equity Index.

Table 4.19 displays the error correction of long term correlation that captures the dynamics of short term correlation of MENA sukuk with MENA equity and MENA bond. According to the results of error correction models the changes in MENA sukuk has statistically significant short term and lagged impact on MENA equity and MENA bond. Moreover, it is noticed that MENA sukuk is statistically insignificant in long term but is statistically significant in short term. Whereas MENA sukuk is identified as statistically significant both in long and short term.

The coefficient of ECM(-1) tells about the degree of the disequilibrium in short is fixed in the long term. Practically ECM(-1) should be negative and statistically significant. The result also shows negative and statistically significant ECM(-1) for the pair of MENA sukuk with MENA bond and tells that the adjustment process is slow as below 1 percent. For the pair of MENA sukuk with MENA equity ECM(-1) is negative but statistically insignificant that tells there is no disequilibrium in the short term is fixed in the long term.

4.3 An Application of Time Varying Conditional Correlation DCC GARCH

In order to measure whether correlation is time varying or constant over period of time for all the pairs of sukuk with international financial markets DCC GARCH model is applied. Initially ARCH effect is measured in all series in order to test the heteroscedasticity. **Table 4.20** reports the findings of ARCH effect of all the time series and indicates that heteroscedasticity is present in series of global equity, global bond, 3-5 year sukuk, 7-10 year sukuk, AA rated sukuk, total return sukuk, MENA sukuk, MENA equity and MENA bond. Whereas in the series of 1-3 year sukuk, AAA rated sukuk, A rated sukuk and BBB rated sukuk heteroscedasticity is not present.

Table 4.21 reports the results of DCC GARCH of all possible pairs of sukuk with international financial markets where heteroscedasticity is present. It also shows the suitable bivariate DCC models. The appropriate models are selected based on lowest possible AIC. This table reports the coefficient and p-values of θ_1 for the effect of past residual shocks and θ_2 for lagged dynamic conditional correlation.

The condition of $\theta_1 + \theta_2 < 1$ for the stability of DCC models is met for all possible pairs of sukuk with international financial markets except for the pair of MENA sukuk with MENA bond. For the relationship of sukuk with global equity the θ_1 is found positively statistically significant only for the pair of AA rated

TABLE 4.20: ARCH Effect

	Value	Prob
RG	69.3661	0.0000
RB	5.9888	0.0148
R13	0.0006	0.9802
R35	120.2675	0.0000
R710	4.3736	0.0366
RAAA	0.9789	0.3226
RAA	14.1047	0.0002
RA	0.1964	0.6577
RBBB	1.0245	0.3116
RT	960.0076	0.0000
RMS	112.8070	0.0000
RMD	91.9420	0.0000
RME	48.9990	0.0000

Where RG=Logged Return of Global Equity Index, RB=Logged Return of Global Bond Index, R13=Logged Return of 1-3 Year Sukuk Index, R35=Logged Return of 3-5 Year Sukuk Index, R710=Logged Return of 7-10 Year Sukuk Index, RAAA=Logged Return of AAA Rated Sukuk Index, RAA=Logged Return of AA Rated Sukuk Index, RA=Logged Return of A Rated Sukuk Index, RBBB=Logged Return of BBB Rated Sukuk Index, RT=Logged Return of Total Return Sukuk Index, RMS=Logged Return of MENA Sukuk Index, RMD=Logged Return of MENA Bond Index, RME=Logged Return of MENA Equity Index.

sukuk with global equity. It indicates that AA rated sukuk exhibits past residual shocks on conditional correlation. θ_2 is found statistically significant in for the pairs of 3-5 year sukuk, AA rated sukuk and total return sukuk with global equity that tells effect of lagged dynamic correlation is present. It is also noted that the impact of past residual shocks and lagged dynamic conditional correlation is present in the pair of AA rated sukuk with global equity.

For the relationship of sukuk with global bond θ_1 is found statistically insignificant for all the possible pairs that are reported in **Table 4.21**. θ_2 is found statistically significant for the pair of AA rated sukuk with global bond only that indicates the effect of lagged dynamic correlation exists.

For the relationship of MENA sukuk with MENA equity both θ_1 and θ_2 found statistically insignificant that tells no impact of past residual shocks and lagged

Table 4.21: DCC GARCH

	$\theta 1$	$\theta 2$	Selected Model
RG-R35	0.0029	0.9923	GJR/TARCH
	(0.2007)	(0.0000)	
RG-R710	0.0779	0.1231	GJR/TARCH
	(0.1027)	(0.6153)	
RG-RAA	0.0105	0.9778	GJR/TARCH
	(0.0113)	(0.0000)	
RG-RT	0.0071	0.9608	GJR/TARCH
	(0.5928)	(0.0000)	
RB-R35	0.029	0.5506	GJR/TARCH
	(0.4285)	(0.2381)	
RB-R710	0.0427	0.5280	GJR/TARCH
	(0.3730)	(0.1589)	
RB-RAA	-0.0243	0.9050	GJR/TARCH
	(0.3013)	(0.0000)	
RB-RT	0.0390	0.4840	GJR/TARCH
	(0.3238)	(0.2827)	
RME-RMS	0.0212	0.7187	EGARCH
	(0.3192)	(0.0589)	

Where RG=Logged Return of Global Equity Index, RB=Logged Return of Global Bond Index, R35=Logged Return of 3-5 Year Sukuk Index, R710=Logged Return of 7-10 Year Sukuk Index, RAA=Logged Return of AA Rated Sukuk Index, RT=Logged Return of Total Return Sukuk Index, RMS=Logged Return of MENA Sukuk Index, RME=Logged Return of MENA Equity Index.

dynamic conditional correlation is present.

4.4 An Application of Copula Approach

This section is composed of three sub-sections. The first sub-section discusses the results of copula for the pairs of sukuk with global equity. The second sub-section deals with the results of copula for the pairs of sukuk with global bond. The third section is about the results of copula for the pairs of global MENA sukuk with global MENA bond and global MENA equity.

4.4.1 Dependence Structure of Sukuk with Global Equity

Table 4.22 and **Table 4.23** reports the results of dependence structure for the pairs of sukuk with global equity. In this study the dependence structure is examined through copulas by pseudo-maximum likelihood technique. According to this method the initial parameters are calculated first as copulas are fitted based on one more specific parameter and then final parameters are estimated. This study uses Gaussian Copula, t-Student Copula, Gumbel Copula, Clayton Copula and Frank Copula in order to examine the dependence in the upper and lower tail. The concept behind tail dependence is the degree of dependence in the upper right tail or lower left tail quadrant of a bivariate distribution. Some copulas do not have tail dependence like Gaussian Copula, in contrast to t-Student Copula that measures the dependence in both upper and lower tails. Gumbel Copula tests the upper tail dependence whereas the Clayton Copula examines the lower tail dependence.

For selection of copula two known statistical information criterion Akaike Information Criterion AIC and Bayesian Information Criterion BIC are reported but this study uses AIC for selection of copulas. Copula that best fits AIC is t-Student Copula for all the pairs of sukuk with global equity. Therefore, there exist both lower and upper tail dependence as mostly financial time series are not normally distributed and kurtosis in majority of financial time series is high. Moreover, the highest lower and upper tail dependence is observed for the pair of total return sukuk with global equity, that is 0.0218. Whereas, the lowest lower and upper tail dependence is observed for the pair of BBB rated sukuk with global equity that is 0.0008.

Table 4.22: Dependence Structure of Sukuk with Global Equity (A)

	Copulae	Initial Parameteres	Final parameters	Loglikelihood	AIC	BIC	Lower Tail Dep.	Upper Tail Dep.
RG-R13	Gaussian	-0.0009	0.0707	6.4351	-10.8703	-5.0066	0.0000	0.0000
	t-Student		0.0685 / df = 13.3251	13.7970	-23.5939	-11.8666	0.0032	0.0032
	Gumbel	1.0443	1.0350	4.8583	-7.7167	-1.8530	0.0000	0.0463
	Clayton	0.0887	0.0901	9.4999	-16.9997	-11.1361	0.0005	0.0000
	Frank		0.3790	5.1165	-8.2331	-2.3694	0.0000	0.0000
RG-R35	Gaussian	-0.0217	-0.0160	0.3295	1.3410	7.2046	0.0000	0.0000
	t-Student		(-0.0115 / df = 9.0330)	13.7351	-23.4703	-11.7430	0.0094	0.0094
	Gumbel	0.9960	-	-	-	-	-	-
	Clayton	-0.0079	0.0078	0.0823	1.8354	7.6990	0.0000	0.0000
	Frank		0.3895	0.0531	1.8938	7.7575	0.0000	0.0000
RG-R710	Gaussian	0.0504	0.0571	4.1846	-6.3692	-0.5056	0.0000	0.0000
	t-Student		0.0538 / df = 10.8545	14.3232	-24.6465	-12.9191	0.0069	0.0069
	Gumbel	1.0340	1.0350	6.0972	-10.1943	-4.3307	0.0000	0.0463
	Clayton	0.0680	0.0742	6.5807	-11.1615	-5.2978	0.0001	0.0000
	Frank		0.0298	3.1222	-4.2445	1.6192	0.0000	0.0000
RG-RAAA	Gaussian	-0.1120	-0.1295	21.7670	-41.5339	-35.6703	0.0000	0.0000
	t-Student		(-0.1289 / df = 11.6271)	29.6564	-55.3128	-43.5855	0.0015	0.0015
	Gumbel	0.9264	-	-	-	-	-	-
	Clayton	-0.1471	-0.0660	7.5154	-13.0308	-7.1671	0.0000	0.0000
	Frank		-0.7264	18.5663	-35.1326	-29.2690	0.0000	0.0000

Where RG=Logged Return of Global Equity Index, R13=Logged Return of 1-3 Year Sukuk Index, R35=Logged Return of 3-5 Year Sukuk Index, R710=Logged Return of 7-10 Year Sukuk Index, RAAA=Logged Return of AAA Rated Sukuk Index.

Table 4.23: Dependence Structure of Sukuk with Global Equity (B)

	Copulae	Initial Parameteres	Final Parameters	Loglikelihood	AIC	BIC	Lower Tail Dep.	Upper Tail Dep.
RG-RAA	Gaussian	0.0578	0.0494	3.1483	-4.2967	1.5670	0.0000	0.0000
	t-Student		0.0430 / df = 9.9300	14.4940	-24.9879	-13.2606	0.0090	0.0090
	Gumbel	1.0255	1.0340	4.9963	-7.9926	-2.1290	0.0000	0.0451
	Clayton	0.0510	0.0634	5.0424	-8.0847	-2.2211	0.0000	0.0000
	Frank		0.2255	1.7850	-1.5701	4.2936	0.0000	0.0000
RG-RA	Gaussian	-0.0276	-0.0471	2.8525	-3.7050	2.1587	0.0000	0.0000
	t-Student		(0.0494 / df = 9.6992)	14.9136	-25.8273	-14.1000	0.0058	0.0058
	Gumbel	0.9692	-	-	-	-	-	-
	Clayton	-0.0615	-0.0084	0.1096	1.7808	7.6444	0.0000	0.0000
	Frank		-0.2913	2.9678	-3.9357	1.9280	0.0000	0.0000
RG-RBBB	Gaussian	0.0797	0.1481	28.5559	-55.1119	-49.2482	0.0000	0.0000
	t-Student		0.1489 / df = 19.5494	32.3888	-60.7776	-49.0503	0.0008	0.0008
	Gumbel	1.1037	1.0890	26.1750	-50.3499	-44.4863	0.0000	0.1101
	Clayton	0.2074	-	-	-	-	-	-
	Frank		0.8503	25.6525	-49.3050	-43.4414	0.0000	0.0000
RG-RT	Gaussian	0.0248	0.0372	1.7781	-1.5563	4.3074	0.0000	0.0000
	t-Student		0.0363 / df = 7.4557	20.8918	-37.7835	-26.0562	0.0218	0.0218
	Gumbel	1.0244	1.0330	5.1131	-8.2263	-2.3626	0.0000	0.0438
	Clayton	0.0489	0.0559	3.8856	-5.7712	0.0925	0.0000	0.0000
	Frank		0.2216	1.6975	-1.3950	4.4687	0.0000	0.0000

Where RG=Logged Return of Global Equity Index, RAA=Logged Return of AA Rated Sukuk Index, RA=Logged Return of A Rated Sukuk Index, RBBB=Logged Return of BBB Rated Sukuk Index, RT=Logged Return of Total Return Sukuk Index.

4.4.2 Dependence Structure of Sukuk with Global Bond

Table 4.24 and **Table 4.25** reports the results of dependence structure for all the pairs of sukuk with global bond. The copulas that best fit AIC are selected. Findings report that t-Student Copula is selected and there exist both lower and upper tail dependence for the pairs of 1-3 year sukuk with global bond and AA rated sukuk with global bond that is 0.0149 and 0.0127 respectively. Frank copula is selected for the pair of 3-5 year sukuk with global bond that indicate no lower and upper tail dependence. Clayton copula is selected for the pairs of 7-10 year sukuk, BBB rated sukuk and total return sukuk with global bond that tells lower tail dependence of 0.0963, 0.0245 and 0.0052. The highest lower tail dependence is seen for the pair of 7-10 year sukuk with global bond whereas, the lowest lower tail dependence is observed for the pair of total return sukuk with global bond. Gumbel copula is selected for the pairs of AAA rated sukuk and A rated sukuk with global bond that indicate the upper tail dependence of 0.0361 and 0.0438.

Table 4.24: Dependence Structure of Sukuk with Global Bond (A)

	Copulae	Initial Parameteres	Final Parameters	Loglikelihood	AIC	BIC	Lower Tail Dep.	Upper Tail Dep.
RB-R13	Gaussian	-0.0147	-0.0304	0.2080	1.5839	5.7366	0.0000	0.0000
	t-Student		(-0.0396 / df = 7.5290)	3.0329	-2.0658	6.2397	0.0149	0.0149
	Gumbel	0.9751	-	-	-	-	-	-
	Clayton	-0.0499	-0.0238	0.1326	1.7347	5.8875	0.0000	0.0000
	Frank		-0.2316	0.3321	1.3358	5.4886	0.0000	0.0000
RB-R35	Gaussian	0.0077	-0.0025	0.0014	1.9973	6.1500	0.0000	0.0000
	t-Student		(-0.0164 / df = 13.1027)	1.0060	1.9879	10.2934	0.0019	0.0019
	Gumbel	0.9818	-	-	-	-	-	-
	Clayton	-0.0363	0.0080	0.0150	1.9700	6.1227	0.4403	0.0000
	Frank		-0.1716	0.1879	1.6242	5.7769	0.0000	0.0000
RB-R710	Gaussian	0.2265	0.2205	11.2165	-20.4330	-16.2803	0.0000	0.0000
	t-Student		0.2168 / df = 35.0662	11.3166	-18.6332	-10.3278	0.0000	0.0000
	Gumbel	1.1372	1.1210	8.7151	-15.4303	-11.2775	0.0000	0.1442
	Clayton	0.2743	0.2962	13.3953	-24.7906	-20.6379	0.0963	0.0000
	Frank		1.1360	8.1411	-14.2823	-10.1295	0.0000	0.0000
RB-RAAA	Gaussian	0.0383	0.0325	0.2377	1.5247	5.6774	0.0000	0.0000
	t-Student		0.0241 / df = 11.2370	1.7311	0.5378	8.8433	0.0050	0.0050
	Gumbel	1.0115	1.0270	0.7378	0.5244	4.6771	0.0000	0.0361
	Clayton	0.0230	0.0382	0.2924	1.4153	5.5680	0.0000	0.0000
	Frank		0.1073	0.0733	1.8534	6.0061	0.0000	0.0000

Where RB=Logged Return of Global Bond Index, R13=Logged Return of 1-3 Year Sukuk Index, R35=Logged Return of 3-5 Year Sukuk Index, R710=Logged Return of 7-10 Year Sukuk Index, RAAA=Logged Return of AAA Rated Sukuk Index

Table 4.25: Dependence Structure of Sukuk with Global Bond (B)

	Copulae	Initial Parameteres	Final Parameters	Loglikelihood	AIC	BIC	Lower Tail Dep.	Upper Tail Dep.
RB-RAA	Gaussian	0.2391	0.2392	13.2754	-24.5508	-20.3981	0.0000	0.0000
	t-Student		0.2354 / df = 12.3705	14.5100	-25.0199	-16.7145	0.0127	0.0127
	Gumbel	1.1682	1.1490	11.5727	-21.1454	-16.9927	0.0000	0.1719
	Clayton	0.3363	-	-	-	-	-	-
	Frank		1.3390	11.1272	-20.2543	-16.1016	0.0000	0.0000
RB-RA	Gaussian	0.0625	0.0461	0.4783	1.0435	5.1962	0.0000	0.0000
	t-Student		0.0267 / df = 10.2946	1.8282	0.3437	8.6491	0.0072	0.0072
	Gumbel	1.0078	1.0330	1.3440	-0.6881	3.4647	0.0000	0.0438
	Clayton	0.0156	0.0777	1.2900	-0.5800	3.5727	0.0001	0.0000
	Frank		0.0797	0.0399	1.9202	6.0729	0.0000	0.0000
RB-RBBB	Gaussian	0.1616	0.1498	5.1020	-8.2041	-4.0513	0.0000	0.0000
	t-Student		0.1452 / df = 23.2250	5.3208	-6.6416	1.6638	0.0004	0.0004
	Gumbel	1.0877	1.0830	4.9114	-7.8228	-3.6701	0.0000	0.1035
	Clayton	0.1754	0.1868	5.5835	-9.1670	-5.0143	0.0245	0.0000
	Frank		0.7440	3.4812	-4.9623	-0.8096	0.0000	0.0000
RB-RT	Gaussian	0.1227	0.1050	2.4874	-2.9749	1.1778	0.0000	0.0000
	t-Student	-	0.0936 / df = 16.4317	2.9793	-1.9585	6.3469	0.0566	0.0566
	Gumbel	1.0468	1.0570	2.9696	-3.9392	0.2135	0.0000	0.0734
	Clayton	0.0936	0.1317	3.1955	-4.3911	-0.2383	0.0052	0.0000
	Frank		0.4219	1.1253	-0.2507	3.9021	0.0000	0.0000

Where RB=Logged Return of Global Bond Index, RAA=Logged Return of AA Rated Sukuk Index, RA=Logged Return of A Rated Sukuk Index, RBBB=Logged Return of BBB Rated Sukuk Index, RT=Logged Return of Total Return Sukuk Index.

4.4.3 Dependence Structure of MENA Sukuk with MENA Equity and MENA Bond

Table 4.26 displays the findings of dependence structure for the pairs of MENA sukuk with MENA equity and MENA bond. AIC is used for the selection of copula. Gaussian copula is selected for the pair of MENA sukuk with MENA equity and t-Student copula is selected for the pair of MENA sukuk with MENA bond. The results indicate that there exists no lower and upper tail dependence for the pair of MENA sukuk with MENA equity whereas, the lower and upper dependence of 0.6119 is present for the pair of MENA sukuk with MENA bond that is the highest tail dependence among all the pairs of sukuk.

Table 4.26: Dependence Structure of MENA Sukuk with MENA Equity and MENA Bond

Copulae	Initial Parameteres	Final Parameters	Loglikelihood	AIC	BIC	Lower Tail Dep.	Upper Tail Dep.
Gaussian	0.1652	0.1285	15.6962	-29.3924	-23.8307	0.0000	0.0000
t-Student		0.1262 / df = 48.9084	16.0952	-28.1904	-17.0672	0.0000	0.0000
Gumbel	1.0836	1.0670	13.2227	-24.4455	-18.8838	0.0000	0.8518
Clayton	0.1672	-	-	-	-	-	0.0000
Frank		0.6800	12.2477	-22.4954	-16.9338	0.0000	0.0000
Gaussian	0.8391	0.8339	1133.4450	-2264.8910	-2259.3290	0.0000	0.0000
t-Student		0.8442 / df = 2.6323	1248.0780	-2492.1550	-2481.0320	0.6119	0.6119
Gumbel	2.8732	2.6870	1152.8290	-2303.6580	-2298.0960	0.0000	0.7057
Clayton	3.7464	2.3450	933.1941	-1864.3880	-1858.8270	0.7441	0.0000
Frank		9.5770	1101.7300	-2201.4610	-2195.8990	0.0000	0.0000

Where RMS=Logged Return of MENA Sukuk Index, RMD=Logged Return of MENA Bond Index, RME=Logged Return of MENA Equity Index.

Chapter 5

Conclusion & Recommendations

5.1 Conclusion

The major purpose of this research is to investigate the bivariate relationship of sukuk with international financial markets in terms of co-movement dynamics. The co-movement dynamics are examined in context of long and short run cointegration, the time varying correlation in the volatility and tail dependence structure for the pairs of sukuk with international financial markets. The international financial markets represent global equity, global bond, MENA equity and MENA bond. The data included for analysis are total return sukuk index, sukuk indices based on maturity and credit risk rating, global equity index, global bond index, MENA sukuk index, MENA equity index and MENA bond index.

The long and short run relationship of sukuk with global equity, global bond, MENA equity and MENA bond is examined through famous ARDL approach. The time varying DCC GARCH approach is applied to investigate the time varying correlation in the volatility. The copula approach is employed to investigate the tail dependence structure by Gaussian, t-Student, Gumbel, Clayton and Frank copulas.

The results of ARDL in context of sukuk with global equity report that only 7-10 year sukuk and A rated sukuk has statistically significant long run effect on global equity. The changes in 7-10 year sukuk, AAA rated sukuk AA rated sukuk

and BBB rated sukuk have statistically significant short run effect on global equity. 3-5 year sukuk, AA rated sukuk, A rated sukuk and total return sukuk have short run lagged effect on global equity. The short run elasticities of 7-10 year sukuk, AAA rated sukuk, AA rated sukuk and BBB rated sukuk are 0.09, -0.65, 0.20 and 0.18 respectively. Moreover, 1-3 year sukuk, 3-5 year sukuk and total return sukuk are not statistically significant both in long and short run. Whereas, 7-10 year sukuk is statistically significant both in short and long run.

The findings of ARDL for the pairs of sukuk with global bond report that 1-3 year sukuk, 7-10 year sukuk, A rated sukuk, BBB rated sukuk and total return sukuk have statistically significant long run impact on global bond. The changes in 7-10 year sukuk, AAA rated and AA rated sukuk have statistically significant short term effect on global bond with short term elasticities of 0.14, 0.23 and 0.55 respectively. Furthermore, 3-5 year sukuk is appeared to be insignificant both in long and short run. Whereas, 7-10 year sukuk is statistically significant both in long and short run.

The results of ARDL for the pairs of MENA sukuk with MENA equity and MENA bond indicate that MENA sukuk has statistically significant long run impact on MENA bond. Whereas, MENA sukuk have statistically significant short run and lagged impact on MENA equity and MENA bond. It is also observed that MENA sukuk is found statistically significant both in long and short term.

DCC GARCH is applied in order to measure whether correlation is constant or time varying over the period for all pairs of sukuk with international financial markets. The findings for the pairs of sukuk with global equity report that AA rated sukuk exhibit past residual shocks on conditional correlation. It is also observed that the effect of lagged dynamic conditional correlation is present for the pairs of 3-5 year sukuk, AA rated sukuk and total return sukuk with global equity. For the pairs of sukuk with global bond the results report that the effect of lagged dynamic conditional correlation is present only for the pair of AA rated sukuk with global bond. However, no impact of past residual shocks and lagged dynamic conditional correlation is present for the pairs of MENA sukuk with MENA equity and MENA bond.

The copula approach is employed to investigate the tail dependence structure for the pairs of sukuk with international financial markets. The findings for the all the pairs of sukuk with global equity indicate that there exist both lower and upper tail dependence. As mostly financial time series are not normally distributed and kurtosis in majority of financial time series is high. Moreover, the highest lower and upper tail dependence is observed for the pairs of 3-5 year sukuk with global equity, and AAA rated sukuk with global equity that is 0.0094 and 0.0090 respectively. Whereas, the lowest lower and upper tail dependence is observed for the pair of BBB rated sukuk with global equity that is 0.0008.

For the pairs of sukuk with global bond the results report that both upper and lower tail dependence is present for the pairs of 1-3 year sukuk with global bond and AA rated sukuk with global bond that is 0.0149 and 0.0127 respectively. For the pair of 3-5 year sukuk with global bond there exist no upper and lower tail dependence. Furthermore, the findings for the pairs of 7-10 year sukuk, BBB rated sukuk and total return sukuk with global bond report the presence of lower tail dependence of 0.0963, 0.0245 and 0.0052 respectively. The highest lower tail dependence is seen for the pair of 7-10 year sukuk with global bond whereas, the lowest lower tail dependence is observed for the pair of total return sukuk with global bond. The upper tail dependence of 0.0361 and 0.0438 is present for the pairs of AAA rated sukuk and A rated sukuk with global bond.

The results for the pairs of MENA sukuk with MENA equity and MENA bond report that no lower and upper tail dependence is present for the pair of MENA sukuk with MENA equity whereas, the lower and upper dependence of 0.6119 is present for the pair of MENA sukuk with MENA bond that is the highest tail dependence among all the pairs of sukuk.

Finally, It can be concluded, sukuk that have low credit risk rating are more volatile and sukuk that have higher credit risk rating are less volatile and more stable. Therefore, the chances for long term relationship with international financial markets get weaker for sukuk that have low credit risk rating and vice versa.

5.2 Recommendations

It is observed for overall ARDL results that of all sukuk indices which are based on maturity, only 7-10 year sukuk has both long and short term relationship with global equity and global bond. Therefore, investors with much longer time horizon should not include 7-10 year sukuk while constructing their portfolio as this will increase the risk. However, 1-3 year sukuk and 3-5 year sukuk are not correlated with global equity and global bond in short run. 1-3 year sukuk is seen to be correlated with global bond only in long run. So, the investors with short run horizon should consider 1-3 year and 3-5 year sukuk while constructing their portfolio.

On other hand the sukuk indices that are based on credit risk rating have almost same relationship with both global equity and global bond. AAA rated and AA rated sukuk are not correlated with global equity and global bond in long run but are correlated in short run. Moreover, A rated sukuk is correlated in long run with both global equity and global bond. Whereas, BBB rated is correlated with global equity in short run but with global bond it has short term relationship. Therefore, investors, fund managers, traders and policy makers should consider sukuk indices that based on credit risk rating while constructing their portfolio.

In terms of comparison of total return sukuk with global equity and global bond, it is observed that total return sukuk does not have long and short run co-movement with global equity. However, it is correlated with global bond only in long run as sukuk shares some of its characteristics with bond. Therefore, fund managers should be careful as total return sukuk is correlated in long run with global bond.

MENA sukuk is not correlated in long term but in short term it has co-movement with MENA equity. However, MENA sukuk is correlated in long and short run with MENA bond therefore, investors should be careful as MENA sukuk and MENA bond are correlated.

Of all pairs of sukuk with global equity only AA rated sukuk has past residual shocks on conditional correlation and lagged dynamic correlation. However, all

pairs of sukuk with global bond exhibit no past residual shocks on conditional correlation, only AA rated sukuk has lagged dynamic conditional correlation with global bond. Therefore, investors should be vigilant while including AA rated sukuk in their portfolio. Moreover, no conditional and lagged dynamic correlation is observed for the pairs of MENA sukuk with MENA equity and MENA bond.

The understanding of co-movement and dependence structure between sukuk and international financial market is essential for risk management as well as for diversification of portfolios. The results find out that all the pairs of sukuk have both upper and lower tail dependence with global equity. But with respect to relationship of sukuk with global bond, only 3-5 year sukuk does not have upper and lower tail dependence.

Finally, This study is beneficial for regulatory authorities with respect to creating macro stabilization policies, efficient resource allocation and risk management. Furthermore, this study is also effective and useful for fund managers and traders in formulating investment and trading objectives for portfolio structuring and portfoilio diversification. This research also offers evidence of the timely and appropriate measure of changes in correlation and the behaviors of sukuk and international financial markets, that is beneficial for portfolio managers.

Bibliography

Akhtar, S. M., Akhtar, F., Jahromi, M., and John, K. (2016). Intensity of volatility linkages in Islamic and conventional markets. *Available at SSRN 2906546*.

Aloui, C., Hammoudeh, S., and ben Hamida, H. (2015a). Global factors driving structural changes in the co-movement between sharia stocks and sukuk in the gulf cooperation council countries. *The North American Journal of Economics and Finance*, 31:311–329.

Aloui, C., Hammoudeh, S., and Hamida, H. B. (2015b). Co-movement between sharia stocks and sukuk in the GCC markets: A time-frequency analysis. *Journal of International Financial Markets, Institutions and Money*, 34:69–79.

Aloui, C., Hammoudeh, S., and Hamida, H. B. (2015c). Price discovery and regime shift behavior in the relationship between sharia stocks and sukuk: A two-state markov switching analysis. *Pacific-Basin Finance Journal*, 34:121–135.

Ariff, M., Chazi, A., Safari, M., and Zarei, A. (2017). Significant difference in the yields of sukuk bonds versus conventional bonds. *Journal of Emerging Market Finance*, 16(2):115–135.

Asutay, M. and Hakim, A. (2018). Exploring international economic integration through sukuk market connectivity: A network perspective. *Research in International Business and Finance*, 46:77–94.

Azmat, S., Skully, M., and Brown, K. (2017). The (little) difference that makes all the difference between Islamic and conventional bonds. *Pacific-Basin Finance Journal*, 42:46–59.

Balcilar, M., Cerci, G., and Demirer, R. (2016). Is there a role for Islamic bonds in global diversification strategies? *Managerial Finance*.

Bhuiyan, R. A., Rahman, M. P., Saiti, B., and Ghani, G. M. (2018). Financial integration between sukuk and bond indices of emerging markets: Insights from wavelet coherence and multivariate-garch analysis. *Borsa Istanbul Review*, 18(3):218–230.

Bhuiyan, R. A., Rahman, M. P., Saiti, B., and Ghani, G. M. (2019). Co-movement dynamics between global sukuk and bond markets. *International Journal of Emerging Markets*.

Cappiello, L., Engle, R. F., and Sheppard, K. (2006). Asymmetric dynamics in the correlations of global equity and bond returns. *Journal of Financial econometrics*, 4(4):537–572.

Embrechts, P., Kaufmann, R., and Patie, P. (2005). Strategic long-term financial risks: Single risk factors. *Computational optimization and applications*, 32(1-2):61–90.

Engle, R. (2002). Dynamic conditional correlation: A simple class of multivariate generalized autoregressive conditional heteroskedasticity models. *Journal of Business & Economic Statistics*, 20(3):339–350.

Engle, R. F. and Granger, C. W. (1987). Co-integration and error correction: representation, estimation, and testing. *Econometrica: journal of the Econometric Society*, pages 251–276.

Fathurahman, H. and Fitriati, R. (2013). Comparative analysis of return on sukuk and conventional bonds. *American Journal of Economics*, 3(3):159–163.

Floros, C. and Vougas, D. (2007). Lead-lag relationship between futures and spot markets in Greece: 1999-2001. *International Research Journal of Finance and Economics*, (7):168–174.

Hamzah, S. R., Bacha, O. I., Mirakhor, A., and Malim, N. A. K. (2018). Empirical evidence of risk shifting in bonds and debt-based sukuk. *Journal of Islamic Accounting and Business Research*.

Hansen, B. E. and Phillips, P. C. (1990). Estimation and inference in models of cointegration: A simulation study. *Advances in Econometrics*, 8(1989):225–248.

Hansson, M., Liljeblom, E., and Löflund, A. (2013). International bond diversification strategies: the impact of currency, country, and credit risk. In *Asset Management and International Capital Markets*, pages 193–222. Routledge.

Haque, M. M., Chowdhury, M. A. F., Buriev, A. A., Bacha, O. I., and Masih, M. (2017). Who drives whom-sukuk or bond? a new evidence from granger causality and wavelet approach. *Review of Financial Economics*.

Hassan, M. K., Paltrinieri, A., Dreassi, A., Miani, S., and Sclip, A. (2018). The determinants of co-movement dynamics between sukuk and conventional bonds. *The Quarterly Review of Economics and Finance*, 68:73–84.

International Islamic Financial Market (2019). IIFM Sukuk Report.

Islamic Financial Services Board (2018). Islamic financial services industry stability report.

Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of economic dynamics and control*, 12(2-3):231–254.

Johansen, S. (1991). Estimation and hypothesis testing of cointegration vectors in gaussian vector autoregressive models. *Econometrica: journal of the Econometric Society*, pages 1551–1580.

Johansen, S. and Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration with applications to the demand for money. *Oxford Bulletin of Economics and statistics*, 52(2):169–210.

Kenourgios, D., Naifar, N., and Dimitriou, D. (2016). Islamic financial markets and global crises: Contagion or decoupling? *Economic Modelling*, 57:36–46.

Maghyereh, A. I. and Awartani, B. (2016). Dynamic transmissions between sukuk and bond markets. *Research in International Business and Finance*, 38:246–261.

Miller, N. D., Challoner, J., and Atta, A. (2007). UK welcomes the sukuk: How the UK finance bill should stimulate Islamic finance in London, much to the delight of the city's banks. *Int'l Fin. L. Rev.*, 26:24.

Naifar, N. (2016). Modeling dependence structure between stock market volatility and sukuk yields: A nonlinear study in the case of Saudi Arabia. *Borsa Istanbul Review*, 16(3):157–166.

Naifar, N., Hammoudeh, S., et al. (2016). Dependence structure between sukuk (Islamic bonds) and stock market conditions: An empirical analysis with Archimedean copulas. *Journal of International Financial Markets, Institutions and Money*, 44:148–165.

Naifar, N., Mroua, M., and Bahloul, S. (2017). Do regional and global uncertainty factors affect differently the conventional bonds and sukuk? new evidence. *Pacific-Basin Finance Journal*, 41:65–74.

Najeeb, S. F., Bacha, O., and Masih, M. (2017). Does a held-to-maturity strategy impede effective portfolio diversification for Islamic bond (sukuk) portfolios? a multi-scale continuous wavelet correlation analysis. *Emerging Markets Finance and Trade*, 53(10):2377–2393.

Nasir, A. and Farooq, U. (2017). Analysis of value at risk of sukuk and conventional bonds in Pakistan. *Journal of Islamic Accounting and Business Research*.

Nasr, A. B., Lux, T., Ajmi, A. N., and Gupta, R. (2016). Forecasting the volatility of the Dow Jones Islamic Stock Market Index: Long memory vs. regime switching. *International Review of Economics & Finance*, 45:559–571.

Ouattara, B. (2004). The impact of project aid and programme aid inflows on domestic savings: A case study of côte divoire. In *Centre for the Study of African Economies Conference on Growth, Poverty Reduction and Human Development in Africa*, pages 21–22. Citeseer.

Pesaran, M. H. and Shin, Y. (1998). An autoregressive distributed-lag modelling approach to cointegration analysis. *Econometric Society Monographs*, 31:371–413.

Pesaran, M. H., Shin, Y., and Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of applied econometrics*, 16(3):289–326.

Raei, F. and Cakir, S. (2007). *Sukuk vs. Eurobonds: Is there a difference in value-at-risk?* Number 7-237. International Monetary Fund.

Raza, M. W. and Ashraf, D. (2019). Does the application of smart beta strategies enhance portfolio performance? The case of Islamic equity investments. *International Review of Economics & Finance*, 60:46–61.

Reboredo, J. C. and Naifar, N. (2017). Do Islamic bond (sukuk) prices reflect financial and policy uncertainty? a quantile regression approach. *Emerging Markets Finance and Trade*, 53(7):1535–1546.

Rodriguez, J. C. (2007). Measuring financial contagion: A copula approach. *Journal of empirical finance*, 14(3):401–423.

Rusgianto, S. and Ahmad, N. (2013). Volatility behavior of sukuk market: An empirical analysis of the Dow Jones Citigroup Sukuk Index. *Middle-East Journal of Scientific Research*, 13:93–97.

Sclip, A., Dreassi, A., Miani, S., and Paltrinieri, A. (2016). Dynamic correlations and volatility linkages between stocks and sukuk: Evidence from international markets. *Review of Financial Economics*, 31:34–44.

Shrestha, M. B. and Chowdhury, K. (2005). ARDL modelling approach to testing the financial liberalisation hypothesis.

Warnock, F. E. and Burger, J. D. (2003). Diversification, original sin, and international bond portfolios. *FRB International Finance Discussion Paper*, (755).

Widad, M. and Hadjer, B. (2018). Causal relationship between Islamic bonds, oil price and precious metals: evidence from Asia pacific. *Al-Iqtishad Journal of Islamic Economics*, 10(2):285–298.

Wilson, R. (2008). Innovation in the structuring of Islamic sukuk securities. *Humanomics*.

Yang, J. (2005). International bond market linkages: a structural var analysis. *Journal of International Financial Markets, Institutions and Money*, 15(1):39–54.

Zulkhibri, M. (2015). A synthesis of theoretical and empirical research on sukuk. *Borsa Istanbul Review*, 15(4):237–248.