

CAPITAL UNIVERSITY OF SCIENCE AND  
TECHNOLOGY, ISLAMABAD



# Information Spillover Between Oil and Equity Market: An Examination of Dynamic Patterns During Pandemic

by

Ifrac Amjad

A thesis submitted in partial fulfillment for the  
degree of Master of Science

in the

Faculty of Management & Social Sciences  
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*I want to dedicate this thesis to my parents, respected teachers and friends for their love, support and care.*



## CERTIFICATE OF APPROVAL

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**(Ifrah Amjad)**

## *Abstract*

The focus of this study is to analyze the transmission of volatility and return from oil to conventional and shariah compliant equity market and vice versa by using daily closing prices of oil and equity markets of Pakistan. The sample period of the study is Jan 1, 2009 to September 30, 2020. Volatility and return spillover is measured by using ARMA (1,1)- GARCH (1,1)-M model. The study further uses DCC- GARCH model is used to examine the time varying correlation. The study provides that no mean spillover exists from oil to conventional and shariah compliant equity market. These results are consistent in bear market as spillover is not found different in bear period for conventional and Shariah compliant securities. However, it is worth mentioning that mean spillover during covid-19 period is significantly different in conventional equity market. The study provides evidence of volatility spillover from oil to shariah compliant securities during bearish period and pandemic while limited evidence is found for the conventional equity. The volatility spillover exists from oil to conventional and shariah compliant equity markets. However during bearish period volatility spillover is not different from bullish period in conventional equity market whereas in case of shariah compliant equity the volatility spillover is different in bearish market. Volatility of shariah compliant securities are more exposed to oil market bearish trends and pandemic. The volatility spillover exists from conventional to oil market but it does not exist from shariah compliant equity market to oil market. The correlation between the markets is found time varying. However, no asymmetric behavior in both markets is observed. The portfolio managers and risk professional can use this insight for optimization of their decisions.

**Keywords: Return & Volatility Spillovers, GARCH, DCC, ADCC, Oil and Equity Market**



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# Abbreviations

<b>ADCC</b>	Asymmetric Dynamic Conditional Correlations
<b>ARMA-GARCH</b>	Autoregressive Moving Averages GARCH
<b>DCC</b>	Dynamic Conditional Correlations
<b>EMH</b>	Efficient Market Hypothesis
<b>GARCH</b>	Generalized Autoregressive Conditional Heteroscedasticity
<b>GARCH-M</b>	Generalized Autoregressive Conditional Heteroscedasticity in Mean
<b>MV-GARCH</b>	Multivariate GARCH

# Chapter 1

## Introduction

The investment in financial assets is based on the information that different market participants use. Equity market behavior is evaluated by the available information that is either firm-specific or macroeconomic. The EMH is that asset prices considers to the market information. The available information influences on the prices of different financial assets. The EMH claims that at a stated point of time any change occur in the available information is completely reflected in the prices of securities so various assets have relationship with each other.

After the institution of Efficient market hypothesis, another important theory comes that is signaling theory. Typically, two parties have different information they have different behavior both parties consider information in different way. Signaling theory shows the behavior of two parties (sender, receiver). The COVID-19 effects in many ways on the economy. Everyone will take COVID-19 in different ways for policymaking, management decisions etc. The significant return and volatility spillover of equity and shariah compliance affects not only selection of asset, allocation of asset and for risk management decisions but also for the regulation of policies that are planned to maintain global financial system stability.

This study considers oil, equity and shariah compliant securities. Oil plays a dominant role as an energy source so it is the most important commodity that trades in markets around the world. The Equity market is in which shares of

company are traded and shared in the market. The Equity market is the market for trading equity instruments. Shariah compliance is an activity that accommodate with the requirements of the Islamic law or Shariah. Shariah compliant funds are the funds of investment that are managed by the principles of the Islam and according to the requirements of shariah. Shariah compliant funds are observed to be a type of socially responsible investing. By considering and observing we better able to evaluate the direction in which a market is moving. All of the work individually as well as combine so some move against each other, and some move with each other.

COVID-19 is a phenomenon that is having attenuation. COVID-19 is an infectious disease and has resulted an ongoing pandemic. In December 2019 it was first identified in Wuhan in China. In July 28, 2020, approximately 16.5 million cases have been reported across different territories and countries and COVID-19 is the reason of more than 655,000 deaths and almost 9.61 million people have been recovered as of the month of July. In the middle of the 2020 financial market collapsed due to COVID-19 unpredicted risks have been faced by corporate sectors (Corbet, Hou, Hu, Lucey, & Oxley,2020). On the prices of oil, COVID-19 affect is found negative by Narayan (2020).

The COVID-19 risk is the reason of economic crisis and it affects to job securities, businesses but also other services. The main source of systemic risk is COVID-19 and further research is needed on financial sectors due to corona virus (Sharif, Aloui & Yarovaya, 2020). The oil prices have been collapsed due to COVID-19 pandemic. (Ansari and Kemfert 2020) due to lockdown measures accross world economies have gone into the condition of hibernation as COVID-19 pandemic has resulted decrease in the demand of oil.

There is a linkage between global financial system because of the transmission of the information from one market to the other market that causes the coordinated actions in the financial markets. The benefit of portfolio diversification can achieve by the good financial decisions. This study gives might an empirical and theoretical for dynamic to the investors that correlation is among asset classes and markets can vary on the happening of certain events at any point of time. In the times of



global financial crises, it is seen that the stock markets generally show a system-wide movement that can influence diversification.

## 1.1 Theoretical Background

### 1.1.1 Efficient Market Hypothesis (EMH)

The EMH claims that there exists rapid and timely link between information and prices of stock. The assessment of the stock market behavior is essential. Different practitioners and economists give a lot of attention to the Stock market efficiency. Modern financial markets assume that the market are effective. The term efficiency creates a link between stock prices and information. Fama (1965) states, when the markets are in efficient form and considers all the information then resource allocation can be done is based on the fair price.

Dyckman and Morse (1986) state "An efficient security market is a market if (a) the price of the traded security fully shows the all available information (b) these prices react immediately and in an un-bias form to new information. On the other side there is a chance prices effect on the selection of securities and mislead to the investors. Malkiel (2003) criticize on the idea of Efficient Market Hypothesis and argue that prices of stocks cannot be predicted and his argument related to partial prediction of the prices of stocks.

Malkiel state that if information flow is speedily reflected in the stock prices then there is no link between todays price and tomorrows price because they are totally independent He respond to the study of Fama that argues states prices adjust with the arrival of new information and spread speedily without any delay. In this way, technical analysis just scrutinizes the change of past prices to predict the prices of future and fundamental analysis helps the investors to make the comparison on the basis of cash flows, profit and other characteristics of a firm. So, because of the presence of lesser rationality in some market participants It doesnt support the argument that markets are fully efficient. Experts and professionals cannot uncover the quick incorporation of information in stock prices (Grossman and

Stiglitz 1980). The Efficient market theory supports to this study strongly. EMH tells about the accurate consideration of facts from the prices at any point of time in same way. So, when professionals and market participants forecast that in the future prices will increase on the basis of this information so they will modify their cost in a suitable way so that there will be not big effect on the market value of firm. On the other side if in the world market they found a high level of probability it is very hard to change their costs satisfactorily. So, if any change occurs in the prices of any market, then that will shift the effects in the prices of other markets.

### **1.1.2 Signaling Theory**

Signaling theory has been developed to address the problems of asymmetry information. Signaling phenomenon that applicable in any market in which asymmetric information available. Signaling theory explains the behavior of parties they have approach to different information. One party choose to communicate the information in different way and other party will take it in different way. The sender must choose how to signal that information and receiver must choose how to explicate the signal. The theory and its key concepts has its own importance in management decisions and provides forward direction for future research that will be helpful for decision makers to use signaling theory in different ways.

## **1.2 Gap Analysis**

For the policymakers and investors there is need to determine and investigate the volatility and return that related to equity and oil market. The relation between oil and equity market has been explained by few studies. Few studies explain the investigated extensively in literature of financial economics on spillover effects in financial markets. Most of the studies illuminate on analyzing return and volatility with some identical assets. Similarly, the spillover of other assets like cryptocurrency with this asset is available but evidence on oil is limited. There is lack of literature studies on oil to equity and shariah compliance vice versa volatility and return spillover and the difference with in spillover between condi-

-tions of bearish and bullish. This study attempt to address these gaps. The main contributions of this study prominent many aspects. However, there exists a contextual gap that the spillover effect of oil with other assets in during pandemic is still untouched.

Moreover, with the passage of time, its becoming the part of emerging markets or frontier markets and there is an interest of people then the insight of this phenomenon had to be increased. So, this research provides a gateway to future researchers in a new domain. So, as this is a pandemic situation so there is lack of understanding though people can take better decision for future on the basis of this study. This study is considering a rich set of asset class (equities and shariah compliance). The pandemic effect on oil and asset spillover is being explored in this study. Additionally, the study also examines the link of equity and oil and with focus on the pandemic and it effects.

### 1.3 Problem Statement

The understanding of the link between oil and equity market is important. In past studies, most of the studies report that through contagion effect information created in one market quickly transfers to the other market. The information of one market effects to the volatility and mean of other market as well (Masulis, Hamao, and Ng, 1990; Wadhvani and King, 1990; Engle and Susmel, 1993; Karolyi, 1995; Lin, Engle, and Ito, 1994; Frank and Young, 1972; Soenen and Hennigan, 1988; Pan et al., 2007 & Nieh and Lee, 2001).

In emerging markets it is generally seen that the macroeconomic links dont remain constant and with the passage of time relationship between different variables changes. The co-movement between different markets is already studied in the previous studies. Moreover the previous literature also shows that the spillover effects mostly seen across markets. Information about oil-to-equity market and equity market-to-oil market is not available in emerging markets i.e. Pakistan. So, the debate on the bidirectional transmission of information is still inconclusive.

## 1.4 Research Questions

This study has the following research questions:

- Is there any interdependence between oil and equity market?
- Does spillover between oil and equity market differ during bear and bull market?
- Does the volatility and return spillover between oil and equity market decrease or increases due to covid-19?
- Is there any interdependence between oil and shariah compliance?
- Does spillover between oil and shariah compliance differ during bear and bull market?
- Does the volatility and return spillover between oil and sharia compliance market decrease or increases due to covid-19?

## 1.5 Objectives of the Study

This study has the following research objectives:

- To provide insight about volatility and mean spillover between oil and equity market.
- To provide insight about volatility and mean spillover between oil and sharia compliant.
- To explain the difference of spillover between oil and equity market during bear and bull market.
- To investigate the impact of covid-19 on the spillover between oil and equity market and vice versa.

- To explain the difference of spillover between oil and shariah compliance during bear and bull market.
- To investigate the impact of covid-19 on the spillover between oil and shariah compliance and vice versa.

## 1.6 Significance of the Study

Most of the research is done on spillover in developed market with focus from oil to asset class. The evidence for spillover from equity to oil market is generally limited. This study provide evidence from spillover from oil to equity market and vice versa from an emerging market that is Pakistan. It not only examine the behavior during bearish and bullish periods but also provides insight about the impact of Covid-19 on spillover pattern across oil and equity market and vice versa. The spillover pattern is conventional and shariah compliant securities also add insight to linkage pattern. This study contributes in domains of effect of COVID-19 on spillover pattern. This study consider conventional unit equity and shariah compliance both. The information about the dynamics of COVID-19 help the people to analyze the market in a better way and to take better decision. COVID-19 is a main focused thing now a days. It reflects negative news (Narayan et al.,2020).

The pandemic is observed differently over the long-run and short run (Sharif, Alou & Yarovaya, 2020). The Pakistani investors have interest in local and foreign opportunities of investment and the oil and the stock markets are the most important area for the economy market and it provides capital access to the corporations to increases business and to provide ownership of companies with investment gains that depends on the companys performance. So, investors can do better investments. The risk protectors can illustrate the problems by the knowledge of oil and equity markets and can elaborate the importance of risk management decisions. Policy makers maintain the level of trust as new data emerges and by adopting policies and new technologies for dissemination and for rapid generation of data makes it possible to collect and to observe data about covid-19 in near real-time.

Policymakers must be willing to live with uncertainty in the predictions and adjust their recommendations accordingly and by the knowledge of equity market and oil market policymakers can take timely actions. Oil is important for the maintenance of economic performance in a smooth way because it is an important source of energy. The stock market performance has importance for emerging and developed economies.

## **1.7 Plan of Study**

Chapter 1 Introduction of Topic, Theoretical Background, Gap Analysis, Problem Statement, Research Questions, Research Objectives and Significance of the Study. Chapter 2 includes the past studies literature studies and Hypotheses for the Study. Chapter 3 covers the Research Methodology of the current Study. Chapter 4 covers Data Analysis and Results. Finally, the Chapter 5 covers the Conclusion, Limitation and Recommendations of the current research study.

# Chapter 2

## Literature Review

The study investigates if there is a connection between the pandemic situation and companies negative effect. In late 2019 the COVID-19 pandemic has been developed in china within Wuhan city that has showed a warning to the financial international markets with regards to spread that can distribute so quickly. The literature between oil and other equity market so little is available and the link between them remains unclear in nature. There is an increased interest in transfer of risk between assets and oil and volatility and return spillover. The literature seems to be little and more attention is required to the risk transmission dynamics. The direction of spillovers across a wide variety of asset is affected by financial events. The studies on spillovers of oil and assets the large scope of literature on subject confine review.

Financial markets players are more conscious about that, how mean and volatility spillover or the transformation of shocks from one market to another market over time. However, there exists a lack in the previous literature that most of these studies are done on some particular area but don't provide the information regarding mean and volatility spillover of oil and assets. This study examines the effect of COVID-19 on spillover of oil and asset. This study is used by different policymakers and practitioners to make the process of decision-making regarding asset and oil market. It is believed that an unwanted event in any market either less or more influences the return and volatility of the other markets. Sometimes the shocks created in one market transfers in only one aspect to the other markets

i.e., mean or volatility. As the volatility spillover is often used as a proxy for risky assets, so the analysis of volatility is particularly important than mean or return spillover.

The countries that are in industrial level the work has concerned that are like Japan, Canada, US and UK there is few studies that has been done on studying the relationship between stock markets and oil prices and vice versa. The link between oil and stock markets is a good topic, but few studies has focused on the time-varying asymmetric volatility spillover in a quantitative manner. For market participants, portfolio diversification, energy policy-makers and energy risk management the volatility spillovers between the oil market and stock markets is crucial as such this linkage between the stock markets and oil market is having more consideration (Filis et al., 2011; Awartani and Maghyereh, 2013; Ewing and Malik, 2016; Maghyereh et al., 2017; Kang et al., 2017). The financing activity or banking is Sharia compliant finance that complies with sharia through the Islamic economics development and its practical application. Some of the modes of Islamic banking finance include Mudarabah, Wadiah, Musharaka, Murabahah, and Ijara.

The players of financial markets are so much deliberate about how shocks transmit from one market to another market. The shocks transmission from one market to another market is highlighted in these papers includes Hamao, Masulis, and Ng (1990), King and Wadhvani (1990), Engle and Susmel (1993), Lin, Engle, and Ito (1994), and Karolyi (1995). In the previous studies most of the focus was on specific financial markets but the information was not available on shocks transmission or volatility and mean spillover. In the result of globalization, the demand of some research on the movements of shocks has been increased because financial markets are coming near to each other as due to globalization.

Different practitioners and policymakers used these studies for the decisions regarding strategies, hedging and for asset pricing. The point of view of International investors is the weak linkage of stock market is less than the best relationship between their profits gives possible additions from expansion of the portfolio of worldwide whereas diversification advantages are eliminated through movement in the returns or by the strong linkage between markets. Occasionally the shocks



that occurs in one market moves in one direction to other market i.e., volatility or mean spillover. So, the volatility spillover is more important than return or mean spillover and the volatility spillover is often used as a proxy for risky assets. The fact is any unexpected event effects to returns and volatility of any market either less or more. The focus of our research is to the analysis of mean and volatility spillovers during situation of pandemic.

## **2.1 Return and Volatility Relationship Between Oil and Equity Market**

The oil market is distinctive in its complications and in varieties. The markets of oil have attracted the large scale of participants: not only banks but also government agencies, oil companies, commodity traders, government agencies, fund managers, airlines. Oil markets are being used for betting the moves of prices. The movements of oil are being affected by the stock prices changes.

The link between oil market and stock market has more attention in world. The spillover of volatility between market of stocks and market of oil is important for the participants of market, risk management, policy makers, diversification of portfolio (Filis et al., 2011; Wen et al., 2012; Awartani and Maghyereh, 2013; Ewing and Malik, 2016; Maghyereh et al., 2017; Kang et al., 2017). The literature is available related to the relationship between Chinese stock market and oil price. They investigate the relation between stocks in china and oil prices and the result is the change in oil prices is correlated with the stocks in china (Wen et al., 2012; Zhou et al., 2012; Broadstock et al., 2012; Zhang and Wang, 2014). The study has been done in US recently to check the impact of shocks on oil prices and COVID-19. The Pandemic effect on geopolitical risk is greater than on the economy of US uncertainty. (Arshian et al., 2020). The literature related to the link between financial markets and oil markets is very Limited by Farooq and Shawkat (2005). The major financial markets increased integration has been generated interest in spillover of volatility effects from market to market. This volatility spillover is allocated to market hedging across over and difference in the information that is

shared which at the same alter across markets. The asset return volatility depends on the available flow of information. In individual markets and across markets time and flow of information used in the processing of information by Ross (1989). prices of stocks of different firms either domestic, multinational or export oriented affected by the oil. The past studies available on the oil and stock market returns relationship. In previous studies, the relationship between two variables is only discussed by using the basic statistical models e.g., Regression and Correlation analyses. So, keeping all these scenarios in mind, a new proposition that there exists a volatility and mean spillover relation between oil and stock market in Pakistan is proposed.

The study tells that prices of oil increases and policy of economic uncertainty in China is Correlated and has impact on the market returns of stocks by Wensheng and Ronald (2014). The positive shocks oil prices of world decrease growth of economic and the inflation rate in China increased Du et al. (2010). Oil is used in production as an input and business and consumer spending on services and goods influenced to the shocks of the prices of oil that affects to the prices of stocks and the value of firm gets affected by the shocks of the oil prices by affecting the discount rate for cash flow through the expected rate of real interest rate and the expected rate of inflation. When the oil prices volatility becomes higher that results to increase the firms uncertainty and will also affects to the value of firm (Wensheng & Ronald, 2014). For the management of portfolio, the Stock market linkage with oil prices is important. The study of volatility transmission between the stock markets of Europe and the markets of oil by using VAR-GARCH model.

The result is significant between the volatility transmission between the returns of stock market and the oil prices (Arouri, Jouini & Nguyen 2012). The study of a paper is within four markets of developed countries they have done the study that are US, UK, Canada and Japan and they have been analyzed the reaction of stock market on the shocks of oil and the result of their study is that the movements of the prices of oil on future and current cash flows effects partially on changes the prices of stocks (Jones & kaul, 1996). The volatility between five US sector indices by adopting bivariate BEKK-GARCH (1,1) models and oil volatility

examined and the result is of significant transmission of volatility between different stock market sectors and oil prices (Malik & Ewing, 2009). For the development of Pakistani stock market there are many factors that includes intermediaries, volume of trading, Pakistani stock exchange, stock turnovers, stock indices. Any shock of one market fully effects to the other volatility and return of other market and in this study interdependent relation within 5 sectors (transportations, capital goods, industrials, financial, and utilities,) by employing the VAR and variance decomposition techniques (Ewing, 2002).

Hassan and Malik (2007) used GARCH model in his study on different U.S. industrial indices and the result shows that the result is significant mean and volatility of one market influences to other market. This study examines the volatility and mean spillover within 5 different industries of U.S. this study considers weekly data of oil prices and used bivariate GARCH models. The result found to be significant so the oil prices effects to the volatility and return of their sector (Malik & Ewing, 2009). In a study the sample pick up from the period of 1988-2000 from 6 emerging Asian market includes Japan, Korea, Hong Kong, Malaysia, Singapore and Indonesia, Philippines, Taiwan and Thailand, and 3 developed. They used MGARCH model for the study of shocks. The result reveals there exists a positive relation between volatility and return spillover (Worthington & Higgs, 2004). The transmission of volatility spillover from Chinese stock market to Australian Stock market. The study uses use multivariate GARCH model.

Another study examines the study on volatility spillover among 4 developed countries that are UK, USA, Japan and Singapore and regional countries that are china, Pakistan, India and Srilanka. The volatility found volatility among the regional countries as their economic boundaries are inter linked with each others (Abbas, Khan, & Shah 2013). The long-term relation has been examined by volatility spillover and analysis of integration in these countries Australia, Japan, UK, india and USA. In this study unidirectional as well as a bidirectional volatility transmission is found from the USA market to Indian and United Kingdom, Japan, to Indian market (Sakthivel, Bodkhe, & Kamaiah 2012). The relationship of mean and volatility spillover is found in in America they use the stock markets

of American region; Argentina, Brazil, Mexico, Chile and U.S. they report that there exists a wide variation with respect to mean and volatility spillover among the markets. Volatility spillover arises when some particular economic events occur, while mean spillover are found to occur gradually (Yilmaz, 2011). From U.S markets to Japanese and Asian markets of stock the unidirectional volatility transmission is studied by the use of stock market samples of Japan, U.S and 6 emerging countries that are as follows; India, Malaysia, china, Thailand, Indonesia and Philippines. So, in the result spillover of bidirectional volatility is also found from the market of U.S.A market to markets of Asia during financial crises in markets of Asia by Li and Giles (2015).

## **2.2 Return and Volatility Relationship Between Oil and Shariah Compliance**

Shariah compliance funds are considered as funds that are tools for investment that are considered as a kind of investing that is socially responsible. These investments follow the rules of Islamic religion. There are so many rules according to Muslim religion so Shariah compliance needs a lot of attention. The implications of shariah compliance is difficult and its execution is also difficult. Shariah compliance has 6 foundations are as follows: prohibition of Gambling, profit sharing, riba prohibition, successful real economy, only lawful investment, follow moral and ethical values. In socially responsible investing the shariah compliant funds found and it is one of many categories. The concept of shariah compliance was first developed in the late 1960s and recently in popularity Shariah-compliant funds have expanded. For Shariah compliant funds shariah board appointment ,shariah audit annually , and exhibit some income that is prohibited just as donation of interest to the charity. There are many requirements that are necessary to follow with halal funds. shariah compliant funds have some requirements that includes the prevention of investment that gets big portion of their income from the sale of gambling, pork products, pornography, sale of alcohol, military weapons. In shariah compliance the Popular categories of investment for funds are exchange

traded funds and land. Shariah compliant fund many rules have been added that add costs to the management and complexity as well. The Shariah makes basic difference between halal and haram and forbidden and lawful practice. By shariah compliance managers might have hazy moral obligations. So for the investors shariah compliance is important to understand for funds.its knowledge is important to win the investors trust that is beneficial for the growth.

Without consideration of the status of development for fueling the world economies the prices of oil affects to the global market and oil market has its importance. Oil plays an important role so the prices of oil prices affect to the markets of globe. The study analyze risk between markets of stock of Islamic countries. That are the participants of oil market and investors that are faith oriented. Along with this oil plays an important role in financial and Islamic markets the reason behind this statement is that the countries that have major production of oil are Islamic.

The international investors especially who have interest in faith oriented investments the relationship between prices of oil at global and Islamic equity return is important. The effect on prices of oil of spillover on extreme downward or upward has important implication on the Islamic trading of equity and for risk management but also for the strategies of hedging that are used by the international market investors. The study analyze spillover upside and downside between Islamic returns of equity and the changes of prices of oil so that provides a gateway to investors of international market that can predict the expectations of Islamic equity investments (Shahzad, 2018).

The Islamic capital universe representative activities that rely on rules of islam and perspectives is considered as Islamic equity market. Over the last few decades a variety of Islamic financing structures and investments of shariah compliance has come in front as competitor to fixed income markets and conventional equity markets. The indices of Islamic market have attained popularity especially due their Islamic ideology that further go for the strict compliance and according to shariah compliance activities. Their operations dont include that activities that are not according to the shariah law that includes alcoholic activities transactions that are interest based, gambling activities and pork production etc. There are

few past studies that analysis the relationship between the Islamic equity universe and changes in oil price (Shahzad et.al 2018).

Chebbi and Derbali (2015) in their study stated that commodity markets and markets of equity are interlinked with each other. In financial economics the relationship between oil prices and equity returns has been a crucial topic from the last two decades and traders analyses the trend between these markets by examining their combine fluctuations (Choi & Hammoudeh, 2010). The important determinants of stock market at international level volatility are the global prices of oil (Shafaai & Masih, 2013). The prices of equity market sensitivities depend on demand, size and cost of changes of oil price Reported by(Gogineni,2010). The impact of negative oil prices changes on the equity returns of the UK, France, USA and the results are price of oil impacts significantly on returns of stocks (Park & Ratti,2008).

The point of view that returns of equity respond negatively to changes of oil price but the change is temporary and vary according to different phases of the business cycle (Jammazi & Aloui, 2010). In Malaysia the indices of Islamic equity are sensitive to the prices of oil in short run (Hussin et al., 2013). Ghorbel et al. (2014) according to the study during the financial crisis of 2008 they find in Malaysia and Indonesia a significant correlation between Islamic equity returns oil prices. Global prices of oil have a significant impact on Islamic markets of equity and also impact on correlation between bonds and Islamic stocks.

The linkages between commodity markets and Islamic equity has examined. they have found the correlations between the DJIM index and commodity markets are changing with time and the return correlations between commodities and Islamic equity is considerable. The study have found diversification benefits for equity holders Islamic and that benefits change in different commodities in different time series (Nagayev et al., 2016).

The macroeconomic variables and global prices of oil have a significant and positive effect at lower level on the Dow Jones Islamic Market Index (Naifar & Hammoudeh, 2016). For market participants, energy policy makers and for portfolio diversification stock markets and energy markets are so important although the

stock and oil linkage is more important around globe (Wen et al., 2012; Ewing and Malik, 2016; Kang et al., 2017). To investigate the spillover volatility dynamic asymmetric between Chinese and US stock and Oil market during 2007 to 2016. The stock market of china is one of the fast and large developing stock market in the world and stock market of china slowly interact to the economy of globe by implication of liberalization policies like policies of WTO, QFII and RQFII. From investors and scholars by analyzing these factors the stock market of china get more focus (Barunik et al. 2017).

Mensi et al. (2017) due to structural changes the financial of globe becoming complicated that has effect on the economy of the world and from the last two decades the Integration of financial global system combines different classes of assets together and finds a link between them and from few decades the industries that follow shariah compliance have a significant growth experience by watching the interest of investors that are faith oriented and western world especially after the financial crises of 2008 and investors faithful participation has been faced and countries faithful participation has been observed.

IFSI Stability Report (2016) the movements of price and volatility affects to the stock markets of global and also effect on the securities of Shariah compliance . It further leads to find investors of globe who includes securities of islamic in investments. According to Mensi et al. (2017) research is much needed to examine relationship between Islamic equity markets, oil and gold. The lack of is that we just analyses Islamic stocks at aggregate level and we lose the chance of diversification at the sectoral level. According to that study that is one of the first that examine the link between Islamic equities and oil,gold at sectoral level.

Nagayev et al. (2016) In this study wavelet coherence framework and the MGARCH-DCC has been used and show the correlations between world index of Islamic market and commodity markets that are volatile and time varying in nature from the period of January 1999 to April 2015 . A constant increase is being noticed in the return correlations Islamic equity and commodity at the onset of the 2008. The benefits get changed in different time scales and across different commodities. The commodity and Islamic stock markets have time varying equity correlation. the

findings are analysis of spillover index shows that gold has low effect on Islamic equity markets as compare to the crude oil market. The spillover risk between Islamic stock markets are globally weak (Mensi et.al, 2017).

Arouri et al, (2012) In the financial markets of Islamic countries the constructions of portfolios of Islamic and non investment the funds of shariah considers as instruments of primary investments. Chang et al. (2020) The fluctuations of oil price sensitivity of indices of stocks the empirical study estimation gives detail study. The test of unit root and test of cointegration study the variables. The DJ Islamic index study considers findings of sectors of finance, gas and oil sectors, sectors of healthcare. The effect on prices of oil on the markets of stocks is based on rational and have effect directly on the prices of oil on the flows of cash and on earnings of the work of corporate sectors.

Kilian and Park (2009) The nature of the oil-stock relationship varies with respect to the nature of the country. The positive relationship is unanimously observed in oil exporting economies. The relationship of stock and oil changes according to country to country. Arouri and Nguyen (2010) observes relation that is positive in countries that are oil exporting. Different macroeconomic situations and conditions included by discounted values that includes inflation, growth of economics, cost of production, rates of interest, producers confidence and shocks of oil.

Choi and Hammoudeh (2010) studies that investors can predict trends of future by studying the combine change occurs in commodity market and equity. The France, USA and UK face negative effect of prices of oil on the stock market and they have found positive relationship in exporting countries between stocks and oil market and found big effects from oil to stock market (Park & Ratti, 2008). The stock return volatility due to shocks of prices of oil is greater than the volatility because of shocks of macroeconomic (Malik & Ewing, 2009). The equity price change depends on the due to prices of oil depends on the changes in prices of oil (Gogineni, 2010). Jammazi and Aloui (2010) states that there is negative effect on prices of oil that is temporary and increases returns of stocks and effect changes according to the cycles of business and in normal stage. Chang et.al (2020) states that previous research on the Islamic stocks is considering on its risk factors its



working and on outcomes and compare it with counterparts that are conventional. The effect of prices of oil are majorly studied in stocks that are conventional. The study related to changes effect in the prices of oil at global level and stock market islamic at the level of sectors.

For investors and managers of portfolio this study works good to get diversification in indices Islamic markets of stocks at cross sectional level. For reliable activities across market its important to have knowledge about Islamic stocks. According to one of the study has been used variance causality test to study volatility spillover. Shariah compliant fund is the main branch of Islamic financial system along with the activities of insurance and banking. For investors a new area of the investment is by increasing interest in financial Islamic development system and by Islamic finance. The Islamic financial system reliability is the main point that increases the system attraction due to its accuracy. For Islamic finance development stock market index that is Islamic is essential (Hafner & Herwartz, 2006).

The relationship between the index and macroeconomic indicators is important to study the source of instability trends of economic world and to maintain the policies (Chang et.al,2020). Hussain (2012) states that in Malaysia islamic market of stocks examines the changing effects of macronomic variables and prices of oil by using VAR method as an estimation and the period of data starts from 2007-2011 and study includes Granger causality test, Cointegration, Variance Decomposition, Impulse response analysis for the study. The study analysis prices of stocks that is according to Islamic laws and its integration with exchange rates and prices of oil and on the bases of relationship analysis of cointegration that Islamic prices of oil is positively releted to the prices of oil but have non significant relationship with the variable of exchange rate. The prices of oil has been increased and have impact on the economic world in different ways especially in the increment in the production cost of services and goods that has impact on the confidence of consumer and inflation rate and in markets of financial economy. On the other side Elton & Gruber, (1991) establishing the changing relation between variables at macroeconomic level and return of shares have been observed in the previous studies. By expected discounted cash flow model the return of share is determined

by variables at macroeconomic level. The future cash flows and required returns has been affected by exchange rates and prices of oil and have affect on the prices of shares. So, there exist a stable relation between macroeconomic variables and prices of stocks and on commodity variables.

The study examines the changing relation between stock exchange and shocks of oil prices in Greece. He discovered a negative relationship between them. The changings of prices of oil affect negatively on stocks by analyzing negative growth of employment and output (Papapetrau, 2001). The study explored the prices of oil to the returns of equity that are asymmetric in nature. prices of oil how affects to the prices of oil and the result shows that prices of oil effects negatively output and when oil is being used as an input used as that affects adversely to the profit of corporation. The result of this study is prices of oil impact on prices of equity and that is symmetric in nature (Nandha & Faff, 2008).The study extended by Miller and Ratti (2009) on relation between oil prices and exchange of stocks at international level. Another study uses market that is multifactor in nature that includes exchange rate, interest rate and premium of risk and with this real oil prices is important determinant of gas and oil returns of stocks (Sadorsky, 2001). The GCC stock market has positive link with oil market so due to this the increment in prices (Arouri & Julien 2009). This is the study that is supporting to such kind of concept further. So that the prices of oil have positive relation with the shocks of oil prices and that effect also seen in the demand but have negative relation with prices of stocks by observing change in supply (Gogineni 2007).

The literature is available on the interdependencies of different markets of stocks and oil but the studies are on the return and volatility transmission is based on the spillover across different regions, countries and on different financial markets. The previous studies discussed above shows that the information flow vary from market to market and country to country. The studies any volatility and return linkage between stock and oil of a particular country or region is scarce. In simple words the studies on the interdependencies of stock and oil market in terms of volatility and mean linkage is less or near to missing in previous studies. So, analyzing all these scenarios, another new preposition that, there exists a mean and volatility

spillover relation across industries in Pakistan is proposed.

## **2.3 Hypotheses of the Study**

### **Hypothesis 1:**

There exists a mean and volatility spillover of oil and equity market and vice versa.

### **Hypothesis 2:**

Mean and volatility spillover of oil and equity market is different during bear and bull market and vice versa.

### **Hypothesis 3:**

Mean and volatility spillover relation of oil and equity market is different in covid-19 pandemic and vice versa.

### **Hypothesis 4:**

There exists a time-varying conditional correlation of oil and equity market and vice versa.

### **Hypothesis 5:**

There exists a mean and volatility spillover of oil and Shariah market and vice versa.

### **Hypothesis 6:**

Mean and volatility spillover of oil and Shariah market is different during bear and bull market and vice versa.

### **Hypothesis 7:**

Mean and volatility spillover relation of oil and Shariah market is different in covid-19 pandemic and vice versa.

### **Hypothesis 8:**

There exists a time-varying conditional correlation of oil and Shariah market and vice versa.

# Chapter 3

## Research Methodology

The methodology for this research is split in two main parts. The first part of this study examines the volatility and mean transmission from oil to equity and shariah market and from equity and shariah market to oil market by using ARMA (1,1) GARCH in Mean model presented by (Liu and Pan, 1997). In second part, time-varying conditional correlation between oil and equity market effect in covid Dynamic Conditional Correlation (DCC) and Asymmetric-DCC (ADCC) Multivariate Generalized Autoregressive Conditional Heterosexuality (MV-GARCH) models proposed by Engle (2002) and Cappiello et al. (2006).

### 3.1 Description of Data

#### 3.1.1 Sample

This study employs the daily closing prices of oil market to equity and shariah compliant securities of Pakistan to examine the impact of return and volatility spillovers from oil market-to-equity market in Pakistan and time varying conditional correlations, respectively. The sample period in starting from 1st Jan 2009 to 30th September 2020 and COVID period is from 30th Jan to 2020 to 30th September 2020.

## 3.2 Description of Variables

### 3.2.1 Oil Prices - WTI Futures

Crude oil is a liquid fuel source and it comes from the underground. After refining, it is used as fuel in vehicles, machinery, fertilizers and other petroleum products. Crude oil prices estimates the spot price of different barrels of oil in which WTI (West Taxes Intermediate) is most common.

The current study uses the daily data of oil for the period of 1st Jan 2009 to 30th September 2020 and for COVID-19 effect daily data for the period of 30th Jan 2020 to 30th September 2020.

$$r_t = \ln\left(\frac{OM_t}{OM_{t-1}}\right) \quad (3.1)$$

### 3.2.2 Shariah Compliance Market - KMI-30 Index

The current study uses the daily closing prices of KMI-30 index for the period of 1st Jan 2009 to 30th September 2020 and for COVID-19 30th Jan 2020 to 30th September 2020.

$$r_t = \ln\left(\frac{KMI_t}{KMI_{t-1}}\right) \quad (3.2)$$

### 3.2.3 Equity Market - KSE-100 Index

The current study uses the daily closing prices of KSE-100 index for the period of 1st Jan 2009 to 30th September 2020 for COVID-19 30th Jan 2020 to 30th September 2020.

$$r_t = \ln\left(\frac{KSE_t}{KSE_{t-1}}\right) \quad (3.3)$$

### 3.3 Econometric Models

#### 3.3.1 Oil to Equity Market

The first part is divided into four sections. The first section includes spillover from oil to equity market. The second section includes difference in spillover in Bull and Bear period the third section includes difference in spillover in covid-19 period and the fourth section includes the difference in spillover on Bear and Covid-19 period.

#### 3.3.2 Equity Market to Oil

The second part is divided into four sections. The first section includes spillover from equity market to oil market. The second section includes difference in spillover in bull and Bear period the third section includes difference in spillover in covid-19 period and the fourth section includes the spillover difference in Bear and Covid-19 period. The process is repeated from conventional equity equity market and shariah compliant market.

#### 3.3.3 Return and Volatility Spillover (ARMA-GARCH)

##### 3.3.3.1 Oil to Equity Market Spillover

In 1997 Liu and Pan presents (GARCH-M) GARCH-in-mean two stage approach and it is used to study the volatility and mean spillover from oil market to equity market and Shariah Compliance. The stage first is the return series of oil are presented by an ARMA (1, 1)-GARCH (1, 1)-M econometric model.

$$r_{o,t} = \beta_o + \beta_1.r_{o,t-1} + \beta_2.\varepsilon_{o,t-1} + \beta_3.\sigma_{o,t} + \varepsilon_{o,t} \quad (3.4)$$

$$\sigma_{o,t}^2 = \gamma_o + \gamma_1.\mu_{o,t-1}^2 + \gamma_2.\sigma_{o,t-1}^2 \quad (3.5)$$

Where  $r_{o,t}$  is the daily returns of oil market at time  $t$  and  $\varepsilon_{o,t}$  is the unexpected or residual return in other words, the error term. Basically, the adjustment of the serial correlation in the data is major purpose of the inclusion of MA (1) and ARMA (1,1) structure in the model.

The influence of return and volatility transmission of equity and shariah compliance is determined by getting standardized term of error and its square in the first stage and putting them in to the equations of volatility and return.

$$r_{s,t} = \beta_o + \beta_1 \cdot r_{s,t-1} + \beta_2 \cdot \varepsilon_{s,t-1} + \beta_3 \cdot \sigma_{s,t} + \varepsilon_{o,t} \quad (3.6)$$

$$\sigma_{s,t}^2 = \gamma_o + \gamma_1 \cdot \mu_{s,t-1}^2 + \gamma_2 \cdot \sigma_{s,t-1}^2 + \lambda_2 \varepsilon_{o,t}^2 \quad (3.7)$$

### 3.3.3.2 Difference in Spillover in During Bear and Bull Period

In second stage the influence of volatility and mean spillover asset market is determined by obtaining the standardized term of error and its square in the first stage and substituting them into volatility and return equations of asset with BEAR period is as follows:

For difference in mean spillover during bull and bear period that is given as under:

$$r_{s,t} = \beta_o + \beta_1 \cdot r_{s,t-1} + \beta_2 \cdot \varepsilon_{s,t-1} + \beta_3 \cdot \sigma_{s,t} + \lambda_1 \cdot \varepsilon_{o,t} + \beta_4 \cdot BEAR + \beta_5 \cdot BEAR * \varepsilon_{o,t} \quad (3.8)$$

$$\sigma_{s,t}^2 = \gamma_o + \gamma_1 \cdot \mu_{s,t-1}^2 + \gamma_2 \cdot \sigma_{s,t-1}^2 \quad (3.9)$$

For difference in volatility spillover during bull and bear period that is given as under:

$$r_{s,t} = \beta_o + \beta_1 \cdot r_{s,t-1} + \beta_2 \cdot \varepsilon_{s,t-1} + \beta_3 \cdot \sigma_{s,t} + \lambda_1 \cdot \varepsilon_{o,t} \quad (3.10)$$

$$\sigma_{s,t}^2 = \gamma_o + \gamma_1 \cdot \mu_{s,t-1}^2 + \gamma_2 \cdot \sigma_{s,t-1}^2 + \gamma_3 \cdot BEAR + \lambda_2 \cdot \varepsilon_{o,t}^2 + \gamma_4 \cdot BEAR * \varepsilon_{o,t}^2 \quad (3.11)$$

BEAR is a dummy variable that is capturing the effect of structural break of 1 January-2009 to 30 September-2020 in financial market of Pakistan.

### 3.3.3.3 Difference in Spillover in Covid-19 Period

In the third stage, the influence of volatility and mean return spillover across market of asset is determined by obtaining the standardized error term and its square in the first stage and substituting them into the volatility and mean equations of asset also with the inclusion of a structural break due to pandemic of COVID-19.

For difference in mean spillover during COVID-19 period that is given as under:

$$r_{s,t} = \beta_o + \beta_1 \cdot r_{s,t-1} + \beta_2 \cdot \varepsilon_{s,t-1} + \beta_3 \cdot \sigma_{s,t} + \lambda_1 \cdot \varepsilon_{o,t} + \beta_4 \cdot COVID + \beta_5 \cdot COVID * \varepsilon_{o,t} \quad (3.12)$$

$$\sigma_{s,t}^2 = \gamma_o + \gamma_1 \cdot \mu_{s,t-1}^2 + \gamma_2 \cdot \sigma_{s,t-1}^2 \quad (3.13)$$

For difference in volatility spillover during COVID-19 period that is given as under:

$$r_{s,t} = \beta_o + \beta_1 \cdot r_{s,t-1} + \beta_2 \cdot \varepsilon_{s,t-1} + \beta_3 \cdot \sigma_{s,t} + \lambda_1 \cdot \varepsilon_{o,t} \quad (3.14)$$

$$\sigma_{s,t}^2 = \gamma_o + \gamma_1 \cdot \mu_{s,t-1}^2 + \gamma_2 \cdot \sigma_{s,t-1}^2 + \gamma_3 \cdot COVID + \lambda_2 \cdot \varepsilon_{o,t}^2 + \gamma_4 \cdot COVID * \varepsilon_{o,t}^2 \quad (3.15)$$

COVID is a dummy variable of pandemic of COVID-19 that is capturing the effect of structural break of 30 January-2020 to 30 September-2020 in financial market of Pakistan.



### 3.3.3.4 Difference in Spillover in Bear-bull and Covid-19 Period

In the fourth stage, the influence of mean return and volatility spillover of COVID and BEAR period is determined. In this stage the comparison occurs between them. In this stage the behavior of COVID and BEAR analyzed either the behavior of BEAR is different during COVID-19 or not. The equation is as follows: For difference in mean spillover during BEAR and COVID-19 period that is given as under:

$$r_{s,t} = \beta_o + \beta_1.r_{s,t-1} + \beta_2.\varepsilon_{s,t-1} + \beta_3.\sigma_{s,t} + \lambda_1.\varepsilon_{o,t} + \beta_4.BEAR + \beta_5.BEAR * \varepsilon_{o,t} + \beta_6.BEAR * COVID * \varepsilon_{o,t} \quad (3.16)$$

$$\sigma_{s,t}^2 = \gamma_o + \gamma_1.\mu_{s,t-1}^2 + \gamma_2.\sigma_{s,t-1}^2 \quad (3.17)$$

For difference in volatility spillover during BEAR and COVID-19 period that is given as under:

$$r_{s,t} = \beta_o + \beta_1.r_{s,t-1} + \beta_2.\varepsilon_{s,t-1} + \beta_3.\sigma_{s,t} + \lambda_1.\varepsilon_{o,t} \quad (3.18)$$

$$\sigma_{s,t}^2 = \gamma_o + \gamma_1.\mu_{s,t-1}^2 + \gamma_2.\sigma_{s,t-1}^2 + \gamma_3.BEAR + \gamma_4.\varepsilon_{o,t}^2 * BEAR + \lambda_2.\varepsilon_{o,t}^2 + \gamma_5.BEAR * COVID * \varepsilon_{o,t}^2 \quad (3.19)$$

## 3.3.4 Return and Volatility Spillover (ARMA-GARCH)

### 3.3.4.1 Equity market to oil Market Spillover

Liu and Pan 1997 presented (GARCH-M) GARCH-in-mean two stage approach is used to examine the volatility and mean spillover from equity market to oil market. In the first stage the relevant return of equity series is presented through an econometric model ARMA (1, 1)-GARCH (1, 1)-M.

$$r_{s,t} = \beta_s + \beta_1 \cdot r_{s,t-1} + \beta_2 \cdot \varepsilon_{s,t-1} + \beta_3 \cdot \sigma_{s,t} + \varepsilon_{s,t} \quad (3.20)$$

$$\sigma_{s,t}^2 = \gamma_o + \gamma_1 \cdot \mu_{s,t-1}^2 + \gamma_2 \cdot \sigma_{s,t-1}^2 \quad (3.21)$$

Where  $r_{s,t}$  is the daily returns of equity market at time t and  $\varepsilon_{s,t}$  is the residual or unexpected return in other words, the error term. Basically, the adjustment of the serial correlation in the data is major purpose of the inclusion of MA (1) or ARMA (1,1) structure in the model.

The influence of return and volatility transmission of oil is determined by obtaining the standardized error term and its square in the first stage and putting them in to the equations of volatility and return.

$$r_{o,t} = \beta_o + \beta_1 \cdot r_{o,t-1} + \beta_2 \cdot \varepsilon_{o,t-1} + \beta_3 \cdot \sigma_{o,t} + \lambda_1 \cdot \varepsilon_{s,t} \quad (3.22)$$

$$\sigma_{o,t}^2 = \gamma_o + \gamma_1 \cdot \mu_{o,t-1}^2 + \gamma_2 \cdot \sigma_{o,t-1}^2 + \lambda_2 \varepsilon_{s,t}^2 \quad (3.23)$$

### 3.3.4.2 Difference in Spillover during Bear and Bull Period

In second stage the volatility and mean spillover influence across asset market is determined by obtaining standardized error term and its square in the stage first and substituting them into the volatility and mean equations of asset also with BEAR period as follows:

For difference in mean spillover during bull and bear period that is given as under:

$$r_{o,t} = \beta_o + \beta_1 \cdot r_{o,t-1} + \beta_2 \cdot \varepsilon_{o,t-1} + \beta_3 \cdot \sigma_{o,t} + \lambda_1 \cdot \varepsilon_{s,t} + \beta_4 \cdot BEAR + \beta_5 \cdot BEAR * \varepsilon_{s,t} \quad (3.24)$$

$$\sigma_{o,t}^2 = \gamma_o + \gamma_1 \cdot \mu_{o,t-1}^2 + \gamma_2 \cdot \sigma_{o,t-1}^2 \quad (3.25)$$

For difference in volatility spillover during bull and bear period that is given as under:

$$r_{o,t} = \beta_o + \beta_1 \cdot r_{o,t-1} + \beta_2 \cdot \varepsilon_{o,t-1} + \beta_3 \cdot \sigma_{o,t} + \lambda_1 \cdot \varepsilon_{s,t} \quad (3.26)$$

$$\sigma_{o,t}^2 = \gamma_o + \gamma_1 \cdot \mu_{o,t-1}^2 + \gamma_2 \cdot \sigma_{o,t-1}^2 + \gamma_3 \cdot BEAR + \lambda_2 \varepsilon_{s,t}^2 + \gamma_4 \cdot BEAR * \varepsilon_{s,t}^2 \quad (3.27)$$

BEAR is a dummy variable that is capturing the process bearish bullish during 1 January-2009 to 30 September-2020 in financial market of Pakistan.

### 3.3.4.3 Difference in Spillover in Covid-19 Period

In the third stage the influence of volatility and mean return spillover across asset market is determined by acquiring standardized error term and its square in stage first and substituting them into volatility and mean equations of asset also with the inclusion of a during for pandemic of COVID-19 as follows:

For difference in mean spillover during COVID-19 period that is given as under:

$$r_{o,t} = \beta_o + \beta_1 \cdot r_{o,t-1} + \beta_2 \cdot \varepsilon_{o,t-1} + \beta_3 \cdot \sigma_{o,t} + \lambda_1 \cdot \varepsilon_{s,t} + \beta_4 \cdot COVID + \beta_5 \cdot COVID * \varepsilon_{s,t} \quad (3.28)$$

$$\sigma_{o,t}^2 = \gamma_o + \gamma_1 \cdot \mu_{o,t-1}^2 + \gamma_2 \cdot \sigma_{o,t-1}^2 \quad (3.29)$$

For difference in volatility spillover during COVID-19 period that is given as under:

$$r_{o,t} = \beta_o + \beta_1 \cdot r_{o,t-1} + \beta_2 \cdot \varepsilon_{o,t-1} + \beta_3 \cdot \sigma_{o,t} + \lambda_1 \cdot \varepsilon_{s,t} \quad (3.30)$$

$$\sigma_{o,t}^2 = \gamma_o + \gamma_1 \cdot \mu_{o,t-1}^2 + \gamma_2 \cdot \sigma_{o,t-1}^2 + \gamma_3 \cdot COVID + \lambda_2 \varepsilon_{s,t}^2 + \gamma_4 \cdot COVID * \varepsilon_{s,t}^2 \quad (3.31)$$

COVID is a dummy variable of pandemic of COVID-19 that is capturing the effect of covid-19 during of 30 January-2020 to 30 September-2020 in financial market of Pakistan.

### 3.3.4.4 Difference in Spillover in Bear-bull and Covid-19 period

In the fourth stage, the influence of mean return and volatility spillover of COVID and BEAR period is determined. In this stage the comparison occurs between them. In this stage the behavior of COVID and BEAR analyzed either the behavior of BEAR is different during COVID or not. The equation is as follows:

For difference in mean spillover during bear-bull and COVID-19 period that is given as under:

$$\begin{aligned} r_{o,t} = & \beta_o + \beta_1.r_{o,t-1} + \beta_2.\varepsilon_{o,t} + \beta_3.\sigma_{o,t} + \lambda_1.\varepsilon_{s,t} + \beta_4.BEAR \\ & + \beta_5.BEAR * \varepsilon_{s,t} + \beta_6.BEAR * COVID * \varepsilon_{s,t} \end{aligned} \quad (3.32)$$

$$\sigma_{o,t}^2 = \gamma_o + \gamma_1.\mu_{o,t-1}^2 + \gamma_2.\sigma_{o,t-1}^2 \quad (3.33)$$

For difference in volatility spillover during bear-bull and COVID-19 period that is given as under:

$$r_{o,t} = \beta_o + \beta_1.r_{o,t-1} + \beta_2.\varepsilon_{o,t} + \beta_3.\sigma_{o,t} + \lambda_1.\varepsilon_{s,t} \quad (3.34)$$

$$\begin{aligned} \sigma_{o,t}^2 = & \gamma_o + \gamma_1.\mu_{o,t-1}^2 + \gamma_2.\sigma_{o,t-1}^2 + \gamma_3 * BEAR + \gamma_4.\varepsilon_{s,t}^2 * BEAR \\ & + \gamma_5 * BEAR * COVID * \varepsilon_{s,t}^2 + \lambda_2\varepsilon_{s,t}^2 \end{aligned} \quad (3.35)$$

### 3.3.5 Time-Varying Conditional Correlation

The correlation is constant over the time period above model assumes but correlation may be vary with the passage of time. So, in that situation the DCC-GARCH

dynamic conditional correlation model is used and possibility of asymmetry in the model will be captured by ADCC-GARCH model. Dynamic Conditional Correlation model or DCC, models the volatilities and correlations in two steps. The detail about the dynamics of correlation is reached out to permit asymmetries vital for financial practice.

When two stocks move same direction in a time the correlation increases marginally. On the opposite side, when similar two stocks move inverse way correlation become vanished. In the markets that are down the effect is stronger of stock movements. The temporarily correlations moves from a long run mean.

A symmetric DCC model gives higher tail dependence for both upper and lower tails of the multi-period joint density while, an asymmetric DCC or ADCC gives higher tail dependence in the lower tail of the multi-period density.

The dynamic conditional correlation model is shown as under:

$$Q_t = \bar{R} + \theta_1(\varepsilon_{t-i}\varepsilon'_{t-i} - \bar{R}) + \theta_2(Q_{t-1} - \bar{R}) \quad (3.36)$$

The asymmetric dynamic conditional correlation model is shown as under:

$$Q_t = \bar{R} + \theta_1(\varepsilon_{t-i}\varepsilon'_{t-i} - \bar{R}) + \theta_2(Q_{t-1} - \bar{R}) + \theta_3(\eta_t\eta'_t - \bar{N}) \quad (3.37)$$

# Chapter 4

## Data Analysis and Discussions

### 4.1 Return & Volatility Spillover from Oil Market to Equity Market

The methodology's first part is to examine volatility and return spillover from the oil market to equity market by using a suitable econometric model. Table 4.1 shows the estimates of spillover of volatility and return from oil to equity market by using an ARMA GARCH (o,t) model. Moreover, a dummy variable is also used in the study with both return and volatility spillover. All coefficients are also reported with their p-value (in parenthesis) of ARCH and GARCH.

For equity  $\beta_1$  is insignificant that means the return of KSE cannot be predicted by using past prices behavior.  $\beta_2$  is an insignificant market so that the market cannot make some necessary adjustments for the next day based on previous shocks. While  $\beta_3$  is found to be insignificant so that means the mean returns cannot be predicted by using forecasted volatility. The result of mean spillover  $\lambda_1$  is found to be insignificant so the changes that occur in the OIL market will not affect the returns of the KSE market. So the mean spillover doesn't exist. In other words, the fluctuations in the OIL market will not affect the KSE market significantly. The  $\gamma_1$  is found to be significant which shows the current period volatility can be estimated by using the prices behavior of past.  $\gamma_2$  is significant so that means the persistence of volatility exists. The result of volatility spillover  $\lambda_{52}$  is found to

TABLE 4.1: Return &amp; Volatility Spillover from oil market-to-equity market - ARMA GARCH Model

	OIL	KSE
$\beta_0$	-0.0006 (0.2725)	0.0007 (0.0166)
$\beta_1$	-0.0755 (0.9139)	0.0985 (0.4324)
$\beta_2$	0.0527 (0.9399)	0.056 (0.6600)
$\beta_3$	2.8884 (0.1808)	3.6081 (0.2027)
$\lambda_1$	-	-4.06E-05 (0.7948)
$\gamma_0$	7.36E-06 -	2.02E-06 (0.0001)
$\gamma_1$	0.0954 (0.0000)	0.1144 (0.0000)
$\gamma_2$	0.893 (0.0000)	0.8537 (0.0000)
$\lambda_2$	-	5.08E-10 (0.0000)

*The values in parenthesis are p-values.  $\lambda_1$  denotes the parameters of mean spillover. While  $\lambda_2$  denotes the parameters of volatility spillover*

be significant so the volatility spillover exists. So that the fluctuation in the OIL market affect the KSE market and it is positive so that means the volatility of the KSE market increases when the volatility of the OIL market increases.

#### 4.1.1 The Difference in Volatility and Return Spillover from Oil to Equity in Bear and Bull Period

The study further uses a dummy variable of the bear period to see the effect of

TABLE 4.2: The Mean Spillover from Oil Market-To-Equity Market in Bearish and Bullish Period

Parameter	Coefficient
$\beta_0$	0.0006 (0.0262)
$\beta_1$	0.1566 (0.0000)
$\beta_2$	-2.30E-08 (0.3362)
$\beta_3$	3.6999 (0.1896)
$\lambda_1$	-0.0002 (0.2263)
$\beta_4$	2.24E-05 (0.9388)
$\beta_5$	0.00049 (0.1097)

*The values in parenthesis are p-values. The  $\lambda_1$  denotes the returns of bear period. Where  $\beta_4$  shows change in the returns in bear period. While  $\beta_5$  shows the change in the return spillover in bear period*

the bear-bull period on spillover between the oil market and the equity market. For equity  $\beta_1$  is significant that means the return of KSE can be predicted by using past prices behavior.  $\beta_2$  is an insignificant market so that the market cannot make some necessary adjustments for the next day based on previous shocks. While  $\beta_3$  is found to be insignificant so that means the mean returns cannot be predicted by using forecasted volatility. The result of  $\beta_4$  is found to be insignificant so the returns of the bear period are not different from the rest of the period.  $\beta_5$  is found to be insignificant so the return spillover during the bear period is not different from the rest of the period. The result of mean spillover  $\lambda_1$  is found to



be insignificant so the changes that occur in the OIL market will not affect the returns of the KSE market. So the mean spillover doesn't exist. In other words, the fluctuations in the OIL market will not affect the KSE market significantly.

TABLE 4.3: Volatility Spillover from Oil Market to Equity Market in Bullish and Bearish Period

Parameter	Coefficient
$\gamma_0$	1.49E-07 (0.8646)
$\gamma_1$	0.1134 (0.0000)
$\gamma_2$	0.8559 (0.0000)
$\gamma_3$	3.67E-06 (0.0123)
$\lambda_2$	5.98E-10 (0.0004)
$\gamma_6$	-2.21E-10 (0.3498)

*The values in parenthesis are p-values. The  $\lambda_1$  denotes the returns of bear period. Where  $\beta_4$  shows change in the returns in bear period. While  $\beta_5$  shows the change in the return spillover in bear period*

The  $\gamma_1$  is found to be significant which shows the current period volatility can be estimated by using the prices behavior of past.  $\gamma_2$  is significant so that means the persistence of volatility exists. The  $\gamma_3$  is significant so volatility exists. The result of volatility spillover  $\lambda_2$  of the bear-bull period is found to be significant so the volatility during the bear is different from the rest of the period. The  $\gamma_6$  is insignificant so the volatility spillover during the bear is not different from the rest of the period.

### 4.1.2 The Difference in Volatility and Return Spillover from Oil to Equity in Covid-19 Period

The study further uses a dummy variable of the covid-19 period to see the effect of the covid-19 period on spillover between the oil and the equity market. For equity  $\beta_1$  is significant that means the return of KSE can be predicted by using past prices behavior.

TABLE 4.4: The Mean Spillover from Oil Market-To-Equity Market in Covid-19 Period

Parameter	Coefficient
$\beta_0$	0.0006 (0.0179)
$\beta_1$	0.1566 (0.0000)
$\beta_2$	-2.35E-08 (0.3265)
$\beta_3$	3.7575 (0.1847)
$\lambda_1$	9.60E-05 (0.5502)
$\beta_4$	0.0009 (0.2112)
$\beta_5$	0.001533 (0.0146)

*The values in parenthesis are p-values. The  $\lambda_1$  denotes the returns of covid period. Where  $\beta_4$  shows change in the returns in covid period. While  $\beta_5$  shows the change in the return spillover in volatility period. Covid is a dummy variable*

$\beta_2$  is an insignificant market so that the market cannot make some necessary adjustments for the next day based on previous shocks. While  $\beta_3$  is found to be insignificant so that means the mean returns cannot be predicted by using forecasted volatility. The result of  $\beta_4$  is found to be insignificant so the returns of the bear period are not different from the rest of the period.  $\beta_5$  is found to be

significant so the return spillover during covid-19 is different from the rest of the period. It is positive so that means in the period of covid-19 the return spillover has increased. The  $\lambda_1$  is found to be insignificant so the returns of the covid-19 period are not different from the rest of the period. So basically the spillover doesn't exist but the spillover has been increased during this period.

TABLE 4.5: Volatility Spillover from Oil Market to Equity Market During Covid-19 Period

Parameter	Coefficient
$\gamma_0$	2.09E-06 (0.0001)
$\gamma_1$	0.1151 (0.0000)
$\gamma_2$	0.8522 (0.0000)
$\gamma_3$	-1.04E-06 (0.4744)
$\lambda_2$	4.89E-10 (0.0000)
$\gamma_6$	9.66E-10 (0.2516)

*The values in parenthesis are p-values. The  $\lambda_2$  denotes the change in volatility spillover in covid period.. While  $\gamma_6$  shows the volatility spillover in covid period. The covid is a dummy variable*

The  $\gamma_1$  is found to be significant which shows the current period volatility can be estimated by using the prices behavior of past.  $\gamma_2$  is significant so that means the persistence of volatility exists. The  $\gamma_3$  is insignificant so volatility doesn't exist. While the volatility  $\lambda_2$  of the covid period is significant so the volatility during covid-19 is different from the rest of the period.  $\gamma_6$  is insignificant so the volatility spillover during covid-19 is not different from the rest of the period.

### 4.1.3 The Difference in Volatility and Return Spillover from Oil to Equity in Bear-Bull and Covid-19 Period

The study used a dummy variable of the bear-covid period to see the effect of the bear-covid period on spillover between the oil market and the equity market. For equity  $\beta_1$  is significant that means the return of KSE can be predicted by using past prices behavior.

TABLE 4.6: The Mean Spillover from Oil Market-To-Equity Market in Bear-Bull and Covid-19 Period

Parameter	Coefficient
$\beta_0$	0.0006 (0.0266)
$\beta_1$	0.1566 (0.0000)
$\beta_2$	-2.31E-08 (0.3354)
$\beta_3$	3.7126 (0.1887)
$\lambda_1$	-2.00E-04 (0.2265)
$\beta_4$	0.0000242 (0.9339)
$\beta_5$	0.0004 (0.1205)
$\beta_6$	0.0001 (0.8661)

*The values in parenthesis are p-values.  $\beta_4$  shows the change occur in the returns of bear period. The  $\beta_5$  shows the change in the behavior of bear and covid period.. While  $\beta_6$  shows the change in the spillover*

$\beta_2$  is an insignificant market so that the market cannot make some necessary adjustments for the next day based on previous shocks. While  $\beta_3$  is found to

be insignificant so that means the mean returns cannot be predicted by using forecasted volatility. The  $\lambda_1$  is found to be insignificant so the returns of the covid-19 period are not different from the rest of the period. The result of  $\beta_4$  is found to be insignificant so the returns of the bear period are not different from the rest of the period.  $\beta_5$  is found insignificant so that means there is no change in the spillover.  $\beta_6$  is found to be insignificant so there is no change in the behavior of the bear period and the covid period.

TABLE 4.7: Volatility Spillover from Oil Market-To-Equity Market in Bear-Bull and Covid Period

Parameter	Coefficient
$\gamma_0$	1.40E-07 (0.8730)
$\gamma_1$	0.1132 (0.0000)
$\gamma_2$	8.56E-01 (0.0000)
$\gamma_3$	3.69E-06 (0.0119)
$\gamma_4$	-2.27E-10 (0.3368)
$\gamma_5$	3.48E-10 (0.7428)
$\lambda_2$	6E-10 (0.0004)

*The values in parenthesis are p-values. The  $\gamma_3$  shows the behavior of bear period. The  $\gamma_5$  shows the change in the behavior of bear and covid period. The  $\lambda_2$  denotes the volatility spillover. While  $\gamma_4$  shows the change in volatility spillover*

The  $\gamma_1$  is found to be significant which shows the current period volatility can be estimated by using the prices behavior of past.  $\gamma_2$  is significant so that means the persistence of volatility exists. The  $\gamma_3$  is insignificant so volatility doesn't exist. While the volatility  $\lambda_2$  of the covid period is significant so the volatility during covid-19 is different from the rest of the period. The spillover of the bear and

covid period both are the same.  $\gamma_3$  is significant so the behavior of the bear period is different. The volatility of bear period effects.  $\gamma_4$  is insignificant so there is no change in the spillover volatility.  $\gamma_5$  is insignificant so there is no change in the behavior of the bear period and the covid period. The spillover of the bear and covid period both are the same.

## 4.2 Return & Volatility Spillover from Oil Market-To-Shariah Compliance

The first part of the methodology is to examine the return and volatility spillover from the oil-to-shariah compliance market by using a suitable econometric model.

TABLE 4.8: Return & Volatility Spillover from oil market-to-sharia compliance-ARMA GARCH Model

	OIL	KMI
$\beta_0$	-0.0006	0.0002
	-0.2649	-0.0352
$\beta_1$	-0.0713	-0.0801
	-0.9162	-0.6124
$\beta_2$	0.0475	0.1976
	-0.9442	-0.216
$\beta_3$	2.8853	3.0421
	-0.171	-0.0534
$\lambda_1$	-	1.44E-05
	-	-0.924
$\gamma_0$	7.46E-06	2.07E-07
	(0.0000)	(0.0000)
$\gamma_1$	0.0959	0.1153
	(0.0000)	(0.0000)
$\gamma_2$	0.8923	0.8515
	(0.0000)	(0.0000)
$\lambda_2$	-	1.41E-09
	-	(0.0000)

*The values in parenthesis are p-values.  $\lambda_1$  denotes the parameters of mean spillover. While  $\lambda_2$  denotes the parameters of volatility spillover*

Table 4.8 shows the estimates of return and volatility spillovers from oil-to-shariah compliance market by using an ARMA GARCH (o,t) model. Moreover, a dummy variable is also used in the study with both return and volatility spillover. All ARCH and GARCH coefficients are also reported with their p-value (in parenthesis).

For shariah compliance  $\beta_1$  is insignificant that means the return of KMI cannot be predicted by using past prices behavior.  $\beta_2$  is an insignificant market so that the market cannot make some necessary adjustments for the next day based on previous shocks. While  $\beta_3$  is found to be significant so the returns can be predicted by forecasted volatility. The result of mean spillover  $\lambda_1$  is found to be insignificant so the changes that occur in the OIL market will not affect the returns of the KMI market. So the mean spillover doesn't exist. In other words, the fluctuations in the OIL market will not affect the KMI market significantly. The  $\gamma_1$  is found to be significant which indicates that, the volatility of the current period can be predicted by using the past prices behavior.  $\gamma_2$  is significant so it means the persistence of volatility exists. The result of volatility spillover  $\lambda_2$  is found to be significant so the volatility spillover exists. So the fluctuation in the OIL market will affect the KMI market and it is positive so that means the volatility of the KMI market increases when the volatility of the OIL market increases.

#### **4.2.1 The Difference in Return and Volatility Spillover from Oil to Shariah Compliance in Bear Period**

For shariah compliance  $\beta_1$  is significant that means the return of KMI can be predicted by using past prices behavior.  $\beta_2$  is an insignificant market so that the market cannot make some necessary adjustments for the next day based on previous shocks. While  $\beta_3$  is found to be insignificant so the returns cannot be predicted by forecasted volatility. The result of mean spillover  $\lambda_1$  is found to be insignificant so the changes that occur in the OIL market will not affect the returns of the KMI market. So the mean spillover doesn't exist. In other words, the fluctuations in the OIL market will not affect the KMI market significantly. The

TABLE 4.9: The Mean Spillover from Oil Market to Sharia Market in Bear-Bull Period

Parameter	Coefficient
$\beta_0$	0.0002 (0.1910)
$\beta_1$	0.1169 (0.0000)
$\beta_2$	-1.46E-08 (0.6203)
$\beta_3$	3.021 (0.1404)
$\lambda_1$	0.0003 (0.0630)
$\beta_4$	-1.00E-04 (0.4779)
$\beta_5$	-0.0003 (0.1893)

*The values in parenthesis are p-values. The  $\lambda_1$  denotes the returns of bear period. Where  $\beta_4$  shows change in the returns in bear period. While  $\beta_5$  shows the change in the return spillover in bear period*

study further uses a dummy variable of the bear period to see the effect of the bear period on spillover between the oil market and the shariah compliance. The result of  $\beta_4$  is found to be insignificant so the returns of the bear period are not different from the rest of the period.  $\beta_5$  is found to be insignificant so the return spillover during the bear period is not different from the rest of the period.

The  $\gamma_1$  is found to be significant which indicates that, the volatility of the current period can be predicted by using the past prices behavior.  $\gamma_2$  is significant so it means the persistence of volatility exists. The result of volatility spillover  $\gamma_3$  is found insignificant so volatility doesn't exist. While the volatility  $\lambda_2$  of the bear period is significant so the volatility during the bear is different from the rest of the period. The  $\gamma_4$  is significant so the volatility spillover during bear is different from the rest of the period. It is negative so it means that in the period of bear the volatility spillover was less.



TABLE 4.10: Volatility Spillover from Oil Market to Sharia Market in Bear-Bull Period

Parameter	Coefficient
$\gamma_0$	-3.76E-07 (0.0000)
$\gamma_1$	0.1129 (0.0000)
$\gamma_2$	0.8547 (0.0000)
$\gamma_3$	2.17E-07 (0.1381)
$\lambda_2$	2.38E-09 (0.0000)
$\gamma_4$	-2.01E-09 (0.0000)

*The values in parenthesis are p-values. The  $\lambda_2$  denotes the change in volatility spillover in bear period. While  $\gamma_4$  shows the volatility spillover in bear period*

#### 4.2.2 The Difference in Return and Volatility Spillover from Oil to Shariah Compliance in Covid-19 Period

The study further uses a dummy variable of the covid-19 period to see the effect of the covid-19 period on spillover between the oil market and the shariah compliance. For shariah compliance  $\beta_1$  is significant that means the return of KMI can be predicted by using past prices behavior.  $\beta_2$  is an insignificant market so that the market cannot make some necessary adjustments for the next day based on previous shocks. While  $\beta_3$  is found to be significant so the returns can be predicted by forecasted volatility.  $\beta_4$  is found to be insignificant so the returns of the bear period are not different from the rest of the period.  $\beta_5$  is insignificant so the return spillover during covid-19 is not different from the rest of the period. The  $\lambda_1$  is found to be insignificant so the return of the covid period is not different from the rest of the period.

The  $\gamma_1$  is found to be significant which indicates that, the volatility of the current period can be predicted by using the past prices behavior.  $\gamma_2$  is significant so it

TABLE 4.11: The Mean Spillover from Oil Market-To-Shariah Compliance in Covid-19 Period

Parameter	Coefficient
$\beta_0$	2.60E-05 (0.7578)
$\beta_1$	0.1142 (0.0000)
$\beta_2$	-7.71E-09 (0.7879)
$\beta_3$	3.7037 (0.0419)
$\lambda_1$	5.57E-05 (0.7483)
$\beta_4$	0.0009 (0.2089)
$\beta_5$	0.0008 (0.3402)

The values in parenthesis are  $p$ -values. The  $\lambda_1$  denotes the returns of covid period. Where  $\beta_4$  shows change in the returns in covid period. While  $\beta_5$  shows the change in the return spillover in covid period. Covid is a dummy variable

TABLE 4.12: Volatility Spillover from Oil Market-To-Shariah Compliance in Covid-19 Period

Parameter	Coefficient
$\gamma_0$	-2.26E-07 (0.0000)
$\gamma_1$	0.1084 (0.0000)
$\gamma_2$	0.8654 (0.0000)
$\gamma_3$	5.48E-06 (0.0204)
$\lambda_2$	1.41E-09 (0.0000)
$\gamma_6$	-1.68E-09 (0.0157)

The values in parenthesis are  $p$ -values. The  $\lambda_2$  denotes the change in volatility spillover in covid period. While  $\gamma_6$  shows the volatility spillover in covid period. The covid is a dummy variable

means the persistence of volatility exists. The result of volatility spillover  $\gamma_3$  is found significant so volatility exists. While the volatility  $\lambda_2$  of the covid period is significant so the volatility during covid is different from the rest of the period.  $\gamma_6$  significant so the volatility spillover during covid is different from the rest of the period. It is negative so it means that in the period of covid the volatility spillover was less.

### 4.2.3 The Difference in Return and Volatility Spillover from Oil to Shariah Compliance in Bear-Covid Period

The study further uses a dummy variable of the bear-covid period to see the effect of the bear-covid period on spillover between the oil market and the shariah compliance. For shariah compliance  $\beta_1$  is significant that means the return of KMI

TABLE 4.13: The Mean Spillover from Oil Market-To-Shariah Compliance in Bear-Bull and Covid Period

Parameter	Coefficient
$\beta_0$	0.0002 (0.4022)
$\beta_1$	0.1163 (0.0000)
$\beta_2$	-1.27E-08 (0.6929)
$\beta_3$	4.2745 (0.0693)
$\lambda_1$	0.0003 (0.0744)
$\beta_4$	-0.0001 (0.5501)
$\beta_6$	0.0013 (0.2601)
$\beta_5$	-0.0004 (0.2601)

*The values in parenthesis are p-values. The  $\lambda_1$  denotes the volatility spillover.  $\beta_4$  shows the change occur in the returns of bear period. The  $\beta_5$  shows the change in the behavior of bear and covid period. While  $\beta_6$  shows the change in the spillover*

can be predicted by using past prices behavior.  $\beta_2$  is an insignificant market so that the market cannot make some necessary adjustments for the next day based on previous shocks. While  $\beta_3$  is found to be insignificant so the returns cannot be predicted by forecasted volatility. The  $\beta_4$  is found to be insignificant so there is no change occur in the returns of the bear period.  $\beta_5$  is found insignificant so that means there is no change in the spillover.  $\beta_6$  is found to be insignificant so there is no change in the behavior of the bear period and the covid period. The spillover of the bear and covid period both are the same. The  $\lambda_1$  is found to be insignificant so the return of the covid period is not different from the rest of the period.

TABLE 4.14: Volatility Spillover from Oil Market-To-Shariah Compliance in Bear-Bull and Covid Period

Parameter	Coefficient
$\gamma_0$	0.0001 (0.0000)
$\gamma_1$	0.1500 (0.0001)
$\gamma_2$	0.6000 (0.0000)
$\gamma_3$	-8.34E-06 (0.5934)
$\lambda_2$	-9.83E-10 (0.0001)
$\gamma_4$	-1.02E-09 (0.0014)
$\gamma_5$	-4.90E-09 (0.0104)

*The values in parenthesis are p-values. The  $\gamma_3$  shows the behavior of bear period. The  $\gamma_5$  shows the change in the behavior of bear and covid period. The  $\lambda_2$  denotes the volatility spillover. While  $\gamma_4$  shows the change in volatility spillover*

The  $\gamma_1$  is found to be significant which indicates that, the volatility of the current period can be predicted by using the past prices behavior.  $\gamma_2$  is significant so it means the persistence of volatility exists.  $\gamma_3$  is insignificant so there is no change

occur in the volatility of bear period. The volatility of bear period effects.  $\gamma_4$  is significant so there is change in the spillover.  $\gamma_5$  is insignificant so there is no change in the behavior of the bear period and the covid period. The spillover of the bear and covid period both are the same. While the volatility  $\lambda_2$  of the covid period is significant so the volatility during covid is different from the rest of the period.

### 4.3 Return & Volatility Spillover from Equity Market-to-Oil Market

The first part of the methodology is to examine the return and volatility spillover from the equity-to-oil market by using a suitable econometric model. Table 4.15 shows the estimates of return and volatility spillovers from equity to oil market by using an ARMA GARCH (s,t) model. Moreover, a dummy variable is also used in the study with both return and volatility spillover. All ARCH and GARCH coefficients are also reported with their p-value (in parenthesis).

For oil  $\beta_1$  is insignificant that means the return of oil cannot be predicted by using past prices behavior.  $\beta_2$  is an insignificant market so that the market cannot make some necessary adjustments for the next day based on previous shocks. While  $\beta_3$  is insignificant so the returns cannot be predicted by forecasted volatility. The result of mean spillover  $\lambda_1$  is found to be insignificant so the changes that occur in the equity market will not affect the returns of the oil market. So the mean spillover doesn't exist.

In other words, the fluctuations in the equity market will not affect the oil market significantly. The  $\gamma_1$  is found to be significant which indicates that, the volatility of the current period can be predicted by using the past prices behavior.  $\gamma_2$  is significant so it means the persistence of volatility exists. The result of volatility spillover  $\lambda_2$  is found to be significant so the volatility spillover exists. So that means fluctuation in the equity market will affect the oil market and it is positive

TABLE 4.15: Return & Volatility Spillover from Equity Market-to-Oil Market  
- ARMA GARCH Model

	KSE	OIL
$\beta_0$	0.0007 (0.0165)	-0.0004 (0.4025)
$\beta_1$	0.1166 (0.0000)	0.1285 (0.8554)
$\beta_2$	0.0339 (0.7888)	-0.1489 (0.8331)
$\beta_3$	3.476 (0.2260)	2.2434 (0.2992)
$\lambda_1$	-	-0.0004 (0.1442)
$\gamma_0$	3.55E-06 (0.0000)	3.51E-06 (0.0410)
$\gamma_1$	0.1166 (0.0000)	0.0968 (0.0000)
$\gamma_2$	0.8531 (0.0000)	0.8915 (0.0000)
$\lambda_2$	-	2.86E-10 (0.0002)

*The Values in parenthesis are p-values.  $\lambda_1$  denotes the parameters of mean spillover. While  $\lambda_2$  denotes the parameters of volatility spillover*

so that means the volatility of the oil market increases when the volatility of the equity market increases.

### 4.3.1 The Difference in Return and Volatility Spillover from Equity to Oil in Bear-Bull Period

The study used a dummy variable of the bear period to see the effect of the bear period on spillover between the equity market and the oil market. For oil  $\beta_1$  is insignificant that means the return of oil cannot be predicted by using past prices behavior.  $\beta_2$  is an insignificant market so that the market cannot make some necessary adjustments for the next day based on previous shocks. While  $\beta_3$  is

TABLE 4.16: The Mean Spillover from Equity Market-To-Oil Market in Bear-Bull Period

Parameter	Coefficient
$\beta_0$	-0.0007 (0.1306)
$\beta_1$	-0.0191 (0.3487)
$\beta_2$	-1.53E-08 -0.1365
$\beta_3$	2.5584 (0.0000)
$\lambda_1$	-9.53 (0.1365)
$\beta_4$	0.0007 (0.2040)
$\beta_5$	0.0013 (0.0229)

*The values in parenthesis are p-values. The  $\lambda_1$  denotes the returns of bear period. Where  $\beta_4$  shows change in the returns in bear period. While  $\beta_5$  shows the change in the return spillover in bear period*

significant so the returns can be predicted by forecasted volatility. The result of mean spillover  $\lambda_1$  is found to be insignificant so the changes that occur in the equity market will not affect the returns of the oil market. So the mean spillover doesn't exist.

In other words, the fluctuations in the equity market will not affect the oil market significantly. The  $\beta_4$  is found to be insignificant so there is no change occur in the returns of the bear period.  $\beta_5$  is significant so the return spillover during bear is different from the rest of the period. It is positive so it means that in the period of bear the return spillover was more. So basically the spillover doesn't exist but the spillover increased in this period.

The  $\gamma_1$  is found to be significant which indicates that, the volatility of the current period can be predicted by using the past prices behavior.  $\gamma_2$  is significant so it means the persistence of volatility exists.  $\gamma_3$  is found significant so volatility exists.

TABLE 4.17: Volatility Spillover from Equity Market-To-Oil Market in Bear-Bull Period

Parameter	Coefficient
$\gamma_0$	-1.23E-05 (0.0000)
$\gamma_1$	0.0858 (0.0000)
$\gamma_2$	0.9037 (0.0000)
$\gamma_3$	3.28E-05 (0.0000)
$\lambda_2$	4.02E-10 (0.0003)
$\gamma_4$	-3.77E-10 (0.0243)

*The values in parenthesis are p-values. The  $\lambda_2$  denotes the change in volatility spillover in bear period. While  $\gamma_4$  shows the volatility spillover in bear period*

While the volatility  $\lambda_2$  of the bear period is significant so the volatility during the bear is different from the rest of the period. The  $\gamma_4$  is significant so the volatility spillover during bear is different from the rest of the period. It is negative so it means that in the period of bear the volatility spillover was less.

### 4.3.2 The Difference in Return and Volatility Spillover from Equity to Oil in Covid-19 Period

The study used a dummy variable of the covid period to see the effect of the covid period on spillover between the equity market and the oil market. For oil  $\beta_1$  is insignificant that means the return of oil cannot be predicted by using past prices behavior.  $\beta_2$  is an insignificant market so that the market cannot make some necessary adjustments for the next day based on previous shocks. While  $\beta_3$  is significant so the returns can be predicted by forecasted volatility. The  $\beta_4$  is found to be insignificant so there is no change occur in the returns of the bear



TABLE 4.18: The Mean Spillover from Equity Market-To-Oil Market in Covid Period

Parameter	Coefficient
$\beta_0$	-0.0003 (0.3338)
$\beta_1$	-0.0204 (0.3175)
$\beta_2$	-0.0204 (0.3175)
$\beta_3$	2.5654 (0.0001)
$\lambda_1$	-0.0004 (0.1894)
$\beta_4$	0.0002 (0.9247)
$\beta_5$	0.0009 (0.4524)

*The values in parenthesis are p-values. The  $\lambda_1$  denotes the returns of covid period. Where  $\beta_4$  shows change in the returns in covid period. While  $\beta_5$  shows the change in the return spillover in covid period. Covid is a dummy variable*

period. The  $\lambda_1$  is found to be insignificant so the return of the covid period is not different from the rest of the period.  $\beta_5$  is insignificant so the return spillover during covid is not different from the rest of the period.

The  $\gamma_1$  is found to be significant which indicates that, the volatility of the current period can be predicted by using the past prices behavior.  $\gamma_2$  is significant so it means the persistence of volatility exists.  $\gamma_3$  is found significant so volatility exists. While the volatility  $\lambda_2$  of the bear period is significant so the volatility during the bear is different from the rest of the period. The  $\gamma_4$  is significant so the volatility spillover during bear is different from the rest of the period. It is negative so it means that in the period of bear the volatility spillover was less.  $\gamma_6$  significant so the volatility spillover during covid is different from the rest of the period. It is negative so it means that in the period of covid the volatility spillover was less.

TABLE 4.19: Volatility Spillover from Equity Market-To-Oil Market in Covid Period

Parameter	Coefficient
$\gamma_0$	0.0001 (0.0000)
$\gamma_1$	0.162 (0.0000)
$\gamma_2$	0.608 (0.0000)
$\gamma_3$	0.0004 (0.0000)
$\lambda_2$	-6.79E-10 (0.0000)
$\gamma_6$	-7.80E-09 (0.0082)

*The values in parenthesis are p-values. The  $\lambda_2$  denotes the change in volatility spillover in covid period. While  $\gamma_6$  shows the volatility spillover in covid period. The covid is a dummy variable*

### 4.3.3 The Difference in Return and Volatility Spillover from Equity to Oil in Bear-Covid Period

The study used a dummy variable of the bear-covid period to see the effect of the bear-covid period on spillover between the equity market and the oil market. For oil  $\beta_1$  is insignificant that means the return of oil cannot be predicted by using past prices behavior.  $\beta_2$  is an insignificant market so that the market cannot make some necessary adjustments for the next day based on previous shocks.

While  $\beta_3$  is significant so the returns can be predicted by forecasted volatility. The  $\lambda_1$  is found to be significant so the return of the covid period is different from the rest of the period. The  $\beta_4$  is found to be insignificant so there is no change occur in the returns of the bear period.  $\beta_5$  is found significant so there is change in the spillover of bear period.  $\beta_6$  is found to be insignificant so there is no change in the behavior of the bear period and the covid period. The spillover of the bear and covid period both are the same.

TABLE 4.20: The Mean Spillover from Equity Market-To-Oil Market in Bear-Bull and Covid-19 Period

Parameter	Coefficient
$\beta_0$	-0.0007 (0.1338)
$\beta_1$	-0.0187 (0.3567)
$\beta_2$	-1.54E-08 (0.1360)
$\beta_3$	2.5503 (0.0000)
$\lambda_1$	-0.001 (0.0092)
$\beta_4$	0.0007 (0.2067)
$\beta_5$	0.0014 (0.0226)
$\beta_6$	-0.0028 (0.1794)

*The values in parenthesis are p-values. The  $\lambda_1$  denotes the volatility spillover.  $\beta_4$  shows the change occur in the returns of bear period. The  $\beta_5$  shows the change in the behavior of bear and covid period. While  $\beta_6$  shows the change in the spillover*

The  $\gamma_1$  is found to be significant which indicates that, the volatility of the current period can be predicted by using the past prices behavior.  $\gamma_2$  is significant so it means the persistence of volatility exists. While the volatility  $\lambda_2$  of the bear period is significant so the volatility during the bear is different from the rest of the period.  $\gamma_3$  is significant so there is change occur in the volatility of bear period.

The volatility of bear period effects:  $\gamma_4$  is insignificant so there is no change in the spillover.  $\gamma_5$  is insignificant so there is no change in the behavior of the bear period and the Covid period. The spillover of the bear and covid period both are the same.  $\gamma_6$  significant so the volatility spillover during covid is different from the rest of the period. It is negative so it means that in the period of covid the

volatility spillover was less.

TABLE 4.21: Volatility Spillover from Equity Market-To-Oil Market in Bear-Bull and Covid-19 Period

Parameter	Coefficient
$\gamma_0$	-9.35E-06 (0.0006)
$\gamma_1$	0.0873 (0.0000)
$\gamma_2$	0.9015 (0.0000)
$\gamma_3$	2.66E-05 (0.0000)
$\gamma_4$	-1.12E-06 (0.7442)
$\lambda_2$	2.43E-10 (0.0081)
$\gamma_5$	1.35E-05 (0.7442)

*The values in parenthesis are p-values. The  $\gamma_3$  shows the behavior of bear period. The  $\gamma_5$  shows the change in the behavior of bear and covid period. The  $\lambda_2$  denotes the volatility spillover. While  $\gamma_4$  shows the change in volatility spillover*

## 4.4 Return & Volatility Spillover from Shariah Compliance-To-Oil Market

The first part of the methodology is to examine the return and volatility spillover from the shariah compliance-to-oil market by using a suitable econometric model. Table 4.22 shows the estimates of return and volatility spillovers from shariah compliance to oil market by using an ARMA GARCH (s,t) model. Moreover, a dummy variable is also used in the study with both return and volatility spillover. All ARCH and GARCH coefficients are also reported with their p-value (in parenthesis).

TABLE 4.22: Return &amp; Volatility Spillover from Sharia Compliance-To-Oil Market -ARMA GARCH Model

	KMI	OIL
$\beta_0$	0.0005 (0.0479)	-0.0006 (0.2582)
$\beta_1$	-0.0998 (0.5378)	-0.0926 (0.8917)
$\beta_2$	0.2159 (0.1865)	0.0726 (0.9153)
$\beta_3$	5.1718 (0.0455)	2.9085 (0.1665)
$\lambda_1$	-	-0.0006 (0.0289)
$\gamma_0$	1.20E-06 (0.0000)	7.41E-06 (0.0000)
$\gamma_1$	0.0994 (0.0000)	0.0964 (0.0000)
$\gamma_2$	0.899 (0.0000)	0.8924 (0.0000)
$\lambda_2$	-	-1.16E-11 (0.8109)

*The values in parenthesis are p-values.  $\lambda_1$  denotes the parameters of mean spillover. While  $\lambda_2$  denotes the parameters of volatility spillover*

For oil  $\beta_1$  is insignificant that means the return of oil cannot be predicted by using past prices behavior.  $\beta_2$  is an insignificant market so that the market cannot make some necessary adjustments for the next day based on previous shocks. While  $\beta_3$  is insignificant so the returns cannot be predicted by forecasted volatility. The result of mean spillover  $\lambda_1$  is found to be is significant so the changings that occur in KMI market will effect to the returns of OIL. So the mean spillover does exist. We can say the flucations in KMI market will not effect to the OIL market significantly. The  $\lambda_1$  is found to be significant which indicates that, the volatility of the current period can be predicted by using the past prices behavior.  $\lambda_2$  is

significant so it means the persistence of volatility exists. The result of volatility spillover  $\lambda_2$  is found to be it is insignificant so volatility spillover exists. So it means fluctuations in KMI market will effect to the OIL market. It is negative so that means volatility of OIL market decreases when the volatility of KMI market decreases.

#### 4.4.1 The Difference in Return and Volatility Spillover from Shariah Compliance to Oil in Bear and Bull Period

We have been used a dummy variable of the bear period to see the effect of the bear period on spillover between the shariah compliance and the oil market. For

TABLE 4.23: The Mean Spillover from Sharia Compliance-To-Oil Market in Bear-Bull Period

Parameter	Coefficient
$\beta_0$	-0.0018 (0.0029)
$\beta_1$	-0.0088 (0.6340)
$\beta_2$	2.94E-09 (0.6917)
$\beta_3$	3.2749 (0.0007)
$\lambda_1$	0.0013 (0.0014)
$\beta_4$	0.0011 (0.0746)
$\beta_5$	-0.001 (0.0739)

*The values in parenthesis are p-values. The  $\lambda_1$  denotes the returns of bear period. Where  $\beta_4$  shows change in the returns in bear period. While  $\beta_5$  shows the change in the return spillover in bear period*

oil  $\beta_1$  is insignificant that means the return of oil cannot be predicted by using past prices behavior.  $\beta_2$  is an insignificant market so that the market cannot make some necessary adjustments for the next day based on previous shocks. While  $\beta_3$  is significant so the returns can be predicted by forecasted volatility. The result of  $\lambda_1$  is found to be is significant so the return of bear period is different from the rest of the period.  $\beta_5$  is insignificant so the return spillover during bear is not different from the rest of the period.

TABLE 4.24: Volatility Spillover from Sharia Compliance-To-Oil Market in Bear-Bull Period

Parameter	Coefficient
$\gamma_0$	8.66E-05 (0.0000)
$\gamma_1$	0.1504 (0.0000)
$\gamma_2$	0.6003 (0.0000)
$\gamma_3$	2.68E-05 (0.0108)
$\lambda_2$	-2.43E-12 (0.9809)
$\gamma_4$	7.88E-11 (0.7412)

*The values in parenthesis are p-values. The  $\lambda_2$  denotes the change in volatility spillover in bear period. While  $\gamma_4$  shows the volatility spillover in bear period*

The  $\gamma_1$  is found to be significant which indicates that, the volatility of the current period can be predicted by using the past prices behavior.  $\gamma_2$  is significant so it means the persistence of volatility exists.  $\gamma_3$  significant so volatility exists.  $\lambda_2$  The volatility of bear period is insignificant so the volatility during bear is not different from the rest of the period. The  $\gamma_4$  is insignificant so the volatility spillover during bear is not different from the rest of the period.

#### 4.4.2 The Difference in Return and Volatility Spillover from Shariah Compliance to Oil in Covid-19 Period

We have been used a dummy variable of the covid period to see the effect of the covid period on spillover between the shariah compliance and the oil market. For oil  $\beta_1$  is insignificant that means the return of oil cannot be predicted by using past prices behavior.  $\beta_2$  is an significant market so that the market can make some necessary adjustments for the next day based on previous shocks.

TABLE 4.25: The Mean Spillover from Shariah Compliance-To-Oil Market in Covid Period

Parameter	Coefficient
$\beta_0$	-0.0028 (0.0029)
$\beta_1$	-0.0178 (0.4826)
$\beta_2$	7.89E-09 (0.0057)
$\beta_3$	4.6202 (0.0002)
$\lambda_1$	0.0004 (0.3415)
$\beta_4$	-0.0032 (0.1056)
$\beta_5$	0.0154 (0.0000)

*The values in parenthesis are p-values. The  $\lambda_1$  denotes the returns of covid period. Where  $\beta_4$  shows change in the returns in covid period. While  $\beta_5$  shows the change in the return spillover in covid period. Covid is a dummy variable*



While  $\beta_3$  is significant so the returns can be predicted by forecasted volatility. The  $\lambda_1$  is found to be insignificant so the return of the covid period is not different from the rest of the period.  $\beta_5$  is significant so the return spillover during covid is different from the rest of the period. It is positive so it means that in the period of covid the return spillover was more. So the spillover doesn't exist but the spillover increased in this period.

TABLE 4.26: Volatility Spillover from Shariah Compliance-To-Oil Market in Covid Period

Parameter	Coefficient
$\gamma_0$	9.40E-05 (0.0000)
$\gamma_1$	0.1502 (0.0000)
$\gamma_2$	0.6002 (0.0000)
$\gamma_3$	0.0005 (0.0000)
$\lambda_2$	3.10E-11 (0.7963)
$\gamma_6$	-8.32E-09 (0.1383)

*The values in parenthesis are p-values. The  $\lambda_2$  denotes the change in volatility spillover in covid period. While  $\gamma_6$  shows the volatility spillover in covid period. The covid is a dummy variable*

The  $\gamma_1$  is found to be significant which indicates that, the volatility of the current period can be predicted by using the past prices behavior.  $\gamma_2$  is significant so it means the persistence of volatility exists.  $\gamma_3$  significant so volatility exists.  $\lambda_2$  The volatility of covid period is insignificant so the volatility during covid is not different from the rest of the period.  $\gamma_6$  is insignificant so the volatility spillover during covid is not different from the rest of the period.

### 4.4.3 The Difference in Return and Volatility Spillover from Shariah Compliance to Oil in Bear-Covid Period

We have been used a dummy variable of the bear-covid period to see the effect of the bear-covid period on spillover between the shariah compliance and the oil market. For oil  $\beta_1$  is insignificant that means the return of oil cannot be predicted

TABLE 4.27: The Mean Spillover from Shariah Compliance-To-Oil Market in Bear-Covid Period

Parameter	Coefficient
$\beta_0$	-0.0026 (0.0000)
$\beta_1$	-0.0112 (0.5493)
$\beta_2$	4.52E-09 (0.6582)
$\beta_3$	4.0138 (0.0000)
$\lambda_1$	0.0012 (0.0024)
$\beta_4$	0.0011 (0.0769)
$\beta_5$	-0.0016 (0.0077)
$\beta_6$	0.0176 (0.0000)

*The values in parenthesis are p-values. The  $\lambda_1$  denotes the volatility spillover.  $\beta_4$  shows the change occur in the returns of bear period. The  $\beta_5$  shows the change in the behavior of bear and covid period. While  $\beta_6$  shows the change in the spillover*

by using past prices behavior.  $\beta_2$  is insignificant market so that the market cannot make some necessary adjustments for the next day based on previous shocks.

While  $\beta_3$  is significant so the returns can be predicted by forecasted volatility. The  $\lambda_1$  is found to be insignificant so the return of the covid period is not different from the rest of the period. The  $\beta_4$  is found to be insignificant so there is no change occur in the returns of the bear period.  $\beta_5$  is found significant so there is change in the spillover of bear period.  $\beta_6$  is found to be is significant so there is change in the behavior of bear period and the covid period. The spillover of bear and covid period both are different.

TABLE 4.28: Volatility Spillover from Shariah Compliance-To-Oil Market in Bear-Covid Period

Parameter	Coefficient
$\gamma_0$	-1.09E-05 (0.0000)
$\gamma_1$	0.0923 (0.0000)
$\gamma_2$	0.891 (0.0000)
$\gamma_3$	4.39E-05 (0.0000)
$\lambda_2$	-4.01E-11 (0.3124)
$\gamma_4$	1.38E-06 (0.6711)
$\gamma_5$	-3.40E-05 (0.0587)

*The values in parenthesis are p-values. The  $\gamma_3$  shows the behavior of bear period. The  $\gamma_5$  shows the change in the behavior of bear and covid period. The  $\lambda_2$  denotes the volatility spillover. While  $\gamma_4$  shows the change in volatility spillover*

The  $\gamma_1$  is found to be significant which indicates that, the volatility of the current period can be predicted by using the past prices behavior.  $\gamma_2$  is significant so

it means the persistence of volatility exists.  $\lambda_2$  The volatility of covid period is insignificant so the volatility during covid is not different from the rest of the period.  $\gamma_3$  is significant so there is change occur in the volatility of bear period. The volatility of bear period effects.  $\gamma_4$  is insignificant so there is no change in the spillover.  $\gamma_5$  is significant so there is change in the behavior of bear period and the covid period. The spillover of bear and covid period both are different.

## 4.5 Time Varying Conditional Correlation

The first step dynamic conditional correlation has been estimated to explore the time varying correlation as under:

$$Q_t = \bar{R} + \theta_1(\varepsilon_{t-i}\varepsilon'_{t-i} - \bar{R}) + \theta_2(Q_{t-1} - \bar{R}) \quad (4.1)$$

The second step asymmetric behavior is observed through ADCC model as given below:

$$Q_t = \bar{R} + \theta_1(\varepsilon_{t-i}\varepsilon'_{t-i} - \bar{R}) + \theta_2(Q_{t-1} - \bar{R}) + \theta_3(\eta_t\eta'_t - \bar{N}) \quad (4.2)$$

### 4.5.1 DCC GARCH Model Results Between Oil and Equity Market

The table 4.29 shows the effect of residual shock ( $\theta_1$ ) of past and lagged dynamic conditional correlation ( $\theta_2$ ) with p-values respective. The DCC models first condition observe the condition of stability it should be less than 1 for example  $\theta_1 + \theta_2 < 1$ . The stability condition is successfully met by industries. The time varying conditional correlation can be calculated by the model of DCC.

The  $\theta_1$  parameter shows the residual shocks past impact on the correlation. It has significant value so there exist past residual shock impact on the correlation. The  $\theta_2$  parameters shows that lagged dynamic conditional correlation impact. It has significant value so there is lagged dynamic conditional correlation impact.

TABLE 4.29: DCC MV-GARCH Estimates B/W Oil &amp; Equity Shariah Market

Sr. #	Variables	$\theta_1$	$\theta_2$
1	OIL-KSE (E-GARCH)	0.0175 (0.0248)	0.9101 (0.0000)
2	OIL-KMI (E-GARCH)	0.017 (0.0306)	0.9161 (0.0000)

*This table summarizes the estimated coefficients from DCC-MV-GARCH model in a bivariate framework for oil and other variable. p-values are reported in parenthesis. Theta(1) and Theta(2) are reported above the p-values. The Akaike Information Criteria (AIC) is used for the selection of a suitable univariate GARCH model*

#### 4.5.2 ADCC MV-GARCH Models & Estimates between Oil Market & Equity Market

The table 4.30 covers the estimates of ADCC GARCH model between oil and equity and shariah market. The first two parameters of this table are same as that of DCC GARCH models i.e. the impact of the past residual shocks ( $\theta_1$ ) and lagged dynamic conditional correlation ( $\theta_2$ ). An additional parameter of ( $\theta_3$ ) is used in this model that provides the information about the shocks of positive and negative news on dynamic conditional correlation. Like previous model of DCC, the first condition that is the stability of model is also met in all industries (i.e.  $\theta_1 + \theta_2 < 1$ ).

TABLE 4.30: ADCC MV-GARCH Model between Oil Market &amp; Equity Market

Sr. #	Variables	$\theta_1$	$\theta_2$	$\theta_3$
1	OIL-KSE (GJR/TARCH)	0.0128 (0.1320)	0.9191 (0.0000)	0.0054 (0.4450)
2	OIL-KMI (GARCH)	0.0118 (0.1483)	0.9241 (0.0000)	0.0066 (0.3618)

*This table summarizes the estimated coefficients from the Asymmetric DCC-MV-GARCH model in a bivariate framework for all sector pairs in the study. p-values are reported in parenthesis. Theta(1), Theta(2) and Theta(3) are reported above the p-values. The Akaike Information Criteria (AIC) is used for the selection of a suitable univariate GARCH model*

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It means, the model is stable. The parameters of  $\theta_1$  is found significantly positive for KSE and KMI that shows impact of past residual shocks on correlation. The Parameters of  $\theta_2$  is found to be highly significant for KSE and KMI which indicates that, there exists the lagged dynamic conditional correlation The parametric values of  $\theta_3$  is found insignificant it also show a asymmetric behavior. It is insignificant so there is no asymmetric behavior in the market. So good and bad news effects similarly there is no difference with in their behavior. The correlation of good news and the correlation of bad news is same.

# Chapter 5

## Conclusion & Recommendations

### 5.1 Conclusion

The study is conducted to examine spillover of volatility and return from oil market to conventional and shariah compliant equity market of Pakistan. The study uses ARMA GARCH model to investigate the spillover for the period of 1st Jan 2009 to 30th September 2020. The study further examines the bear period effect. The COVID-19 effect for the period of 30th Jan 2020 to 30th September 2020 has also been studied.

It has been observed that no mean spillover exists from oil to conventional and shariah compliant equity market. These results are consistent in bear market as spillover is not found different in bear period for conventional and Shariah compliant securities. However, it is worth mentioning that mean spillover during covid-19 period is significantly different in conventional equity market. It is higher than rest of the period for conventional equity. In shariah compliant stocks the spillover in market is different from rest of the periods. This clearly provides that returns of shariah compliant securities are completely independent of oil market return. When bear period and COVID-19 periods are combined the mean spillover have no difference with rest of the period.

So for as the volatility spillover from oil to conventional and shariah compliant equity is concerned results are interesting and mixed. The volatility spillover exists

from oil to conventional and shariah compliant equity markets. However, during bearish period volatility spillover is not different from bullish period in conventional equity market whereas in case of shariah compliant equity the volatility spillover is different in bearish market in comparison to bullish market.

The volatility parameter from oil to shariah compliant is lower during bearish period. Similar pattern is observed in Covid-19 period. Spillover from oil to equity market is not different during covid-19 period but in case of shariah compliant securities spillover from oil to shariah securities is different than rest of the period. It is lower in Covid-19 period in general. This maybe outcome of generally low activities during the set time frame. No change is observed in when bearish and covid-19 periods are combined for conventional equities. It remained the same.

Finally for shariah compliant section it is found that spillover exists from oil to securities. This spillover is different in bearish period in comparison to bullish period. Further the spillover is again different in COVID-19 period in comparison to rest of the period. The volatility in bearish period is lower and in Covid-19 period it further decreases. It can be concluded that volatility of shariah compliant securities are more exposed to oil market bearish trends and pandemic.

It has been observed that no mean spillover exists from conventional and shariah compliant equity market to oil market exists. In bear market mean spillover is found different for conventional market that spillover exists and in shariah compliant securities mean spillover does not exist. However the mean spillover during covid-19 period is not found in conventional equity market. In shariah compliant stocks the spillover in market is found and it is higher than rest of the period for shariah compliant market. When bear period and covid period is combined the mean spillover have no difference with rest of the period in conventional market while in shariah market it is found different.

So far as the volatility spillover from conventional and shariah compliant equity to oil market is concerned results are interesting and mixed. The volatility spillover exists from conventional to oil market but it does not exist from shariah compliant equity market to oil market. However during bearish period volatility spillover is different from bullish period in conventional equity to oil market therefore in case



of shariah compliant equity to oil the volatility spillover is not different in bearish market in comparison to bullish market. The volatility parameter from equity to oil is lower during bearish period. Similar pattern is observed in Covid-19 period. Spillover from equity to oil market is different during covid-19 period but in case of shariah compliant securities to oil spillover is not different from the rest of the period. No change in results is observed when bearish and covid-19 periods are combined for conventional equities to oil. The second part of the study covers the time varying correlation among oil equity market. Both segments conventional and shariah compliant equity markets are considered. As the correlation between the markets is found time varying, so Dynamic Condition Correlation DCC model is used and asymmetric behavior is also assessed by using Asymmetric Dynamic Conditional Correlation GARCH model. It is observed that past residual shock have impact on the correlation. An evidence of lagged dynamic conditional correlation exists in case of both representative indices Oil, KSE-100 and KMI-30. Further, no asymmetric behavior of correlation is observed tin both markets. Bad news neither increases nor decreases correlation oil and representative indices of oil, conventional and shariah compliant equities. The implications of DCC and ADCC models provide a strong conceptual understandings that variables are interconnected to each others and with the passage of time, correlation is time varying.

## 5.2 Recommendations

After concluding all findings, this study recommends to all market players including investors, portfolio managers and policy makers to keep an eye on the information arising in different markets. Some important recommendations of this study are given below:

- Oil and equity markets are not completely independent and information spillover exists between markets that has implication for risk diversification.
- Investor can use these findings in the process of risk management for investments as the volatilities are found more influenced than returns.

- Connectedness between oil and conventional market is same during bearish and bullish periods but it different in oil and shariah compliant securities during bearish and bullish periods. Therefore, said aspect be considered during resource allocation and portfolio formation
- For investors and policy makers it is necessary to consider pandemic effect on market performance.
- Market have time-varying conditional correlation which indicates decision makers should consider the dynamic nature of correlation for portfolio restructuring and optimal hedging.

### **5.3 Limitations & Future Directions**

This study is limited only to the Pakistani market. So, a comparative study can also be conducted by including more emerging markets. A study on extreme movement using tailed distribution can also be conducted in near future.

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